

LONDON  
SCHOOL of  
HYGIENE  
& TROPICAL  
MEDICINE



**Exploring the assessment of functioning:  
developing a population-based survey method to estimate  
assistive product need for the domains of vision, hearing and  
mobility**

**DOROTHY PETERS BOGGS**

**Thesis submitted in accordance with the requirements for the  
degree of**

**Doctor of Philosophy  
of the  
University of London**

**August 2023**

**Department of Clinical Research**

**Faculty of Infectious and Tropical Diseases**

**LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE**

Funded by UK Aid through the AT2030 programme

Research group affiliation: International Centre for Evidence in  
Disability

## Declaration of own work

I, Dorothy Boggs, confirm that the work presented in this thesis is my own. Where data and information have been derived from other sources, I confirm that these have been indicated in the thesis.

Signature:

A solid black rectangular box redacting the signature of Dorothy Boggs.

Date: 31/08/2023

# **Abstract**

## **Background**

Globally, over 2.5 billion people are estimated to be in need of assistive products (AP), but coverage is low. These estimates are uncertain as data is inadequate and lacks comparability. A survey methodology to assess population AP need is crucial to plan services.

## **Study Aim**

To investigate the development of population-based survey assessment methods to measure AP need in low and middle-income countries (LMICs) in the functional domains of vision, hearing and mobility and present methodology for a draft AP need survey tool.

## **Methods**

This thesis advances AP assessment through six linked studies investigating assessment methodology of AP need.

- 1) Systematic review of AP need estimates and review of identified functional assessment methodologies.
- 2) Secondary analysis of clinical and self-report assessment approaches and need for glasses, hearing aids and wheelchairs in population-based surveys in Cameroon and India.
- 3) Population-based survey of vision and hearing impairments in The Gambia to estimate need for glasses and hearing aids and compare clinical and self-report assessment approaches.
- 4) Population-based survey of rapid assessment of musculoskeletal impairment in Syrian refugees in Turkey to estimate AP need.
- 5) Population-based self-reported rapid assessment of assistive technology survey in Guatemala to estimate AP need and access.
- 6) Secondary analysis of five datasets (Cameroon, Chile, India, The Gambia, Turkey) to explore Washington group questions as a screening tool for population-based functioning for AP need.

## **Key findings**

*Functioning:* The systematic review found heterogeneity in assessment and reporting of AP need, emphasising the need to standardise data collection. A range of functioning assessment methodologies exist, however there is a gap for a fit-for-purpose functional assessment tool for use in surveys to assess AP need in LMICs.

*Impairment:* The surveys advanced vision and hearing impairment (Cameroon, India, Gambia) and musculoskeletal impairment (Turkey) measurement protocols for AP. Poor agreement was found between self-report and clinical impairment assessment of AP need; this provides rationale for the development of a hybrid assessment tool.

*Self-report:* The Guatemala survey estimated self-reported AP access, but recommended a hybrid assessment approach. Washington Group questions had moderate sensitivity and specificity in estimating AP need.

## **Conclusion**

This thesis provides recommendations for the development of a population-based hybrid survey methodology to estimate AP need in the domains of vision, hearing and mobility and presents a draft AP need survey tool titled the “Functional Needs Assessment Tool (FNAT)”.

## **Format of the Thesis**

The thesis for this PhD is presented in the “research paper style” format, according to the London School of Hygiene & Tropical Medicine research degree regulations. It includes seven different, but related, journal articles that have been published in peer-reviewed journals.

The subchapters in italics in the Table of Contents are in the research paper format and include a preamble and publication details in a cover sheet. The chapters and other subchapters of the thesis include information and data not covered in the papers to make the thesis a coherent body of work.

This thesis is divided into three main sections with each section divided into chapters and subchapters. A preliminary section explains the changes to the research due to coronavirus. Appendices are provided at the end of the thesis, following the three main sections.

### **SECTION A (Introduction)**

Chapter 1 includes an introduction to assistive technology (AT) and assistive products (AP), and the epidemiology of vision, hearing and mobility impairments. Four priority AP are presented as the main focus of the PhD: distance and reading glasses, hearing aid, wheelchairs, and prosthetics.

Chapter 2 gives an overview of the International Classification of Functioning, Disability and Health (ICF) as the conceptual framework and discusses assessment approaches to measuring population-level AP need. A published research paper discusses the importance of measuring functioning, arguing for “Functioning” as a third global health indicator. The paper reviews available survey tools and discusses the rationale for a hybrid functional assessment tool.

Chapter 3 discusses the study rationale, aim and objectives, and presents an overview of the research methodology, implementation of the research and PhD timescale.

### **SECTION B (Methodology and Results)**

There are six published research papers (Chapters 4-9) in this section, together with reflections on lessons learned and key implications for informing the development of the AP need survey methodology.

Chapter 4 provides indicator definitions for AP and presents a global systematic review of AP data. The subsequent section reviews identified functional assessment tools for use in population surveys.

Chapter 5 focuses on clinical impairment assessment for estimating AP need and the comparison with self-report assessment methods using:

- i. a secondary quantitative data analysis of all-age vision, hearing and mobility surveys conducted in Cameroon and India, and
- ii. primary quantitative data analysis of a survey in The Gambia for vision and hearing in adults aged 35 years and over.

Based upon these results, the lessons learned and implications for a protocol for clinical impairment assessment for vision and hearing AP are discussed.

Chapter 6 presents the feasibility and results from an updated Rapid Assessment of Musculoskeletal Impairment (RAM) survey methodology in Turkey with Syrian refugees.

Chapter 7 presents the results of fieldwork using WHO GATE's rapid Assistive Technology Assessment (rATA) tool in the municipality of Sololá in Guatemala; it provides the rationale for the self-reported AP indicator sections of an AP need assessment tool and discusses some of the limitations of this approach.

Chapter 8 explores the use of the Washington Group (WG) question sets to screen and estimate AP need, through quantitative data analysis from five surveys – Cameroon, Chile, India, The Gambia and Turkey.

Chapter 9 presents lessons learned from conducting the surveys in The Gambia, Turkey and Guatemala.

### **SECTION C (Discussion, Recommendations and Conclusion)**

Chapter 10 provides a synthesis of the findings from the research papers and presents a draft hybrid AP need survey tool for the three functional domains of vision, hearing and mobility. The strengths and limitations of the research are detailed, and the implications for ongoing methodology development are discussed. Specifically, this Chapter concludes by presenting the wider survey tool, the Functional Needs Assessment Tool (FNAT), which would also include broader service need, such as rehabilitation (e.g. physiotherapy and occupational therapy for assessment of wheelchair need).

Chapter 11 provides recommendations and gives the overall conclusions.

**APPENDICES** contain content related to the three main thesis sections, including a glossary of terms, PhD thesis timetable, ethics approvals from LSHTM and partner organisations, copyright license permissions, functional assessment tool summaries and feasibility rating scores, the proposed draft AP need survey questionnaire modules for vision, hearing and mobility and a summary table of implications for the methodology.

## Acknowledgements

I am very grateful for the support and contributions of many people throughout my PhD. First, I would like to thank my supervisors, Professor Allen Foster, Associate Professor Sarah Polack and Professor Hannah Kuper. It has been a privilege to work with all three of you over the past 4 years, especially given you were the pivotal trio who initially formed and developed the International Centre for Evidence in Disability (ICED). I am grateful for your guidance, wisdom, time, patience and intellectual questioning and challenges as my PhD progressed, especially during the past 2.5 pandemic years. Allen, it has been an honour to work with you and learn from you during your treasured time before retirement; your vision expertise, systems thinking and management objectivity have especially been invaluable. Sarah, an immense thank you for your supervision, guidance and support throughout both my PhD and our main research project, and I am especially indebted to you for helping me improve my quantitative research skills and for sharing your vast population-based survey knowledge and expertise. Hannah, thank you for your leadership providing this opportunity and for your skilled strategic input, it has been nice to be part of the growing ICED research team following on from our previous network collaborations.

Thank you to my LSHTM Advisory committee members, Dr. Catey Bunce, Dr. Priya Morjaria, Dr. Tess Bright and Mr. Satish Mishra, for contributing your sector knowledge and expertise, especially in statistics, vision, hearing and rehabilitation/assistive products respectively.

Thank you also to ICED colleagues, especially to those whose work is built upon in this PhD and who provided overall encouragement, and to wider Maternal Adolescent Reproductive & Child Health (MARCH) Centre and LSHTM colleagues, your support, knowledge, encouragement and advice greatly contributed to, and started, my PhD journey.

I have had the privilege of working with a wider network of colleagues during this PhD research. Through the AT2030 research consortium, I especially would like to thank colleagues at the Global Disability Innovation (GDI) Hub, University College of London (UCL) and World Health Organization (WHO) for their coordination, collaboration and expertise. To Peek, hearX, University of Oxford and NHS colleagues, thank you for sharing your knowledge and tools. To The Gambia, Turkey and Guatemala research and in-country data collection teams, and the Cameroon, India and Chile research coordination teams, thank you for your invaluable and inspiring commitment and hard

work. It has been a pleasure to work and collaborate with you all, and most of all to learn from you.

I especially want to thank every research participant who gave their time to take part in these studies, without you this work would not have been possible.

Thank you to UK Aid for funding these studies and, more generally, for championing the work of disability inclusion and assistive technology globally. I hope the research contained in my thesis contributes towards this evidence base.

My PhD journey builds upon my previous work and education experiences. I especially want to thank former INGO HI technical colleagues, in particular Michael Guy who exhibited the value of being both a mentor and a manager, and importantly enabled and facilitated my shift to international disability and development work. To my many occupational therapy, allied health professional and public health colleagues, thank you for your skilled clinical input, collaborations and friendships during my BSOT, my formative professional and MScPH years, and beyond. I am always grateful for, and proud of, my “OT lens” focusing more holistically on functioning.

To my family, extended families and friends, thank you as always for your support and patience, and laughs and adventures, as I progressed my PhD “ultra” journey. I especially want to thank my parents for being strong role models pursuing higher education, teaching and advocating for social issues – I look forward to hopefully joining our family’s Dr. Boggs lineage as the first female and with a new global health focus. Finally, I want to dedicate my doctorate to specific family members. First, in memory of my two sets of grandparents, Ralph & Do and Wade & Lou, who instilled the importance and value of education, alongside family and travel, as priorities in our families – we all have benefitted and are forever grateful. Second, in honour of my sweet smiley nephew who was born during my thesis research and gratefully has accessed services, including assistive products, since his birth. Let us strive towards achieving similar inclusive rights-based access globally, with the aim to optimise functioning for *all*.



## Contributors to the research presented in this thesis

ROLE	PERSON	POSITION	ORGANISATION
<b>Supervision</b>	Allen Foster	Professor	LSHTM
	Sarah Polack	Associate Professor	LSHTM
	Hannah Kuper	Professor	LSHTM
<b>Advisory committee members</b>	Catey Bunce	Reader in Medical Statistics	Kings College London (previously LSHTM)
	Priya Morjaria	Assistant Professor	LSHTM
	Tess Bright	Research Fellow	University of Melbourne (previously LSHTM)
	Satish Mishra	Technical Manager, Disability and Rehabilitation	WHO/Europe
<b>Upgrading examiners</b>	Richard Bowman	Clinical Associate Professor	LSHTM; Institute of Child Health
	Will Oswald	Assistant Professor	LSHTM
<b>Administrative support</b>	Anthony Climpson-Stewart	Research Projects Manager	LSHTM
	Jyoti Shah	Research Projects Administrator	LSHTM
<b>Systematic review research team</b>	Jamie Danemayer	Research Assistant	UCL/GDI Hub
	Sarah Polack	Associate Professor	LSHTM
	Catherine Holloway	Professor	UCL/GDI Hub
	Vinicius Ramos	Research Fellow	Faculdade de Medicina da USP
	Emma Smith	Post-doc Research Fellow	Maynooth University
	Felipe Ramos	Project Manager	UCL/GDI Hub
<b>The Gambia research team</b>	Abba Hydar	Senior Consultant Ophthalmologist and Head of Clinical Services, Training and Research	Sheik Zahid Regional Eye Care Centre (SZRECC)
	Yaka Faal	Audiology Nurse	Edward Francis Small Teaching Hospital
	Matthew Burton	Professor	LSHTM
	Islay Mactaggart	Assistant Professor	LSHTM
	Sarah Polack	Associate Professor	LSHTM
	Tess Bright	Research Fellow	University of Melbourne (previously LSHTM)
	Ian McCormick	Research Assistant	LSHTM
	Suzannah Bell	Honorary Research Assistant	LSHTM
	John Atta Okoh	Ophthalmologist	SZRECC
	Segun Isaac Olaniyan	Ophthalmologist	SZRECC

	Haruna Sanneh	Senior Optometrist	SZRECC
	Abdoulie Ngett	Principal Ophthalmic Medical Assistant	SZRECC
	Isatou Bah	Principal Ophthalmic Medical Assistant	SZRECC
	Mildred Aleser	Ophthalmologist	SZRECC
	Erima Denis	Ophthalmologist	Lubaga Hospital
<b>Turkey research team</b>	Sarah Polack	Associate Professor	LSHTM
	Oluwarantimi Atijosan-Ayodele	Orthopaedic Surgeon	Maidstone and Tunbridge Wells NHS Trust
	Hisem Yonso	Physiotherapist	Relief International
	Nathaniel Scherer	Research Assistant	LSHTM
	Gülten Deniz	Study coordinator	Mülteciler Derneği
	Ahmed Örucü	Project Coordinator	Mülteciler Derneği
	Rukayye Esved	Physiotherapist	Mülteciler Derneği
	Mohamed Yahya	Physiotherapist	Mülteciler Derneği
	Muhammet Eyad Sahloul	Physiotherapist	Mülteciler Derneği
	<b>Guatemala research team</b>	Angelique Kester	Adviser Rehabilitation and CBR
Sarah Polack		Associate Professor	LSHTM
Ana Cordon		Consultant, Study coordinator	Wuqu' Kawoq   Maya Health Alliance
Jonathan Naber		Chief Program Officer	Range of Motion Project
Gonna Rota		Consultant	Liliane Foundation
<b>Statistical support</b>	Sarah Polack	Associate Professor	LSHTM
	Min Kim	Research Fellow	LSHTM

Note: All photos displayed in this thesis were taken with written consent.

## Role in the research studies

I, Dorothy Boggs, am lead researcher for this PhD research. For the systematic review and in each study in The Gambia, Turkey, and Guatemala, I worked with research colleagues and partners to implement this research.

For the AP systematic review, I co-supervised the first author Jamie Danemayer (an AT2030 Research Assistant at University College of London) to develop, implement and draft the AP systematic review. The study was coordinated by AT2030 alongside a technical team of co-researchers. With the team, I contributed to the systematic search, screened abstracts and papers for eligibility, extracted data, worked on data visualisation and revised paper drafts.

In The Gambia, I worked with colleagues in the International Centre for Eye Health at LSHTM (Professor Matthew Burton and Dr. Islay Mactaggart) and the Sheik Zahid Regional Eye Care Centre in Banjul (Dr. Abba Hydera, Senior Consultant Ophthalmologist and Head of Clinical Services), alongside an Audiology nurse from the Ear Nose and Throat Unit in the Edward Francis Small Teaching Hospital in Banjul (Ms. Yaka Faal) and a broader team of co-researchers. With the team, I was responsible for drafting the AP questionnaire, training survey teams in this and for all the data analysis from the Gambia survey presented in this thesis. I also contributed to the vision, hearing and mobility impairment measurement methodology and supporting fieldwork. I drafted the paper for publication.

In Turkey, I worked with Dr. Sarah Polack and Dr. Oluwarantimi Atijosan-Ayodele (an Orthopaedic surgeon from NHS Turnbridge Wells and Maidstone) to develop and coordinate the musculoskeletal impairment (MSI) population-based study in Sultanbeyli district in Istanbul. The survey was coordinated by Relief International Turkey (Lead physiotherapist technical input Hisem Yonso and Study coordinator Gülten Deniz) alongside a broader team of co-researchers. I coordinated updates to MSI assessment methodology and questionnaire, co-led training and ongoing fieldwork support to MSI data collection, and was responsible for the MSI data cleaning and analysis. I drafted the paper for publication.

In Guatemala, I worked with Dr. Sarah Polack and a study consortium coordinated by Liliane Foundation (Study coordinator Angelique Kester and local study technical lead Gonna Rota) with the Range of Motion Project (Study technical lead Jonathan Naber) and local organisation Asociación de Padres y Amigos de Personas con Discapacidad

de Santiago Atitlán (ADISA) who coordinated logistics. The local Study coordinator was Dr. Ana Cordon, who was supported by the consortium organisations and a local survey supervisor for the second half of the data collection. With the team, I coordinated local ethics and training materials, questionnaire/app, and co-led ongoing fieldwork support and data monitoring. Data analysis was completed by Dr. Sarah Polack. I drafted the paper for publication.

I undertook the data management and analysis for The Gambia and Turkey studies, with statistical advice from Dr. Sarah Polack (both studies) and Ms. Min Kim (The Gambia only).

I undertook the secondary analyses with datasets from population-based surveys completed in Cameroon (2013-14), India (2013-14) and Chile (2019-2020) working closely with the original research teams, in particular with colleagues from the International Centre for Evidence in Disability (ICED) (Dr. Sarah Polack and Dr. Tess Bright) and the Department of Otorhinolaryngology in the Faculty of Medicine at Universidad de Chile (Otorhinolaryngologists Dr. Natalia Tamblay and Dr. Mariela Torrente) for Chile survey's hearing (and cognition) analyses. I drafted these papers for publication.

Dr. Catey Bunce, Dr. Priya Morjaria, Dr. Tess Bright and Mr. Satish Mishra provided advice on this research through a PhD advisory committee.

Professor Allen Foster, Associate Professor Sarah Polack and Professor Hannah Kuper provided supervision throughout the implementation of this research.

## List of Abbreviations

AP	Assistive product(s)	HI	Hearing impairment
AD	Assistive device	HL	Hearing loss
ADISA	Asociación de Padres y Amigos de Personas con Discapacidad de Santiago Atitlán	IADLs	Instrumental activities of daily living
ADLs	Activities of daily living	ICD	International Classification of Disease
APL	Priority assistive products list	ICED	International Centre for Evidence in Disability
ASPREX	Assistive Product Explorer	ICEH	International Centre for Eye Health
AT	Assistive technology	ICF	International Classification of Functioning, Disability and Health
ATA-C	Assistive Technology Capacity Assessment	IOV	Interobserver variability
BRFSS	Behavioral Risk Factor Surveillance System	LMICs	Low- and middle-income countries
CFM	Child functioning module	LSHTM	London School of Hygiene & Tropical Medicine
COPM	Canadian Occupational Performance Measure	MDS	Model Disability Survey
COVID-19	Coronavirus 2019	MI	Mobility impairment
CRPD	Convention on the Rights for Persons with Disabilities	MSI	Musculoskeletal impairment
dB	Decibel	NGO	Non-governmental organisation
DPO	Disabled Persons' Organisation	NHIS	National Health Information survey
DTT	Digit Triplet Test	OAE	Otoacoustic Emissions
EARC	Educational Assessment and Resource Center	OT	Occupational therapist
ELSA	English Longitudinal Study of Ageing	ODK	Open data kit
ENT	Ear, Nose and Throat	PDA's	Personal digital assistants
ES	Extended set	Peek	Portable Eye Examination Kit
FAM	Functional Assessment Measure	PHC	Primary healthcare
FIM	Functional Impedence Measure	PPE	Personal protective equipment
FNAT	Functional Needs Assessment Tool	PTA	Pure tone audiometry
GATE	Global Cooperation on Assistive Technology	RAAB	Rapid Assessment of Avoidable Blindness
GBD	Global Burden of Disease	RAHL	Rapid Assessment of Hearing Loss
GDI	Global Disability Innovation Hub	RAM	Rapid Assessment of Musculoskeletal Impairment
GHO	Global Health Observatory	rATA	Rapid Assistive Technology Assessment
GReAT	Global Report on Assistive Technology		

SDG	Sustainable Development Goal
SES	Socioeconomic status
SS	Short set of questions
TAP	Training in priority assistive products package
UHC	Universal Health Coverage
UK	United Kingdom
UN	United Nations
UNICEF	United Nations Children's Fund
URE	Uncorrected refractive error
VA	Visual acuity
VI	Vision impairment
WG	Washington Group
WHO	World Health Organization
WHODAS 2	WHO Disability Assessment Schedule 2.0

# Table of Contents

Declaration of own work.....	2
Abstract .....	3
Format of the Thesis.....	5
Acknowledgements.....	7
Contributors to the research presented in this thesis .....	9
Role in the research studies .....	11
List of Abbreviations .....	13
Table of Contents .....	15
List of Tables .....	18
List of Figures .....	19
0. Changes due to coronavirus .....	20
SECTION A. INTRODUCTION .....	22
Chapter 1: Background .....	23
1.1 Global context.....	23
1.2 Defining AT: assistive products.....	25
1.3 Vision, hearing and mobility impairments, and AP .....	27
Chapter 2: Approaches to measuring population-level AP.....	30
2.1 <i>Research paper 1: Shifting the focus to functioning: essential for achieving SDG 3, inclusive UHC and supporting COVID-19 survivors</i> .....	32
2.2 Clinical impairment-focused assessment survey methodologies .....	41
2.3 Self-reported assessment survey methodologies.....	43
2.4 Hybrid assessment survey methodologies .....	45
2.5 Tools and methods that directly assess AP need.....	45
Chapter 3: Study rationale, aims and objectives.....	49
3.1 Study rationale.....	49
3.2 Study aim and objectives .....	50
3.3 Research methodology overview .....	51
3.4 Research timescale .....	52
SECTION B. METHODOLOGY AND RESULTS.....	53
Chapter 4: AP need indicators, estimates and assessment approaches .....	54
4.1 AP indicator definitions .....	55
4.2 <i>Research paper 2: Estimating need and coverage for five priority assistive products: a systematic review of global population-based research</i> .....	56
4.3 Review of population-based survey tools that use functional assessments to measure AP need.....	76
4.4 Hybrid functional assessment protocol development .....	83

Chapter 5: Clinical impairment AP assessment methods and comparison with self-report .....	85
5.1 <i>Research paper 3: Estimating AP need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches</i> .....	86
5.2 <i>Research paper 4: Estimating need for glasses and hearing aids in The Gambia: results from a national survey and comparison of clinical impairment and self-report assessment approaches</i> .....	114
5.3 Clinical vision and hearing impairment AP assessment protocol development .....	138
5.4 Comparison of clinical impairment and self-report AP assessment methods	143
Chapter 6: Field test and assess feasibility of mobility methodology in one LMIC..	145
6.1 <i>Research paper 5: MSI prevalence, cause, diagnoses and related need for services and APs among Syrian refugees living in Sultanbeyli, Turkey using an updated RAM</i> .....	146
6.2 Updating RAM methodology .....	165
Chapter 7: Conducting an AP need self-report survey.....	171
7.1 <i>Research paper 6: Measuring access to AT using the WHO rATA questionnaire in Guatemala: results from a population-based survey</i> .....	172
7.2 AP survey methodology development.....	199
Chapter 8: Exploring use of self-reported screening questions.....	203
8.1 <i>Research paper 7: Use of WG question sets as screening for functional impairments and related service and AP needs in five countries: Cameroon, Chile, India, The Gambia and Turkey</i> .....	204
8.2 AP survey methodology development.....	225
Chapter 9: Lessons learned from fieldwork in The Gambia, Turkey and Guatemala .....	228
9.1 Planning.....	229
9.2 Training and IOV assessment.....	231
9.3 Logistics.....	232
9.4 Supervision/support .....	233
9.5 Data collection .....	234
SECTION C. DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS .....	236
Chapter 10: Discussion .....	237
10.1 Overview.....	237
10.2 Synthesis of research findings .....	237
10.3 Strengths and limitations.....	254
10.4 Implications of the findings.....	259
Chapter 11: Conclusion and recommendations.....	273
11.1 Conclusion.....	273
11.2 Recommendations.....	273
REFERENCES .....	276



APPENDICES .....	284
Appendix 1: Glossary of terms .....	284
Appendix 2: PhD thesis timetable.....	285
Appendix 3: Ethical approvals .....	287
Appendix 4: Functional assessment tool summaries and detailed feasibility rating scores .....	307
Appendix 5: Copyright license permissions .....	315
Appendix 6: Draft AP need survey questionnaire modules .....	324
Appendix 7: Summary table of implications for the overall AP assessment methodology .....	410

## List of Tables

Table 0-1: Overview of previously planned PhD research and decision/actions taken to mitigate the research prevented by COVID-19.....	21
Table 1-1: WHO definitions of the four priority AP included in this PhD.....	27
Table 1-2: Examples of the WHO estimates of AP need and unmet need in vision, hearing and mobility domains .....	29
Table 2-1: RAAB, RAHL and RAM measurement gaps for all-age AP need .....	43
Table 2-2: Measuring AP: methodology advantages and disadvantages .....	48
Table 3-1: Overview of PhD study objectives and methods .....	52
Table 4-1: Population-level AP indicators and definitions.....	55
Table 4-2: Studies using functional assessment from the AP indicator systematic review.....	77
Table 4-3: Functional assessment summary: methods, ICF components, AP indicators measured and feasibility score.....	79
Table 10-1: Summary of clinical impairment and AP need prevalence estimates by functional domain from the Cameroon, India, The Gambia and Turkey PhD studies.	240
Table 10-2: Clinical impairment assessment methodology for the AP need survey...	246
Table 10-3: Clinical impairment assessment AP need indicator definitions for the four priority AP measured in this PhD thesis .....	247
Table 10-4: Self-reported assessment methodology for the AP need survey .....	252
Table 10-5: Main strengths and limitations of PhD methodology by Study objective .	255
Table 10-6: AP need survey functional assessment cut-off filter criteria by each domain .....	261
Table 10-7: Proposed data collector cadres for FNAT survey module administration	268
Table 10-8: Age groups included in the six PhD population-based survey studies ....	269

Footnote: Tables from Chapter sections 2.1, 4.2, 5.1, 5.2, 6.1, 7.1 and 8.1 are imbedded in the pdf of the published paper and are excluded from the list above. A list of these tables can be found on the first page of the relevant section.

## List of Figures

Figure 1-1: Key Assistive Technology milestones from 2011 to 2022.....	24
Figure 1-2: WHO GATE 5Ps ecosystem with examples.....	25
Figure 1-3: Examples of assistive products.....	26
Figure 2-1: International Classification of Functioning, Health and Disability with this study's focus highlighted.....	30
Figure 3-1: Overview of PhD study population-based AP need survey method development.....	51
Figure 4-1: Feasibility rating criteria for assessing functional assessment tools in a population-based AP need survey .....	78

Footnote: Figures from Chapter sections 2.1, 4.2, 5.1, 5.2, 6.1, 7.1 and 8.1 are imbedded in the pdf of the published paper and are excluded from the list above. A list of these figures can be found on the first page of the relevant section.

## **0. Changes due to coronavirus**

In this preliminary section, I document how and why my original research plan and timelines needed to change due to coronavirus 2019 (COVID-19).

### **0.1. How the disruption caused by COVID-19 impacted my research**

After my upgrading examination in July 2019, I planned to undertake three additional surveys.

1. A follow up vision, hearing and mobility survey in The Gambia ages 35+.
2. An all-age Rapid Assessment of Hearing Assessment (RAHL) survey in the Philippines.
3. An all-age population-based pilot survey to estimate assistive product (AP) need for vision, hearing and mobility impairments in one LMIC (Kenya was to be confirmed as location).

By the end of 2019, ethical approval had been received for the Philippines hearing survey and applied for The Gambia follow up survey. However, due to the unprecedented global outbreak of SARS-CoV-2 at the end of 2019, it was not possible to complete the planned fieldwork throughout 2020 and 2021. This was due to both global and national COVID-19 travel restrictions and risk, and UK Aid funding cuts (51%) during the pandemic. Critically, all of my planned survey fieldwork involved one to one clinical assessment with individual participants which was contraindicated because of safety considerations.

### **0.2. How this planned work would have fitted within my thesis narrative**

These three surveys were intended to pilot test methods, collect data and analyse the results in order to iteratively develop and test a new AP need survey methodology.

Specifically, my PhD aim for The Gambia follow up survey was to pilot and refine methods for functional vision, hearing and mobility assessments and questions to assess AP need. This follow up survey would've assessed the feasibility of the functional vision and hearing assessments for glasses, hearing aids and additional AP, and advanced the self-reported and Rapid Assessment of Musculoskeletal Impairment (RAM) methodology to include more detailed mobility AP assessment.

In the Philippines survey, my PhD aim was to further test and develop the all-age self-reported functional hearing assessment and questions to assess AP need. Specifically, this survey would have piloted hearing assessment methodology for all ages, including functional AP assessment, and assessed the feasibility of this methodology, including time taken to administer the hearing assessment. These analyses would have informed

the development of the hybrid self-reported and clinical functional hearing assessment sections of the AP need survey tool.

Finally, the pilot survey in one LMIC was planned to test and assess the feasibility of the all-age population-based survey methodology to estimate AP need for vision, hearing and mobility impairments for approximately 25 AP. Specifically, this survey would have piloted vision, hearing and mobility hybrid AP assessment methodology for all ages and assessed the feasibility of this methodology, including time taken to administer the overall assessment and each module.

### 0.3. Summary of decisions/actions taken to mitigate the impact of COVID-19 on the original research plan

Given that I was not able to collect and analyse data from the three planned surveys, an updated PhD plan and timeline was iteratively developed and agreed with my PhD supervisors. This resulted in a shift to more emphasis on secondary data analysis, a narrowing of focus on AP assessed and conducting a WHO rapid Assistive Technology Assessment (rATA) survey in Guatemala. An overview of the final PhD decisions and actions taken are outlined below in **Table 0-1**.

**Table 0-1: Overview of previously planned PhD research and decision/actions taken to mitigate the research prevented by COVID-19**

PLANNED PHD RESEARCH JULY 2019	PHD RESEARCH DECISIONS AND ACTIONS TAKEN JANUARY 2022
<b>The Gambia follow up vision, hearing and mobility survey</b>	<ul style="list-style-type: none"> <li>➤ In depth analysis completed on initial The Gambia vision and hearing survey data for i) different vision and hearing impairment thresholds, ii) self-reported AP sections and iii) comparison between the two methods (see <b>Chapter 5.2</b>).</li> <li>➤ Completed detailed analysis of Turkey musculoskeletal survey with Syrian refugees using an updated RAM (See <b>Chapter 6</b>).</li> </ul>
<b>The Philippines hearing survey</b>	<ul style="list-style-type: none"> <li>➤ Completed secondary analysis of a hearing survey conducted in Chile (see <b>Chapter 8</b>).</li> </ul>
<b>Pilot survey in one LMIC to test and assess the feasibility of the all-age population-based survey methodology</b>	<ul style="list-style-type: none"> <li>➤ Narrowed AP focus to four priority AP in vision, hearing and mobility functional domains due to the shift to secondary data analysis.</li> <li>➤ Completed AP systematic review (see <b>Chapter 4.2</b>).</li> <li>➤ Completed analysis of five surveys to explore use of functional screening questions (see <b>Chapter 8</b>).</li> <li>➤ Conducted AT survey in Guatemala, using the WHO rATA, to explore self-reported AP need survey protocol and strengths/limitations of the methodology (see <b>Chapter 7</b>).</li> <li>➤ Building upon the PhD study results and findings, the PhD focus was adjusted to <i>investigating</i> the development of an all-age population-based survey methodology for AP (see <b>Chapter 9</b> and <b>SECTION C</b>).</li> </ul>

## SECTION A. INTRODUCTION



A young woman sitting in a wheelchair by a street. © Relief International

## Chapter 1: Background

The World Health Organization (WHO) estimates that there are at least 2.5 billion people globally in need of assistive technology (AT) and this figure is set to rise to 3.5 billion by 2050.(1) AT is an umbrella term covering the *systems* and *services* related to the delivery of *assistive products* (AP). People who might benefit from AT include older people, people with disabilities, and people living with non-communicable diseases, communicable diseases and chronic conditions.(2) Access to AT for people has been shown to positively impact on inclusion in education for children and participation in work, family and community life for adults.(2) However, to date, there is very limited comparable data on population-level AT need, access and coverage. A tool for measuring AT need is critical for planning policies and services to improve availability and access to AT.

### 1.1 Global context

The WHO estimates that approximately one in three people around the world need AT, and about 900 million people need one or more AP other than spectacles.(1, 3) Yet, people worldwide have limited access to the AP they need. Barriers to access include high costs, lack of awareness, availability, trained personnel, policy, and financing.(1, 3, 4)

#### 1.1.1 AT as a human right

Access to AT is a human right as established within United Nations (UN) Frameworks and Conventions. In 2015, the Sustainable Development Goals (SDGs) were agreed by UN member states, and access to AT is a key cross-cutting component in delivering the 17 SDGs - the use of AP can facilitate both the achievement of many of the goals as well as the relationship between goals.(5, 6) For example, relating to SDG 3, when a person who has diabetes has need for therapeutic footwear and is provided this AP, he/she could avoid ulcers and in some cases the need for amputation potentially enabling better quality of life and wellbeing.(6, 7) Moreover, preserving health and functioning in this way could help to maintain employment (SDG 8). Additionally, the UN Convention on the Rights of Persons with Disabilities (CRPD), now ratified by 185 nations, mandates access to AT in many of the articles, including Articles 4, 20, 26 and 32.(8-10) Furthermore, to achieve Universal Health Coverage (UHC), access to affordable and available AT is a necessary and important inclusive strategy contributing to effective sustainable development.(1, 3, 11)

### 1.1.2 AT initiative

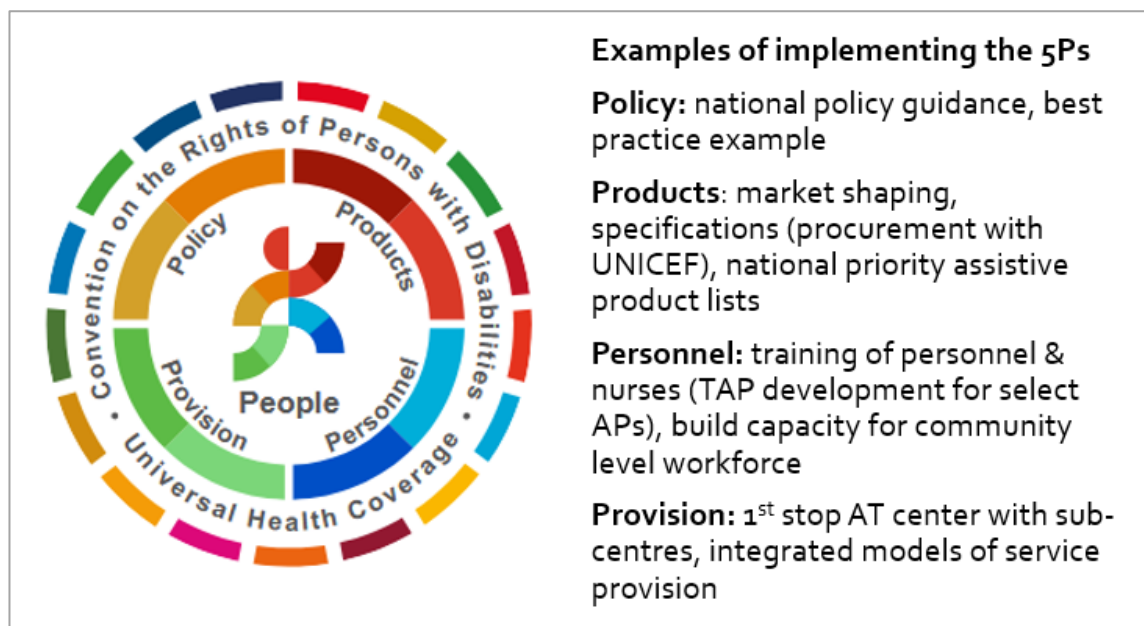
Many disability and mainstream initiatives have supported improving access to AT over the past ten years, in recognition of the human right to AT and the ways in which it can improve lives (See **Figure 1-1**). Notably, the WHO Global Cooperation on Assistive Technology (GATE) initiative aims to ensure that everyone, everywhere has access to affordable and high-quality AP.(12)



**Figure 1-1: Key Assistive Technology milestones from 2011 to 2022**

In 2016, based on the model of the WHO Essential Medicine List, GATE released the first global Priority Assistive Products List (APL), which included the 50 AP considered most needed in all healthcare systems and which governments should ensure are available and affordable to all citizens.(2) Additionally, GATE is mandated to support Member States to develop people-centred policy frameworks, provision and procurement standards, and training, through the 5Ps of improving policy, products, personnel and provision and supporting people. (**Figure 1-2**).(4, 11) Most notably, WHO and United Nations Children’s Fund (UNICEF) launched the first Global Report on Assistive Technology (GReAT) in May 2022.





**Figure 1-2: WHO GATE 5Ps ecosystem with examples** (1, 11, 13)

In 2018, ATscale launched as a broad global cross-sector partnership aiming to reach 500 million people with AT by 2030. This partnership is supported by the AT2030 programme which aims to build the evidence base for AT.(14, 15) AT2030 is delivered through a partnership with Global Disability Innovation (GDI) Hub, GATE, Clinton Health Access Initiative, UNICEF and some of the world’s leading AT innovators, universities, non-governmental organisations (NGOs) and disabled person’s organisations (DPOs). The AT2030 programme recognises that a lack of comparable data on AT need and coverage is a major impediment to scaling up. This PhD study is part of London School of Hygiene & Tropical Medicine (LSHTM)’s wider AT2030 research to develop a population-based survey tool to estimate impairments, functioning, and service and AP need across seven functional domains (i.e. vision, hearing, mobility, communication, cognition, self-care and mental health) in order to support the scale up of AT.

## 1.2 Defining AT: assistive products

AT is considered a subset of health technology and is defined by WHO as “the application of organized knowledge and skills related to AP, including *systems* and *services*”.(1, 2) This PhD specifically focuses only on assessing AP need, while recognising that referral needs will also include services, such as rehabilitation, and that AP must be accompanied by appropriate provision services. This will form part of a wider tool being developed which will also collect data on service referral needs.



**Table 1-1: WHO definitions of the four priority AP included in this PhD (2)**

DOMAIN	ASSISTIVE PRODUCT	ITEM DESCRIPTION
<b>VISION</b>	<b>Glasses</b>	
	- Distance glasses	Distance glasses focus on things that are further away in positive selected power grades.
	- Near glasses	Eyeglasses that help correct close-range vision issues for selected fixed power range.
<b>HEARING</b>	<b>Hearing aids</b>	Devices worn behind the ear to amplify sound. Partial or completely in the canal. Devices worn in the ear or in the ear canal to amplify sound.
<b>MOBILITY</b>	<b>Wheelchairs</b>	
	- Basic type for active users	Intended to be self-propelled by the users by pushing rims or wheels. Can be used indoor/outdoor and on various types of terrain.
	- Push type	Only for indoor use and limited outdoors, pushed by an attendant.
	-Intermediate/advanced type	Manual wheelchairs with postural support that can be adjusted to the individual user's needs.
	<b>Prosthetics</b>	Device that replaces part of the lower limb between the knee joint and the ankle joint after amputation or in cases of limb deficiency (includes trans-tibial, foot prosthesis and partial foot prosthesis).
		Device that replaces part of the lower limb between the hip joint and the knee joint after amputation or in cases of limb deficiency (includes trans-femoral, knee disarticulation and hip disarticulation prosthesis).

### 1.3 Vision, hearing and mobility impairments, and AP

While AP cover seven functional domains, this PhD focuses on vision, hearing and mobility, and does not include communication, cognition, self-care and mental health. These three functional domains are linked to the four priority AP and also to the previous work of International Centre for Evidence in Disability (ICED) which is built upon in this thesis. An overview of the global magnitude of impairment and AP need in each of these three domains related to the four priority AP, as defined by ATscale, is provided below.

#### 1.3.1 Vision impairment

The 2019 WHO World Report on Vision estimates 2.2 billion people are visually impaired (VI) globally.(22) Of these, at least 1 billion people with a VI (approximately 50%) have a VI that is considered avoidable with treatment (e.g. cataract surgery; eye glasses) or preventable (e.g. trachoma).(22) The majority (80%) of people with VI are over the age of 50 years.(22) According to The Lancet Global Health Commission on Global Eye Health the 2020 estimates for distance vision are 258 million people had mild VI (visual acuity (VA)<6/12-6/18), 295 million had moderate / severe VI (VA<6/18-3/60), and 43.3 million people were blind (VA<3/60).(23) Considering near vision, an estimated 1.8 billion people live with a near VI of which 510 million have uncorrected

presbyopia and would benefit from near glasses.(22-25) Global estimates of VI are expected to increase further with population growth and aging, increasing the related need for vision AP, including distance and near glasses. There will also be increased need for other vision-related AP such as low vision aids. However, as noted in **Chapter 1.2**, this thesis will focus on glasses as one of the four ATscale priority AP.

### 1.3.2 Hearing impairment

Globally more than 1.5 billion people experience some degree of hearing loss (HL), and, of these, an estimated 430 million have HL of moderate or worse severity in the better hearing ear.(26) The vast majority of people affected with HL live in LMIC, and over 42% of people with HL are aged above 60 years, with numbers expected to increase over the coming years.(26, 27) HL includes conductive, sensorineural and mixed HI. Previously WHO defined moderate or worse hearing impairment (HI), also referred to as disabling HI, as  $\geq 41$  decibels (dB) in the better ear in adults (15 years or older) and  $\geq 31$  dB in children (0 to 14 years) in the better ear. Mild or worse HI was defined as  $\geq 26$  dB in the better ear.(28) These definitions of HI are used in the PhD studies, however it is noted that they were updated/changed by WHO in 2021 after the PhD studies were conducted so the final tool will make recommendations according to the new HI thresholds.(26) Many people with HI will benefit from hearing aids.

### 1.3.3 Mobility impairment

Comparable epidemiological data on mobility impairment (MI) is lacking, which is partly due to variation in how mobility is defined and subsequently how it is measured. “MI” is defined by the International Classification of Diseases (ICD) 11 as a “difficulty or need for assistance with mobility”.(29) Difficulties with mobility and pain were amongst the most commonly reported problems in the *World Health Survey*, with the proportion of respondents reporting mild, moderate, severe and extreme levels of difficulty in the mobility domain of functioning for “moving around” being 16.5%, 11.4%, 5.9% and 1.3% respectively.(30) MI can involve impairments resulting from a various health conditions, such as neurological, musculoskeletal, developmental and pain related conditions as identified in the Global Burden of Disease (GBD) (31), so assessment is therefore complex. Existing population-based studies estimating mobility-related impairments have often used musculoskeletal impairment (MSI) as a proxy; for instance MSI include more than 150 of the 350 GBD health conditions.(31-33) Population-based studies in Rwanda, Cameroon and India have used a specific MSI tool to measure all-age MSI prevalence, reporting estimates of 5.2%, 11.6% and 19.6% respectively, with the majority in the mild category.(34-37) The diversity of type and




severity of MI means that there is great diversity in types of AP needed (e.g. wheelchair, other mobility aids, prostheses).

### 1.3.4 AP data

Scoping reviews highlighted that both individual and population-level evidence on AP, particularly in resource-limited environments, is scarce and uneven.(38, 39) Further, there is a lack of reliable data on AP need in different settings, hindering evidence-based planning and comparison of settings.

Data on AP is limited globally. Previous WHO figures based upon GBD data provided AP estimates of need, unmet need and low coverage in LMICs in each domain (see **Table 1-2**); however, these estimates were based on extrapolations from sparse data. While useful for advocacy, these global level estimates are not very informative for service planning within countries and/or for district level planning.

**Table 1-2: Examples of the WHO estimates of AP need and unmet need in vision, hearing and mobility domains (12)**

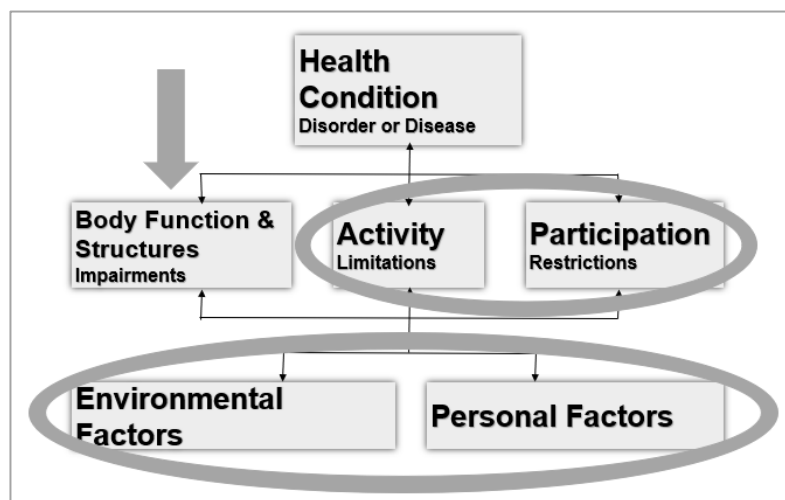
DOMAIN	ASSISTIVE PRODUCT	POTENTIAL NEED	UNMET NEED
VISION	 Glasses	970 million people	Over 200 million people do not have access to glasses or other low-vision devices.
	HEARING	 Hearing aids	
MOBILITY	 Wheelchair	75 million people	Only 5–15% of the population has access to these AP.
	Prosthetics	65 million people (40)	

As AP data within countries were lacking, WHO GATE led an initiative to develop a self-reported AP assessment tool, the rapid Assistive Technology Assessment (rATA) which is discussed in detail in this thesis. The rATA was used to gather data from 29 countries for the recent GReAT report (1), to provide estimates of the self-reported prevalence of “need for” and “access to” different types of AP in surveyed countries. The report estimates that the proportion of people who have access to the AP they need is: 53.7% for glasses, 9.1% for hearing aids and 17.7% for lower limb prosthesis, showing great unmet needs (note: three separate proportions are provided for different types of wheelchairs).(1)

## Chapter 2: Approaches to measuring population-level AP

AP assessment is complex. There are different approaches to measuring AP need in population-level surveys, and this depends on the way that impairments, functioning and AP are defined, conceptualised, screened and measured. Some surveys rely solely on clinical assessment, while others use only participants' self-report of AP need, and some combine the two approaches.

The conceptual framework guiding the development of the AP need tool in this PhD is the International Classification of Functioning, Disability and Health (ICF). This is the prevailing WHO framework for measuring health and disability at both individual and population levels (**Figure 2-1**).<sup>(41)</sup> In this framework, a health condition (e.g. diabetes) may lead to an abnormality in body structure or function (i.e. impairment e.g. mobility), which can consequently cause activity limitations (e.g. difficulty walking) and participation restriction (e.g. exclusion from employment). This pathway will not be the same for all people but is influenced by the presence of personal factors (e.g. education) and environmental factors (e.g. terrain). The ICF definitions used in this PhD are provided in more detail in **Appendix 1**.



**Figure 2-1: International Classification of Functioning, Health and Disability with this study's focus highlighted**

Importantly, the need for AP will be influenced by all these different ICF components. For example, if the person's mobility impairment in the example above was a lower limb amputation due to diabetes, a prosthetic and/or wheelchair and/or elbow crutches might be most appropriate for AP. However, the choice will depend on the person's body structures (e.g. the integrity of the stump's skin, oedema etc.), usual activities (e.g. length of walking distances to grocery store, work etc.), type of participation (e.g. manual versus desk-based job), personal factors (e.g. education and mood levels) and

environment (e.g. rough terrain versus pavement with curb cuts). As a consequence, people with the same impairment may have different AP need. For instance, near glasses may not be appropriate/needed for a person with a near VI who works a gross motor manual labour job in a rural setting given personal and environmental factors.

This PhD focuses on the assessment of functioning in line with the ICF to estimate population level AP need. Functioning refers to “an umbrella term in the ICF for body functions, body structures, activities, and participation; it denotes the positive aspects of the interaction between an individual (with a health condition) and that individual’s contextual factors (environmental and personal factors)”.(41) This chapter will begin with a research paper on functioning and an overview of key measurement approaches. Following the paper, the chapter will review measurement approaches for the different components of the ICF.

## **2.1 Research paper 1: *Shifting the focus to functioning: essential for achieving SDG 3, inclusive UHC and supporting COVID-19 survivors***

### **Preamble**

This paper presents a published article which discusses functioning and tools to measure components of functioning. This paper explains that, if Sustainable Developmental Goal 3 and Universal Health Coverage are to be achieved, there is need for a third health indicator alongside mortality and morbidity, namely “Functioning”. This indicator needs to be developed and integrated into global health population-based metrics.

Functioning is defined by the ICF as an umbrella term for body functions and structures, activities, and participation; it denotes the interaction between an individual (with a health condition) and his/her contextual factors (environmental and personal factors).(41) This paper discusses the importance of measuring functioning, especially when considering the need for, and outcome of, rehabilitation and AP. Clinical assessment and self-report methodologies that measure components of functioning are discussed. The development of a comprehensive population level tool, which aligns with the ICF and combines self-report and clinical measurement methods to measure functioning and the need for rehabilitation and AP, is presented. Throughout the article, given the context of the coronavirus pandemic at the time of writing, an example of a COVID-19 survivor with mobility difficulties is provided to illustrate the different components of the ICF and the need for, and benefits of, AP.

This paper was published in April 2021 in Global Health Action. The manuscript was published under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), and the published manuscript is included in full below.



### 2.1.1 List of Tables

**Table 1:** Examples of four tools that measure components of the International Classification of Functioning, Health and Disability (ICF).

### 2.1.2 List of Figures

**Figure 1:** Example of International Classification of Functioning, Health and Disability (ICF) diagram for health condition of coronavirus disease 2019 (COVID-19) with access to related service and assistive technology needs.

### 2.1.3 Citation

Boggs, D; Polack, S; Kuper, H; Foster, A; (2021) *Shifting the focus to functioning: essential for achieving Sustainable Development Goal 3, inclusive Universal Health Coverage and supporting COVID-19 survivors*. Global health action, 14 (1). 1903214-. ISSN 1654-9716 DOI: <https://doi.org/10.1080/16549716.2021.1903214>



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms.
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	Global Health Action		
When was the work published?	April 2021		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	Yes, This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.	Was the work subject to peer review?	Yes

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**




For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I led the conceptualisation of the debate article and the drafting of the manuscript, considering revisions and comments from other authors.
--	--

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022

<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022

# Shifting the focus to functioning: essential for achieving Sustainable Development Goal 3, inclusive Universal Health Coverage and supporting COVID-19 survivors

Dorothy Boggs <sup>a</sup>, Sarah Polack <sup>a</sup>, Hannah Kuper <sup>a</sup> and Allen Foster <sup>b</sup>

<sup>a</sup>International Centre for Evidence in Disability, London School of Hygiene & Tropical Medicine, London, UK; <sup>b</sup>International Centre for Eye Health, London School of Hygiene & Tropical Medicine, London, UK

## ABSTRACT

If Sustainable Developmental Goal 3 and Universal Health Coverage are to be achieved, functioning is a third health indicator which must be assessed and integrated into global health population-based metrics alongside mortality and morbidity. In this paper, we define functioning according to the International Classification of Functioning, Disability and Health (ICF) and present why functioning is important to measure, especially when considering the need for, and outcome of, rehabilitation and assistive technology (AT). We discuss examples of tools that measure components of functioning through clinical assessment and self-report methodologies, and present the development of a comprehensive population level tool which aligns with the ICF and combines self-report and clinical measurement methods to measure functioning and the need for rehabilitation and AT. Throughout the paper a survivor of Coronavirus 2019 (COVID-19) is given as an example to illustrate functioning according to the ICF and how access to the interventions of rehabilitation and AT might be of benefit to improve and optimise his/her functioning. We argue that the Global Health community must take action and ensure that the measurement of functioning is well established, accepted and integrated as the third health indicator following the COVID-19 pandemic.

## ARTICLE HISTORY

Received 25 November 2020  
Accepted 10 March 2021

## RESPONSIBLE EDITOR

Maria Nilsson

## KEYWORDS

Functioning; population measurement; global health; rehabilitation; assistive technology

## Background



Historically population-based metrics in Global Health have relied heavily on mortality and morbidity. These two health indicators have accumulated great importance and are used widely when assessing health within nations and populations. Though gaps still remain, mortality and morbidity data have led to the development of life-saving health interventions and are increasingly routinely measured in health systems. Morbidity is defined as having a disease or the amount of disease in a population, but what about the Global Health metrics *after* morbidity? As members of a population survive with health conditions, including communicable or non-communicable diseases, what indicator is available to measure their lived experiences of health throughout the life course?

The importance of these questions can be illustrated through the coronavirus disease 2019 (COVID-19). Though much is still unknown about COVID-19 and the recovery trajectory, it is increasingly clear that many COVID-19 survivors experience difficulties in functioning following both hospitalisation for severe acute disease and recovery from mild to moderate symptoms in home/community settings. Evidence suggests high physical, neuropsychological

and social need, and that the most common post-COVID symptoms are fatigue, breathlessness and psychological distress, including depression, anxiety and PTSD [1]. Many COVID-19 survivors are experiencing these symptoms alongside several months of general deconditioning, leading to the now more common terminology of ‘Long COVID’; yet, the issue of Long COVID and the needs of survivors are not being identified and addressed [1–3].

## Functioning, the third indicator in population health

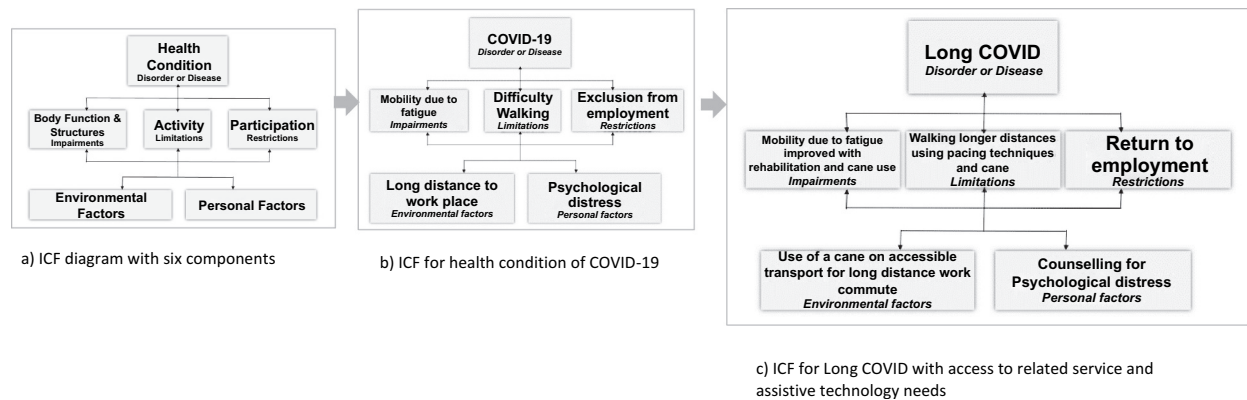
An essential complementary third health indicator, *functioning*, provides metrics about *how people are living in their daily lives* [4]. Functioning is defined as an umbrella term in the International Classification of Functioning, Disability and Health (ICF- [Figure 1 \(a\)](#)) for body functions and structures, activities, and participation; it denotes the interaction between an individual (with a health condition) and his/her contextual factors (environmental and personal factors) [5]. Functioning is complex given it incorporates all of the six key ICF components and is incorporated in

**CONTACT** Dorothy Boggs  [dorothy.boggs@lshtm.ac.uk](mailto:dorothy.boggs@lshtm.ac.uk)  International Centre for Evidence in Disability (ICED), London School of Hygiene & Tropical Medicine, Keppel St, London WC1E7HT, UK

This article has been republished with minor changes. These changes do not impact the academic content of the article.

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



**Figure 1.** Example of International Classification of Functioning, Health and Disability (ICF) diagram for health condition of coronavirus disease 2019 (COVID-19) with access to related service and assistive technology needs [5].

a supplementary section of the International Classification of Diseases eleventh revision (ICD-11) [6].

Figure 1(b) presents an example of functioning, using the ICF framework, as applied to a hypothetical COVID-19 survivor. In this example, a COVID-19 survivor experiences a mobility impairment due to high levels of fatigue and breathlessness resulting in poor endurance. He/she might experience difficulty walking long distances (activity restriction) preventing the survivor from getting to his/her office job (participation restriction) in the context of a long-distance commute involving both walking and public transport (environmental factor). These difficulties may also result in psychological distress (personal factor) which in turn may further limit participation in work.

### Why is measuring function important?

Functioning data are vital to understand the experiences of people with disabilities, older people and people living with chronic health conditions, non-communicable diseases, and communicable diseases with long term conditions, including COVID-19 survivors. More broadly, functioning is critical as the Global Health community aims to achieve Sustainable Development Goal (SDG) 3 'Ensure healthy lives and promote well-being for all at all ages' and Universal Health Coverage (UHC) [7]; we cannot know if we are *actually* reaching the most vulnerable and marginalised populations if we don't have accurate data on who they are, what they have difficulty doing, and how their daily lives could be improved.

These factors have become even more important given changing global health and demographic trends, and the increased numbers of people experiencing functional difficulties and disability [8,9].

Further, given functioning is environmental and personal context dependent, population-based functioning needs will change over time as populations age and contexts change and adapt. Functioning indicators could enable more responsive measurement and monitoring of specific needs within contexts and settings. For example, Disability-Adjusted Life Years (DALYs), a widely used population health disability measurement, are primarily based upon the impact of living with a health condition's impairment (i.e. body function and structure component of the ICF) that is associated with certain functional limitations. DALYs are not sensitive enough to be able to measure people's overall functioning resulting from either changes over time (with or without interventions) or interactions with other components of the ICF, such as personal and environmental factors, recognising that functioning can change even if an underlying 'health condition' does not [10,11]. Therefore, identifying, measuring and monitoring population-based functioning incorporating *all* ICF components will be key for advancing the agenda for this indicator. Functioning data are important for informing evidence-based health and social rights-based policies, planning services and identifying appropriate interventions that can support populations to live more holistic and complete lives. This data will provide information about an individual's health in a more comprehensive way, which will in turn support broader cross-sectoral interventions.

Rehabilitation and assistive technology (AT) are two inter-related sectors that rely on functional assessment to identify appropriate interventions to optimise functioning and independence. Comprehensive data on functioning at the population-level are key for identifying need/unmet need for rehabilitation and AT. However, as both sectors advance their global agendas, these data are lacking in many areas of the world, constraining the effective planning and provision of these services [12,13].

Estimates that are available, such as the recent WHO estimates that 2.4 billion or one in three people are in need of rehabilitation services, are often based upon gross estimates of Global Burden of Disease data [14]. These need to be advanced with more accurate disaggregated measurement.

### How to measure: functioning, rehabilitation and AT?

Given the importance of data on functioning, how can it be measured?

As summarised in Table 1, different methods are used to assess functioning, and/or rehabilitation or AT needs at the population-level (e.g. through surveys). However, most of them capture only one or a sub-set of the six ICF components.

Two of the most commonly used approaches are clinical measurement and self-report; however, they produce inconsistent results and typically remain siloed, and do not provide holistic cross-ICF component measurement [15]. Clinical measurement typically focuses solely upon body structure and function. Clinical impairment-based assessments are important for identifying select health-related service needs (e.g. surgical, medical and some ‘correctable’ impairment service referrals such as spectacles for refractive error), but they do not capture broader aspects of a person’s functioning (e.g. activities, participation and context) as defined by the ICF [15]. For example, the Rapid Assessment of Avoidable Blindness (RAAB) [16] is a widely used impairment survey method which includes visual acuity assessment and eye examinations to identify visual impairment and likely ‘cause’, such as cataracts and refractive error. Referrals to surgical, medical and vision services are made based on this information.

Self-reported functioning measures are cheaper and easier to administer than clinical measures. The Washington Group on Disability question sets ask about difficulty completing activities, such as the Short set which focuses upon activities in six domains (seeing, hearing, walking, remembering, understanding and self-care) alongside select AT use [17]. These tools are short to administer and widely used internationally. However, they primarily focus on the activity limitation component of the ICF only. The self-reported WHO Model Disability Survey [18] incorporates all six ICF components to assess broader health and social needs, including rehabilitation and AT use, with the brief version recommended in the ICD-11 functioning assessment supplementary section, and the WHO rapid Assistive Technology Assessment focuses upon self-reported activity, participation and environment components to assess AT use and need [19]. However, evidence suggests that self-report alone is unreliable and can either over- or

under-estimate functioning difficulties and related needs [15]. A comprehensive functional assessment approach which incorporates all the ICF components is lacking. This is needed to inform rehabilitation and AT service needs, as well as other interventions.

Returning to the COVID-19 example, identifying long term effects, such as vocal cord damage from invasive ventilator use, and associated functional difficulties with COVID-19 and its variants will require functional screening and measurement tools across multiple domains at both individual and population levels. It also will be important to ensure disaggregation of these data by key characteristics, such as age, race, ethnicity, gender, disability and other socio-demographic variables as well as qualitative methods to explore lived experience in more depth. Further, managing functional needs will require i) person-centred care; ii) a continuum of care from clinicians to community workers, and; iii) uptake of referrals to rehabilitation and AT interventions from acute to community health settings either virtually or face-to face [3,20]. In Figure 1(c), for the same person, access to rehabilitation services including counselling and the use of a single-point cane on accessible transport could facilitate participation in his/her job.

The ‘Post-COVID-19 Functional Status (PCFS) Scale’ is a self-report screening tool designed for telephone administration to assess the spectrum of functional outcomes following COVID-19 and track progress over time [21]. However, there is a need for more comprehensive tools which integrate clinical impairment assessment as well as other ICF components to assess functioning in different domains. This will be important to better understand functioning and associated need for rehabilitation/AT services and to highlight an important treatment gap [20]. This assessment method could then be applied more broadly to other communicable and non-communicable diseases, injuries and health conditions, and be used for planning and advocating for health system strengthening of these interventions.

A gap remains for a comprehensive tool, not just specific to COVID-19, which can be used at the population level to measure functioning and the need for rehabilitation and AT. In the AT2030 research funded by UK Aid, a functional needs assessment tool is being developed and tested which combines self-report and clinical measurement methods incorporating all ICF components [15]. Maintaining a people-centred approach is fundamental. Therefore, functioning data will be collected to capture the individual’s impairment, participation, activities and environmental and personal contexts across the functional domains of vision, hearing, mobility, communication, cognition, self-care and mental health.

**Table 1.** Examples of four tools that measure components of the International Classification of Functioning, Health and Disability (ICF) [5].

Measurement tool example	Tool method	Number of ICF component/s	Specific ICF component/s measured	Description
RAAB [16]	Clinical measurement	1	Impairment	Objectively measures distance and near visual impairment (VI) and assesses cause. RAAB 7 integrates Peek acuity which assesses visual acuity by a non-specialist using a smartphone.
Washington Group on Disability question sets [17]	Self-report	1	Activity limitations	<u>Short question module</u> : six questions for participants ≥5 years old measuring six core functional domains- seeing, hearing, walking, cognition, self-care, and communication. <u>Extended question module</u> : 29 questions for participants ≥5 years old including short set module plus upper body functioning, psychosocial difficulties, pain and fatigue, and additional information in certain domains of functioning both with and without the use of assistive technology/aids. <u>Child functioning module</u> : two question sets for participants between 2–4 years old and 5–17 years assessing functional difficulties in different domains including hearing, vision, communication/comprehension, learning, mobility and emotions.
WHO Model Disability Survey [18]	Self-report	6	Health condition; body function; activity limitations; participation restrictions; environment and personal factors	Self-reported questionnaire that asks people what they do, or do not do, in their daily lives focusing on functioning in multiple domains well-aligned with the ICF and a series of questions regarding domain-specific and participation-specific health service, rehabilitation and AT use.
WHO GATE's rapid Assistive Technology Assessment [19]	Self-report	3	Activity limitations; participation restrictions; environment	Self-reported questionnaire that assesses participants' need, unmet need and access to AT using adapted Washington Group Short Set as initial screening and images alongside each assistive product.

## Action: build back better with an inclusive focus on functioning

As the world grapples to 'build back better' following the COVID-19 pandemic and at the same time advance the SDG and UHC agendas, it is important to remember the SDGs' tagline 'leave no one behind'. To do this it is essential to ensure that the measurement of functioning is well established, accepted and integrated as the third health indicator. Increased attention is needed to ensure improved clarity, consistency and understanding of its definition and measurement. Development and application of population-based assessment tools which incorporate all components of the ICF will be important for generating comprehensive and comparable data on functioning needed to inform rehabilitation and AT, as well as other interventions/services. To action this, the Global Health community is encouraged to lead a shift of terminology and mindset from focusing on 'mortality' and 'morbidity' to equally include '*functioning*.' This resultant scaling up of the measurement of functioning will enable us to inclusively build back better, improving health and wellbeing for *all*.

## Acknowledgments

N/A.

## Author contributions

All authors were involved in the conceptualisation, drafting and final approval of the manuscript.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Ethics and consent

N/A.

## Funding information

This work was funded by UK Aid through the AT2030 programme led by the Global Disability Innovation Hub. Project Number: 300815 (previously 201879-108).

## Paper context

Alongside mortality and morbidity, functioning is a third health indicator which must be assessed and integrated into global health population-based metrics. This paper defines functioning, presents measurement options and highlights the importance of functioning when considering the need for, and outcome of, rehabilitation and assistive technology following a health condition illustrated by the example of COVID-19. Increased attention

is needed to ensure improved clarity, consistency and understanding of the definition and measurement of functioning.

## ORCID

Dorothy Boggs  <http://orcid.org/0000-0001-5380-2785>

Sarah Polack  <http://orcid.org/0000-0002-7524-7396>

Hannah Kuper  <http://orcid.org/0000-0002-8952-0023>

Allen Foster  <http://orcid.org/0000-0003-2368-4436>

## References

- [1] Halpin SJ, McIvor C, Whyatt G, et al. Post-discharge symptoms and rehabilitation needs in survivors of COVID-19 infection: a cross-sectional evaluation. *J Med Virol.* 2020;93:1013–1022.
- [2] Perego E, Callard F, Stras L, et al. Why we need to keep using the patient made term “Long Covid”. *BMJ Opinion.* 2020. Available from: <https://blogs.bmj.com/bmj/2020/10/01/why-we-need-to-keep-using-the-patient-made-term-long-covid/>
- [3] Bettger JP, Thoumi A, Markevich V, et al. COVID-19: maintaining essential rehabilitation services across the care continuum. *BMJ Glob Health.* 2020;5:e002670.
- [4] Stucki G, Bickenbach J. Functioning: the third health indicator in the health system and the key indicator for rehabilitation. *Eur J Phys Rehabil Med.* 2017;53:134–138.
- [5] World Health Organization. International Classification of Functioning, Disability and Health (ICF). World Health Organization; 2001 [cited 2020 Aug 27]. Available from: <http://www.who.int/classifications/icf/en/>
- [6] World Health Organization. International Classification of Diseases (ICD) 11 Geneva: World Health Organization; [cited 2021 27 February]. Available from: <https://icd.who.int/browse11/l-m/en>
- [7] The Lancet. Prioritising disability in universal health coverage. *Lancet.* 2019;394:187.
- [8] Cieza A. Rehabilitation the health strategy of the 21st century, really? *Arch Phys Med Rehabil.* 2019;100:2212–2214.
- [9] Vos T, Lim SS, Abbafati C, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet.* 2020;396:1204–1222.
- [10] Mont D, Loeb M. Beyond DALYs: developing indicators to assess the impact of public health interventions on the lives of people with disabilities: social protection. Washington, DC: World Bank; 2008.
- [11] Mont D, Loeb M. A functional approach to assessing the impact of health interventions on people with disabilities. *ALTER-Euro J Disability Res/Revue Européenne de Recherche sur le Handicap.* 2010;4:159–173.
- [12] World Health Organization (WHO). Rehabilitation 2030: a call for action. Geneva, Switzerland: WHO.
- [13] Resolution WHA71.8. 2018. Improving access to assistive technology. (Sect. WHA71/2018/REC/1).
- [14] Cieza A, Causey K, Kamenov K, et al. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet.* 2020;396:2006–2017.
- [15] Boggs D, Kuper H, Mactaggart I, et al. Estimating assistive technology need through population-based surveys: an analysis of data from Cameroon and India. In: Layton N, Borg J, editors. Global perspectives on assistive technology: proceedings of the GReAT Consultation. Vol. A. Geneva: World Health Organization; 2019. p. 52–78.
- [16] International Centre for Eye Health. The RAAB repository 2018. Available from: <http://raabdata.info>
- [17] Washington Group on Disability Statistics Secretariat. Washington group on disability statistics. Hyattsville, MD: National Center for Health Statistics; 2020 [cited 2020 Aug 27]. Available from: <http://www.washingtongroup-disability.com/>
- [18] World Health Organization. Model disability survey. Geneva: WHO; [cited 2020 Aug 27]. Available from: <https://www.who.int/disabilities/data/mds/en/>
- [19] Pryor W, Nguyen L, Islam Q, et al. Unmet needs and use of assistive products in two districts of Bangladesh: findings from a household survey. *Int J Environ Res Public Health.* 2018;15:2901.
- [20] Falvey JR, Ferrante LE. Flattening the disability curve: rehabilitation and recovery after COVID-19 infection. *Heart Lung: J Cardiopulmonary Acute Care.* 2020;49:440–441.
- [21] Klok FA, Boon GJ, Barco S, et al. The post-COVID-19 functional status scale: a tool to measure functional status over time after COVID-19. *Eur Respir J.* 2020;56:2001494.



As highlighted in the Research paper, rehabilitation and AT are two inter-related sectors that rely on functional assessment to identify appropriate interventions to optimise functioning and independence. A population-level tool to assess functioning which accurately informs AP, as well as other intervention needs, is essential, but lacking. Standardised methods, including rapid methods, for screening and assessing overall functioning within population-based surveys are limited; however, different measurement approaches and conceptual understandings exist for each of the different ICF components. The next sections briefly define and describe these approaches, namely clinical impairment, self-report and combined hybrid approaches, used in population-based surveys in relation to the ICF, and reflect on key gaps of these methods in terms of estimating population level AP need.

## **2.2 Clinical impairment-focused assessment survey methodologies**

Impairments refer to “the loss or abnormality in body structure or physiological function (including mental functions), where abnormality means significant variation from established statistical norms”.(41) Standardised methods exist for assessing clinical impairment within surveys to assess presence and severity of impairment (e.g. visual acuity) and likely causes and diagnosis (e.g. cataract, refractive error). These assessments are used in population surveys to estimate prevalence and causes of impairment to support service planning. All rely on objective clinical assessment for impairment using standardised tools, often under the guidance of a clinician. Applying these methods to generate population estimates of impairment for all ages typically requires a large sample size as the prevalence across the whole population may be low. Furthermore, reliance on clinical assessment for estimating prevalence and cause of impairments can be expensive, time-consuming and require clinical expertise. As a consequence of these factors, all-age prevalence surveys of impairment are limited.

Rapid survey methodologies have been developed by LSHTM International Centre for Eye Health (ICEH) and ICED in the domains of vision (Rapid Assessment of Avoidable Blindness, RAAB), hearing (Rapid Assessment of Hearing Assessment, RAHL) and MSI (Rapid Assessment of Musculoskeletal Impairment, RAM) to facilitate this data collection in an affordable and timely way in LMICs. These surveys are rapid because they use simplified clinical impairment assessment methods to measure the prevalence and cause of impairment. Further for vision and hearing, they focus on people aged 50+ years where prevalence of impairment is the highest, which reduces the sample size required. RAM typically focuses on people aged  $\geq 6$  months. While these rapid surveys provide data on prevalence and cause of impairment, they do not specifically assess AP need in a standardised way. Furthermore, the vision and hearing

assessments do not provide estimates for people <50 years old. These survey methods are briefly introduced below and key gaps in the context of AP need data are highlighted. This PhD thesis will investigate and advance these ICED methods for measurement for AP need in the three functional domains.

#### *Rapid vision impairment screening and assessment*

The RAAB estimates the prevalence and causes of avoidable blindness, focusing on people aged 50 years and over. Visual acuity is assessed using an “E” chart. Since 2021, this assessment is done through an integrated validated smartphone mobile health tool - Portable Eye Examination Kit (Peek) acuity.(42-44) Participants with VA <6/12 in either eye have their vision tested with pinhole to assess for refractive error and need for distance glasses (i.e. uncorrected refractive error (URE)). Participants with VA <6/12 in either eye, not attributed to refractive error, undergo an eye examination by an ophthalmologist, to determine the likely cause. RAABs generate estimates of prevalence and causes of vision impairment and the referral action required (e.g. surgery, glasses) for participants aged 50 years old and over. To date over 330 RAABs have been conducted globally, and, due to this widespread use, comparable estimates of the prevalence of VI in people in this age group are available.(44-46) The survey methodology used by RAAB is relatively fast and inexpensive using simple examination protocols so has been used for other prevalence of impairment studies.(47, 48) RAAB estimates the need for distance glasses through assessment of refractive error, and more recently (2021) near vision assessment for near glasses. However, gaps remain including: estimates for younger age groups <50 years old, lack of functioning assessment (i.e. personal and environmental factors), and lack of assessment of other vision related AP (e.g. low vision aids).

#### *Rapid hearing impairment screening and assessment*

Based on the RAAB methodology, RAHL was developed by ICED at LSHTM in response to WHO's request for a similar tool for HI and deafness. RAHL focuses on people aged 50 years and over based on evidence that more than 75% of people with HI are aged 50 years and over and uses similar standard sampling methods to RAAB.(49-51) As part of RAHL, all participants have their hearing tested using hearTest (52), an automated mobile tool measuring pure tone audiometry (PTA), and ears examined using otoscopy.(51) Causes of HL are assessed through otoscopy, by an Ear, Nose and Throat (ENT) doctor, audiologist or equivalent, and questions about hearing health are asked of participants.

RAHL is improving the availability of data on prevalence of HI in people aged 50 years and over. In terms of AP, RAHL estimates the number of people who will likely require referral to audiology services and/or hearing aids from impairment assessment only. Similar to RAAB's gaps, it doesn't include participants <50 year olds, there is no standardised functioning assessment and no assessment for other hearing related AP need (e.g. hearing loop).

#### *Rapid MSI screening and assessment*

The RAM was developed as a population-based survey method for people aged ≥6 months to estimate the prevalence and causes of MSI. It includes six initial screening questions. Anyone who screens positive undergoes assessment by a physical therapist of physical functioning to assess presence, severity (mild, moderate or severe) and likely diagnosis and aetiology (if possible) of MSI.(37) The RAM can provide data to assist with planning and advocacy for medical, rehabilitation and other services (34-37). However, learnings from previous studies identified the need for more systematic and standardised assessment of MSI cause, severity and AP need.

#### *AP gaps*

**Table 2-1** Summary of the key gaps in rapid survey methods in terms of estimating all-age AP need.

**Table 2-1: RAAB, RAHL and RAM measurement gaps for all-age AP need**

TOOL	MEASUREMENT GAPS FOR ALL-AGE AP NEED
<b>RAAB</b>	<ul style="list-style-type: none"> <li>➤ Does not measure all-age population-based distance and near VI prevalence.</li> <li>➤ Data gap for non-VA VI, i.e. contrast sensitivity, visual fields.</li> <li>➤ Need for assessments of functional VI, and related AP need.</li> </ul>
<b>RAHL</b>	<ul style="list-style-type: none"> <li>➤ Does not measure all-age population-based HI prevalence.</li> <li>➤ Need for assessments of functional HL, and the related AP need.</li> </ul>
<b>RAM</b>	<ul style="list-style-type: none"> <li>➤ Limited data available for all-age population-based MSI and MI prevalence.</li> <li>➤ Need improved determination of cause and severity measurement, especially in younger children.</li> <li>➤ Need estimates of functional MI to determine related AP need in a standardised consistent way.</li> </ul>

Abbreviations: AP= assistive products; RAAB= Rapid Assessment of Avoidable Blindness; VA= visual acuity; VI= vision impairment; RAHL= Rapid Assessment of Hearing Loss; HI= hearing impairment; HL= hearing loss; RAM= Rapid Assessment of Musculoskeletal Impairment; MSI= musculoskeletal impairment; MI= mobility impairment.

### **2.3 Self-reported assessment survey methodologies**

#### *Screening for activity limitations*

The most widely used assessment in population-based surveys are the validated Washington Group (WG) question sets, which measure activity limitations due to a health condition through self-report. This self-reported approach to assess the *body structure or function* and *activity* components of the ICF is broadly labelled, “functional

limitations/difficulties". The WG question sets include the short set (SS), short set enhanced, and an extended set (ES) questionnaires for adults (>17yrs), and there is also a Child Functioning module (CFM) developed with UNICEF for children (2-17yrs).(53-57) These question sets measure subjective self-assessment (or proxy reported) data across functional domains, including vision, hearing and mobility, and use a four-part scaled response of: no difficulty, some difficulty, a lot of difficulty, or cannot do at all. The WG questions ask about use of glasses, hearing aids and mobility AP/assistance in some of the question subsets. The WG questions are a brief, simple questionnaire that is low cost and rapid to administer, based on participants own assessment within their context. However, they provide limited information for health service planning, including on AP need.

Previous ICED research by Mactaggart et al. (58) compared the WG questions and clinical impairment methods for assessing disability. They found that the WG tools alone (using the widely applied cut-off of "a lot of difficulty" or more in at least one domain) did not identify all people with activity restrictions and moderate or severe clinical impairments.(58) It was estimated that a self-reported functional limitation tool followed by clinical impairment screening of all those who report "any level of difficulty" would identify approximately 95% of people with disabilities (i.e. people with moderate or worse impairment).(58) This approach could reduce time and cost since only select participants would undergo the more time-consuming and expensive clinical impairment assessment. However, it is unclear the extent to which these questions identify people who are likely to benefit from AP. This PhD will explore this recommendation in **Chapter 8** to determine which cut-off of the WG questions might adequately identify the group of people who could potentially benefit from AP.

#### *Health and disability assessment*

Many existing health and disability assessment survey tools utilise self-reported functional difficulties and do not assess AP need. For example, the WHO Disability Assessment Schedule 2.0 (WHODAS 2) is a general measure of health, functioning and disability directly linked with ICF's activity and participation dimensions used in clinical and population settings to determine severity of difficulty covering six life domains (cognition, mobility, self-care, getting along, life activities and participation). However, it does not assess related AP need, relies solely on the self-report approach and needs to be feasible within a survey which has constraints of limited time, resources and need for standardisation.(59)

## 2.4 Hybrid assessment survey methodologies

### *Hybrid functional assessment*

As previously described, people with the same impairment may not have the same AP need. Therefore, additional assessment tools are required to assess the influence of activities, participation and personal and environmental factors on whether and which AP may be appropriate. It is therefore important to use comprehensive functional assessments to provide a holistic picture of individuals' contexts, abilities and daily living skills, to identify their AP needs. This approach is well-aligned with the ICF, and typically includes physical, cognition, mood, and carer related matters.(30, 60) In addition to self-report and impairment methods, functional assessment can use a variety of approaches, including indirect, observational, and experimental/functional analysis procedures; this approach is commonly used in the rehabilitation sector, administered by therapists to determine treatment plans, follow up services and AP need.(60, 61) However, existing hybrid functional assessments primarily measure individual-level functioning for use in clinical settings and are time-intensive (e.g. ICF checklist) (62), and few exist for standardised use in population-level surveys. This PhD will review identified functional assessments in population-level surveys in **Chapter 4.3**.

## 2.5 Tools and methods that directly assess AP need

Examples of identified tools and methods which measure population-based AP need are provided below according to assessment type: clinical impairment, self-reported, hybrid and other assessment methods. A brief overview of the pros and cons of the assessment methodology is provided.

### *Clinical impairment AP assessment*

Clinical impairment AP assessments can provide data on impairment type, severity and causality using standardised methods. However, they are resource intensive and require a clinical examiner. Moreover, they only focus on one ICF component as they lack broader functioning assessment and so are more in keeping with the "medical model of disability". An example of a study which used a clinical impairment approach is research conducted by Mactaggart et al. in Cameroon and India (data used in this thesis).(58) This survey collected clinical impairment assessment data on health and rehabilitation needs, including services and select AP. An analysis of the clinical impairment assessment of AP need from the survey is included as part of this PhD thesis (see **Chapter 5.1**).(63) This survey also collected self-reported AP need data so a comparison of participants' self-reported AP need assessment with clinical impairment AP assessment is also included in this thesis (see **Chapter 5.1**). However, Dorothy Boggs

though this study utilised two assessment methods, it was not a hybrid assessment study given the clinical impairment and self-reported findings remained separate and were not integrated to make a final AP need recommendation.

#### *Self-reported AP assessment*

Self-reported AP assessment is simple to administer and incorporates information on lived experience and impact. However, we do not know how well this assessment methodology relates to clinical assessment of AP need. There could be a risk of both underestimating or overestimating AP need due to poor awareness of AP; therefore, this method has more limited use for planning services and interventions (see **Chapters 5 and 8**). One example is the WHO GATE rATA.(64) Recently developed (2021) as part of a series of population-level WHO AT-specific tools, this tool measures self-reported AP need and unmet need, alongside using adapted WG SS (see **Chapter 7.1**).(1, 16, 64, 65).

Some self-report tools have a specific focus on functioning assessment, such as the WHO Model Disability Survey (MDS). It collects and reports globally comprehensive and comparable disability data by asking people to self-report what they do, or do not do, in their daily lives focusing on functioning in multiple domains well-aligned with the ICF. It also asks a series of questions regarding domain-specific and participation-specific AP use, need and barriers through self-reported questions.(66, 67) This tool is recommended by WHO as a reliable disability assessment utilising the ICF's biopsychosocial approach to assess broader health and social needs, including rehabilitation and AP use, and the brief version is the currently recommended tool in the ICD-11 for measuring functioning assessment; however, this tool relies on self-report assessment only and does not use the findings to assess AP need in an integrated way.(66, 67) Further, though the MDS was found to have good reliability in terms of internal consistency of the scale and targeting, these findings were in terms of disability assessment and not AP.(68)

Another approach used in surveys is to ask the single question "Do you use AP?" or "Do you need AP?". Though rapid and useful in a limited survey space, it is possible that AP estimates could be underestimated or overestimated due to poor awareness of availability and individual need.

### *Hybrid functional AP assessment*

Hybrid functional AP assessments, which utilise a more holistic approach including a combination of broader self-reported and clinical based assessments focusing on impairment and wider functioning components, can provide AP data more congruent with ICF measurement. However, this assessment approach can be time intensive and complex, focusing on multiple components of ICF. Population-based multi-domain hybrid functional assessment methodology is not yet developed and will be the focus of this thesis.

### *Other AP assessment approaches*

For settings where AP estimates from population surveys are unavailable, then two indirect assessment methods could be used to estimate AP need. One method is to extrapolate AP need from prevalence or incidence of related pathologies or conditions using data from those that were most strongly correlated with use of AP (e.g. WHO global AP estimates from GBD data).(12) This method is potentially useful if relevant data is available as some conditions or pathologies can be strongly correlated with specific AP. One example of this is the use of RE data to derive estimated need for glasses.(69) However, a limitation is that it can be impractical for some AP to base estimates on correlations with pathologies or medical conditions (e.g. the mobility needs of a lower limb amputee will depend on factors related to the person's clinical condition and living circumstances). The second method is to estimate AP need from international AP data. AP estimates are available (i.e. WHO estimates), however these estimates are gross estimates, not country specific, and the reliability of AP global data estimates is unclear. These methods were both used in a WHO regional office Tajikistan study to gather population-based AT data for a national APL.(16) For example, the UK's approximate communication board AP need estimate of 0.5% was used to estimate Tajikistan's annual communication board AP need of 5816 units.(16) The study authors acknowledged that this method could produce inaccurate results and was only utilised in the absence of regional/national data statistics.

### *Summary of methodology advantages and disadvantages*

Measuring population-based AP need is critical for governments to develop policies, plan services and procure AP for improving access to AP. In a population-based survey, the following assessment methods could be used: self-report assessment, clinical impairment assessment, and hybrid assessment. The advantages and disadvantages of using the different methods are summarised in **Table 2-2**.(58) This PhD will explore how accurate these different methods are for assessing AP need and how they inter-relate in terms of generating information on AP need.

**Table 2-2: Measuring AP: methodology advantages and disadvantages (58, 70)**

<b>AP METHOD</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>	<b>EXAMPLE</b>
<b>Clinical impairment assessment</b>	Provides data on impairment type, severity and causality assessed using standardised methods.	Resource intensive. Only focuses on one ICF component. Lacks broader functioning assessment. Medical model of disability.	RAAB
<b>Self-report assessment</b>	Simple to administer. Information on experience and impact.	Risk of underestimate or overestimate due to poor awareness of AP. Limited use for planning services and interventions.	Single question rATA MDS
<b>Hybrid functional assessment</b>	Congruent with ICF. More holistic and comprehensive method. Usually combination of self-reported and clinical based.	Time intensive. Complex focusing on multiple components of ICF. Multi-domain hybrid methodology not yet developed.	Both clinical and self-report: none.

Abbreviations: AP= assistive products; ICF= International Classification of Functioning, Disability and Health; RAAB= Rapid Assessment of Avoidable Blindness; rATA= rapid Assistive Technology Assessment; MDS= Model Disability Survey.



## Chapter 3: Study rationale, aims and objectives

### 3.1 Study rationale

There is a need to close the AP data gap by building up the evidence base for planning AP services. This requires the development of assessment methodologies compatible with the ICF that can better estimate the all-age population-level AP indicators (i.e. use, met need, unmet need and coverage); this will also improve comparability in data between settings and over time. Different approaches exist to measure components of ICF and AP need as discussed in **Chapter 2**. Emphasis has typically been on using either clinical impairment or self-reported assessment methodologies in isolation, however each has limitations (see **Table 2-2**), and we don't know what the agreement is in terms of AP assessment (e.g. between clinical impairment and self-report assessment of AP need).

Standardised clinical impairment assessment methods are often used as the “gold standard” and have been developed for population-based impairment surveys (e.g. RAAB, RAHL, RAM), but have a single functional domain focus and there are gaps in terms of assessing all-age AP need, including a lack of broader functional assessment. Presently, there is a drive to collect self-reported AP data using the recently developed WHO rATA (64), which is useful in terms of driving data collection and advocacy, however it is unclear what these results are indicating and how accurate and reliable the findings are in terms of estimating need. A hybrid approach combining clinical and self-reported assessment may offer advantages in terms of feasibility and accuracy, but is not yet available. For instance, the WG questions have previously been recommended as first-stage screen before clinical impairment assessment to decrease time in disability surveys.(58) However, the extent to which this two-stage screening captures different impairments and AP need is currently unknown.

Therefore, this study will investigate the development of an all-age population-based survey methodology to assess AP need in the domains of vision, hearing and mobility. This will build upon previous study methods and recommendations through exploring and advancing assessment approaches of ICF components in six linked studies. Lessons learned with key implications will be provided throughout for a combined hybrid functional assessment survey tool integrating self-report and clinical methodologies, including impairment, to estimate AP need for vision, hearing and mobility.

### 3.2 Study aim and objectives

**Study aim:** To investigate the development of a population-based survey assessment methods to measure AP need in LMICs in the functional domains of vision, hearing and mobility and present methodology for a draft AP need survey tool.

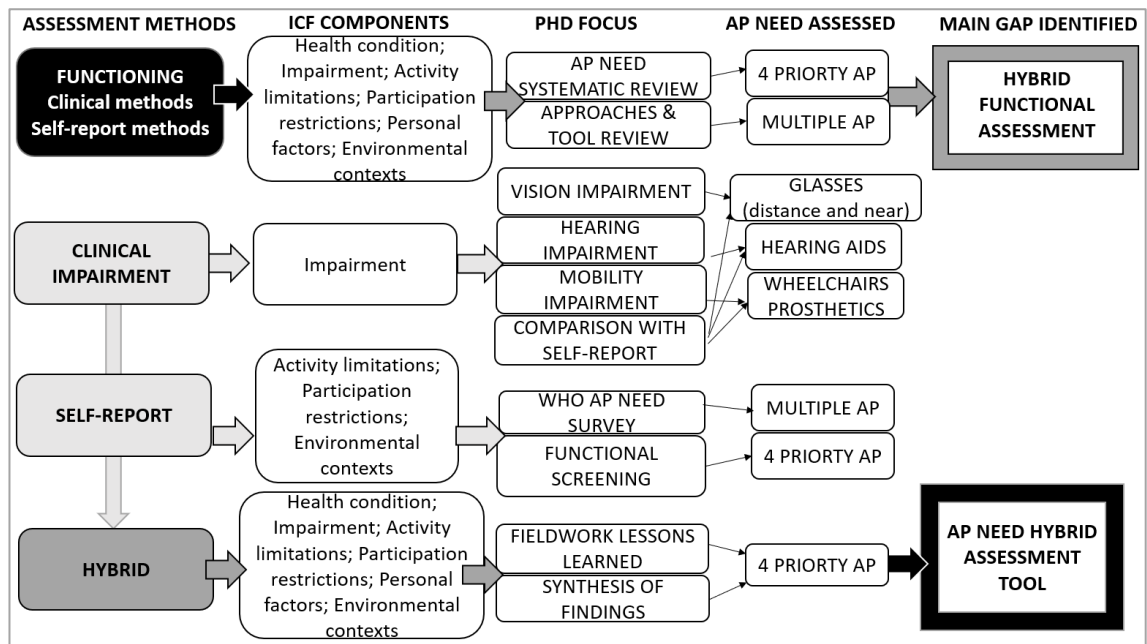
**Study objectives:**

1. **FUNCTIONING:** To review i) AP need estimates and ii) the approaches identified for the assessment of functioning to measure population-level AP need.
2. **IMPAIRMENT:** To explore the measurement of vision, hearing and mobility impairment as a method to estimate AP need through all-age population-based surveys.
  - a. To compare clinical impairment vs self-report<sup>1</sup> assessment methodology for measuring AP need.
  - b. To review and advance clinical impairment assessment protocols to estimate AP need for all ages.
3. **SELF-REPORT:** To explore self-report<sup>1</sup> assessment as a method to estimate AP need through population-based surveys.
  - a. To conduct a population-based AP need survey using self-report assessment.
  - b. To explore the use of first-stage self-report screening questions to measure AP need.
4. **HYBRID:** To provide recommendations for a hybrid “AP need survey protocol” for vision, hearing and mobility functional domains in LMICs.
  - a. To gather practical lessons learned from survey fieldwork.
  - b. To synthesise, provide recommendations for “AP need survey protocol”, and present a draft AP need survey tool.

**Figure 3-1** presents an overview of this PhD study objectives as a population-based survey method is developed through an ICF lens to estimate AP need in LMICs in the functional domains of vision, hearing and mobility.

---

<sup>1</sup> Note: here, “self-report” refers to self-reporting an AP need (e.g. self-reported need for glasses).



**Figure 3-1: Overview of PhD study population-based AP need survey method development**

### 3.3 Research methodology overview

The PhD uses predominantly quantitative methods to explore and advance AP need survey methodologies through six linked studies. The study methods for each specific objective are summarised in **Table 3-1** with each of the six research papers highlighted to present how the approaches build upon each other to address the overall aim.

**Table 3-1: Overview of PhD study objectives and methods**

STUDY OBJECTIVE	METHOD	PHD CHAPTER
<b>Objective 1: FUNCTIONING</b>		
To review i) AP need estimates and ii) available approaches for the assessment of functioning that have been used to measure population-level AP need.	Systematic review of AP need. <i>(Research paper 2)</i>	4.2
	Review of tools identified.	4.3
<b>Objective 2: IMPAIRMENT</b>		
a) To compare clinical impairment vs self-report assessment methodology for measuring AP need.	Secondary quantitative analysis of survey datasets for vision, hearing and mobility domains. <i>(Research paper 3)</i>	5.1
	Conduct and analyse population-based survey in The Gambia for vision and hearing domains. <i>(Research paper 4)</i>	5.2
b) To review and advance all-age clinical impairment assessment protocols to estimate AP need for all ages.	Secondary analysis of population-based surveys in Cameroon and India, and conduct and analyse surveys in The Gambia and Turkey for vision, hearing and mobility domains. <i>(Research papers 3, 4 and 5)</i>	5.1; 5.2; 6
<b>Objective 3: SELF-REPORT</b>		
a) To conduct a population-based AP need survey protocol using self-report assessment.	Coordinate and analyse population-based AP survey in Guatemala for vision, hearing and mobility domains. <i>(Research paper 6)</i>	7
b) To explore the use of self-report screening questions to measure AP need.	Secondary quantitative analysis of five survey datasets for vision, hearing and mobility domains. <i>(Research paper 7)</i>	8
<b>Objective 4: HYBRID</b>		
a) To gather practical lessons learned from survey fieldwork.	Summarise lessons learned from population-based survey fieldwork in The Gambia, Turkey and Guatemala. <i>(Research papers 4, 5 and 6)</i>	9
b) To synthesise and provide recommendations for AP need measurement protocol.	Consolidate information gathered in draft AP need survey module questionnaires.	10; 11

### 3.4 Research timescale

The time plan and activities of this PhD thesis are outlined in **Appendix 2**.

## SECTION B. METHODOLOGY AND RESULTS

In this section, the methodology and results of the PhD thesis are presented. First, a systematic review of AP need surveys is presented. This review identified surveys which used functioning assessment, and these are described in detail in **Chapter 4.3**. In **Chapters 5** and **6**, clinical impairment AP assessment methodologies for vision, hearing and mobility are explored in the Cameroon, India, Gambia and Turkey surveys. These methods measure one ICF component, the body structure/function or impairment, and are compared to self-report assessment. In **Chapter 7**, the recently developed WHO rATA survey tool which utilises only self-report is explored in the Guatemala survey, and **Chapter 8** explores the use of the self-reported WG questions as a first-stage screening to identify impairment and related service/AP need in five surveys. The survey results and analysis highlight the need for an AP assessment tool that combines both clinical impairment with self-report methodologies. Further, the need for hybrid functional assessment was a gap identified across all studies.

## Chapter 4: AP need indicators, estimates and assessment approaches

Alongside limited global data estimates, additional challenges with population level AP data are that terms, definitions and measurement approaches for different AP access indicators (e.g. need, unmet need, coverage) are lacking in consistency, often used interchangeably, and have not been systematically documented. This limits comparability of AP need estimates between settings and over time. To address these gaps in data, definitions and methods, a systematic review was undertaken to obtain population level estimates of need for five priority products (glasses, hearing aids, wheelchairs, limb prostheses and personal digital assistants). Personal digital assistants were included in this review but are not a focus of the wider thesis. As part of this review, definitions for AP access indicators were developed.

This chapter presents:

- i) the agreed AP access indicator definitions,
- ii) the findings of the systematic review of population-based estimates of AP access indicators,
- iii) a review of identified population-based survey tools that use functional assessments to measure AP need, and
- iv) discussion of the implications for hybrid functional assessment methodology (see **Appendix 1** for definition/explanation).

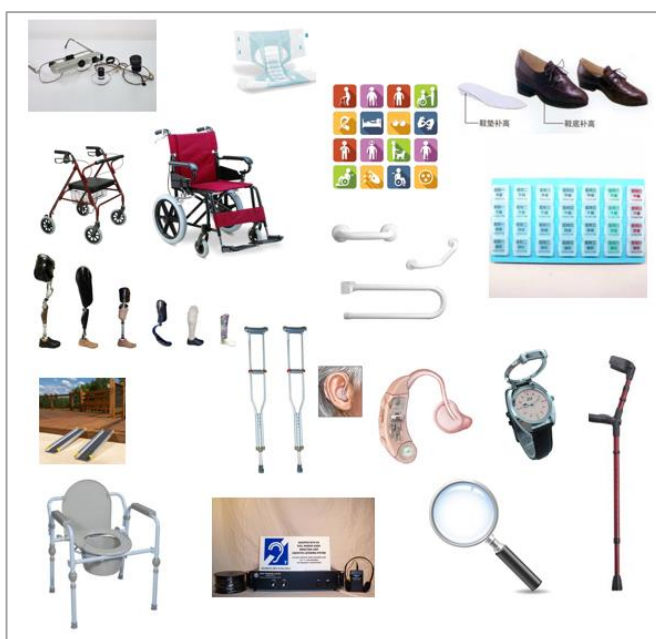


Photo examples of assistive products. © WHO

## 4.1 AP indicator definitions

Consistent definitions of population-based AP access indicators, such as AP need and coverage, are required to inform and interpret data collection and assessment methodology. In 2019, a scoping review was commissioned by WHO to explore population-level research informing AP supply and demand estimates through identifying common AP approaches and methods, comparing their strengths and limitations and describing the settings where each may be most effective.(71) To inform the review, definitions of population-level AP supply and demand indicators were developed and proposed through literature review and expert input and consensus, including with this PhD candidate. **Table 4-1** presents the AP access indicator working definitions and equations used in this PhD thesis. Herein, these will be referred to as AP indicators (of AP need).

**Table 4-1: Population-level AP indicators and definitions (71)^**

AP INDICATOR	WORKING DEFINITION*	EQUATION
<b>DEMAND</b>		
<b>Need</b>	The proportion of a defined population who could benefit from using an appropriate AP.	Population who could benefit from an AP / Defined population
<b>Perceived demand</b>	The proportion of a population who need AP, based on a self-reported AP assessment approach.	Population who self-report needing AP / Defined population
<b>Prevalence of use</b>	The proportion of a defined population who use an AP.	Population who use AP / Defined population
<b>Coverage</b>	The proportion of a defined population who need and use an AP.	Population who need and use AP / Population who need AP
<b>Met need</b>	The proportion of a population who need and use appropriate AP.	Population who need and use appropriate AP / Defined population
<b>Undermet need</b>	The proportion of a population who need and use AP that are insufficient to maximise functioning.	Population who use insufficient AP / Defined population
<b>Unmet need</b>	The proportion of a population who need and do not use any AP.	Population who need and do not use appropriate AP / Defined population

\* A “defined population” could include general populations, all age, specific age group, people with impairment or people with self-reported functioning difficulties; “AP assessment approach” could include as applies across definitions. ^ Table presents select “Demand” AP access indicator working definitions and equations from the paper that are used in this PhD thesis and does not include the “Supply” indicators.

## **4.2 Research paper 2: Estimating need and coverage for five priority assistive products: a systematic review of global population-based research**

### **Preamble**

Access to AP is limited globally.(1) To improve access to AP, data is required to inform evidence-based policy development and programme planning. This systematic review was undertaken to appraise and synthesise research evidence in studies presenting population-based estimates of need and coverage for five AP (glasses, hearing aids, wheelchairs, limb prostheses, personal digital assistants) grouped by four functional domains (vision, hearing, mobility and cognition).

Working with colleagues at the University College of London (Jamie Danemayer and Catherine Holloway) and wider AT2030 research consortium colleagues, the literature review for this systematic review was completed in March 2020.

This systematic review identified 655 AP indicators extracted from 207 studies. The review found considerable heterogeneity; first, in the approaches used to assess AP indicators, with over half of the studies (n=110) utilising a combination of clinical and self-reported assessment; and second, in how AP indicators were reported/defined. Studies reporting AP need indicators demonstrated high unmet need (>60%) for each of the five AP in most settings.

Overall, the systematic review highlights:

- i) that the variation in definitions of AP indicators likely led to inaccuracies in estimation of need and coverage, particularly where the relationship between functioning difficulty and the need for an AP is complex; and
- ii) the need to standardise AP data collection and reporting strategies to provide a comparable evidence base to improve access to AP.

This paper was published in January 2022 in the British Medical Journal of Public Health. As co-supervisor of the first author, I had a key role in the development of the systematic search terms and strategy, data extraction and presentation of the data. The paper was published under the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license (<http://creativecommons.org/licenses/by-nc/4.0/>), and the published manuscript is included in full below.



#### 4.2.1 List of Tables

**Table 1:** AP access indicators definitions and calculations.

**Table 2:** Hearing aid studies and indicators.

**Table 3:** Mobility AP studies and indicators.

**Table 4:** Near and distance glasses studies and indicators.

**Table 5:** Grouped and cognitive AP studies and indicators.

#### 4.2.2 List of Figures

**Figure 1:** Study selection. AP, assistive product; AT, assistive technology.

**Figure 2:** Cumulative publication frequency by WHO Region (A) and AP type (B). AP, assistive product; PDAs, personal digital assistants.

**Figure 3:** Need indicators for hearing aids (A), manual wheelchairs (B), near glasses (C), distance glasses (D) and grouped APs (E). HI, High-Income; SS, Sub-Saharan.

#### 4.2.3 Supplementary material

The Supplementary material referenced in the paper is available at

[https://gh.bmj.com/highwire/filestream/149634/field\\_highwire\\_adjunct\\_files/0/bmjgh-2021-007662supp001\\_data\\_supplement.pdf](https://gh.bmj.com/highwire/filestream/149634/field_highwire_adjunct_files/0/bmjgh-2021-007662supp001_data_supplement.pdf).

#### 4.2.4 Citation

Danemayer J, Boggs D, Delgado Ramos V, *et al*. Estimating need and coverage for five priority assistive products: a systematic review of global population-based research. *BMJ Global Health* 2022;7:e007662. doi:10.1136/bmjgh-2021-007662



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms.
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	BMJ Global Health		
When was the work published?	January 2022		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	Yes, copyright is with the Author(s) (or their employer(s)). This is an open access article published under the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <a href="http://creativecommons.org/licenses/by-nc/4.0/">http://creativecommons.org/licenses/by-nc/4.0/</a> .	Was the work subject to peer review?	Yes

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### **SECTION C – Prepared for publication, but not yet published**

Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**




For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I co-supervised the first author as she led the systematic review, including developing the search strategy, reviewing titles, abstracts and full text, completing data extraction, and supporting the data visualisation/presentation, drafting and reviewing of the manuscript.
--	---

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022

<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022

# Estimating need and coverage for five priority assistive products: a systematic review of global population-based research

Jamie Danemayer <sup>1</sup>, Dorothy Boggs <sup>2</sup>, Vinicius Delgado Ramos,<sup>3</sup> Emma Smith,<sup>4</sup> Ariana Kular,<sup>5</sup> William Bhot,<sup>1</sup> Felipe Ramos-Barajas <sup>1</sup>, Sarah Polack,<sup>2</sup> Cathy Holloway<sup>1</sup>

**To cite:** Danemayer J, Boggs D, Delgado Ramos V, *et al*. Estimating need and coverage for five priority assistive products: a systematic review of global population-based research. *BMJ Global Health* 2022;**7**:e007662. doi:10.1136/bmjgh-2021-007662

**Handling editor** Seema Biswas

Received 7 October 2021  
Accepted 10 December 2021



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

<sup>1</sup>Department of Computer Science, Global Disability Innovation Hub, University College London, London, UK

<sup>2</sup>International Centre for Evidence in Disability, London School of Hygiene and Tropical Medicine, London, UK

<sup>3</sup>Hospital das Clinicas HCFMUSP, Universidade de Sao Paulo, Sao Paulo, Brazil

<sup>4</sup>Department of Psychology, Assisted Living and Learning Institute, Maynooth University, Maynooth, Ireland

<sup>5</sup>Department of Health Sciences, Mental Health and Wellbeing, University of Warwick, Warwick, UK

## Correspondence to

Jamie Danemayer;  
jamie.danemayer.21@ucl.ac.uk

## ABSTRACT

**Introduction** To improve access to assistive products (APs) globally, data must be available to inform evidence-based decision-making, policy development and evaluation, and market-shaping interventions.

**Methods** This systematic review was undertaken to identify studies presenting population-based estimates of need and coverage for five APs (hearing aids, limb prostheses, wheelchairs, glasses and personal digital assistants) grouped by four functional domains (hearing, mobility, vision and cognition).

**Results** Data including 656 AP access indicators were extracted from 207 studies, most of which (n=199, 96%) were cross-sectional, either collecting primary (n=167) or using secondary (n=32) data. There was considerable heterogeneity in assessment approaches used and how AP indicators were reported; over half (n=110) used a combination of clinical and self-reported assessment data. Of 35 studies reporting AP use out of all people with functional difficulty in the corresponding functional domains, the proportions ranged from 4.5% to 47.0% for hearing aids, from 0.9% to 17.6% for mobility devices, and from 0.1% to 86.6% for near and distance glasses. Studies reporting AP need indicators demonstrated >60% unmet need for each of the five APs in most settings.

**Conclusion** Variation in definitions of indicators of AP access have likely led to overestimates/underestimates of need and coverage, particularly, where the relationship between functioning difficulty and the need for an AP is complex. This review demonstrates high unmet need for APs globally, due in part to disparate data across this sector, and emphasises the need to standardise AP data collection and reporting strategies to provide a comparable evidence base to improve access to APs.

## INTRODUCTION

Assistive technology (AT) includes assistive products (APs) and related services that can improve health and well-being, enable increased independence and foster participation for people with functional difficulties, including older adults and people with

## Key questions

### What is already known?

- ▶ Access to assistive technology (AT) is limited globally, especially in low/middle-income countries (LMICs), largely due to sparse, disparate data on assistive products (APs).
- ▶ Currently, there exists no dedicated repository of population-based AP research.
- ▶ As a result, many governments lack coherent information about unmet AP need, which can hinder development of evidence-based programmes and policies to address this gap.

### What are the new findings?

- ▶ The finding of high unmet need (>60%) for each of the five APs emphasises the need to secure political prioritisation and funding to expand access to AT globally.
- ▶ Vision is proportionately overrepresented in the literature, with 76% of studies reporting all or in part on glasses. ‘AP use’ was reported 195 times overall (30% of all 656 indicators), making it the most commonly reported AP indicator from this dataset.
- ▶ Discrepancies in how key terms related to AP access were defined likely led to overestimates/underestimates of need.

### What do the new findings imply?

- ▶ Synthesising disparate evidence and comparing across country contexts and functional domains provided a strong base to advocate for increasing access to APs, while identifying underrepresented regions, populations and APs.
- ▶ The evidence basis in LMICs is particularly sparse, demonstrating that knowledge gaps are widest, where AP access is the most limited.
- ▶ The development of a global minimum dataset on AP research is needed, as well as future research that disaggregates domain-specific and region-specific AP access by additional variables (eg, gender, income and education).

impairments or chronic health conditions.<sup>1</sup> This paper uses the umbrella term ‘functional difficulty’ (FD) to refer to all of these groups.

The WHO estimates 2.4 billion people globally have FD and over 1 billion need APs and related services.<sup>2</sup> This need is expected to rise as populations age, which forecasts an increase in years lived with FD.<sup>2</sup> Furthermore, in some low/middle-income countries (LMICs), higher prevalence of chronic and infectious disease and injury-related morbidity, coupled with a shortage of trained care workers, results in higher overall rates of FD and associated increased demand on healthcare, rehabilitation and AT service delivery systems.<sup>3</sup> The SARS-CoV-2 (COVID-19) pandemic has also resulted in increased FD prevalence due to disruptions of health/rehabilitation services and its direct impact on health and functioning.<sup>4</sup> This includes ‘long COVID-19’, where symptoms decreasing functional abilities persist, the full impact of which is yet to be fully realised.<sup>5,6</sup>

Despite AT’s critical relevance to all 17 sustainable development goals, the sector has not received equitable attention on the international agenda.<sup>7</sup> Data on AP need are essential to support decision-makers to secure political prioritisation, identify causes of delivery system bottlenecks, and implement interventions to address population-level AT access.<sup>8</sup> Information on this access is lacking, including estimates of use, unmet needs, and met needs, due in part to the complexity of assessing individuals for AP need.<sup>9</sup> Further, due to disparate patterns of data collection, analysis, and reporting, it’s often unclear what data are available and impactful data may go unused. An essential next step is, therefore, to centralise and collate available data indicating AP access and synthesise learnings across APs and functional domains to inform the sector overall.

Assistive product lists (APLs) (PAPs) are used to focus and coordinate efforts to expand AP access. Further specifying a list of priority assistive products (PAPs) at

the national level is encouraged in specific countries to ensure the list is contextual and based on their unique needs. The WHO Global Cooperation on Assistive Technology’s priority assistive product list presents a global list of 50 priority APs.<sup>10</sup> Of these, ATScale,<sup>11</sup> a Global Partnership for Assistive Technology, selected five priority APs corresponding to four functional domains: hearing aids (hearing), limb prostheses and wheelchairs (mobility), glasses (vision) and personal digital assistants (PDAs) (cognition).<sup>10</sup>

**Aims**

To contribute to a global effort to increase the AT evidence base, we conducted a systematic review of studies, which generated population-based AP access indicators for the five priority ATScale APs. This review aims to (1) characterise existing population-level research producing AP access indicators and (2) present and synthesise indicators globally to support scaling up AT provision.

This review builds on the findings of an initial scoping review, commissioned by the WHO and published separately,<sup>9</sup> which primarily focused on the strengths, limitations and most effective contexts for different methods used for estimating AP supply and demand at market level in AT research. Results from these methodologies are explored in this systematic review.

**METHODS**

The systematic search was conducted in March 2020 and included peer-reviewed articles and grey literature with findings on APs. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement was followed throughout review.<sup>12</sup>

**AP access indicators defined**

Population-level AP access indicators are variably used and defined in the literature. Table 1 shows the definitions used for the purposes of this review, developed by

AP access indicator	Working definition	Equation
Need	The proportion of a defined population who could benefit from using an appropriate AP, based on an AP assessment approach, including those already using the AP	Population who could benefit from an AP/defined population
Has AP	The proportion of a defined population who have an AP (obtained through purchase, loan, rent, donation or by other means)	Population who have APs/defined population
Use	The proportion of a defined population who use an AP	Population who use APs/defined population
Met need (population with full coverage)	The proportion of a population who need and use appropriate APs	Population who need and use appropriate APs/defined population
Undermet need (population with partial coverage)	The proportion of a population who need and use APs that are insufficient to maximise functioning	Population who use insufficient APs/defined population
Unmet need (population with no coverage)	The proportion of a population who need and do not use any APs	Population who need and do not use appropriate APs/defined population
Coverage	The proportion of a defined population who need and use an AP	Population who need and use APs/ population who need APs

AP, assistive product.

drawing on authors' expertise and relevant background literature (table 1).<sup>9</sup> These terms are referred to as 'indicators' throughout this paper.

### Search strategy

Fifteen databases were searched for empirical and grey literature using a set search string specifying (1) a synonym for AP or the name of the actual AP, (2) an indicator and (3) a synonym for FD in the study's title/abstract (online supplemental appendices 1 and 2). Studies were exported to the Rayyan QCRI web application<sup>13</sup> to remove duplicates and screen abstracts.

### Eligibility criteria

Our search included studies published between 2000 and 2020, written originally in English, French, Portuguese, or Spanish, or providing a translation. Studies were eligible for inclusion if they met the following criteria during full text review:

- ▶ At least a portion of study data is collected since 1 January 2000.
- ▶ The study generated at least one indicator (table 1) for one of the five specified priority APs.<sup>10</sup>
- ▶ The study was a primary or secondary analysis of a representative, population-based sample.

### Review

After removing duplicates, all titles and abstracts were initially screened for any mention of AT or FD. Remaining abstracts were then reviewed by two authors, according to eligibility criteria.<sup>9</sup> In addition, eligible systematic reviews were cross-referenced; any relevant citations missing from our searches were added. All full texts were then reviewed by two authors. Conflicts at all stages were settled by a third reviewer.

### Data extraction and analysis

Data were extracted from full texts and entered into a data portal designed by authors to standardise data extraction for the following: study setting, population, design, assessment methodologies, impairment definitions used, and indicators, including numerator and denominator values (online supplemental appendix 3).

Indicators were included if (1) they were directly reported in the results of studies, meaning they aligned with our terms and definitions (table 1) or (2) they were indirectly reported, meaning it was possible to calculate them using clearly defined data provided in the articles (demonstrated in online supplemental appendix 4).

Given substantial variation in how indicators are presented and reported, not all results were directly comparable and a meta-analysis could not be conducted. Where studies present pooled estimates from previously published results (eg, reviews), the unique pooled indicator was extracted. To facilitate comparison across studies where possible, indicator denominators are denoted in our results tables with the following labels:

- ▶ Total population: the broader regional or national population from which the study sample was drawn.

This denominator is larger than the number of participants when study results are only presented as extrapolations.

- ▶ Total in analysis: all participants included in the study's analysis. This may be smaller than the number of total participants reported in a study, as some participants may not complete all components of the assessments.
- ▶ Total with FD: all study participants assessed to have the relevant impairment (eg, vision impairment) or functioning difficulty (eg, difficulty seeing). Some studies only include individuals with impairment/FD as participants or in the analysis.
- ▶ Total with need: all participants assessed to have need of the relevant AP. Some studies consider all participants with impairment/FD as needing an AP.
- ▶ Total with AP: all participants who already have an AP.

Most included vision AP studies reported on vision assessments done at 6m. Alternative definitions (eg, 20ft, log MAR) were converted to 6m using the NIDEK conversion chart.<sup>14</sup> For distance vision studies, prevalence estimates for uncorrected and undercorrected refractive error were also extracted, as these equate to unmet and undermet need for glasses, respectively. Results for 'refractive error' only (ie, without specifying uncorrected or undercorrected) were not extracted.

### Risk of bias in individual studies

The Critical Assessment Tool for Prevalence Studies from the Joanna Briggs Institute (JBI) was used to evaluate all included full texts.<sup>15</sup> We adapted this tool by adding a 10th criterion: 'The study describes its ethical approval, including how consent was obtained from participants'. We present each study's summary score and specific missing checklist criteria (online supplemental appendix 5).

This review was not registered with PROSPERO due to its relation to the scoping review,<sup>9</sup> which necessitated the extraction of some overlapping systematic review data during the scoping review process. PROSPERO does not register scoping reviews and will not register systematic reviews which have already begun data extraction.

### Role of the funding source

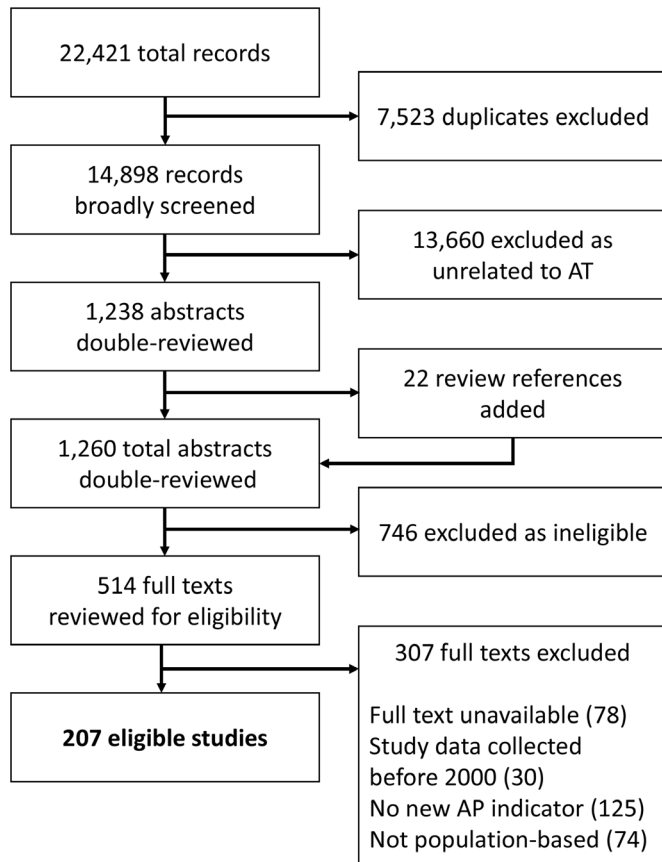
The funder of the study had no role in study design, data collection, data analysis, data interpretation or writing of the report.

### Patient and public involvement

Patients and the public were not involved in any way in this research.

## RESULTS

This section first details overall study selection and characteristics. Next, results including AP indicators are presented for each AP, grouped by functional domain.



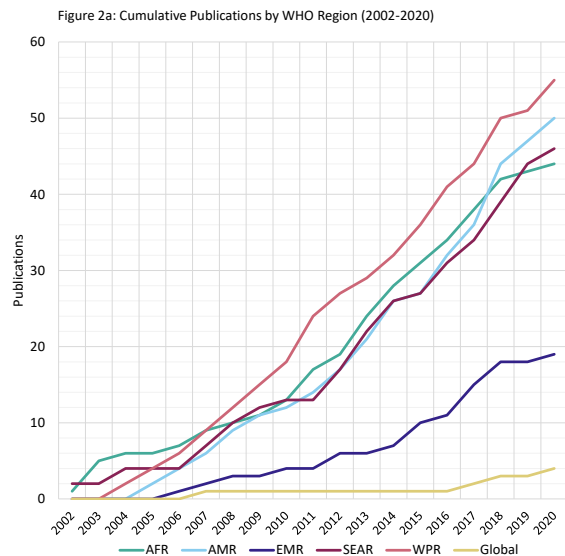
**Figure 1** Study selection. AP, assistive product; AT, assistive technology.

**Study selection**

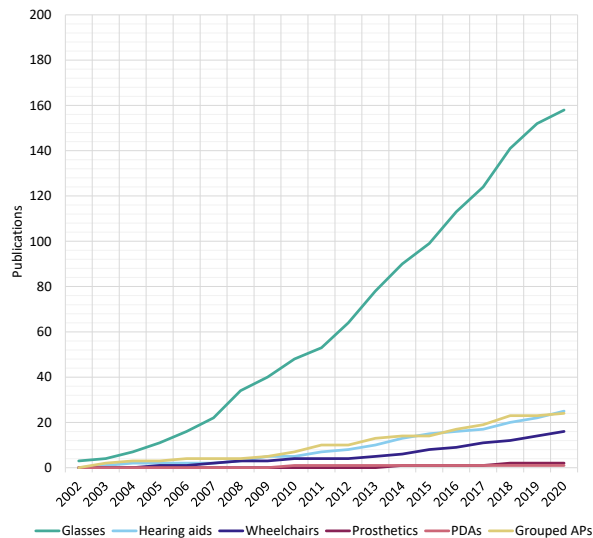
Of 14 898 unique records identified, 1238 abstracts mentioned AT and/or FD (JD). Ten per cent (n=1336) of discarded records were reviewed by a second author (CH, DB and SP) with 100% agreement. Seven reviews were identified at this stage and cross-referenced, adding 22 abstracts (JD, DB and ES). Of 1260 total abstracts, 514 met inclusion criteria, determined by two authors (JD, DB, VDR, SP, CH and ES). Following full-text review, 207 articles met inclusion criteria (with 96% inter-rater agreement) (JD, DB, VDR and ES). Studies excluded at this stage are listed in online supplemental appendix 6. **Figure 1** details the full review process. Corresponding authors were contacted for all articles missing full texts (initially n=85), resulting in seven additions (JD). All extracted data were double-checked (JD, AK, VDR, DB, ES, SP and CH).

**Included study characteristics**

All studies were published between 2002 and 2020. The cumulative frequency of studies published each year is shown by WHO region and AP type in **figure 2A,B**. The most represented region was the Western Pacific Region (WPR) (n=55, 27%), specifically China (n=29/55, 53%), followed by the Region of the Americas (AMR) (n=50, 24%), specifically the USA (n=27/50, 54%) and the Southeast Asian Region (SEAR) (n=46, 22%), specifically India (n=31/46, 67%).



**Figure 2a:** Cumulative Publications by WHO Region (2002-2020)



**Figure 2** Cumulative publication frequency by WHO Region (A) and AP type (B). AP, assistive product; PDAs, personal digital assistants.

**Figure 2B** demonstrates most studies (n=158, 76%) presented indicators for glasses, compared with the other APs.

In terms of study design, the vast majority were cross-sectional (n=199, 96%), using primary (n=167) and secondary data (n=32). Common assessment approaches included clinical (n=60), self-report (n=37), or a combination of both (n=110, 53%).

The youngest included age was zero (included in 27 studies) and 129 studies (62%) included no age maximum. Nineteen studies (9%) include most or all ages (<3 years to >84 years). Children <13 years are included in 91 studies overall (44%) and 20 exclusively (10%), while adults >64 years are included in 137 overall (66%) and 13 exclusively (6%).

The average JBI score among all 207 studies was 9.3/10, with 50% (n=104) achieving all 10 checklist

**Table 2** Hearing aid studies and indicators

Study design	Cohort	Cross-sectional	Mixed-methods	Secondary cross-sectional	–	–	–	Total
N	1	9	1	14	–	–	–	25
%	4%	36%	4%	56%	–	–	–	100%
Assessment approaches	Clinical only	Self-report only	Functional only	Clinical and self-report	Clinical and functional	Other combination	Secondary sources (multiple)	
N	2	4	0	14	2	2	1	25
%	8%	16%	0%	56%	8%	8%	4%	100%
Participants (N)*	<500	500–999	1000–4999	5000–9999	10 000–24 999	>25 000	Not available	
N	3	1	11	2	3	4	1	25
%	12%	4%	44%	8%	12%	16%	4%	100%
Age (years) included†	Under 15	<15 to 85+	15 to 85+	40 to 85+	65 to 85+	Over 85	–	
N	1	7	5	4	7	1	–	25
%	4%	28%	20%	28%	28%	4%	–	100%
JBI score	<7	7	8	9	10	–	–	
N	1	1	5	5	13	–	–	25
%	4%	4%	20%	20%	52%	–	–	100%
Functioning difficulty or impairment definition	Use of AP	Reported activity limitations	Clinical threshold	Combination	–	–	–	
N	3	5	14	3	–	–	–	25
%	12%	20%	56%	12%	–	–	–	100%
WHO Region	AFR	AMR	EMR	EUR	SEAR	WPR	Global	
N	3	10	1	8	3	8	1	34
%	9%	29%	3%	24%	9%	24%	3%	100%
AP access indicator	Total need	Met need	Unmet need	Undermet need	Coverage	Use	Has AP	
N	7	1	17	0	2	26	9	62
%	11%	2%	27%	0%	3%	42%	15%	100%
Indicator denominator	Total with/using AP	Total with need	Total with functioning difficulty	Total participants	Total population	–	–	
N	1	20	15	24	2	–	–	62
%	2%	32%	24%	39%	3%	–	–	100%

\*Participants (N) ranged from 379 to 455 200 for this domain.

†Age group boundaries varied considerably by study; studies are sorted into categories that most closely represent their included age boundaries.

AFR, African Region; AMR, Region of the Americas; AP, assistive product; EMR, Eastern Mediterranean Region; EUR, European Region; JBI, Joanna Briggs Institute; SEAR, Southeast Asian Region; WPR, Western Pacific Region.

items, and only one scoring below 7. By domain, the average JBI score ranged from 8.6 to 9.3. The most missed items were #2 (appropriate or well-described sampling of study participants) (n=30), #4 (study subjects and setting described in detail) (n=49) and our added #10 (consent and ethical approval detailed) (n=18) (online supplemental appendix 5).

### AP access indicators

Overall, 656 AP access indicators were extracted. High-level results are presented for each AP, grouped by functional domain (tables 2–5) with all indicators from each

study listed in online supplemental appendices 7–11. Studies reporting data, which could be disaggregated by comparable need indicators, are also included in figure 3A–E and online supplemental appendix 12.

### Hearing

In total, 25 studies (12%) provided 62 indicators on hearing aid access, detailed in table 2 and online supplemental appendix 7.<sup>16–40</sup> Nearly all were based on primary (n=10, 40%) or secondary analyses (n=14, 56%) of cross-sectional studies. The majority (n=18, 72%) used multiple assessment approaches, while self-report was exclusively used by 4 (16%) and clinical assessment by 2 (8%). All but one study<sup>38</sup> assumed all participants identified as



**Table 3** Mobility AP studies and indicators

Study design	Cohort	Cross-sectional	Mixed-methods	Secondary cross-sectional	–	–	–	Total
N	0	3	1	11	–	–	–	15
%	0%	20%	7%	73%	–	–	–	100%
Assessment approaches	Clinical only	Self-report only	Functional only	Clinical and self-report	Clinical and functional	Other combination	Secondary sources (multiple)	
N	1	9	0	4	0	1	0	15
%	7%	60%	0%	27%	0%	7%	0%	100%
Participants (N)*	<500	500–999	1000–4999	5000–9999	10000–24 999	>25000	Not available	
N	0	1	4	4	2	4	0	15
%	0%	7%	27%	27%	13%	27%	0%	100%
Age (years) included†	Under 15	<15 to 85+	15 to 85+	40 to 85+	60 to 85+	Over 85	–	
N	1	3	5	0	5	1	–	15
%	7%	20%	33%	33%	33%	7%	–	100%
JBI score	<7	7	8	9	10	–	–	
N	0	0	3	5	7	–	–	15
%	0%	0%	20%	33%	47%	–	–	100%
Mobility functioning difficulty or impairment definition	Use of AP	Reported activity limitations	Clinical threshold	Combination	–	–	–	
N	7	6	0	2	–	–	–	15
%	47%	40%	0%	13%	–	–	–	100%
WHO Region	AFR	AMR	EMR	EUR	SEAR	WPR	Global	
N	2	10	0	2	2	1	0	17
%	12%	59%	0%	12%	12%	6%	0%	100%
AP access indicator	Total need	Met need	Unmet need	Undermet need	Coverage	Use	Has AP	
N	3	0	6	1	2	26	4	42
%	7%	0%	14%	2%	5%	62%	10%	100%
Indicator denominator	Total with/using AP	Total with need	Total with functioning difficulty	Total participants	Total population	–	–	
N	3	2	12	19	6	–	–	42
%	7%	5%	29%	45%	14%	–	–	100%

\*Participants (N) ranged from 839 to 66410 for this domain.

†Age group boundaries varied considerably by study; studies are sorted into categories that most closely represent their included age boundaries. AFR, African Region; AMR, Region of the Americas; AP, assistive product; EMR, Eastern Mediterranean Region; EUR, European Region; JBI, Joanna Briggs Institute; SEAR, Southeast Asian Region; WPR, Western Pacific Region.

having a hearing difficulty also needed a hearing aid (ie, prevalence of hearing difficulty equals hearing aid need were the same). The proportion of participants with hearing difficulty who were using hearing aids ranged from 4.5%<sup>38</sup> to 47.5%,<sup>34</sup> although the definition of hearing difficulty varied between these studies (online supplemental appendix 7). Ten studies across 17 settings informed on total need. **Figure 3A** demonstrates high unmet need for hearing aids, with most settings (n=16, 89%) showing over 60% unmet need (ie, >60% of people assessed to need a hearing aid did not have one). All of

these studies reported unmet need, but only one also reported met need<sup>33</sup> while the others substituted AP use.

### Mobility

Fifteen studies (7%) reported 42 access indicators for mobility APs, including prosthetics, motorised and manual wheelchairs. Characteristics are included in **table 3** and all indicators in online supplemental appendix 8.<sup>17 22 25 27 30 40–49</sup> Most mobility AP studies (n=11, 73%) were secondary analyses of national-level surveys/censuses. Six studies relied entirely on

**Table 4** Near and distance glasses studies and indicators

Study design	Cohort	Cross-sectional	Mixed-methods	Secondary cross-sectional	-	-	-	-	-	Total
N	1	46	0	5	-	-	-	-	-	52
%	2%	88%	0%	10%	-	-	-	-	-	100%
Assessment approaches	Clinical only	Self-report only	Functional only	Clinical and self-report	Clinical and functional	Other combination	Secondary sources (multiple)	-	-	
N	18	2	0	30	0	0	2	-	-	52
%	35%	4%	0%	58%	0%	0%	4%	-	-	100%
Participants (N)*	<500	500–999	1000–4999	5000–9999	10 000–24 999	>25 000	Not available	-	-	
N	3	6	24	10	6	2	1	-	-	52
%	6%	12%	46%	19%	12%	4%	2%	-	-	100%
Age (years) Included†	Under 15	<15 to 85+	15 to 85+	40 to 85+	60 to 85+	Over 85	Other	-	-	
N	2	7	1	28	8	0	6	-	-	52
%	4%	13%	2%	15%	15%	0%	-	-	-	100%
JBI score	<7	7	8	9	10	-	-	-	-	
N	0	1	5	19	27	-	-	-	-	52
%	0%	2%	10%	37%	52%	-	-	-	-	100%
Vision functioning difficulty or impairment definition	Use of AP	Reported activity limitations	Clinical threshold	Combination	-	-	-	-	-	
N	1	0	44	7	-	-	-	-	-	52
%	2%	0%	85%	13%	-	-	-	-	-	100%
WHO Region	AFR	AMR	EMR	EUR	SEAR	WPR	Global	-	-	
N	20	23	4	11	27	17	2	-	-	104
%	19%	22%	4%	11%	26%	16%	2%	-	-	100%
AP access indicator	Total need	Met need	Unmet need	Undermet need	Coverage	Use	Has AP	Uncorrected RE	Undercorrected RE	
N	11	40	61	8	29	43	3	37	1	233
%	5%	17%	26%	3%	12%	18%	1%	16%	0%	100%
Indicator denominator	Total with/using AP	Total with need	Total with functioning difficulty	Total participants	Total population	Total with unmet need	-	-	-	
N	10	58	61	81	22	1	-	-	-	233
%	4%	25%	26%	35%	9%	0%	-	-	-	100%

\*Participants (N) ranged from 134 to 3 983 541 for this domain.

†Age group boundaries varied considerably by study; studies are sorted into categories that most closely represent their included age boundaries.

AFR, African Region; AMR, Region of the Americas; AP, assistive product; EMR, Eastern Mediterranean Region; EUR, European Region; JBI, Joanna Briggs Institute; RE, Refractive Error; SEAR, Southeast Asian Region; WPR, Western Pacific Region.

self-reported assessment of activity limitation and/or AP need and seven used self-reported AP use to approximate functioning difficulty or impairment prevalence. AP use was the most reported indicator (n=26/42, 62%). Among the total with mobility difficulty, use of any type of mobility AP ranged from 0.9% (both prosthetics and motorised wheelchairs)<sup>30</sup> to 17.6% (manual/unspecified wheelchairs) (online supplemental appendix 8).<sup>45</sup> Only one clinical impairment assessment study<sup>22</sup> presented AP indicators allowing disaggregation of total need, showing high unmet need (>65%) for manual wheelchairs in two settings among those who needed the AP (figure 3C).

## Vision

Vision results are presented in three categories: near/reading glasses (n=35), distance glasses (n=31) and bifocal/combined/unspecified ('grouped') glasses (n=124). High-level results for near and distance glasses are combined in table 4, with specific results for each type described separately in-text. All included studies and indicators are available for near and distance glasses in online supplemental appendix 9<sup>22 50–100</sup> and grouped glasses in online supplemental appendix 10.<sup>27 30 40 51–55 62–65 72 76 78 80 81 84 86 95 101–202</sup> Need indicators for grouped glasses are also visualised in online supplemental appendix 12.

**Table 5** Grouped and cognitive AP studies and indicators

Study design	Cohort	Cross-sectional	Mixed-methods	Secondary cross-sectional	–	–	–	Total
N	0	17	1	6	–	–	–	24
%	0%	71%	4%	25%	–	–	–	100%
Assessment approaches	Clinical only	Self-report only	Functional only	Clinical and self-report	Clinical and functional	Other combination	Secondary sources (multiple)	
N	1	21	0	1	0	1	0	24
%	4%	88%	0%	4%	0%	4%	0%	100%
Participants (N)*	<500	500–999	1000–4999	5000–9999	10 000–24 999	>25 000	Not available	
N	0	3	7	5	5	4	0	24
%	0%	13%	29%	21%	21%	17%	0%	100%
Age (years) included†	Under 15	<15 to 85+	15 to 85+	40 to 85+	60 to 85+	Over 85	Other	
N	0	16	5	0	2	0	1	24
%	0%	67%	21%	8%	8%	0%	4%	100%
JBI score	<7	7	8	9	10	–	–	
N	0	2	5	10	7	–	–	24
%	0%	8%	21%	42%	29%	–	–	100%
Functioning difficulty or impairment definition	Use of AP	Reported activity limitations	Clinical threshold	Combination	–	–	–	
N	3	21	0	0	–	–	–	24
%	13%	88%	0%	0%	–	–	–	100%
WHO Region	AFR	AMR	EMR	EUR	SEAR	WPR	Global	
N	14	7	1	0	2	1	0	25
%	56%	28%	4%	0%	8%	4%	0%	100%
AP access indicator	Total need	Met need	Unmet need	Undermet need	Coverage	Use	Has AP	
N	2	4	9	1	0	24	2	42
%	5%	10%	21%	2%	0%	57%	5%	100%
Indicator denominator	Total with/using AP	Total with need	Total with functioning difficulty	Total participants	Total population	–	–	
N	1	5	28	8	0	–	–	42
%	2%	12%	67%	19%	0%	–	–	100%

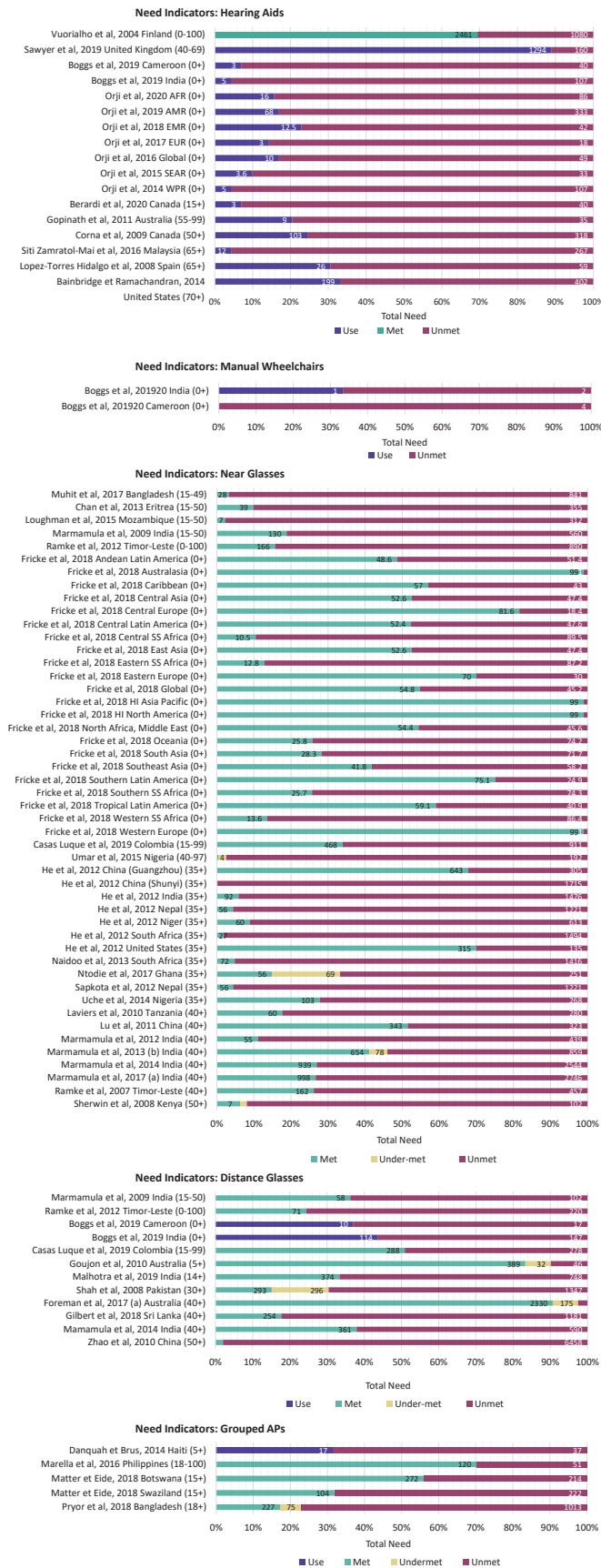
\*Participants (N) ranged from 505 to 393 949 for this domain.

†Age group boundaries varied considerably by study; studies are sorted into categories that most closely represent their included age boundaries. AFR, African Region; AMR, Region of the Americas; AP, assistive product; EMR, Eastern Mediterranean Region; EUR, European Region; JBI, Joanna Briggs Institute; SEAR, Southeast Asian Region; WPR, Western Pacific Region.

Thirty-five studies (17%) provided 126 indicators for near glasses (table 4). Most were primary cross-sectional (n=32; 91%) and used a combination of clinical and self-reported assessment data (n=22; 63%), while 11 (31%) used clinical assessment data only. The most reported indicators were unmet (n=49; 38%) and met need (n=30; 24%). Near glasses use among individuals with vision difficulty ranged from 0.1%<sup>64</sup> to 89.5% (online supplemental appendix 9).<sup>83</sup> Twenty-one studies (60%) reported total need indicators,

with 17 showing unmet need for near glasses above 60% among those who needed the AP (figure 3C).

Thirty-one studies (14%) report 107 indicators for distance glasses (table 4). All studies are either primary (n=21, 81%) or secondary (n=5; 19%) analyses of cross-sectional surveys. Sixteen studies (53%) used both clinical and self-reported assessments, with 11 (37%) relying only on clinical assessment. The most reported indicator was uncorrected refractive error (n=35/107; 33%). Among those with



**Figure 3** Need indicators for hearing aids (A), manual wheelchairs (B), near glasses (C), distance glasses (D) and grouped APs (E). HI, High-Income; SS, Sub-Saharan.

difficulty seeing, use of distance glasses ranged from 0.4%<sup>64</sup> to 55.2%<sup>87</sup> (online supplemental appendix 9). Eleven studies provided total need indicators across 12 settings, the majority (n=8/12; 67%) of which reported an unmet need for distance glasses of >60% among those who needed the AP (figure 3D).

### Grouped APs and cognitive

Twenty-four studies (12%) presented 42 indicators for grouped APs, with one study also presenting a cognitive AP indicator for PDAs<sup>203</sup>; characteristics for all grouped AP studies are described in table 5 with all indicators included in online supplemental appendix 11.<sup>17 25 27 30 203-222</sup> Nearly all (n=21; 88%) used only self-reported activity limitations to identify impairment or FD. 'AP use' was the most commonly reported indicator in the grouped domain (n=24/42, 57%), with the proportion of participants with FD using any AP ranging from 2.8%<sup>217</sup> to 94.8% (online supplemental appendix 11).<sup>27</sup> In three of five studies presenting total need indicators, unmet need for APs was >60% among those who needed APs (figure 3E).

## DISCUSSION

AT is gaining recognition on the international global health agenda, as evidenced in this systematic review by the increasing frequency of publications from 2000 to 2020. However, many data gaps have not been addressed. During this period, 76% (n=158) of the 207 articles reported all or in part on glasses, with fewer articles available for the other APs, emphasising data gaps in hearing, mobility and especially cognitive functional domains. Older adults (65+ years) were more often included in studies than children under 12 years, and <25% of studies focused exclusively on young children, making it challenging to identify disparities in AP need based on age. This review also highlights the heterogeneity in study design and reporting that has led to a lack of standardisation in population-based AP data collection efforts and limits comparability between settings. Total need indicators were reported from 84 study settings, the majority of which (n=57/84, 68%) reported unmet need >60% among all participants with AP need in each functional domain and in all country income contexts. Total need estimates were also commonly reported across all functional domains except mobility, though functional domains were not equally represented in these studies.

AP indicators were often used variably in the literature. The prevalence of FD was frequently equated to AP need, which can overestimate/underestimate true need and coverage.<sup>22</sup> This approach typically lacks a holistic assessment of AP need since it does not account for important data about an individual's personal factors, including their specific health needs, activities, participation and environmental contexts. All but one mobility study<sup>22</sup> made this assumption and relied solely on self-reported assessments, which can be limited by participants' poor awareness of APs or underlying causes for FD, further

misestimating need.<sup>9 22</sup> 'Has AP' or 'use' were also used to approximate 'met need' for an AP; all hearing aid studies indicating need reported 'use' in lieu of met need (excepting one<sup>18</sup>). This substitution limits understanding of AP need in multiple ways: in the literature, the 'use' indicator has included the use of APs that are appropriate ('met need') and APs that might be broken and/or inappropriate ('undermet need'), which obfuscates remaining need. Denominators used when calculating indicators also varied considerably, encompassing individuals with need, functioning difficulty, included in the study, or extrapolated to the total population. Though the latter can provide useful measures for drawing international comparisons and evaluating trends over time, the variation in denominators overall limits comparability across studies. Each has its use in a comprehensive evidence basis, but more comparable methodology and reporting are needed to improve understanding of population-level need.

Self-reported assessments were typically employed in functional domains where a large sample size was needed and/or the relationship between the individual's need and a specific AP is complex (eg, mobility or cognition), or multiple APs were considered (eg, grouped APs). Subsequently, clinical impairment and/or functional assessment for all participants was often not feasible. For example, most of the reviewed mobility studies were secondary data analyses, with over half using censuses or national health studies (n=10/15; 67%), while mobility studies that collected primary data tended to have very low numbers of individuals assessed as needing or already using the AP, ranging from 0<sup>22</sup> to 186<sup>40</sup> individuals. Additionally, most studies reporting on grouped APs relied exclusively on self-reported assessment data (n=21/24; 88%). Clinical impairment assessments produce more standardised, comparable data, yet do not always capture personal factors, which are also necessary to holistically evaluate need. This demonstrates the importance of employing multiple types of data in recommending appropriate AT.<sup>9</sup>

While some established datasets based on universal care<sup>18</sup>/centralised health record systems<sup>46 223</sup> collect potentially impactful population-level data on AP users, these data do not necessarily include everyone. Relying exclusively on these data would miss individuals obtaining their APs by other means, such as private purchase or through the non-government sector. This missing data gap will be even more pronounced where government-led AT provision is more limited. Primary cross-sectional surveys can be helpful to address this gap, yet these surveys can be resource intensive, lack comparability and generalisability, and may not produce timely data needed by AT stakeholders. Our literature presents >150 studies from LMICs, which generate valuable learnings across the sector overall. However, when narrowing to AP-specific or country-specific data, the evidence base drastically decreases, showing the limitations of relying exclusively on few cross-sectional surveys

and demonstrates that the largest knowledge gaps are in areas where access to APs is lowest.

Collating this critical body of work to extract sector-wide learnings has been broached, in parts, by other reviews commissioned by the Lancet Global Health,<sup>224</sup> the WHO,<sup>3 9 225</sup> and development-focused institutes/governmental departments.<sup>226 227</sup> The WHO papers cited heterogeneous approaches to assessment,<sup>3 9 225</sup> severity of FD for inclusion,<sup>9 225</sup> and sampling source demographics,<sup>3 9 225</sup> as main challenges to interpreting results across publications, which mirrored our data extraction and presentation experience. Population-level data are overall extremely limited, and findings on need must be interpreted with caution. Appropriate research methods must also be used for this sector—RCTs are often unsuitable for AT interventions,<sup>3</sup> and based on available data, different approaches may be more effective than others.<sup>9</sup> Key gaps in the AT sector described in this discussion are emphasised when considering other AT reviews. Crucial research into effectiveness and follow-up of AT interventions is limited.<sup>3 9 225–227</sup> Our review similarly found this, as most primary and secondary studies were cross-sectional and did not incorporate any follow-up data collection. Limited awareness of AT demand and effectiveness was a commonly cited barrier to expanding AT production and access.<sup>226 227</sup> Often, available data go unused<sup>226</sup> or are not collected alongside quality-of-life indicators.<sup>226</sup> Furthermore, standardised impact measurement approaches are also needed.<sup>3 9 226</sup> Regarding all types of information relevant to AT, including need indicators, supply and demand data, and product designs, more substantial diffusion is hindered by the fragmented nature of available information.<sup>226</sup>

We have four main recommendations following our comprehensive review. First, considering the methodological and reporting variation between studies, we recommend establishing a global minimum AP dataset allowing researchers to address specific questions and compare evidence. This dataset should include the following: (1) standardised measures to determine individual need for an AP; (2) standardised APs (eg, APLs);<sup>10 228</sup> (3) standardised AP access indicators (as presented in this review) and (4) standardised approaches to measuring them. Second, we recommend the collection and use of data that holistically considers an individual's personal and environmental factors when assessing their capacity to benefit from an AP. As more holistic measurement methodology is developed, it is critical that it is tested and adapted for diverse contexts, especially LMICs. Third, modules collecting data to inform AP indicators should be included in established population surveys to maximise existing data collection methods and enable more nuanced secondary analyses. This can be supported by working with national statistics offices in both high and LMIC countries. Finally, differentiation should be made between the total using an AP, and within that value, the total with met need. This can highlight undermet needs among AP users, which provides further data about the

setting and/or population for which specific APs are not fully appropriate. To begin to collate this dataset, a global AT data portal<sup>229</sup> accompanying this review will make all extracted study data available and more accessible. This portal will also serve as a place to host future data, employing features to map evidence and provide context across disciplines to support knowledge sharing in this sector.

Our large-scale review captured >200 studies and benefited from including five APs across four functional domains, with a broadly inclusive search string and list of article sources. Data extraction criteria were developed to accommodate substantial variation in results reporting, so as much relevant data as possible could be considered, allowing us to extract >650 indicators. Through data extraction, we identified study settings, impairment/FD thresholds and denominators (among other factors) to ensure our comparisons and conclusions are appropriate.

However, this review has several limitations. Given the breadth of literature, we searched terms for FD rather than listing specific health conditions (online supplemental appendix 2), as there is no established list of conditions within each domain/relevant to each AP. Studies may have been missed that focused on specific health conditions without mentioning FD or APs in the title/abstract. This likely occurred for the mobility and cognitive domains, given these are less well defined in terms of which conditions could relate to certain APs. This also means we could not explore the variation in need for APs within a functional domain by certain conditions or pathologies. We also limited the review to five specific APs, while the WHO APL includes 50. Furthermore, a meta-analysis of indicators and exploration into their disaggregation by demographic factors (eg, sex, income, and education) was precluded from the remit of this review due to wide variation in methods/reporting. Finally, some vision studies also reported visual acuity measures, but extracting indicators based on these measures required clinical judgements and assumptions outside the remit of this review. Overall, future domain-specific research is recommended to address each of these limitations, including additional cognitive APs, with appropriate detail to identify sub-population-level disparities in AP access.

## CONCLUSION

This review highlights high unmet AP need across different settings, demonstrating the need to prioritise and expand access to AT globally. It also highlighted key AP research gaps in available literature, including lack of standardised and comparable data collection and reporting methods, particularly in LMICs. These gaps must be addressed so data collection efforts can identify areas with high need and inform, monitor, and evaluate AP service planning and delivery. Improving global access to these life-changing products is essential to each sustainable development goal and our accompanying

data portal<sup>229</sup> will ensure this review is used to its fullest potential in support of this aim.

**Twitter** Dorothy Boggs @boggs\_dorothy

**Acknowledgements** Authors are grateful to the help of many colleagues: Priya Morjaria and Ian McCormick for visual acuity expertise and Ben Duke for preliminary data extraction.

**Contributors** This research was conceptualised by JD and CH, with funding acquired by CH. The investigation was conducted by JD, with input from DB, SP and CH. JD, DB, SP, VDR, ES and CH are responsible for the methodology. FR is responsible for project administration. JD and WB are responsible for software design and maintenance. Data curation was done by JD, DB, VDR, ES and AK. Formal analysis was carried out by JD with input from DB and SP. Data were validated by JD, AK, VDR, ES, SP, DB and CH. Visualisations were designed and executed by JD, with input from DB and SP. The original draft was written by JD with input from DB and SP. Reviewing and editing was done by JD, DB, SP, VDR, ES and CH, with input from AK and FR. The overall project was supervised by DB, SP and CH. JD is acting as guarantor.

**Funding** The research in this paper was made possible by funding from the Foreign, Commonwealth and Development Office, UK, through the AT2030 Programme, led by the Global Disability Innovation Hub (project number: 300 815 (previously 2 01 879–108)).

**Competing interests** None declared.

**Patient consent for publication** Not applicable.

**Ethics approval** Ethical approval was not required for this review.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available in a public, open access repository. All data relevant to the study are included in the article or uploaded as supplementary information. The study protocol is currently available at <https://at2030.org/estimating-need-and-coverage-for-five-priority-assistive-products/>. All data extracted for this review will be publicly available in the AT Data Portal, available at <https://at2030.org/at-data-portal/map/> from March 2022.

**Supplemental material** This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

#### ORCID iDs

Jamie Danemayer <http://orcid.org/0000-0002-0060-5160>

Dorothy Boggs <http://orcid.org/0000-0001-5380-2785>

Felipe Ramos-Barajas <http://orcid.org/0000-0001-8729-2971>

#### REFERENCES

- WHO. Health systems strengthening glossary, 2011. Available: [https://www.who.int/healthsystems/Glossary\\_January2011.pdf](https://www.who.int/healthsystems/Glossary_January2011.pdf)
- Cieza A, Causey K, Kamenov K, et al. Global estimates of the need for rehabilitation based on the global burden of disease study 2019: a systematic analysis for the global burden of disease study 2019. *Lancet* 2021;396:2006–17.
- Matter R, Harniss M, Oderov T, et al. Assistive technology in resource-limited environments: a scoping review. *Disabil Rehabil Assist Technol* 2017;12:105–14.
- Prvu Bettger J, Thoumi A, Marqevich V, et al. COVID-19: maintaining essential rehabilitation services across the care continuum. *BMJ Glob Health* 2020;5:e002670.
- Rajan S, Khunti K, Alwan N. *In the wake of the pandemic: preparing for long COVID*. World Health Organization, 2021.
- Briggs A, Vassall A. Count the cost of disability caused by COVID-19. *Nature* 2021;593:502–5.
- Tebbutt E, Brodmann R, Borg J, et al. Assistive products and the sustainable development goals (SDGs). *Global Health* 2016;12:1–6.
- Savage M, Tyler N, Seghers F. *Applying market shaping approaches to increase access to assistive technology: summary of the wheelchair product narrative*, 2019.
- Danemayer J, Boggs D, Polack S, et al. Measuring assistive technology supply and demand: a scoping review. *Assist Technol* 2021;33:35–49.
- WHO. *Priority assistive products list (APL): improving access to assistive technology for everyone, everywhere*. Geneva, 2016.
- ATScale global partnership. Available: <https://atscale2030.org/> [Accessed 12 Nov 2021].
- Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
- Ouzzani M, Hammady H, Fedorowicz Z, et al. Rayyan—a web and mobile APP for systematic reviews. *Syst Rev* 2016;5:210.
- NIDEK Co. Conversion table for representation of visual acuity. Available: [https://www.nidek-intl.com/visual\\_acuity.html](https://www.nidek-intl.com/visual_acuity.html) [Accessed 19 Jul 2021].
- University of Adelaide. Critical appraisal tools | Joanna Briggs Institute, 2020. Available: <https://jbi.global/critical-appraisal-tools> [Accessed 12 Jul 2021].
- Muga E. Screening for disability in a community: the 'ten questions' screen for children, in Bondo, Kenya. *Afr Health Sci* 2003;3:33–9.
- Vos T, Allen C, Arora M, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the global burden of disease study 2015. *The Lancet* 2016;388:1545–602.
- Vuorialho A, Sorri M, Nuojua I. Costs of hearing aid rehabilitation in two Finnish hearing centres. *Audiol Med* 2004;2:236–40.
- Nash SD, Cruickshanks KJ, Huang G-H, et al. Unmet hearing health care needs: the Beaver dam offspring study. *Am J Public Health* 2013;103:1134–9.
- Dawes P, Fortnum H, Moore DR, et al. Hearing in middle age: a population snapshot of 40- to 69-year olds in the United Kingdom. *Ear Hear* 2014;35:e44–51.
- Sawyer CS, Armitage CJ, Munro KJ, et al. Correlates of hearing aid use in UK adults: self-reported hearing difficulties, social participation, living situation, health, and demographics. *Ear Hear* 2019;40:1061–8.
- Boggs D, Kuper H, Mactaggart I. Estimating assistive technology need through population-based surveys: an analysis of data from Cameroon and India. In: Layton N, Borg J, eds. *Global perspectives on assistive technology: proceedings of the GREAT Consultation*. World Health Organization, 2019: 52–78.
- Orji A, Kamenov K, Dirac M, et al. Global and regional needs, unmet needs and access to hearing AIDS. *Int J Audiol* 2020;59:166–72.
- Gondim LMA, Balen SA, Zimmermann KJ, et al. Study of the prevalence of impaired hearing and its determinants in the city of Itajaí, SANTA Catarina state, Brazil. *Braz J Otorhinolaryngol* 2012;78:27–34.
- Danquah L, Brus A. *Representation and evaluation of disability in Haiti (Port-au-Prince 2012)*. London, UK, 2013.
- von Gablenz P, Hoffmann E, Holube I. Prevalence of hearing loss in northern and southern Germany. *HNO* 2017;65:130–5.
- Berardi A, Smith EM, Miller WC. Assistive technology use and unmet need in Canada. *Disabil Rehabil Assist Technol* 2021;16:851–6.
- Angara P, Tang DC, Snapp H. Factors associated with delayed hearing evaluation in US adults. *Otolaryngol Head Neck Surg* 2018;159:P268.
- Li C-M, Zhao G, Hoffman HJ, et al. Hearing disability prevalence and risk factors in two recent national surveys. *Am J Prev Med* 2018;55:326–35.
- Pryor W, Nguyen L, Islam QN, et al. Unmet needs and use of assistive products in two districts of Bangladesh: findings from a household survey. *Int J Environ Res Public Health* 2018;15:1–13.
- Moon IJ, Baek SY, Cho Y-S. Hearing aid use and associated factors in South Korea. *Medicine* 2015;94:e1580.
- Gopinath B, Schneider J, Hartley D, et al. Incidence and predictors of hearing aid use and ownership among older adults with hearing loss. *Ann Epidemiol* 2011;21:497–506.

- 33 Corna LM, Wade TJ, Streiner DL, *et al*. Corrected and uncorrected hearing impairment in older Canadians. *Gerontology* 2009;55:468–76.
- 34 Mitchell P, Gopinath B, Wang JJ, *et al*. Five-Year incidence and progression of hearing impairment in an older population. *Ear Hear* 2011;32:251–7.
- 35 Kim J-S. Prevalence and factors associated with hearing loss and hearing aid use in Korean elders. *Iran J Public Health* 2015;44:308–17.
- 36 SZMS M, Maamor N, Ishak WS. Hearing loss and risk factors among community Dwelling older adults in Selangor (Hilang Pendengaran DAN Faktor Risiko dalam Kalangan Warga Tua dalam Komuniti di Selangor). *Sains Malaysiana* 2016;45:1405–11.
- 37 Chang H-P, Ho C-Y, Chou P. The factors associated with a self-perceived hearing handicap in elderly people with hearing impairment—results from a community-based study. *Ear Hear* 2009;30:576–83.
- 38 López-Torres Hidalgo J, Boix Gras C, Téllez Lapeira J, *et al*. Functional status of elderly people with hearing loss. *Arch Gerontol Geriatr* 2009;49:88–92.
- 39 Bainbridge KE, Ramachandran V. Hearing aid use among older U.S. adults: the National health and nutrition examination survey, 2005–2006 and 2009–2010. *Ear Hear* 2014;35:289–94.
- 40 Dupraz J, Andersen-Ranberg K, Fors S, *et al*. Use of healthcare services and assistive devices among centenarians: results of the cross-sectional, international5-COOP study. *BMJ Open* 2020;10:e034296.
- 41 Giesbrecht EM, Smith EM, Mortenson WB, *et al*. Needs for mobility devices, home modifications and personal assistance among Canadians with disabilities. *Health Rep* 2017;28:9–15.
- 42 Smith EM, Giesbrecht EM, Mortenson WB, *et al*. Prevalence of wheelchair and scooter use among community-dwelling Canadians. *Phys Ther* 2016;96:1135–42.
- 43 Gale CR, Cooper C, Sayer AA. Prevalence of frailty and disability: findings from the English longitudinal study of ageing. *Age Ageing* 2015;44:162–5.
- 44 Gell NM, Wallace RB, LaCroix AZ, *et al*. Mobility device use in older adults and incidence of falls and worry about falling: findings from the 2011–2012 National health and aging trends study. *J Am Geriatr Soc* 2015;63:853–9.
- 45 Iwashyna TJ, Christie JD. Low use of durable medical equipment by chronically disabled elderly. *J Pain Symptom Manage* 2007;33:324–30.
- 46 Wolff JL, Agree EM, Kasper JD. Wheelchairs, walkers, and canes: what does Medicare pay for, and who benefits? *Health Aff* 2005;24:1140–9.
- 47 Tataryn M, Polack S, Chokocho L, *et al*. Childhood disability in Malawi: a population based assessment using the key informant method. *BMC Pediatr* 2017;17:198.
- 48 Theis KA, Steinweg A, Helmick CG, *et al*. Which one? What kind? How many? Types, causes, and prevalence of disability among U.S. adults. *Disabil Health J* 2019;12:411–21.
- 49 Cornman JC, Freedman VA. Racial and ethnic disparities in mobility device use in late life. *J Gerontol B Psychol Sci Soc Sci* 2008;63:S34–41.
- 50 Azizoğlu S, Crewther SG, Şerefhan F, *et al*. Evidence for the need for vision screening of school children in turkey. *BMC Ophthalmol* 2017;17:230.
- 51 Marmamula S, Keeffe JE, Narsaiah S, *et al*. Changing trends in the prevalence of visual impairment, uncorrected refractive errors and use of spectacles in Mahabnagar district in South India. *Indian J Ophthalmol* 2013;61:755–8.
- 52 Muhit M, Minto H, Parvin A, *et al*. Prevalence of refractive error, presbyopia, and unmet need of spectacle coverage in a northern district of Bangladesh: rapid assessment of refractive error study. *Ophthalmic Epidemiol* 2018;25:126–32.
- 53 Chan VF, Mebrahtu G, Ramson P, *et al*. Prevalence of refractive error and spectacle coverage in Zoba Ma'ekel Eritrea: a rapid assessment of refractive error. *Ophthalmic Epidemiol* 2013;20:131–7.
- 54 Loughman J, Nxele LL, Faria C, *et al*. Rapid assessment of refractive error, presbyopia, and visual impairment and associated quality of life in Nampula, Mozambique. *J Vis Impair Blind* 2015;109:199–212.
- 55 Marmamula S, Keeffe JE, Rao GN. Uncorrected refractive errors, presbyopia and spectacle coverage: results from a rapid assessment of refractive error survey. *Ophthalmic Epidemiol* 2009;16:269–74.
- 56 Taylor HR, Xie J, Fox S, *et al*. The prevalence and causes of vision loss in Indigenous Australians: the National Indigenous eye health survey. *Med J Aust* 2010;192:312–8.
- 57 Ramke J, Brian G, Naduvilath T. Refractive error and presbyopia in timor-leste: the impact of 5 years of a national spectacle program. *Invest Ophthalmol Vis Sci* 2012;53:434–9.
- 58 Fricke TR, Tahhan N, Resnikoff S, *et al*. Global prevalence of presbyopia and vision impairment from uncorrected presbyopia: systematic review, meta-analysis, and modelling. *Ophthalmology* 2018;125:1492–9.
- 59 Casas Luque L, Naidoo K, Chan VF, *et al*. Prevalence of refractive error, presbyopia, and spectacle coverage in Bogotá, Colombia: a rapid assessment of refractive error. *Optom Vis Sci* 2019;96:579–86.
- 60 Robinson B, Feng Y, Woods CA, *et al*. Prevalence of visual impairment and uncorrected refractive error - report from a Canadian urban population-based study. *Ophthalmic Epidemiol* 2013;20:123–30.
- 61 Umar MM, Muhammad N, Alhassan MB. Prevalence of presbyopia and spectacle correction coverage in a rural population of North West Nigeria. *Clin Ophthalmol* 2015;9:1195–201.
- 62 Abdullah AS, Jadoon MZ, Akram M, *et al*. Prevalence of uncorrected refractive errors in adults aged 30 years and above in a rural population in Pakistan. *J Ayub Med Coll Abbottabad* 2015;27:8–12.
- 63 Laitinen A, Koskinen S, Härkänen T, *et al*. A nationwide population-based survey on visual acuity, near vision, and self-reported visual function in the adult population in Finland. *Ophthalmology* 2005;112:2227–37.
- 64 He M, Abdou A, Naidoo KS, *et al*. Prevalence and correction of near vision impairment at seven sites in China, India, Nepal, niger, South Africa, and the United States. *Am J Ophthalmol* 2012;154:107–16.
- 65 He M, Abdou A, Ellwein LB, *et al*. Age-Related prevalence and Met need for correctable and uncorrectable near vision impairment in a multi-country study. *Ophthalmology* 2014;121:417–22.
- 66 Hookway LA, Frazier M, Rivera N, *et al*. Population-Based study of presbyopia in Nicaragua. *Clin Exp Optom* 2016;99:559–63.
- 67 Naidoo KS, Jaggernath J, Martin C, *et al*. Prevalence of presbyopia and spectacle coverage in an African population in Durban, South Africa. *Optom Vis Sci* 2013;90:1424–9.
- 68 Ntodie M, Abu SL, Kyei S, *et al*. Near vision spectacle coverage and barriers to near vision correction among adults in the Cape coast Metropolis of Ghana. *Afr Health Sci* 2017;17:549–55.
- 69 Sapkota YD, Dulal S, Pokharel GP, *et al*. Prevalence and correction of near vision impairment at Kaski, Nepal. *Nepal J Ophthalmol* 2012;4:17–22.
- 70 Uche N, Ezegwui I, Uche E, *et al*. Prevalence of presbyopia in a rural African community. *Rural Remote Health* 2014;14:2731.
- 71 Cheng F, Shan L, Song W, *et al*. Distance- and near-visual impairment in rural Chinese adults in Kailu, inner Mongolia. *Acta Ophthalmol* 2016;94:407–13.
- 72 Gupta N, Vashist P, Malhotra S, *et al*. Rapid assessment of visual impairment in urban population of Delhi, India. *PLoS One* 2015;10:e0124206.
- 73 Laviers HR, Omar F, Jecha H, *et al*. Presbyopic spectacle coverage, willingness to pay for near correction, and the impact of correcting uncorrected presbyopia in adults in Zanzibar, East Africa. *Invest Ophthalmol Vis Sci* 2010;51:1234–41.
- 74 Lu Q, He W, Murthy GVS, *et al*. Presbyopia and near-vision impairment in rural Northern China. *Invest Ophthalmol Vis Sci* 2011;52:2300–5.
- 75 Mansberger SL, Romero FC, Smith NH, *et al*. Causes of visual impairment and common eye problems in northwest American Indians and Alaska natives. *Am J Public Health* 2005;95:881–6.
- 76 Marmamula S, Madala SR, Rao GN. Prevalence of uncorrected refractive errors, presbyopia and spectacle coverage in marine fishing communities in South India: rapid assessment of visual impairment (RAVI) project. *Ophthalmic Physiol Opt* 2012;32:149–55.
- 77 Marmamula S, Narsaiah S, Shekhar K, *et al*. Presbyopia, spectacles use and spectacle correction coverage for near vision among cloth weaving communities in Prakasam district in South India. *Ophthalmic Physiol Opt* 2013;33:597–603.
- 78 Marmamula S, Khanna RC, Narsaiah S, *et al*. Prevalence of spectacles use in Andhra Pradesh, India: rapid assessment of visual impairment project. *Clin Exp Ophthalmol* 2014;42:227–34.
- 79 Marmamula S, Khanna RC, Kunuku E, *et al*. Near visual impairment and spectacle coverage in Telangana, India. *Clin Exp Ophthalmol* 2017;45:568–74.
- 80 Ramke J, du Toit R, Palagyi A, *et al*. Correction of refractive error and presbyopia in Timor-Leste. *Br J Ophthalmol* 2007;91:860–6.
- 81 Cunha CC, Berezovsky A, Furtado JM, *et al*. Presbyopia and ocular conditions causing near vision impairment in older adults from the Brazilian Amazon region. *Am J Ophthalmol* 2018;196:72–81.



- 82 Sherwin JC, Keeffe JE, Kuper H, *et al*. Functional presbyopia in a rural Kenyan population: the unmet presbyopic need. *Clin Exp Ophthalmol* 2008;36:245–51.
- 83 Zebardast N, Friedman DS, Vitale S. The prevalence and demographic associations of presenting Near-Vision impairment among adults living in the United States. *Am J Ophthalmol* 2017;174:134–44.
- 84 Otte B, Woodward MA, Ehrlich JR, *et al*. Self-Reported eyeglass use by US Medicare beneficiaries aged 65 years or older. *JAMA Ophthalmol* 2018;136:1047–50.
- 85 Kodjebacheva G, Brown ER, Estrada L, *et al*. Uncorrected refractive error among first-grade students of different racial/ethnic groups in southern California: results a year after school-mandated vision screening. *J Public Health Manag Pract* 2011;17:499–505.
- 86 Naidoo KS, Chinanayi FS, Ramson P, *et al*. Rapid assessment of refractive error in the eThekweni Municipality of KwaZulu-Natal, Durban, South Africa. *Clin Exp Optom* 2016;99:360–5.
- 87 Goujon N, Brown CM, Xie J, *et al*. Self-Reported vision and health of Indigenous Australians. *Clin Exp Ophthalmol* 2010;38:796–804.
- 88 Vitale S, Cotch MF, Sperduto R, *et al*. Costs of refractive correction of distance vision impairment in the United States, 1999–2002. *Ophthalmology* 2006;113:2163–70.
- 89 Malhotra S, Kalaivani M, Rath R, *et al*. Use of spectacles for distance vision: coverage, unmet needs and barriers in a rural area of North India. *BMC Ophthalmol* 2019;19:252.
- 90 Foreman J, Xie J, Keel S, *et al*. Treatment coverage rates for refractive error in the National eye health survey. *PLoS One* 2017;12:e0175353.
- 91 Shah SP, Jadoon MZ, Dineen B, *et al*. Refractive errors in the adult Pakistani population: the National blindness and visual impairment survey. *Ophthalmic Epidemiol* 2008;15:183–90.
- 92 Ramsewak SSA, Verlander N, Deomansingh F. National eye survey of Trinidad and Tobago: the prevalence and risk factors for refractive error. *Investigative Ophthalmology and Visual Science* 2016;57:3976.
- 93 Foreman J, Xie J, Keel S, *et al*. The prevalence and causes of vision loss in Indigenous and non-Indigenous Australians: the National eye health survey. *Ophthalmology* 2017;124:1743–52.
- 94 Gilbert C, Murthy GVS, Schmidt E, *et al*. Prevalence and types of refractive errors, and spectacle coverage in Sri Lankan adults: the Sri Lanka national survey of blindness and visual impairment. *Ceylon Med J* 2018;63:33.
- 95 Marmamula S, Khanna RC, Kunkunu E, *et al*. Population-Based assessment of prevalence and causes of visual impairment in the state of Telangana, India: a cross-sectional study using the rapid assessment of visual impairment (RAVI) methodology. *BMJ Open* 2016;6:e012617.
- 96 Flaxman SR, Bourne RRA, Resnikoff S, *et al*. Global causes of blindness and distance vision impairment 1990–2020: a systematic review and meta-analysis. *Lancet Glob Health* 2017;5:e1221–34.
- 97 Malhotra S, Vashist P, Gupta N, *et al*. Prevalence and causes of visual impairment among adults aged 15–49 years in a rural area of north India - A population-based study. *Indian J Ophthalmol* 2018;66:951–6.
- 98 Murthy GVS, Vashist P, John N, *et al*. Prevalence and causes of visual impairment and blindness in older adults in an area of India with a high cataract surgical rate. *Ophthalmic Epidemiol* 2010;17:185–95.
- 99 Zhao J, Ellwein LB, Cui H, *et al*. Prevalence of vision impairment in older adults in rural China: the China Nine-Province survey. *Ophthalmology* 2010;117:409–16.
- 100 Naël V, Moreau G, Nonfermé S, *et al*. Prevalence and associated factors of uncorrected refractive error in older adults in a population-based study in France. *JAMA Ophthalmol* 2019;137:3–11.
- 101 Friedman DS, Repka MX, Katz J, *et al*. Prevalence of decreased visual acuity among preschool-aged children in an American urban population: the Baltimore pediatric eye disease study, methods, and results. *Ophthalmology* 2008;115:1786.
- 102 Giordano L, Friedman DS, Repka MX, *et al*. Prevalence of refractive error among preschool children in an urban population: the Baltimore pediatric eye disease study. *Ophthalmology* 2009;116:739.
- 103 Pai AS-I, Wang JJ, Samarawickrama C, *et al*. Prevalence and risk factors for visual impairment in preschool children the Sydney paediatric eye disease study. *Ophthalmology* 2011;118:1495–500.
- 104 Hender K, Mehravaran S, Lu X, *et al*. Refractive errors and amblyopia in the UCLA preschool vision program; first year results. *Am J Ophthalmol* 2016;172:80–6.
- 105 Margines JB, Huang C, Young A, *et al*. Refractive errors and amblyopia among children screened by the UCLA preschool vision program in Los Angeles County. *Am J Ophthalmol* 2020;210:78–85.
- 106 Mehravaran S, Duarte PB, Brown SI, *et al*. The UCLA preschool vision program, 2012–2013. *J Aapos* 2016;20:63–7.
- 107 Zhang X, Wang Y, Huang D, *et al*. Prevalence of reduced visual acuity among preschool children in eastern China and comparison at a 5-year interval. *Clin Exp Ophthalmol* 2018;46:994–1001.
- 108 Ma Y, Qu X, Zhu X, *et al*. Age-Specific prevalence of visual impairment and refractive error in children aged 3–10 years in Shanghai, China. *Invest Ophthalmol Vis Sci* 2016;57:6188–96.
- 109 Robaei D, Rose K, Ojaimi E, *et al*. Visual acuity and the causes of visual loss in a population-based sample of 6-year-old Australian children. *Ophthalmology* 2005;112:1275–82.
- 110 He J, Lu L, Zou H, *et al*. Prevalence and causes of visual impairment and rate of wearing spectacles in schools for children of migrant workers in Shanghai, China. *BMC Public Health* 2014;14:1312.
- 111 Hashemi H, Yekta A, Saatchi M, *et al*. The Met and unmet need for refractive correction and its determinants in 7-year-old children. *British Journal of Visual Impairment* 2017;35:69–80.
- 112 Gursoy H, Basmak H, Yaz Y, *et al*. Vision screening in children entering school: Eskisehir, Turkey. *Ophthalmic Epidemiol* 2013;20:232–8.
- 113 Casson RJ, Kahawita S, Kong A, *et al*. Exceptionally low prevalence of refractive error and visual impairment in schoolchildren from Lao people's Democratic Republic. *Ophthalmology* 2012;119:2021–7.
- 114 Hashim SE, Tan HK, Wan-Hazabbah WH. Prevalence of refractive error in Malay primary school children in suburban area of Kota Bharu, Kelantan, Malaysia. *Annals of the Academy of Medicine Singapore* 2008;37:940–6.
- 115 Aldebasi YH. Prevalence of correctable visual impairment in primary school children in Qassim Province, Saudi Arabia. *J Optom* 2014;7:168–76.
- 116 Choy BNK, You Q, Zhu MM, *et al*. Prevalence and associations of myopia in Hong Kong primary school students. *Jpn J Ophthalmol* 2020;64:437–49.
- 117 Harrington SC, Stack J, Saunders K, *et al*. Refractive error and visual impairment in Ireland schoolchildren. *Br J Ophthalmol* 2019;103:1112–8.
- 118 O'Donoghue L, McClelland JF, Logan NS, *et al*. Refractive error and visual impairment in school children in Northern Ireland. *Br J Ophthalmol* 2010;94:1155–9.
- 119 Al Wadaani FA, Amin TT, Ali A. Prevalence and pattern of refractive errors among primary school children in al Hassa, Saudi Arabia. *Glob J Health Sci* 2013;5:125–34.
- 120 Gupta A, Lal R, Mazta SR. Prevalence of refractive errors, color vision defects and other ocular disorders in school-going children: primary screening by school teachers. *Journal International Medical Sciences Academy* 2012;25:223–4.
- 121 Hameed A. Screening for refractive errors and visual impairment among school children in Kohat, Pakistan. *Rawal Medical Journal* 2016;41:437–40.
- 122 He M, Zeng J, Liu Y, *et al*. Refractive error and visual impairment in urban children in southern China. *Invest Ophthalmol Vis Sci* 2004;45:793–9.
- 123 He M, Xu J, Yin Q, *et al*. Need and challenges of refractive correction in urban Chinese school children. *Optom Vis Sci* 2005;82:26–44.
- 124 Kassa T, Alene GD. Prevalence of refractive errors in pre-school and school children of Debarke and kola Diba towns, north-western Ethiopia. *Ethiopian Journal of Health Development* 2004;17:117–24.
- 125 Hu M, Zhou Y, Huang S, *et al*. Population prevalence of myopia, glasses wear and free glasses acceptance among minority versus Han schoolchildren in China. *PLoS One* 2019;14:e0215660.
- 126 Kaur G, Koshy J, Thomas S, *et al*. Vision screening of school children by teachers as a community based strategy to address the challenges of childhood blindness. *J Clin Diagn Res* 2016;10:NC09–14.
- 127 Dandona R, Dandona L, Srinivas M, *et al*. Refractive error in children in a rural population in India. *Invest Ophthalmol Vis Sci* 2002;43:615–22.
- 128 Falkenberg HK, Langaas T, Svarverud E. Vision status of children aged 7–15 years referred from school vision screening in Norway during 2003–2013: a retrospective study. *BMC Ophthalmol* 2019;19:N.PAG-N.PAG.
- 129 Goh P-P, Abqariyah Y, Pokharel GP, *et al*. Refractive error and visual impairment in school-age children in Gombak district, Malaysia. *Ophthalmology* 2005;112:678–85.

- 130 Kedir J, Girma A. Prevalence of refractive error and visual impairment among rural school-age children of Goro district, Gurage zone, Ethiopia. *Ethiop J Health Sci* 2014;24:353–8.
- 131 Pavithra MB, Hamsa L, Madhukumar S. Factors associated with spectacle-wear compliance among school children of 7–15 years in South India. *Int J Med Public Health* 2014;4:146.
- 132 Wang X, Yi H, Lu L, *et al.* Population prevalence of need for spectacles and spectacle ownership among urban migrant children in eastern China. *JAMA Ophthalmol* 2015;133:1399–406.
- 133 Yekta A, Fotouhi A, Hashemi H, *et al.* Prevalence of refractive errors among schoolchildren in Shiraz, Iran. *Clin Exp Ophthalmol* 2010;38:242–8.
- 134 Zhu Z, Ellwein LB, Wang SK, *et al.* Meeting the need for corrective spectacles in visually impaired Chinese school children: the potential of ready-made spectacles. *Br J Ophthalmol* 2019;103:1106–11.
- 135 Li Z, Xu K, Wu S, *et al.* Population-Based survey of refractive error among school-aged children in rural Northern China: the Heilongjiang eye study. *Clin Exp Ophthalmol* 2014;42:379–84.
- 136 Barria F, Conte F, Muñoz S, *et al.* Prevalence of refractive error and spectacle coverage in schoolchildren in two urban areas of Chile. *Rev Panam Salud Publica* 2018;42:1–8.
- 137 Robaei D, Huynh SC, Kifley A, *et al.* Correctable and non-correctable visual impairment in a population-based sample of 12-year-old Australian children. *Am J Ophthalmol* 2006;142:112.
- 138 Robaei D, Kifley A, Rose KA, *et al.* Refractive error and patterns of spectacle use in 12-year-old Australian children. *Ophthalmology* 2006;113:1567–73.
- 139 Yamamah GAN, Talaat Abdel Alim AA, Mostafa YSED, *et al.* Prevalence of visual impairment and refractive errors in children of South Sinai, Egypt. *Ophthalmic Epidemiol* 2015;22:246–52.
- 140 Mehari ZA, Yimer AW. Prevalence of refractive errors among schoolchildren in rural central Ethiopia. *Clin Exp Optom* 2013;96:65–9.
- 141 Plainis S, Moschandreas J, Nikolitsa P, *et al.* Myopia and visual acuity impairment: a comparative study of Greek and Bulgarian school children. *Ophthalmic Physiol Opt* 2009;29:312–20.
- 142 Sapkota YD, Adhikari BN, Pokharel GP, *et al.* The prevalence of visual impairment in school children of upper-middle socioeconomic status in Kathmandu. *Ophthalmic Epidemiol* 2008;15:17–23.
- 143 Salomão SR, Cinoto RW, Berezovsky A, *et al.* Prevalence and causes of visual impairment in low-middle income school children in São Paulo, Brazil. *Invest Ophthalmol Vis Sci* 2008;49:4308–13.
- 144 AEED A, Ewis AAE, Mahran WM. Prevalence and risk factors of refractive errors among preparatory school students in Beni-Suef, Egypt. *Journal of Public Health* 2019;27:43–7.
- 145 Gao Z, Meng N, Muecke J, *et al.* Refractive error in school children in an urban and rural setting in Cambodia. *Ophthalmic Epidemiol* 2012;19:16–22.
- 146 Qian D-J, Zhong H, Li J, *et al.* Spectacles utilization and its impact on health-related quality of life among rural Chinese adolescents. *Eye* 2018;32:1879–85.
- 147 Ajaiyeoba AI, Isawumi MA, Adeoye AO, *et al.* Pattern of eye diseases and visual impairment among students in southwestern Nigeria. *Int Ophthalmol* 2007;27:287–92.
- 148 Congdon N, Wang Y, Song Y, *et al.* Visual disability, visual function, and myopia among rural Chinese secondary school children: the Xichang Pediatric Refractive Error Study (X-PRES)--report 1. *Invest Ophthalmol Vis Sci* 2008;49:2888–94.
- 149 Congdon N, Zheng M, Sharma A, *et al.* Prevalence and determinants of spectacle nonwear among rural Chinese secondary schoolchildren: the Xichang pediatric refractive error study report 3. *Arch Ophthalmol* 2008;126:1717–23.
- 150 Li L, Song Y, Liu X, *et al.* Spectacle acceptance among secondary school students in rural China: the Xichang Pediatric Refractive Error Study (X-PRES)--report 5. *Invest Ophthalmol Vis Sci* 2008;49:2895–902.
- 151 Zhang M, Lv H, Gao Y, *et al.* Visual morbidity due to inaccurate spectacles among school children in rural China: the see well to learn well project, report 1. *Invest Ophthalmol Vis Sci* 2009;50:2011–7.
- 152 He M, Huang W, Zheng Y, *et al.* Refractive error and visual impairment in school children in rural southern China. *Ophthalmology* 2007;114:793–9.
- 153 Abu EK, Yeboah AA, Ocansey S, *et al.* Epidemiology of ocular disorders and visual impairment among school pupils in the Cape coast Metropolis, Ghana. *Br J Vis Impair* 2015;33:45–53.
- 154 Alsaqr A, Abu Sharha A, Fagehi R, *et al.* The visual status of adolescents in Riyadh, Saudi Arabia: a population study. *Clin Ophthalmol* 2018;12:965–72.
- 155 Zhao J, Guan H, Du K, *et al.* Visual impairment and spectacles ownership among upper secondary school students in northwestern China. *Hong Kong Med J* 2020;26:35–43.
- 156 Wu LJ, You QS, Duan JL, *et al.* Prevalence and associated factors of myopia in high-school students in Beijing. *PLoS One* 2015;10:e0120764.
- 157 Wedner SH, Ross DA, Todd J, *et al.* Myopia in secondary school students in Mwanza City, Tanzania: the need for a national screening programme. *Br J Ophthalmol* 2002;86:1200–6.
- 158 Senicato C, Barros MBdeA. Social inequality in health among women in Campinas, São Paulo state, Brazil. *Cadernos de Saúde Pública* 2012;28:1903–14.
- 159 Ferraz FH, Corrente JE, Opromolla P, *et al.* Influence of uncorrected refractive error and unmet refractive error on visual impairment in a Brazilian population. *BMC Ophthalmol* 2014;14:84.
- 160 Hashemi H, Rezvani F, Yekta A, *et al.* The prevalence and causes of Visual impairment and blindness in a rural population in the North of Iran. *Iran J Public Health* 2015;44:855–64.
- 161 Hashemi H, Abbastabar H, Yekta A, *et al.* The prevalence of uncorrected refractive errors in underserved rural areas. *J Curr Ophthalmol* 2017;29:305–9.
- 162 Fotouhi A, Hashemi H, Raissi B, *et al.* Uncorrected refractive errors and spectacle utilisation rate in Tehran: the unmet need. *Br J Ophthalmol* 2006;90:534–7.
- 163 Danermark B, Hanning M. Hearing and vision: health in Sweden: the National public health report 2012. Chapter 17. *Scand J Public Health* 2012;40:287–92.
- 164 Desalegn A, Tsegaw A, Shiferaw D, *et al.* Knowledge, attitude, practice and associated factors towards spectacles use among adults in Gondar town, Northwest Ethiopia. *BMC Ophthalmol* 2016;16:184.
- 165 Hashemi H, Khabazkhoob M, Emamian MH, *et al.* Visual impairment in the 40- to 64-year-old population of Shahroud, Iran. *Eye* 2012;26:1071–7.
- 166 Ertekin YH, Tekin M, Uludag A, *et al.* Vision screening in children: is 7–9 years of age a threshold for visual impairment? *Pak J Med Sci* 2016;32:1194–8.
- 167 Latorre-Arteaga S, Fernández-Sáez J, Gil-González D. Inequities in visual health and health services use in a rural region in Spain. *Gac Sanit* 2018;32:439–46.
- 168 Sheeladevi S, Seelam B, Nukella PB, *et al.* Prevalence of refractive errors, uncorrected refractive error, and presbyopia in adults in India: a systematic review. *Indian J Ophthalmol* 2019;67:583–92.
- 169 Tahhan N, Fricke TR, Naduvilath T, *et al.* Uncorrected refractive error in the Northern and eastern provinces of Sri Lanka. *Clin Exp Optom* 2009;92:119–25.
- 170 Resnikoff S, Pascolini D, Mariotti SP, *et al.* Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bull World Health Organ* 2008;86:63–70.
- 171 Rosman M, Wong TY, Tay W-T, *et al.* Prevalence and risk factors of undercorrected refractive errors among Singaporean Malay adults: the Singapore Malay eye study. *Invest Ophthalmol Vis Sci* 2009;50:3621–8.
- 172 Huang OS, Zheng Y, Tay WT, *et al.* Lack of awareness of common eye conditions in the community. *Ophthalmic Epidemiol* 2013;20:52–60.
- 173 Vitale S, Cotch MF, Sperduto RD. Prevalence of visual impairment in the United States. *JAMA* 2006;295:2158–63.
- 174 Mashayo ER, Chan VF, Ramson P, *et al.* Prevalence of refractive error, presbyopia and spectacle coverage in Kahama district, Tanzania: a rapid assessment of refractive error. *Clin Exp Optom* 2015;98:58–64.
- 175 Aljied R, Aubin M-J, Buhmann R, *et al.* Prevalence and determinants of visual impairment in Canada: cross-sectional data from the Canadian longitudinal study on aging. *Can J Ophthalmol* 2018;53:291–7.
- 176 Nangia V, Jonas JB, Gupta R, *et al.* Visual impairment and blindness in rural central India: the central India eye and medical study. *Acta Ophthalmol* 2013;91:483–6.
- 177 Bourne RRA, Dineen BP, Huq DMN, *et al.* Correction of refractive error in the adult population of Bangladesh: meeting the unmet need. *Invest Ophthalmol Vis Sci* 2004;45:410–7.
- 178 Laitinen A, Koskinen S, Rudanko S-L, *et al.* Use of eye care services and need for assistance in the visually impaired. *Optom Vis Sci* 2008;85:341–9.
- 179 Han X, Liao C, Liu C, *et al.* Incidence and correction of vision impairment among elderly population in southern urban China. *Clin Exp Ophthalmol* 2019;47:439–44.
- 180 Budenz DL, Bandi JR, Barton K, *et al.* Blindness and visual impairment in an urban West African population: the Tema eye survey. *Ophthalmology* 2012;119:1744–53.

- 181 Casson RJ, Newland HS, Muecke J, *et al*. Prevalence and causes of visual impairment in rural Myanmar: the Meiktila eye study. *Ophthalmology* 2007;114:2302–8.
- 182 Ezelum C, Razavi H, Sivasubramaniam S, *et al*. Refractive error in Nigerian adults: prevalence, type, and spectacle coverage. *Invest Ophthalmol Vis Sci* 2011;52:5449–56.
- 183 Marmamula S, Shekhar K, Banerjee S, *et al*. Population-Based assessment of unilateral visual impairment in the South Indian state of Andhra Pradesh: rapid assessment of visual impairment (RAVI) project. *Ophthalmic Epidemiol* 2016;23:171–5.
- 184 Marmamula S, Khanna RC, Kunuku E, *et al*. Spectacles use in a rural population in the state of Telangana in South India. *Indian J Ophthalmol* 2017;65:509–15.
- 185 Marmamula S, Challa R, Yellapragada S, *et al*. Temporal trends in the prevalence of spectacle use and spectacle coverage in India. *Clin Exp Optom* 2020;103:693–8.
- 186 Marmamula S, Yellapragada S, Khanna RC. Population Based Assessment of Prevalence and Causes of Vision Impairment in the North-eastern State of Tripura, India - The Tripura Eye Survey. *Ophthalmic Epidemiol* 2020;27:283–8.
- 187 Prema R, George R, Sathyamangalam Ve R, *et al*. Comparison of refractive errors and factors associated with spectacle use in a rural and urban South Indian population. *Indian J Ophthalmol* 2008;56:139–44.
- 188 Tafida A, Kyari F, Abdull MM, *et al*. Poverty and blindness in Nigeria: results from the National survey of blindness and visual impairment. *Ophthalmic Epidemiol* 2015;22:333–41.
- 189 Zheng Y, Lavanya R, Wu R, *et al*. Prevalence and causes of visual impairment and blindness in an urban Indian population: the Singapore Indian eye study. *Ophthalmology* 2011;118:1798–804.
- 190 Pan C-W, Qian D-J, Sun H-P, *et al*. Visual impairment among older adults in a rural community in eastern China. *J Ophthalmol* 2016;2016:1–6.
- 191 Furtado JM, Berezovsky A, Ferraz NN, *et al*. Prevalence and causes of visual impairment and blindness in adults aged 45 years and older from Parintins: the Brazilian Amazon region eye survey. *Ophthalmic Epidemiol* 2019;26:345–54.
- 192 Bastawrous A, Mathenge W, Foster A, *et al*. Prevalence and predictors of refractive error and spectacle coverage in Nakuru, Kenya: a cross-sectional, population-based study. *Int Ophthalmol* 2013;33:541–8.
- 193 Gallarreta M, Furtado JM, Lansingh VC, *et al*. Rapid assessment of avoidable blindness in Uruguay: results of a nationwide survey. *Rev Panam Salud Publica* 2014;36:219–24.
- 194 Lee L, D'Esposito F, Garap J, *et al*. Rapid assessment of avoidable blindness in Papua New Guinea: a nationwide survey. *Br J Ophthalmol* 2019;103:338–42.
- 195 Marmamula S, Ravuri CSLV, Boon MY, *et al*. A cross-sectional study of visual impairment in elderly population in residential care in the South Indian state of Andhra Pradesh: a cross-sectional study. *BMJ Open* 2013;3:e002576.
- 196 Neena J, Rachel J, Praveen V, *et al*. Rapid assessment of avoidable blindness in India. *PLoS One* 2008;3:e2867.
- 197 Nirmalan PK, Thulasiraj RD, Maneksha V, *et al*. A population based eye survey of older adults in Tirunelveli district of South India: blindness, cataract surgery, and visual outcomes. *Br J Ophthalmol* 2002;86:505–12.
- 198 Patil S, Gogate P, Vora S, *et al*. Prevalence, causes of blindness, visual impairment and cataract surgical services in Sindhudurg district on the Western coastal strip of India. *Indian J Ophthalmol* 2014;62:240–5.
- 199 Vignesh D, Gupta N, Kalaivani M, *et al*. Prevalence of visual impairment and its association with vision-related quality of life among elderly persons in a resettlement colony of Delhi. *J Family Med Prim Care* 2019;8:1432.
- 200 Zhu M, Tong X, Zhao R, *et al*. Visual impairment and spectacle coverage rate in Baoshan district, China: population-based study. *BMC Public Health* 2013;13:311.
- 201 Choi S, Stagg BC, Ehrlich JR. Disparities in Low-Vision device use among older us Medicare recipients. *JAMA Ophthalmol* 2018;136:1399–403.
- 202 Kuang T-M, Tsai S-Y, Hsu W-M, *et al*. Correctable visual impairment in an elderly Chinese population in Taiwan: the Shihpai eye study. *Invest Ophthalmol Vis Sci* 2007;48:1032–7.
- 203 Lindsay S, Tsybina I. Predictors of unmet needs for communication and mobility assistive devices among youth with a disability: the role of socio-cultural factors. *Disabil Rehabil Assist Technol* 2011;6:10–21.
- 204 Eide AH, van Rooy G, Loeb ME. *Living conditions among people with activity limitations in Namibia: a representative, national study*. Trondheim, Norway, 2003.
- 205 Eide AH, Nhiwathiwa S, Muderedzi J. *Living conditions among people with activity limitations in Zimbabwe. A representative regional survey*, 2003.
- 206 Eide A, Loeb M. *Living conditions among people with activity limitations in Zambia. A national representative study*. SINTEF, 2006.
- 207 Eide AH, Neupane S, Hem K-G. *Living conditions among people with disability in Nepal*, 2016.
- 208 Eide AH, Munthali A. *Living conditions among persons with disabilities in Malawi, a national, representative survey 2017*, 2018.
- 209 JB EAH. *Living conditions among people with disabilities in Swaziland a national representative study*. Trondheim, Norway, 2011.
- 210 Eide AH, Kamaleri Y, Hem K-G. *Living conditions among people with disabilities in Mozambique: a national representative study*, 2009.
- 211 Eide AH, Mmatli T. *Living conditions among people with disability in Botswana*. Trondheim, Norway: SINTEF, 2016.
- 212 Kamaleri Y, Eide AH. *Living conditions among people with disabilities in Lesotho*. Trondheim, Norway, 2011.
- 213 Loeb M, Eide AH. *Living conditions among people with activity limitations in Malawi: a national representative study*. Trondheim, Norway, 2004.
- 214 Maart S, Jelsma J. Disability and access to health care - a community based descriptive study. *Disabil Rehabil* 2014;36:1489–93.
- 215 Smith N. The face of disability in Nigeria: a disability survey in Kogi and niger states. *DCID* 2011;22:35–47.
- 216 Eide A, Sinyenga G, Phiri Mwansa O. *2015 Zambia national disability survey*, 2018.
- 217 Visagie S, Eide AH, Mannan H, *et al*. A description of assistive technology sources, services and outcomes of use in a number of African settings. *Disabil Rehabil Assist Technol* 2017;12:705–12.
- 218 Loggins S, Alston R, Lewis A. Utilization of assistive technology by persons with physical disabilities: an examination of predictive factors by race. *Disabil Rehabil Assist Technol* 2014;9:487–92.
- 219 Marella M, Devine A, Armecin GF, *et al*. Rapid assessment of disability in the Philippines: understanding prevalence, well-being, and access to the community for people with disabilities to inform the W-DARE project. *Popul Health Metr* 2016;14:1–11.
- 220 Matter RA, Eide AH. Access to assistive technology in two southern African countries. *BMC Health Serv Res* 2018;18:792.
- 221 Goins RT, Spencer SM, Goli S, *et al*. Assistive technology use of older American Indians in a southeastern tribe: the native elder care study. *J Am Geriatr Soc* 2010;58:2185–90.
- 222 Frochen S, Mehdizadeh S. Functional status and adaptation: measuring activities of daily living and device use in the National health and aging trends study. *J Aging Health* 2018;30:1136–55.
- 223 Rios A, Miguel Cruz A, Guarín MR, *et al*. What factors are associated with the provision of assistive technologies: the Bogotá D.C. case. *Disabil Rehabil* 2014;9:432–44.
- 224 Burton MJ, Ramke J, Marques AP, *et al*. The Lancet global health Commission on global eye health: vision beyond 2020. *Lancet Glob Health* 2021;9:e489–551.
- 225 World Health Organisation. Prevalence of coverage of assistive technology in the who European region: a scoping review, 2021. Available: <http://apps.who.int/bookorders> [Accessed 5 Nov 2021].
- 226 Holloway C, Austin V, Barbareschi G. Scoping research report on assistive technology: on the road for universal assistive technology coverage, 2018. Available: [https://at2030.org/static/at2030\\_core/outputs/-Scoping-Report\\_2019-compressed-192.pdf](https://at2030.org/static/at2030_core/outputs/-Scoping-Report_2019-compressed-192.pdf) [Accessed 15 Nov 2021].
- 227 Rohwerder B. Assistive technologies in developing countries 2018.
- 228 Mishra S, Pupulin A, Ekman B, *et al*. National priority assistive product list development in low resource countries: lessons learned from Tajikistan. *Disabil Rehabil Assist Technol*. In Press 2021;16:857–64.
- 229 Danemayer J, Bhot W, Kular A. At data portal. Available: <https://at2030.org/at-data-portal/map/> [Accessed 23 Nov 2021].
- 230 Danemayer J, Boggs D, Ramos D V. Estimating need and coverage for five priority assistive products. AT2030 programme, 2021. Available: <https://at2030.org/estimating-need-and-coverage-for-five-priority-assistive-products/> [Accessed 23 Nov 2021].

### **4.3 Review of population-based survey tools that use functional assessments to measure AP need**

The systematic review of AP need (**Chapter 4.2**) described key AP indicator measurement approaches and highlighted the lack of consistency in their measurement.(72) The review found heterogeneity in the assessment approaches used to assess AP need; while over half of the studies (n=110, 53%) used a combination of clinical and self-reported assessment, six studies were identified that specifically utilised functional assessment.(72) A functional assessment approach is well-aligned with the ICF assessing the influence of activities, participation and personal and environmental factors on whether and which interventions, including AP, may be appropriate.(30, 60)

In this section, the functional assessments tools identified in the six studies from the systematic review of AP need are discussed and recommendations are made for the development of the hybrid functional assessment protocol. It is important to note that this PhD research did not include a full literature review of all functional assessment tools. Instead, as first step, the systematic review was used to identify tools that have been utilised in some way to inform AP indicators.(72) It is also important to note that the systematic review “functional assessment” terminology is different to the one used in this PhD thesis (see **Appendix 1**).

#### **4.3.1 Functional assessment studies**

Select study information, about the six studies that utilised functional assessment methodology, extracted from the review are presented below in **Table 4-2**.(72) Of the six studies included, two studies were cross-sectional survey study design, while four provided secondary analyses from data in five cross-sectional surveys. Two of the studies used the same data source, the UK Biobank Resource, and one study compared two different assessments, so a total of seven assessment tool sets are reviewed. The studies included participants aged 2 to 60+ years old, and the number of participants ranged from 399 to 164,770. One study was conducted in Kenya, while the other studies were conducted in the United States and United Kingdom (UK). Reported AP indicators measured in the studies included the following: hearing aid use, need, unmet need; wheelchair (both motorised and manual/unspecified) use; and grouped AP use.

**Table 4-2: Studies using functional assessment from the AP indicator systematic review (72)**

Citation	Survey, or Dataset	Study Design	Approaches	Tool/s	AP indicator	Ages	Participants	Country
<b>HEARING AID INDICATORS</b>								
Muga, 2003(73)	Clinical dataset	Cross-sectional	Functional; Self-report.	Educational Assessment and Resource Center Assessment; Ten questions.	Need	2-9	399	Kenya
Dawes et al., 2014(74)	UK Biobank Resource	Secondary cross-sectional	Functional; self-report.	Questionnaire and physical assessment, including Digit Triplet Test.	Use	40-69	164,770	United Kingdom
Sawyer et al., 2019(75)	UK Biobank Resource	Secondary cross-sectional	Functional; self-report.	Questionnaire and physical assessment, including Digit Triplet Test.	Use; Unmet	40-69	18,730	United Kingdom
Li et al., 2018(76)	Behavioral Risk Factor Surveillance System; National Health Interview Survey	Secondary cross-sectional	Functional; Self-report.	Single question; Self-reported hearing health questions; Gallaudet Functional Hearing Scale.	Use	18+	18,391	United States
<b>MOBILITY AP INDICATORS</b>								
<i>Motorised and manual or unspecified wheelchairs</i>								
Gale et al., 2014(77)	English Longitudinal Study of Aging; Health Survey for England	Secondary cross-sectional	Functional; Self-report.	Self-report questionnaires; physical function and anthropometry assessment.	Use	60+	5,450	United Kingdom
<b>GROUPED AP INDICATORS</b>								
Goins et al., 2010(78)	Native Elder Care Study	Cross-sectional	Functional; Self-report.	Self-reported ADLs, psychosocial and health questionnaires; Short Physical Performance Battery.	Use	55+	505	United States

Abbreviations: AP= assistive product; UK= United Kingdom; ADLs= activities of daily living.

### 4.3.2 Functional assessment tools

An overview of each tool is presented in **Table 4-3** detailing the method, specific ICF components and AP indicators measured. There is also a feasibility rating for inclusion in a population-based AP need survey, assigned by this PhD candidate on a 0 to 3 scale (0=poor, 1=low, 2=good, 3=high). Specific rating criteria, listed below in **Figure 4-1**, considered the following criteria: number of ICF components assessed; number of AP indicators assessed; geographical uptake, specifically for use in LMICs; and resources<sup>2</sup> required (cost, time, equipment, cadres). Scoring criteria were adapted from Boggs et al.'s early childhood development measurement tool rating criteria.<sup>(79)</sup> A summary of each of the seven functional assessment survey tools with their specific rating criteria scores are presented in **Appendix 4**. It is noted that criteria were not scored if information could not be identified through the literature resources.

**Figure 4-1: Feasibility rating criteria for assessing functional assessment tools in a population-based AP need survey**

Criteria	Poor	Low	Good	High
1) Number of ICF components	1	2 to 3	4 to 5	6
2) Number of AP need indicators	1	2 to 3	4 to 5	≥6
3) Geographical uptake	1 country only	Used in 1 continent only	Used in 2 continents only	Used in ≥3 continents
4a) Cost	High	Moderate	Minimal	None
4b) Time	>60 minutes	>30 to ≤60 minutes	>15 to ≤30 minutes	≤15 minutes
4c) Equipment	High	Moderate	Minimal	None
4d) Cadres	Specialist worker, certification required	Specialist worker, no certification required	Non-specialist worker, may require certification	Non-specialist worker, no certification required
<b>OVERALL SCORE</b>	<b>0% TO 25%</b>	<b>26% TO 50%</b>	<b>51% TO 75%</b>	<b>76% TO 100%</b>

<sup>2</sup> The criteria rating for “resources required” is calculated as an average of the criteria ratings for a) cost, b) time, c) equipment and d) cadres.

**Table 4-3: Functional assessment summary: methods, ICF components, AP indicators measured and feasibility score**

Functional assessment	Age range	Method/s	Number of ICF components	Specific ICF component/s	AP indicator measured	Overall feasibility score
Educational Assessment and Resource Center (EARC) Assessment <b>(73, 80)</b>	0-16 years	Record review; Physical, social and emotional observation; developmental screenings (Snellen chart for vision, PTA for hearing); caregiver report; learning tests/assessments.	At least ≥ 4	Impairment; activity limitations; personal factors; environment.	1: Hearing aid need	Poor [2/12, 13%]
Ten questions <b>(73, 81)</b>	2-9 years	Caregiver report	1	Activity limitations	1: Hearing aid use	Low [4/12, 33%]
UK Biobank questionnaire and physical assessments <b>(74, 75, 82, 83)</b>	≥ 40 years	Biopsychosocial factors self-report questionnaire; clinical physical assessments, including blood pressure, anthropometry, hand grip strength and DTT.	At least ≥ 4	Health condition; impairment; activity limitations; personal factors.	4: Hearing aid and glasses use and unmet need.	Low [4/12, 33%]
Behavioral Risk Factor Surveillance System (BRFSS) <b>(76, 84)</b>	≥ 18 years	Self-report telephone questionnaires, including disability, caregiver, vision impairment and diabetes modules.	6	Health condition, Impairment, activity limitations, participation restrictions, personal factors; environment.	1: Grouped AP use	Low [5/12, 42%]
National Health Interview Survey, including 2014 Hearing health and Gallaudet Functional Hearing Scale <b>(76, 85-87)</b>	≥ 18 years	Self-report questionnaires, including review of 2014 hearing health and Gallaudet Functional Hearing Scale.	5	Health condition, Activity limitations, participation restrictions, personal factors; environment.	5: AP use (glasses/contact lenses; hearing aid; mobility grouped; cane/walker; wheelchair/cooter).	Low [6/12, 50%]

English Longitudinal Study of Ageing (ELSA) assessments <b>(77, 88)</b>	>60 years	Self-report questionnaires, including ADLs, IADLs, AP use and depression assessment; physical function and anthropometry assessment, including grip strength, anthropometry and timed walking speed test.	6	Health condition, Impairment, activity limitations, participation restrictions, personal factors; environment.	7: six mobility AP use; personal alarm use.	Low [6/12, 50%]
Native Elder Care ADL, psychosocial, health and mobility assessments <b>(78, 89-92)</b>	≥55 years	Self-reported ADLs, psychosocial and health questionnaires; grip strength; short Physical Performance Battery.	6	Health condition; Impairment, activity limitations, participation restrictions, personal factors; environment.	1: Grouped AP use	Low [4/12, 33%]

Abbreviations: ICF= International Classification of Health, Disability and Functioning; AP= assistive product; PTA= pure tone audiometry; UK= United Kingdom; DTT= Digit Triplet Test; ADLs= activities of daily living; IADLs= instrumental activities of daily living.



### 4.3.3 Overview of key findings

Seven functional assessment survey tool sets were identified from six studies in Danemayer et al.'s systematic review that measured AP need. The key findings of this review are discussed below.

First, the review found a lack of use of functional assessment tools to assess AP need. Upon closer review, the AP data was only generated through either self-reported AP use (i.e. six of the seven tools reported self-reported AP use indicators only) or clinical impairment assessment (i.e. the remaining tool, UK Biobank survey, measured glasses and hearing aid need through clinical impairment assessment only). Therefore, all the tools received either a poor or low score in context of feasibility/applicability for population surveys to assess AP need. Though functional assessment tools exist for clinical settings/individual patient assessment, the literature reviews and sector engagement did not identify a tool developed to specifically assess population-based AP need and unmet need. Existing functional assessment tools may be useful in guiding questions to include in a new survey tool, such as vision functioning questionnaires (93-96), older adults (97, 98) and community-level functional assessments(99, 100).

Second, there is a lack of evidence of the applicability of approaches used in LMIC settings, and all-age surveys. Five of the tools were used in one high-income country only, namely US or UK, which contributed to the lower feasibility ratings. Further, none of the seven tools reviewed assessed all ages; two only assessed children, two only assessed older adults and three assessed adults (two assessing adults 18+ years and one assessing adults 40+ year).

Third, a hybrid approach (i.e. using a combination of clinical and self-assessment) was used in four of the seven tool sets reviewed, but did not integrate a measure of AP need. Two of the large population-based surveys used both clinical and self-reported functional assessments, namely the UK Biobank and English Longitudinal Study of Ageing (ELSA), and the Educational Assessment and Resource Center (EARC) assessment study and Native Elder Care Study. Behavioral Risk Factor Surveillance System (BRFSS) and the National Health Information Survey (NHIS) included more detailed population-based functional assessment questions, but these were based solely upon self-report. The hybrid assessment methods reviewed included clinical assessment (including physical function, anthropometry, demonstration and observation assessment methods), and self-reported assessment (including activities

of daily living (ADLs), instrumental activities of daily living (IADLs), AP and psychosocial factors), and however they were used inconsistently across the tools.

Fourth, the author's feasibility ratings were low for the tool sets reviewed. Six of the tools were rated low (1/3) and one was rated poor (0/3). NHIS and ELSA both scored the highest overall score of 6/12 (50%). These tools measured five and six ICF components and five and seven AP use indicators respectively. ELSA measured the highest indicator count of all the assessment sets reviewed, however the only AP indicator it provided was AP use which is reasonably more straight-forward since it is self-reported. Though these assessments showed some strengths in context of potential use in AP need survey, they were administered in two high income countries (US and UK) so may not be transferrable to LMIC contexts. It is also noted that they utilised different assessment methods (one self-report and one hybrid) and resource details including administration cost and/or time taken to administer the surveys were not stated. Cultural relevance/transferability, lower administration time and cost, and the measurement of all AP indicators are critical for an AP need survey. Therefore, these assessments are not recommended for direct use in an AP need survey.

In conclusion, it is important to acknowledge some of the limitations of relying on the AP need systematic review for identifying functional assessment approaches. In the systematic review, assessment approaches were allocated three labels due to the heterogeneity in methods across studies: clinical assessment (which typically referred to clinical impairment), self-reported assessment and functional assessment. The majority of studies (53%; n=110) used a combination of clinical and self-reported assessment. Functional assessment is typically a clinical assessment that uses a combination of approaches to focus on function by combining impairment, self-report, observation and demonstration assessment methods that take into account the persons individual and environment level contextual factors. Therefore, it is possible that some of the assessments were misclassified in the review, and that some labelled as a combination of clinical assessment and self-report may actually have been "functional". Importantly, the systematic review "functional assessment" terminology is different to the "hybrid functional assessment" terminology used in this PhD thesis (see **Appendix 1**). Additionally, only abstracts that specifically mentioned AP in the literature review were included, so there may be additional functional assessment tools that have not been identified (e.g. WHO MDS). As emphasised in the recommendation in Danemayer et al.'s systematic review, it will be important for future research to agree definitions of assessment approaches and methods. It then might be interesting to

relabel the assessment approaches used in the systematic review's studies to extract a more complete list of available population-based functional assessment survey tools.

Based on this review, there appears to be a gap for a fit-for-purpose functional assessment set/tools for use in surveys for assessing AP need in LMICs.

Future research is needed to conduct a wider review of population-based functional assessment tools and assess their suitability for informing AP need in context of population surveys in LMICs.

#### **4.4 Hybrid functional assessment protocol development**

The functional assessment review provided important lessons about tools and research recommendations which are outlined below, along with the key implications for the AP need survey.

##### **4.4.1 Functional assessment tools**

- 1) Though the feasibility ratings were low, the two highest scoring functional assessment sets were NHIS and ELSA. Notably ELSA included seven AP use indicators and used hybrid clinical and self-report assessment approaches, including physical function, anthropometry, demonstration and observation assessment methods. ELSA assessments also included all six ICF components and focused widely on health, ADLs, IADLs and psychosocial factors; however, the assessment set only focused on older adults >60 years and did not measure AP need. Though the assessment sets reviewed are *not* recommended for inclusion in an AP need survey, it is recommended that an AP need survey include hybrid assessment methods and a wider focus on health, personal, psychosocial and environmental factors. Specific assessment modules could be reviewed in detail to identify any learnings for the AP need tool.
- 2) None of the seven assessment sets reviewed included all the recommended AP indicators. AP use was most frequently measured, and only one survey (75) measured AP unmet need. It is important that functional assessment sets are selected to provide specific measurements of AP need.

##### **Implications for survey development**

- Include hybrid functional assessment methods focusing upon wider health, personal, psychosocial and environmental factors in an AP need survey and review specific assessment modules.
- Select functional assessment sets that can provide specific measurements of AP need.

#### 4.4.2 Research recommendations

- 1) Due to heterogeneity across AP need studies, it is important to agree definitions of assessment approaches and methods. Additional research could relabel the studies included in this review to extract additional population-based functional assessment AP survey tools.
- 2) The systematic review suggests there is a gap for a fit-for-purpose hybrid functional assessment tool set for an AP need survey. Additional functional assessments focusing on observation, participation and environmental factors, and the methods of how to best integrate hybrid assessment types, are required to determine population level AP need.
- 3) It is recommended that a wider functional assessment review is conducted, including broader interventions and a review of functional assessments included within large surveys to determine if a selection of tools might be relevant.

#### **Implications for survey development**

- Agree definitions of assessment approaches and methods.
- Consider relabelling the studies included in the AP systematic review to extract additional population-based functional assessment survey tools.
- Identify additional functional assessment tools and test methods of how best integrate the hybrid assessment methods to estimate population-level AP need.
- Conduct a wider functional assessment review including broader interventions.

## Chapter 5: Clinical impairment AP assessment methods and comparison with self-report

This chapter presents two studies that were undertaken to explore measurement approaches and inform the development of an all-age survey methodology to estimate population-based AP need. The first study is a secondary quantitative analysis of all-age population-based surveys in Cameroon and India for vision, hearing and mobility impairments. The second is a population-based survey conducted in The Gambia for vision and hearing impairments as part of this PhD. Both studies present:

- i) estimates of AP need based on clinical impairment assessment, and
- ii) comparison of data on AP need measured through self-report versus clinical impairment assessment.

Following the two studies, lessons learned and implications for clinical vision and hearing impairment AP assessment protocol development and comparison with self-report AP assessment are provided.



Young boy completing an eye exam in Cameroon. © Islay Mactaggart/ICED

### **5.1 Research paper 3: Estimating AP need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches**

#### **Preamble**

This paper presents secondary analysis of population-based surveys conducted in Cameroon and India in 2013/2014, each including approximately 4000 people. The analysis i) estimates AP need and coverage for distance glasses, hearing aids and wheelchairs and ii) explores the relationship between AP need measured through self-report and clinical impairment assessment.

The Cameroon survey was conducted in the rural District of Fundong through a collaboration with Sightsavers, and the India survey was conducted in the Mahabubnagar district through a collaboration with Indian Institute of Public Health. The relatively large sample size and use of the two methods provide an analysis opportunity for estimating AP need and coverage in the two countries and for exploring AP need measurement methodology.

This paper presents prevalence estimates of use, unmet need, total need and coverage for distance glasses, hearing aids and wheelchairs. It also presents a comparison of self-report and clinical impairment assessment methodology for measuring AP need. This provides further rationale for the development of a hybrid self-report and clinical impairment assessment tool, highlighting a functioning measurement gap. Finally, it identified key evidence gaps, (such as analysing mild/worse versus moderate/worse impairment threshold levels and including assessment for additional AP, such as near glasses) which are explored in the subsequent study of the thesis.

This paper was published in November 2020 in Tropical Medicine and International Health. The copyright is held by the licensed content publisher, John Wiley and Sons. This is the peer reviewed version of the article (see full citation below), which has been published in final form at <https://doi.org/10.1111/tmi.13523>. This article may be used for non-commercial purposes in accordance with [Wiley Terms and Conditions for Self-Archiving](#). See copyright permission licenses in **Appendix 5**.

### 5.1.1 List of Tables

**Table 1:** Measuring population-based AT through self-report and clinical impairment assessment: methodology advantages, disadvantages and examples.

**Table 2:** Clinical impairment assessment methods for vision, hearing and musculoskeletal impairments and related assistive product assessment methods.

**Table 3:** Definitions of proportions for measuring population-based assistive product (AP) use, unmet need, total need and coverage and comparing self-report and clinical impairment assessment AP need measurement approaches.

**Table 4:** Three assistive product use, unmet need, total need and coverage estimates in India and Cameroon.

**Table 5:** Distance glasses < 6/18 (moderate VI) and hearing aids total need and unmet need stratification by age and gender in India and Cameroon.

### 5.1.2 List of Figures

**Figure 1:** Example International Classification of Functioning, Health and Disability diagram for health condition of diabetes.

**Figure 2:** Comparing reported vs. clinical impairment measurement need for distance glasses.

**Figure 3:** Comparing reported vs. clinical impairment measurement need for hearing aids.

### 5.1.3 Supplementary material

The Supporting Information referenced in the paper is available at

<https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1111%2Ftmi.13523&file=tmi13523-sup-0001-Appendix.docx>

### 5.1.4 Citation

Boggs, D; Kuper, H; Mactaggart, I; Murthy, GV; Oye, J; Polack, S; (2020) *Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches*. Tropical medicine & international health : TM & IH, 26 (2). pp. 146-158. ISSN 1360-2276 DOI: <https://doi.org/10.1111/tmi.13523>



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms.
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	Tropical Medicine International Health		
When was the work published?	November 2020		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	<b>No</b> , see Annex 4 for copyright license permission for use in this thesis and for publication in the LSHTM repository using the peer-reviewed copy of the manuscript.	Was the work subject to peer review?	<b>Yes</b>

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### SECTION C – Prepared for publication, but not yet published



Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I conducted the secondary analysis and drafted the manuscript, with supervision input from Sarah Polack, and considered revisions and comments from other authors.
--	--

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022

<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022

1 **Estimating assistive product need in Cameroon and India: results of**  
2 **population-based surveys and comparison of self-report and clinical**  
3 **impairment assessment approaches**  
4

5 Dorothy Boggs<sup>1</sup>, Hannah Kuper<sup>1</sup>, Islay Mactaggart<sup>1</sup>, GVS Murthy<sup>1,2</sup>, Joseph Oye<sup>3</sup>, Sarah  
6 Polack<sup>1</sup>

7 <sup>1</sup>International Centre for Evidence in Disability, London School of Hygiene & Tropical  
8 Medicine, London, UK

9 <sup>2</sup>Indian Institute of Public Health, Plot No #1, A.N.V. Arcade, Amar Co-op Society, Kavuri  
10 Hills, Madhapur, Hyderabad, 500033, India

11 <sup>3</sup>Sightsavers, Yaounde, Cameroon  
12

13 **Corresponding Author:** Dorothy Boggs, c/o International Centre for Evidence in Disability  
14 (ICED), London School of Hygiene & Tropical Medicine, Keppel St, London WC1E7HT, United  
15 Kingdom, [dorothy.boggs@lshtm.ac.uk](mailto:dorothy.boggs@lshtm.ac.uk)

16 **Keywords:** Assistive product (AP); data; surveys; population; need.

17 **ABSTRACT**

18 **Objectives**

19 To i) estimate population need and coverage for distance glasses, hearing aids and  
20 wheelchairs in India and Cameroon; ii) explore the relationship between assistive product  
21 (AP) need measured through self-report and clinical impairment assessment.

22 **Methods**

23 Population based surveys of approximately 4000 people each were conducted in  
24 Mahabubnagar district, India and Fundong district, Cameroon. Participants underwent  
25 standardised vision, hearing and musculoskeletal impairment assessment to assess need for  
26 distance glasses, hearing aids, wheelchairs. Participants with moderate or worse impairment  
27 and/or self-reported difficulties in functioning were also asked about their self-reported AP  
28 need.

29 **Results**

30 6.5% (95% CI 5.4-7.9) in India and 1.9% (95% CI 1.5-2.4) in Cameroon of the population  
31 needed at least one of the three APs based on moderate or worse impairments. Total need  
32 was highest for distance glasses [3.7% (95% CI 2.8-4.7) India; 0.8% (95% CI 0.5-1.1),  
33 Cameroon] and lowest for wheelchairs (0.1% both settings; 95% CI 0.03-0.3 India, 95% CI  
34 0.04-0.3 Cameroon). Coverage for each AP was below 40%, except for distance glasses in  
35 India which was 87% (95% CI 77.1-93.0). The agreement between self-report and clinical  
36 impairment assessment of AP need was poor. For instance, in India, 60% of people  
37 identified through clinical assessment as needing distance glasses did not self-report a need.  
38 Conversely, in India, 75% of people who self-reported needing distance glasses did not  
39 require one based on clinical impairment assessment.

40 **Conclusions**

41 There is high need and low coverage of three APs in two low-and middle-Income settings.  
42 Methodological limitations highlight the need for improved survey methods compatible  
43 with the international classification of functioning, disability and health to estimate  
44 population-level need for AP and related services to inform advocacy and planning.

## 45 INTRODUCTION

46 Assistive Technology (AT) includes both *assistive products* (AP) and the *systems* and *services*  
47 related to AP delivery. Estimates suggest at least 1 billion people in the world are in need of  
48 AT, and, with population ageing and an increase in non-communicable diseases, this is  
49 expected to reach up to two billion people by 2030.(1, 2) People who might benefit from AT  
50 include older people, people with disabilities, and people living with chronic health  
51 conditions, non-communicable diseases, and communicable diseases, including coronavirus-  
52 19 (COVID-19) survivors who may have long-term health and rehabilitation needs.(1, 3, 4)  
53 Access to AT is a fundamental human right(5-7) and is essential for achieving the each of the  
54 17 Sustainable Development Goals (SDGs).(8) AT can be instrumental in facilitating active  
55 and independent participation in key life areas including livelihoods, education, and social  
56 engagement.(1, 2, 8) However, according to World Health Organization (WHO) the majority  
57 of people who need AT do not have access to it, particularly in low-and middle-income  
58 countries (LMIC).(1)

59 Reliable data on population-level AT need/unmet need is essential for evidence-based  
60 advocacy and planning of programmes to increase provision and access to AT. However, few  
61 robust population-level surveys of AT exist globally and among those that do, methods vary  
62 considerably. Global AT estimates are based on extrapolations from sparse data and may  
63 therefore not be reliable.(9, 10) The recognition of need for this data has increased over the  
64 past ten years with the growth in global initiatives to scale up AT access, such as the WHO  
65 Global Cooperation on Assistive Technology (GATE) initiative(11) and more recently  
66 ATscale.(12, 13) ATScale focuses on five priority APs which include: glasses, hearing aids,  
67 wheelchairs, prosthetics, and smart personal digital assistants and tablets with accessible  
68 software/applications.(12)

69 The WHO International Classification of Functioning, Disability and Health (ICF) (**Figure 1**)  
70 identifies that people may have an impairment as a result of a health condition, which can  
71 lead to activity difficulties and participation restrictions. This relationship is mediated by  
72 personal factors, such as education, and environmental factors, such as AT, which can  
73 enhance participation among people with impairments (**Web appendix Table 1**).(14, 15) AT  
74 is typically considered an ICF environmental factor. However, determining an individual's  
75 *need* for AT requires understanding of the impairment as well as activities, participation and  
76 personal and environmental factors, as illustrated in **Figure 1**. AT need is therefore complex  
77 to assess and particularly within population-based surveys which require standardised  
78 measurement approaches completed within time and resources constraints. Different  
79 approaches have been used which often define, conceptualise and measure impairment, AT  
80 and functioning in different ways.

81 This paper, which is adapted from the authors' broader WHO GReAT Consultation 2019  
82 conference paper on AT assessment in population surveys(16), uses an ICF lens to consider  
83 two different approaches used in population-based surveys to assess AP need: i) self-report  
84 and ii) clinical impairment assessment. The first method involves the participant's own  
85 assessment of their functional limitations (usually assessed by self-reported activity  
86 limitations) and associated need for AT. This method is typically quick to administer, lower

87 cost and considers individuals' reported need in their own environment. The second adopts  
88 standardised clinical methods to assess the presence of impairment followed by a clinician's  
89 assessment of AT needs based on type, cause and severity of the impairment. The  
90 impairment approach can provide more reliable data for planning of related health services,  
91 but is more resource intensive. There are therefore advantages and disadvantages of these  
92 approaches (**Table 1**). There is little evidence on the relationship between the AP data  
93 generated by these two approaches, although it would help to improve survey methodology  
94 to collect much-needed data on population-based AP need.

95 In this paper, we undertake a secondary analysis of data from two population-based  
96 disability surveys conducted in one district each of Cameroon and India(17, 18), in order to:

- 97 1. Estimate use, unmet need and coverage for three ATScale priority APs assessed:  
98 distance glasses, hearing aids and wheelchairs.
- 99 2. Explore the relationship between participant self-report and clinical impairment  
100 methods for assessing AP need within population surveys.

101

## 102 **METHODS**

103 Population surveys in one district each in India and Cameroon were conducted in 2013-  
104 14.(17-25) In India, the study was conducted in the Mahabubnagar District, Telangana State,  
105 India, where the majority (85%) of the population live in rural areas and approximately 48%  
106 are literate.(25) In Cameroon, the study was undertaken in Fundong Health District in the  
107 North-West region, a predominately rural (63% of the region) mountainous area and one of  
108 two English-speaking regions in the country.(25) Details of survey findings on disability and  
109 impairment prevalence are published elsewhere: In summary, in India and Cameroon  
110 respectively, overall prevalence of disability was estimated to be 10.5% (95% CI 9.4-11.7)  
111 and 8.4% (95% CI 7.5-9.4); moderate/severe vision impairment (VI) 3.5% (95% CI 2.7-4.4)  
112 and 2.3% (95% CI 1.8-3.0); moderate/severe hearing impairment (HI) 4.4% (95% CI 3.7-5.2)  
113 and 3.6% (95% CI 2.8-4.6), and moderate/severe musculoskeletal impairment (MSI) 3.5%  
114 (95% CI 2.9-4.3) and 3.4% (95% CI 2.7-4.4).(17-24)

115 Two stage cluster-sampling with probability proportionate to size and compact segment  
116 sampling were used to identify approximately 4,000 participants per setting using 2011 and  
117 2005 census data for the sampling frame from India and Cameroon respectively. Data was  
118 collected as part of a wider survey of disability which was powered to detect an all-age  
119 prevalence of disability of 4%. This required a sample of 4,056 per country, assuming  
120 precision of 20%, 95% confidence, a design effect of 1.4 and 20% non-response.

121 Participants were interviewed using the 21-item Washington Group (WG) extended set (ES,  
122 ages >17 years), and the 23-item Child Functioning Module (CFM, for ages 2-17).(26-30)  
123 These tools ask about limitations in different functional domains using a four-point response  
124 scale: no difficulty, some difficulty, a lot of difficulty and cannot do. All participants also  
125 underwent standardised clinical assessment for VI, HI and MSI using Rapid Assessment of  
126 MSI (RAM).(31) Participants with visual acuity (VA)<6/18 (moderate VI) in Cameroon or  
127 VA<6/12 in India (mild VI) which improved to 6/18 or 6/12 in India and Cameroon  
128 respectively with pinhole were classified as having uncorrected refractive error (URE) and

129 needing distance glasses. Participants identified as having HI or MSI were examined by  
130 relevant clinicians to determine cause and associated referral/AT needs, including need for  
131 hearing aids and wheelchairs (**Table 2**).

132 People were defined as having a disability if they had a moderate or more severe  
133 impairment (definitions in **Table 2**) and/or reported “a lot of difficulty” or more with core  
134 domains of the WG questions. They were asked about their self-reported need for and use  
135 of different APs including glasses and hearing aids.

136

137 We used STATA 15.0 to analyse the data. The ‘svy’ command was used to derive proportion  
138 estimates accounting for cluster sampling. The definitions for AP use, unmet need, total  
139 need and coverage according to clinical impairment assessment are listed in **Table 3**.

140 Estimates of ‘total need’ for distance glasses and hearing aids were stratified by age and sex.  
141 This was not possible for wheelchairs because of the low numbers. We compared self-  
142 reported AP need to that identified through clinical impairment assessment making the  
143 assumption that clinical assessment provides more reliable data (**Table 3**).

#### 144 **Ethical considerations**

145 Ethical Approval for the study, including this secondary analysis, was granted by: The  
146 London School of Hygiene & Tropical Medicine (UK); National Ethics Committee for  
147 Research in Human Health (CNERSH, Cameroon); Cameroon Baptist Convention Health  
148 Board Institutional Review Board (Cameroon); Indian Institute of Public Health Hyderabad  
149 Institutional Ethics Committee (India); Government of India Health Ministry Screening  
150 Committee (India). Written (signature or thumb print) informed consent was obtained from  
151 all participants. Caregivers provided consent for participants aged <18 in India and <21 in  
152 Cameroon.

#### 153 **RESULTS**

154 In India, 4,125 people were enumerated and 3574 participants were screened and assessed  
155 for distance glasses, hearing aids and wheelchairs (response rate 88%). Of those who did not  
156 participate, 540 (13.1%) were unavailable and 11 (0.3%) refused. In Cameroon, 4,080 people  
157 were enumerated and 3567 participants were screened and assessed for the three APs  
158 (response rate 87%). Of those who did not participate, 521 (12.7%) were unavailable and 17  
159 (0.5%) refused.

#### 160 **Objective 1: Estimated population AP use, unmet need and coverage**

161 **Table 4** presents estimated use, unmet need, total need and coverage of each AP in the two  
162 settings derived from clinical impairment assessment. In accordance with the original survey  
163 method these estimates are based on AP need for people with moderate or worse vision,  
164 hearing and musculoskeletal impairments. The exception is in India, which also assessed  
165 need for distance glasses for mild or worse VI.

#### 166 *Distance glasses*

167 In India the prevalence of distance glasses use was 3.2% (95% CI 2.4-4.3, n=114), while this  
168 was lower in Cameroon at 0.3% (95% CI 0.2-0.5, n=10). The prevalence of glasses need  
169 based on moderate VI was 3.7% (95% CI 2.8-4.7, n=131) in India and 0.8% (95% CI 0.5-1.1,  
170 n=27) in Cameroon. The prevalence of unmet glasses need based on moderate VI was 0.5%

171 in both settings (n=17; 95% CI 0.3-0.9 India, 95% CI 0.3-0.8 Cameroon). In India, need for  
172 people with mild vision loss or worse was 7.2% (95% CI 6.2-8.5, n=259) and unmet need was  
173 4.1% (95% CI 3.2-5.1, n=141). There was high coverage of glasses (for vision loss of  
174 moderate/worse) in India (87%, 95% CI 77.1-93.0), but was lower (37%, 95% CI 20.3-57.5) in  
175 Cameroon. In India including people with mild vision loss in India, coverage was 44% (95% CI  
176 34.1-54.2).

#### 177 *Hearing aids*

178 Hearing aid use was low in both India (0.1%, 95% CI 0.1-0.3, n=5) and Cameroon (0.1%, 95%  
179 CI 0.03-0.3, n=3). The prevalence of need for hearing aids was 3.1% (95% CI 2.4-4.1, n=112)  
180 in India and 1.2% (95% CI 0.9-1.6, n=43) in Cameroon, while unmet need was 3.0% (95% CI  
181 2.2-4.0, n=107) in India and 1.1% (95% CI 0.8-1.5, n=40) in Cameroon. Coverage was low in  
182 both settings: 4.5% (95% CI 1.8-10.6) in India and 7% (95% CI 2.2-20.3) in Cameroon.

#### 183 *Wheelchairs*

184 Only one participant in India and none in Cameroon used a wheelchair. Wheelchair need  
185 was also low; with two participants in India (0.1%, 95% CI 0.01-0.2) and four in Cameroon  
186 (0.1%, 95% CI 0.04-0.3) identified as needing a wheelchair. Coverage was therefore 33.3%  
187 (95% CI 0.1-99.7) in India and 0% in Cameroon.

#### 188 *Need across the three APs*

189 In total, 119 people (3.3%, 95% CI 2.5- 4.3) used at least one of the three devices in India  
190 and 13 (0.4%, 95% CI 0.2-0.6) in Cameroon. Based on moderate/worse impairment, the  
191 number who needed at least one of the three APs was 234 (6.5%, 95% CI 5.4-7.9) and 69  
192 (1.9, 95% CI 1.5-2.5) in India and Cameroon respectively, and this total need increased in  
193 India to 334 (9.3%, 95% CI 8.0-10.9) if mild VI was included. Based on moderate/worse  
194 impairment, the number who had unmet need for at least one device was 124 (3.5%, 95% CI  
195 2.7-4.5) in India and 57 (1.6%, 95% CI 1.2-2.1) in Cameroon. Extending the criteria to include  
196 people with mild VI in India (VA<6/12) increased unmet need to 224 (6.3%, 95% CI 5.1-7.7).  
197 Overall coverage of at least one AP was moderate in India (50.9%, 95% CI 41.5-60.2),  
198 decreasing if mild VI was included (35.6%, 95% CI 27.7-44.4), and low in Cameroon (18.8%,  
199 95% CI 11.1-30.2).

#### 200 *Total need for distance glasses and hearing aids by age and gender*

201 The need for distance glasses and hearing aids increased significantly with age (p<0.001)  
202 (**Table 5**) so that 8.2% (95% CI 5.7-11.7) and 4.4% (95% CI 2.8-6.8) of adults aged over 60  
203 needed glasses and 20.7% (95% CI 15.9-26.6) and 7.7% (95% CI 5.5-10.7) needed hearing  
204 aids in India and Cameroon respectively. In India the need for distance glasses (mod VI) was  
205 significantly higher among women (4.7%, 95% CI 3.5-6.2) compared to men (2.6%, 95% CI  
206 1.8-3.7, p<0.01).

#### 207 *Unmet need for distance glasses and hearing aids by age and gender*

208 The unmet need for distance glasses and hearing aids increased significantly with age  
209 (p<0.001) (**Table 5**) so that 2.0% (95% CI 0.9-4.5) and 3.1% (95% CI 1.8-5.2) of adults aged  
210 over 60 needed glasses and 20.7% (95% CI 15.9-26.6) and 7.7% (95% CI 5.5-10.7) needed  
211 hearing aids in India and Cameroon respectively. There was no significant difference in  
212 unmet need by gender.

213

## 214 **Objective 2: Relationship between AP need measurement approaches**

215 Figures 2 and 3 present findings on the relationship between the two different approaches  
216 for assessing distance glasses and hearing aids need.

### 217 *Self-reported need for distance glasses among people with URE (VA<6/18)*

218 In India, of the 10 people with URE (VA<6/18), 6 (60%) reported they did not need distance  
219 glasses (see **Figure 2A1**). In Cameroon, of the 15 people with URE, 6 (40%) reported not  
220 needing distance glasses (see **Figure 2A2**).

221 In India, of the 60 people who self-reported needing distance glasses, 15 (25%) actually  
222 needed distance glasses based on clinical impairment assessment, while 28 (47%) needed  
223 cataract surgery and 17 (28%) didn't have a VI according to the study definition (see **Figure**  
224 **2B1**). In Cameroon, of the 69 people who self-reported needing distance glasses, 6 (9%)  
225 actually needed distance glasses based on clinical assessment, 14 (20%) needed cataract  
226 surgery, 14 (20%) had other eye conditions (e.g. posterior segment disease) and 45 (51%)  
227 didn't have moderate or worse VI. (see **Figure 2B2**).

### 228 *Self-reported need for hearing aids among people who were clinically assessed*

229 In India, of the 102 people who were clinically assessed to need hearing aids, 4 (4%) use one,  
230 62 (61%) reported needing one, 26 (26%) reported not needing one and 10 (10%) reported  
231 not knowing what it was (see **Figure 3A1**). In Cameroon, of the 38 people who were clinically  
232 assessed to need hearing aids, 18 (47%) reported needing one, 9 (24%) reported not needing  
233 one and 11 (29%) reported not knowing what it was (see **Figure 3A2**).

234 In India, of the 90 people who self-reported needing hearing aids, 62 (69%) actually needed  
235 hearing aids based on clinical assessment and 28 (31%) did not (see **Figure 3B1**). In Cameroon,  
236 of the 54 people who self-reported needing hearing aids, 18 (33%) actually needed hearing  
237 aids based on clinical assessment and 36 (66%) did not (see **Figure 3B2**).

## 238 **DISCUSSION**

### 239 **Estimated population AP use, unmet need and coverage**

240 This study, using data from population-based surveys based on clinical impairment  
241 assessment, found evidence of relatively high need and low coverage of three priority APs  
242 (distance glasses, hearing aids and wheelchairs) in India and Cameroon. In total, based on  
243 impairments of moderate or worse severity, 6.5% (95% CI 5.4-7.9) and 1.9% (95% CI 1.5-2.5)  
244 of the population needed at least one of the three APs in India and Cameroon, respectively.  
245 This prevalence increased in India to 9.3% (95% CI 8.0-10.9) if mild VI was included. Total  
246 need was highest for distance glasses and hearing aids and considerably lower for  
247 wheelchairs. Total need and unmet need for glasses and hearing aids increased rapidly with  
248 age in both settings, and in India total need was significantly higher among females  
249 compared to males for distance glasses (mod VI).

250 The total need was low for wheelchairs in both settings (0.1%; 95% CI 0.03-0.3 India, 95% CI  
251 0.04-0.3 Cameroon). Our estimates were lower than estimates from Canada and United  
252 States (between 0.6%-0.8%)(32) which may reflect differences in environmental factors; for



253 instance, the study area in Cameroon was largely rural and hilly and uneven terrain was  
254 common so wheelchairs might not have been considered by the clinicians, while other  
255 mobility devices (e.g. walking devices) might have been considered more appropriate.  
256 Differences in the age distributions of populations or availability of services are other likely  
257 explanations. The lower estimates have implications for survey sample size calculations  
258 when estimating AP need associated with mobility and also emphasises the need to further  
259 develop tools to improve and standardise the complexities of mobility impairment and AP  
260 assessment which is generally more complex compared to hearing and vision.

261 AP coverage was relatively low with less than 40% of people who needed distance glasses,  
262 hearing aids or wheelchairs actually using them. This aligns with previous assertions that  
263 many people in need of AP in LMICs do not have access to them(9, 10) and highlights the  
264 urgent need to scale up AP service provision and access. The exception was the high  
265 coverage of distance glasses in India (87%, 95% CI 77.1-93.0) which may reflect availability  
266 and access to eye care services in this setting; however, it is noted a study in the same  
267 region at a similar time reported lower spectacle coverage (38%).(33)

268 There are limited studies available for comparison, emphasising the AT data gap. While  
269 population-based clinical impairment studies provide estimates of impairment type, cause  
270 and severity, many do not explicitly measure or present specific AP need. Other studies of  
271 population level AP need estimates only use self-reported AP methodology, limiting  
272 comparison with our findings such as Pryor et al.'s study in two districts in Bangladesh using  
273 WHO GATE's rapid assistive technology assessment (rATA).(34)

#### 274 **Relationship between AP need measurement approaches**

275 We compared findings of self-reported AP need to clinical impairment assessment.

276 Advantages of the self-report approach include that it is rapid, lower cost, and is based on a  
277 person's reported functioning in his/her own environment. Though self-report may indicate  
278 a need for clinical care, our findings suggest self-report may give an unreliable estimate of  
279 AP need. A key concern is that people were over-reporting their need for AP when they  
280 actually required curative treatments, such as cataract surgery or the removal of impacted  
281 ear wax(24), or had other conditions/impairments that would not benefit from the AP. On  
282 the other hand, under-estimations of need also occurred due to low awareness of having an  
283 impairment and of knowledge about the AP. For instance, in Cameroon, 29% of people  
284 needing a hearing aid were unaware of what one was. For other less common devices, such  
285 as gesture to voice technology, AP awareness is likely to be even lower.

286 This study used clinical impairment assessment as the 'gold standard' method of assessment  
287 for AP to compare self-reported AP need. However, this approach also has limitations. It is  
288 more expensive and requires personnel that may be limited in number. Most importantly,  
289 need is classified only on the basis of 'impairment' and doesn't take into account  
290 participants' activities, participation and contextual factors which can be key in determining  
291 their AP requirements.(25) People with the same impairment may have different AP needs  
292 which may explain some of the discrepancy between the two measures. For example, a

293 person's need for glasses may be different in a rural agricultural setting versus urban so  
294 even if he/she has a clinical 'need,' he/she may not have a perceived need.

### 295 **Gaps and opportunities for AP need measurement approaches**

296 This study has highlighted some key gaps and opportunities in methods of population level  
297 assessment of AP for improvement.

298 First, a limitation of both approaches is an absence of comprehensive clinical functional  
299 assessment which provides holistic overview of individuals' abilities and daily living skills  
300 important for determining the extent to which they may benefit from AP in their contexts.  
301 This approach usually assesses factors related to individuals' physical, sensory, cognitive and  
302 psychosocial functioning, and support available. Functional assessments are commonly used  
303 by rehabilitation professionals and can use a variety of approaches, including indirect,  
304 observational, and experimental/functional analysis procedures to determine treatment  
305 plans, follow up services and AP need. However, most existing functional assessment tools  
306 are time intensive and primarily designed for use at individual level, and few exist for  
307 population-level measurement in LMIC settings. Of the limited number of population-based  
308 assessments, most are disability tools that either measure self-reported functioning and AP  
309 need only or do not assess AP need. For example, the WHO Disability Assessment Schedule  
310 2.0 (WHODAS 2) and WHO Model Disability Survey (MDS) ask functioning questions across  
311 multiple domains, however the former does not collect data on AP need and the latter only  
312 assesses AP need through self-report.

313 There is therefore a gap in multi-domain clinical functional assessment methodology for use  
314 in population-based surveys. Future research is needed to develop and test tools to ensure  
315 the essential integration of *all* ICF components and that a standardised approach to clinical  
316 reasoning for determining service and AP need is used within the context of population-  
317 based surveys (e.g. unilateral versus bilateral impairments and assessment of each service  
318 and AP). Within this, research could explore capturing clinicians' clinical reasoning and  
319 analysis through using decision trees following an algorithm.(35)

320 Secondly, this study only presented data on three APs, however there are 50 priority APs  
321 included in the WHO GATE priority assistive product list (APL).(1) In the vision domain for  
322 example, it is possible that some participants without visual impairment (according to  
323 distance VA assessment) who self-reported distance glasses need may have been  
324 experiencing difficulty with near vision, contrast sensitivity or other low vision impairments  
325 not assessed by VA assessment alone and could have benefitted from other AP, such as  
326 short distance, filter and protection, or low vision glasses.(1) Further work is required to  
327 determine if additional clinical assessments to identify specific referral service and AP needs  
328 would be beneficial to include.

329 Thirdly, in this study, AP need was assessed only for people with moderate or worse  
330 impairments (with the exception of vision for India) and based on bilateral (not unilateral)  
331 vision and hearing loss. As people with milder impairments may also benefit from AP this is  
332 likely to have resulted in underestimates of need. This was evident in the India survey where  
333 including milder cases of VI (VA<6/12) increased the prevalence of need to 4.1% (95% CI 3.2-

334 5.1) compared to only 0.5% (95% CI 0.3-0.9) for moderate VI (VA<6/18). There is a need for  
335 further research to identify appropriate cut-off impairment severity for determining AP  
336 need. It is important to recognise that people who might benefit from AP and related  
337 services includes, but is not limited to, people with disabilities.

338 Fourthly, the all-age AP prevalence estimates were low among children, and it is noted that  
339 the WG CFM is only for children aged 2-17. Although the prevalence is low, long term  
340 impact is potentially great so therefore there is a need to explore additional measurement  
341 tools and other methods to collect data on this age group.

342 Finally, there is also a need to develop standardised AP definitions with pictorial aids to  
343 ensure more consistent AP data collection within and across settings.(1, 36, 37) Alongside  
344 APs, it is also essential to define and collect data on related services, such as rehabilitation,  
345 so prevalence data can be used for planning AT.

#### 346 **Study strengths and limitations**

347 In terms of strengths, the surveys were population-based, included all ages and used  
348 standardised clinical impairment assessment procedures. The inclusion of self-reported AP  
349 need enabled comparisons between two approaches for three priority APs. However, there  
350 were also limitations. Firstly, the surveys were not initially designed or powered statistically  
351 to assess AP need and to compare AP measurement approaches. The sample size for overall  
352 estimates of AP need is adequate for at least one of the three APs in India, but  
353 underpowered in Cameroon and for estimates for individual APs. The relatively wide  
354 confidence intervals should be noted and some caution in interpretation is warranted, while  
355 also acknowledging that this study provides some data to inform adequate power future  
356 studies. Secondly, with the exception of VA in India's, the surveys did not assess for mild  
357 impairments, limiting comparison of AP need by impairment severity in the three domains.  
358 Further only presenting, and not uncorrected, visual acuity was assessed. Additionally, this  
359 study did not fully explore the reasons for self-reporting not needing AP, such as if  
360 age/severity were reasons, and only focused upon the three ATScale priority APs that were  
361 assessed. Finally, a lack of standardised AP definitions were used in data collection and it is  
362 important to note that the met need for the three APs is temporary given further services  
363 would still be needed for these individuals for training, follow up, maintenance and repair.

#### 364 **CONCLUSIONS AND RECOMMENDATIONS**

365 This study highlighted the high need and low coverage of three APs in two LMIC settings, as  
366 well as limitations in methodology used to assess AP need. There is an urgent need to build  
367 up the AP evidence base, and this will require the development of ICF-compatible tools to  
368 estimate the population-level AP need, unmet need and coverage, alongside estimating the  
369 need for essential related services. Such a tool would help to generate data that are  
370 comparable between settings and over time in order to inform evidence-based policy  
371 making and planning of appropriate services, and support national and global programmes  
372 during this SDG era to scale up AT provision as we progress towards 2030.

373 **Acknowledgements**

374 The authors are grateful to the project teams and the participants who contributed to these  
375 surveys. This paper is adapted from the authors' broader WHO GReAT Consultation  
376 conference paper "Estimating assistive technology need through population-based surveys:  
377 An analysis of data from Cameroon and India" with permission for republication and  
378 copyright held by the journal. The conference paper was presented on 22 August 2019 and  
379 published in Layton N, Borg J, Ed. "Global perspectives on assistive technology: proceedings  
380 of the GReAT Consultation, Volume A." (16) The survey study was funded by CBM  
381 International, and this secondary analysis was funded by the Department for International  
382 Develop (DFID) through the AT2030 programme.

383 **Declarations of Interest**

384 None to declare.

385 **REFERENCES**

- 386 1. World Health Organization. Priority assistive products list. Geneva: WHO. 2016.
- 387 2. World Health Organization. Assistive technology factsheet: WHO; May 2018 [cited  
388 2020 27 April]. Available from: [http://www.who.int/news-room/fact-sheets/detail/assistive-](http://www.who.int/news-room/fact-sheets/detail/assistive-technology)  
389 [technology](http://www.who.int/news-room/fact-sheets/detail/assistive-technology).
- 390 3. Falvey JR, Ferrante LE. Flattening the disability curve: Rehabilitation and recovery  
391 after COVID-19 infection. Heart & Lung: The Journal of Cardiopulmonary and Acute Care.  
392 2020.
- 393 4. Pan American Health Organization (PAHO). Rehabilitation considerations during the  
394 COVID-19 outbreak. Washington, DC: PAHO, 2020.
- 395 5. United Nations. Transforming our world: the 2030 Agenda for Sustainable  
396 Development. Geneva: United Nations General Assembly, 2015.
- 397 6. United Nations. Convention on the Rights of Persons with Disabilities (CRPD) New  
398 York: UN; [cited 2020 27 April]. Available from:  
399 [https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-](https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html)  
400 [with-disabilities.html](https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html).
- 401 7. Borg J, Lindström A, Larsson S. Assistive technology in developing countries: national  
402 and international responsibilities to implement the Convention on the Rights of Persons  
403 with Disabilities. The Lancet. 2009;374(9704):1863-5.
- 404 8. Tebbutt E, Brodmann R, Borg J, MacLachlan M, Khasnabis C, Horvath RJG, et al.  
405 Assistive products and the sustainable development goals (SDGs). 2016;12(1):79.
- 406 9. Matter R, Harniss M, Oderud T, Borg J, Eide AHJD, Technology RA. Assistive  
407 technology in resource-limited environments: A scoping review. 2017;12(2):105-14.
- 408 10. Global Disability Innovation Hub. Assistive technology scoping research executive  
409 summary. London: University College of London, 2018 July 2018. Report No.
- 410 11. World Health Organization. Assistive technology: making Universal Health Coverage  
411 inclusive. Geneva: WHO.
- 412 12. ATscale. ATscale: global partnership for assistive technology [cited 2020 27 April].  
413 Available from: <https://atscale2030.org/>
- 414 13. Global Disability Innovation Hub. AT2030 University College London [cited 2020 27  
415 April]. Available from: <https://www.disabilityinnovation.com/at-2030>.
- 416 14. World Health Organization. International classification of functioning, disability and  
417 health 2001 [27 April 2020]. Available from: [www.who.int/classification/icf/en](http://www.who.int/classification/icf/en).
- 418 15. World Health Organization. World Report on Disability Geneva: World Health  
419 Organization; 2011.
- 420 16. Boggs D, Kuper H, Mactaggart I, Oye J, Murthy G, Polack S. Estimating assistive  
421 technology need through population-based surveys: an analysis of data from Cameroon and  
422 India. In: Layton N, Borg J, editors. Global perspectives on assistive technology: proceedings  
423 of the GReAT Consultation, . Vol. A. Geneva: World Health Organization; 2019. p. 52-78.
- 424 17. Mactaggart I, Kuper H, Murthy G, Oye J, Polack S. Measuring Disability in Population  
425 Based Surveys: The Interrelationship between Clinical Impairments and Reported Functional  
426 Limitations in Cameroon and India. PLoS One. 2016;11(10):e0164470.
- 427 18. Mactaggart I, Kuper H, Murthy G, Sagar J, Oye J, Polack S. Assessing health and  
428 rehabilitation needs of people with disabilities in Cameroon and India. Disability and  
429 rehabilitation. 2015:1-8.

- 430 19. Mactaggart I, Polack S, Murthy G, Kuper HJOe. A population-based survey of visual  
431 impairment and its correlates in Mahabubnagar district, Telangana State, India.  
432 2018;25(3):238-45.
- 433 20. Smythe T, Mactaggart I, Kuper H, Murthy G, Lavy C, Polack S, et al. Prevalence and  
434 causes of musculoskeletal impairment in Mahabubnagar District, Telangana State, India:  
435 results of a population-based survey. J Transactions of The Royal Society of Tropical  
436 Medicine PLOS One. 2017;111(11):512-9.
- 437 21. Smythe T, Mactaggart I, Kuper H, Oye J, Sieyen NC, Lavy C, et al. Prevalence and  
438 causes of musculoskeletal impairment in Fundong District, North-West Cameroon: results of  
439 a population-based survey. J Tropical medicine international health PloS one.  
440 2017;22(11):1385-93.
- 441 22. Oye J, Mactaggart I, Polack S, Schmidt E, Tamo V, Okwen M, et al. Prevalence and  
442 Causes of Visual Impairment in Fundong District, North West Cameroon: Results of a  
443 Population-Based Survey. 2017;24(6):394-400.
- 444 23. Bright T, Mactaggart I, Kuper H, Murthy G, Polack SJE, hearing. Prevalence of Hearing  
445 Impairment in Mahabubnagar District, Telangana State, India. 2019;40(1):204-12.
- 446 24. Ferrite S, Mactaggart I, Kuper H, Oye J, Polack S. Prevalence and causes of hearing  
447 impairment in Fundong Health District, North-West Cameroon. Tropical medicine &  
448 international health. 2017.
- 449 25. Zuurmond M, Mactaggart I, Kannuri N, Murthy G, Oye JE, Polack S. Barriers and  
450 Facilitators to Accessing Health Services: A Qualitative Study Amongst People with  
451 Disabilities in Cameroon and India. International journal of environmental research public  
452 health. 2019;16(7):1126.
- 453 26. Washington Group on Disability Statistics Secretariat. Washington Group on  
454 Disability Statistics Hyattsville, MD: National Center for Health Statistics; 2019 [cited 2020 27  
455 April]. Available from: <http://www.washingtongroup-disability.com/>.
- 456 27. UNICEF. UNICEF/ Washington Group on Disability Statistics Module on Child  
457 Functioning Concept Note. Available from: [https://data.unicef.org/wp-](https://data.unicef.org/wp-content/uploads/2017/03/UNICEF-WG-Module-on-Child-Functioning-Concept-Note.pdf)  
458 [content/uploads/2017/03/UNICEF-WG-Module-on-Child-Functioning-Concept-Note.pdf](https://data.unicef.org/wp-content/uploads/2017/03/UNICEF-WG-Module-on-Child-Functioning-Concept-Note.pdf):  
459 2016.
- 460 28. Washington Group on Disability Statistics. Development of Disability Measures for  
461 Surveys: The Extended Set on Functioning. Available From:  
462 [http://www.cdc.gov/nchs/data/washington\\_group/Development\\_of\\_Disability\\_Measures\\_f](http://www.cdc.gov/nchs/data/washington_group/Development_of_Disability_Measures_for_Surveys_The_Extended_Set_on_Functioning.pdf)  
463 [or\\_Surveys\\_The\\_Extended\\_Set\\_on\\_Functioning.pdf](http://www.cdc.gov/nchs/data/washington_group/Development_of_Disability_Measures_for_Surveys_The_Extended_Set_on_Functioning.pdf): 2011.
- 464 29. United Nations Economic and Social Council. Disability Statistics Report of the  
465 Secretary-General and the Washington Group. 2016.
- 466 30. Washington Group on Disability Statistics. Understanding and interpreting disability  
467 as measured using the WG short set of questions. Hyattsville: 2009.
- 468 31. Atijosan O, Kuper H, Rischewski D, Simms V, Lavy C. Musculoskeletal impairment  
469 survey in Rwanda: design of survey tool, survey methodology, and results of the pilot study  
470 (a cross sectional survey). BMC musculoskeletal disorders. 2007;8(1):30.
- 471 32. Smith EM, Giesbrecht EM, Mortenson WB, Miller WC. Prevalence of wheelchair and  
472 scooter use among community-dwelling Canadians. Physical therapy. 2016;96(8):1135-42.
- 473 33. Marmamula S, Khanna RC, Narsaiah S, Shekhar K, Rao GN. Prevalence of spectacles  
474 use in Andhra Pradesh, India: Rapid Assessment of Visual Impairment project. Clinical &  
475 experimental ophthalmology. 2014;42(3):227-34.

- 476 34. Pryor W, Nguyen L, Islam Q, Jalal F, Marella MJJoer, health p. Unmet Needs and Use  
477 of Assistive Products in Two Districts of Bangladesh: Findings from a Household Survey.  
478 2018;15(12):2901.
- 479 35. Bae J-M. The clinical decision analysis using decision tree. J Epidemiology and Health.  
480 2014;36.
- 481 36. World Health Organization, USAID. Standards for Prosthetics and Orthotics: Part 1  
482 Standards; Part 2 Implementation manual. World Health Organization, 2017.
- 483 37. J Borg, Khasnabis C, (Eds.). Guidelines on the provision of manual wheelchairs in less-  
484 resourced settings. Geneva: World Health Organization, 2008.

485

## Tables

**Table 1:** Measuring population-based AT through self-report and clinical impairment assessment: methodology advantages, disadvantages and examples(17,18)

METHOD	ADVANTAGES	DISADVANTAGES	EXAMPLES
<b>Self-report</b>	<p>Simple and rapid.</p> <p>Fewer cost and resources to administer.</p> <p>Doesn't require clinical expertise or equipment.</p> <p>Based on participants' reported need in their own environment.</p> <p>Gathers information on participants' experience and impact.</p>	<p>Risk of underestimate due to low awareness of APs (e.g. hearing frequency modulation system).</p> <p>Risk of overestimate due to poor awareness of underlying cause (e.g. people reporting functional limitations with vision due to cataracts which can be treated by a simple operation).</p> <p>Limited reliability for use planning services and interventions.</p>	<p><u>WHO Model Disability Survey(MDS)</u>: asks people what they do, or do not do, in their daily lives focusing on functioning in multiple domains well-aligned with the ICF and a series of questions regarding domain-specific and participation-specific AT use, need and barriers through self-reported questions using show cards as AT picture prompts.(39,40)</p> <p><u>WHO GATE's rapid Assistive Technology Assessment (rATA)</u>: measures AP need and unmet need using adapted Washington Group Short Set as initial screening and AT images alongside each.(34)</p>
<b>Clinical impairment assessment</b>	<p>Impairment type, severity and causality assessed (e.g. assessing the need for cataract surgery or wax impaction for hearing).</p> <p>Reliable impairment estimates.</p>	<p>Costly.</p> <p>Time and resource intensive, often requiring presence of clinician.</p> <p>Only focuses on one ICF component, providing a more limited medical view of disability.</p> <p>Lacks broader functioning assessment with consideration of personal or environmental factors.</p>	<p><u>Standardised population-based assessment methods for examining the presence of impairment.</u></p> <ul style="list-style-type: none"> <li>• <i>Vision</i>: visual acuity (VA).</li> <li>• <i>Hearing</i>: pure tone audiometry.</li> <li>• <i>Mobility</i>: comprehensive clinical examination.</li> </ul>



**Table 2:** Clinical impairment assessment methods for vision, hearing and musculoskeletal impairments and related assistive product assessment methods.

IMPAIRMENT	CLINICAL ASSESSMENT METHODS	MODERATE IMPAIRMENT DEFINITION	ASSISTIVE PRODUCT NEED ASSESSMENT
Vision	<p>1. Presenting visual acuity (VA) assessed using a tumbling E-chart.</p> <p>2. Pinhole vision assessed for people with vision impairment (VI) to identify uncorrected refractive error (URE) and therefore need for distance glasses.</p> <ul style="list-style-type: none"> <li>• India: VI defined as VA&lt;6/12 ('mild' VI) in either eye.</li> <li>• Cameroon: VI defined as VA&lt;6/18 ('moderate' VI) in either eye.</li> </ul> <p>3. Participants with vision loss not due to URE underwent examination with an ophthalmoscope by an ophthalmologist/ophthalmic nurse to determine the cause.</p>	Participants with presenting visual acuity (VA) <6/18 in the better eye.	<u>Distance glasses</u> : URE indicating VA improved with pinhole to 6/18 or 6/12 for VA<6/18 ('moderate' VI) and VA<6/12 ('mild' VI) in India only respectively.
Hearing	<p>1. All participants screened using Otoacoustic Emissions Testing.</p> <p>2. Participants ages <math>\geq 4</math> years old who failed this underwent Pure Tone Audiometry at 0.5, 1, 2, and 4 kHz to assess for presence and severity of hearing loss (HL).</p> <p>3. Participants with disabling HL (using WHO's definition of disabling hearing impairment &gt;31dB HL for children 4 to 17 years of age and &gt;41dB HL for adults <math>\geq 18</math> years of age) in the better ear underwent examination by ENT specialist using an otoscope to assess cause and service/intervention needs, including hearing aids.</p>	Participants with >31dB Hearing loss (HL) for children 4 to 17 years of age and >41dB HL for adults $\geq 18$ years of age.	<u>Hearing aid</u> : clinician assessed based on cause, severity and diagnosis.
Musculoskeletal (MSI)	1. Participants were asked six validated screening questions from the Rapid Assessment of MSI (RAM).(31)	Participants determined to have moderate impairment	<u>Wheelchair</u> : clinician assessed based on cause, severity and diagnosis.

2. Anyone who screened positive underwent a standardized examination by a physiotherapist using the RAM to assess presence, severity, cause, diagnosis and need for services and APs, including wheelchairs. The RAM includes head and neck, upper limb, lower limb and pelvis, trunk and spine assessment.

assessed using  
RAM.(31)

**Table 3:** Definitions of proportions for measuring population-based assistive product (AP) use, unmet need, total need and coverage and comparing self-report and clinical impairment assessment AP need measurement approaches

STATISTIC	DEFINITION
<b>AP proportions through clinical impairment assessment</b>	
<b>Use</b>	Proportion of the study population who were using the AP.
<b>Unmet need</b>	Proportion identified in the study population as needing, but not using, AP.
<b>Total need</b>	Proportion identified in the study population as using and/or needing the AP.
<b>Coverage</b>	Proportion of people who actually use the AP by the total number of people who need the AP, calculated as 'use' divided by 'total need'.
<b>AP need proportions exploring the relationship between self-report and clinical impairment assessment</b>	
	1. Proportion of people identified as needing an AP through clinical impairment assessment (e.g. distance glasses) who reported 'no difficulty' with functioning using the WG questions in the corresponding domain (e.g. vision). This was to assess how many people who could benefit from an AP would be captured through using self-report of functional difficulty alone (i.e. no clinical assessment).
	2. Proportion of people identified as needing distance glasses or hearing aids through clinical impairment assessment who also self-reported a need for the corresponding AP.
	3. Among people who self-reported needing distance glasses, the distribution of the causes of vision loss identified through clinical impairment assessment.

**Table 4:** Three assistive product use, unmet need, total need and coverage estimates in India and Cameroon

	INDIA				CAMEROON			
	N=3574*				N=3567			
	USES	UNMET NEED	TOTAL NEED	COVERAGE <sup>++</sup>	USES	UNMET NEED	TOTAL NEED	COVERAGE <sup>++</sup>
	N [% (95% CI)]	N [% (95% CI)]	N [% (95% CI)]	(USES/ TOTAL NEED) % (95% CI)	N % (95% CI)	N % (95% CI)	N % (95% CI)	(USES/ TOTAL NEED) % (95% CI)
<b>Glasses &lt;6/12 (mild VI)</b>	114* [3.2 (2.4-4.3)]	145** [4.1 (3.2-5.1)]	259 [7.2 (6.2-8.5)]	44% (34.1-54.2)				
<b>Glasses &lt;6/18 (moderate VI)</b>	114* [3.2 (2.4-4.3)]	17** [0.5 (0.3-0.9)]	131 [3.7 (2.8-4.7)]	87% (77.1-93.0)	10* [0.3 (0.2-0.5)]	17** [0.5 (0.3-0.8)]	27 [0.8 (0.5-1.1)]	37% (20.3-57.5)
<b>Hearing aids</b>	5 [0.1 (0.1-0.3)]	107 [3.0 (2.2-4)]	112 [3.1 (2.4-4.1)]	4.5% (1.8-10.6)	3 [0.1 (0.03-0.3)]	40 [1.1 (0.8-1.5)]	43 [1.2 (0.9-1.6)]	7% (2.2-20.3)
<b>Wheelchairs</b>	1 [0.03 (0.004-0.2)]	2 [0.1 (0.01-0.2)]	3 [0.1 (0.03-0.3)]	33.3% (0.1-99.7)	0 [0]	4 [0.1 (0.04-0.3)]	4 [0.1 (0.04-0.3)]	0% [0]
<b>TOTAL 3 APs (moderate VI)</b>	119 [3.3 (2.5-4.3)]	124 [3.5 (2.7-4.5)]	234 [6.5 (5.4-7.9)]	50.9% (41.5-60.2)	13 [0.4 (0.2-0.6)]	57 [1.6 (1.2-2.1)]	69 [1.9 (1.5-2.5)]	18.8% (11.1-30.2)
<b>TOTAL 3 APs (mild VI)</b>	119 [3.3 (2.5-4.3)]	224 [6.3 (5.1-7.7)]	334 [9.3 (8.0-10.9)]	35.6% (27.7-44.4)				

Abbreviations: VI=vision impairment, CI=confidence interval; \* Data from one participant is missing; \*\* Coverage is defined as (uses/total need)%, for example the coverage of glasses <6/12 (mild VI) in India is calculated as (114/259)x100 which is 44%. \* Reports wearing glasses (and no refractive error); \*\* Uncorrected refractive error is case definition for the unmet need for glasses.

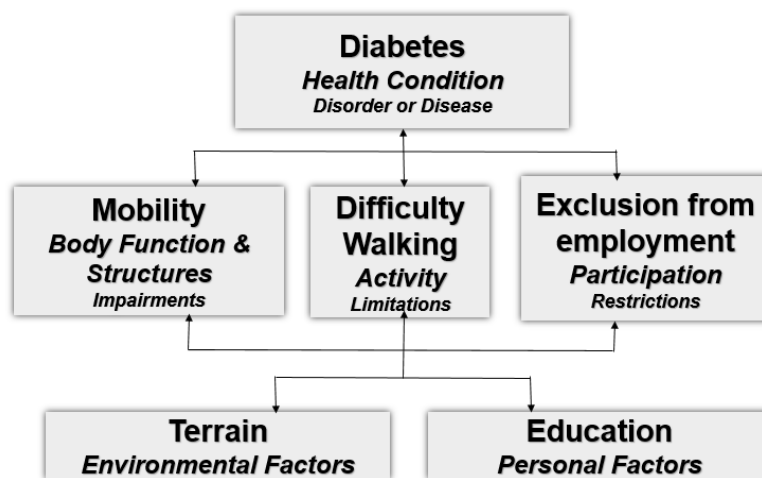
**Table 5:** Distance glasses <6/18 (moderate VI) and hearing aids total need and unmet need stratification by age and gender in India and Cameroon

	DISTANCE GLASSES				HEARING AIDS			
	INDIA		CAMEROON		INDIA		CAMEROON	
	Total need N % (95% CI)	Unmet need N % (95% CI)	Total need N % (95% CI)	Unmet need N % (95% CI)	Total need N % (95% CI)	Unmet need N % (95% CI)	Total need N % (95% CI)	Unmet need N % (95% CI)
<b>TOTAL</b>	131 3.7 (2.8-4.7)	17* 0.5 (0.3-0.9)	27 0.8 (0.5-1.1)	17* [0.5 (0.3-0.8)]	112 3.1 (2.4-4.1)	107 3.0 (2.2-4.0)	43 1.2 (0.9-1.6)	40 1.1 (0.8-1.5)
<b>GENDER</b>								
<b>Male</b>	44 2.6 (1.8-3.7)	6 0.4 (0.2-0.8)	13 0.9 (0.5-1.5)	7 0.5 (0.2-1.0)	48 2.8 (2.0-3.9)	47 2.8 (2.0-3.8)	22 1.5 (1.0-2.3)	20 1.4 (0.9-2.1)
<b>Female</b>	87 4.7 (3.5-6.2)	11 0.6 (0.3-1.2)	14 0.7 (0.4-1.1)	10 0.5 (0.3-0.9)	64 3.4 (2.6-4.5)	60 3.2 (2.4-4.3)	21 1.0 (0.6-1.5)	20 0.9 (0.6-1.5)
<b>P-value</b>	<0.01	0.3	0.4	0.975	0.1	0.3	0.2	0.2
<b>AGE GROUPS</b>								
<b>0 to 17 years</b>	12 1.0 (0.4-2.2)	0 [0]	2 0.1 (0.03-0.4)	2 0.1 (0.02-0.4)	5 0.4 (.02-1.0)	2 0.2 (0.04-0.7)	2 0.1 (0.02-0.4)	1 0.05 (0.01-0.4)
<b>18 to &lt;60 years</b>	90 4.5 (3.4-5.6)	10 0.5 (0.2-1.1)	6 0.5 (0.2-1.1)	2 0.1 (0.04-0.7)	34 1.7 (1.1-2.7)	32 1.6 (1.0-2.6)	8 0.7 (0.3-1.3)	6 0.5 (0.2-1.1)
<b>60+ years</b>	29 8.2 (5.7-11.7)	7 2.0 (0.9-4.5)	19 4.4 (2.8-6.8)	13 3.1 (1.8-5.2)	73 20.7 (15.9-26.6)	73 20.7 (15.9-26.6)	33 7.7 (5.5-10.7)	33 7.7 (5.5-10.7)
<b>P-value</b>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Abbreviations: VI=vision impairment, CI=confidence interval; \* Uncorrected refractive error is case definition for the unmet need for glasses.

## Figures

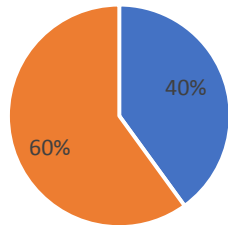
**Figure 1:** Example International Classification of Functioning, Health and Disability diagram for health condition of diabetes(14)



**Figure 2:** Comparing reported versus clinical impairment measurement need for distance glasses

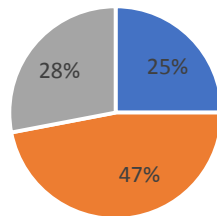
**INDIA**

A1) Cases (moderate vision impairment) who need distance glasses (n=10)



- Reported needing glasses (n=4)
- Reported not needing glasses (n=6)

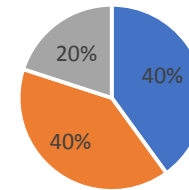
B1) Cases (moderate vision impairment) who reported needing distance glasses (n=60)



- Refractive error (n=15)
- Cataract surgery (n=28)
- No vision impairment (n=17)

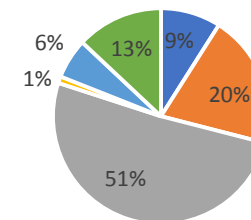
**CAMEROON**

A2) Cases (moderate vision impairment) who need distance glasses (n=15)



- Reported needing glasses (n=6)
- Reported not needing glasses (n=6)
- Reported using glasses (n=3)

B2) Cases (moderate vision impairment) who reported needing distance glasses (n=69)

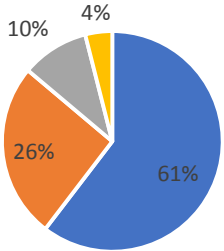


- Refractive error (n=6)
- No vision impairment (n=35)
- Glaucoma (n=4)
- Cataract surgery (n=14)
- Surgical complications (n=1)
- Other post segment/CNS (n=9)

**Figure 3:** Comparing reported versus clinical impairment measurement need for hearing aids

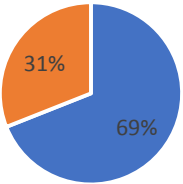
**INDIA**

A1) Cases with hearing impairment who need hearing aids (n=102)



- Reported needing a hearing aid (n=62)
- Reported not needing a hearing aid (n=26)
- Reported not knowing what a hearing aid is (n=10)

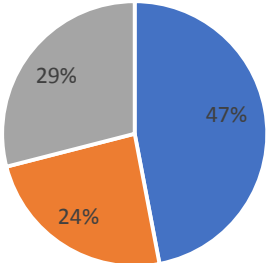
B1) Cases who reported needing a hearing aid (n=90)



- Need a hearing aid (n=62)
- Do not need a hearing aid (n=28)

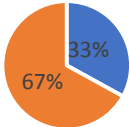
**CAMEROON**

A2) Cases with hearing impairment who need hearing aids (n=38)



- Reported needing a hearing aid (n=18)
- Reported not needing a hearing aid (n=9)
- Reported not knowing what a hearing aid is (n=11)

B2) Cases who reported needing a hearing aid (n=54)



- Need a hearing aid (n=18)
- Do not need a hearing aid (n=36)



## Supplemental web appendix

### Web appendix Table 1: International Classification of Functioning, Health and Disability (ICF) definitions

Definitions for the ICF terms that are used throughout this paper are provided below as defined in WHO and World Bank's *World Report on Disability*.

ICF TERM	DEFINITION
<b>Disability</b>	An umbrella term for impairments, activity limitations, and participation restrictions, denoting the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).(15)
<b>Functioning</b>	An umbrella term in the ICF for body functions, body structures, activities, and participation. It denotes the positive aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).(15)
<b>Impairment</b>	Loss or abnormality in body structure or physiological function (including mental functions), where abnormality means significant variation from established statistical norms.(15)
<b>Activity</b>	The execution of a task or action by an individual. It represents the individual perspective of functioning.
<b>Participation</b>	A person's involvement in a life situation, representing the societal perspective of functioning.(15)
<b>Environmental factors</b>	A component of contextual factors within the ICF, referring to the physical, social, and attitudinal environment in which people live and conduct their lives – for example, products and technology, the natural environment, support and relationships, attitudes, and services, systems, and policies.(15)
<b>Personal factors</b>	A component of contextual factors within the ICF that relate to the individual – for example, age, gender, social status, and life experiences.(15)

## ***5.2 Research paper 4: Estimating need for glasses and hearing aids in The Gambia: results from a national survey and comparison of clinical impairment and self-report assessment approaches***

### **Preamble**

The secondary analysis of Cameroon and India surveys highlighted a need to update and test the impairment assessment methods to estimate AP need for vision and hearing impairments. To address this gap, an AP study was included as part of the National Eye Health survey in The Gambia which took place in February to July 2019. Working with the International Centre for Eye Health colleagues at LSHTM, a collaboration was established with the Sheik Zahid Regional Eye Care Centre in Banjul to conduct a comprehensive National Eye Health survey to estimate the prevalence and causes of vision impairment and risk factors. The survey also included estimates of AP need for glasses (distance and near) and hearing aids, which previously had not been conducted in surveys in the country. Notably, this study only included adults aged 35 years old and above. I led the AP study training and was involved in the field work and data collection with the team.

This paper presents:

- i) a draft methodology for estimating vision and hearing clinical impairments and AP need for glasses (distance and near) and hearing aids, building upon the findings of the earlier work,
- ii) estimates of the prevalence of need and coverage for glasses (distance and near) and hearing aids, and
- iii) a comparison of clinical impairment and self-report assessment approaches providing further rationale for a hybrid functional needs assessment tool.

This paper was published in June 2021 in the International Journal of Environmental Research and Public Health. The manuscript was published under a Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>), and the published manuscript is included in full below.

### 5.2.1 List of Tables

**Table 1:** Overall prevalence of vision and hearing impairment/difficulty with participants 35+ who completed distance vision, near vision and hearing clinical assessments and self-reported difficulty questioning in The Gambia.

**Table 2:** Three assistive devices total need, unmet need, coverage and effective coverage estimates in The Gambia.

**Table 3:** Total need for distance glasses, near glasses, and hearing aids stratified by sex, age, socioeconomic status and urban/rural in The Gambia.

**Table 4:** Self-reported awareness, need and barriers to accessing vision and hearing assistive devices amongst participants who self-reported “some or worse” difficulty in vision and hearing, respectively.

### 5.2.2 List of Figures

**Figure 1:** Comparing reported versus clinical impairment assessment unmet/undermet need for near and/or distance glasses (mild vs. moderate vision impairment (VI)). **(A1):** Participants who could benefit from glasses (distance mild VI and/or near) (n = 4166), **(A2):** Participants who could benefit from glasses (distance moderate VI and/or near) (n = 4246), **(B1):** Participants who reported needing glasses and “some or worse” visual difficulty (n = 1681), **(B2):** Participants who reported needing glasses and “a lot or worse” visual worse difficulty (n = 128).

**Figure 2:** Comparing reported versus clinical impairment assessment unmet/undermet need for hearing aids for both mild and moderate hearing impairment (HI). **(A1):** Participants with mild HI (>25 dB) who could benefit from hearing aids (n = 367), **(A2):** Participants with moderate HI (>40 dB) who could benefit from hearing aids (n = 23), **(B1):** Participants who reported needing a hearing aid with “some or worse” hearing difficulty (n = 17), **(B2):** Participants who reported needing a hearing aid with “a lot or worse” hearing difficulty (n = 3).

### 5.2.3 Supplementary materials

The Supplementary materials referenced in the paper are available at online at <https://www.mdpi.com/article/10.3390/ijerph18126302/s1>

#### 5.2.4 Citation

Boggs, D; Hy dara, A; Faal, Y; Okoh, JA; Olaniyan, SI; Sanneh, H; Ngett, A; Bah, I; Aleser, M; Denis, E; McCormick, I; Bright, T; Bell, S; Kim, M; Foster, A; Kuper, H; Burton, MJ; Mactaggart, I; Polack, S; (2021) *Estimating Need for Glasses and Hearing Aids in The Gambia: Results from a National Survey and Comparison of Clinical Impairment and Self-Report Assessment Approaches*. International Journal of Environmental Research and Public Health, 18 (12). p. 6302. ISSN 1661-7827 DOI: <https://doi.org/10.3390/ijerph18126302>



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms.
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	International Journal of Environmental Research and Public Health		
When was the work published?	June 2021		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	Yes, This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.	Was the work subject to peer review?	Yes

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I co-designed the study, conducted the analysis and drafted the manuscript with supervision input from Sarah Polack, and considered revisions and comments from other authors.
--	--

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022

<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022



Article

# Estimating Need for Glasses and Hearing Aids in The Gambia: Results from a National Survey and Comparison of Clinical Impairment and Self-Report Assessment Approaches

Dorothy Boggs <sup>1,\*</sup>, Abba Hydera <sup>2</sup>, Yaka Faal <sup>3</sup>, John Atta Okoh <sup>2</sup>, Segun Isaac Olaniyan <sup>2</sup>, Haruna Sanneh <sup>2</sup>, Abdoulie Ngett <sup>2</sup>, Isatou Bah <sup>2</sup>, Mildred Aleser <sup>2</sup>, Erima Denis <sup>4</sup>, Ian McCormick <sup>5</sup>, Tess Bright <sup>1</sup>, Suzannah Bell <sup>5</sup>, Minjung Kim <sup>5</sup>, Allen Foster <sup>5</sup>, Hannah Kuper <sup>1</sup>, Matthew J. Burton <sup>5,6</sup>, Islay Mactaggart <sup>1,5</sup> and Sarah Polack <sup>1</sup>

<sup>1</sup> International Centre for Evidence in Disability, London School of Hygiene & Tropical Medicine, London WC1E 7HT, UK; Tess.Bright@lshtm.ac.uk (T.B.); Hannah.kuper@lshtm.ac.uk (H.K.); islay.mactaggart@lshtm.ac.uk (I.M.); Sarah.Polack@lshtm.ac.uk (S.P.)

<sup>2</sup> Sheikh Zayed Regional Eye Care Centre, Kanifing, The Gambia; ahydara@gmail.com (A.H.); okohaj@yahoo.com (J.A.O.); segstar007@gmail.com (S.I.O.); harunatssanneh@yahoo.com (H.S.); ngett10@yahoo.com (A.N.); ndeysatou@yahoo.com (I.B.); msgbireh@yahoo.com (M.A.)

<sup>3</sup> Ear Nose and Throat Unit, Edward Francis Small Teaching Hospital, Banjul, The Gambia; yaka.faal@yahoo.com

<sup>4</sup> Lubaga Hospital, Kampala, Uganda; deni-remas@hotmail.com

<sup>5</sup> International Centre for Eye Health, London School of Hygiene & Tropical Medicine, London WC1E 7HT, UK; Ian.McCormick@lshtm.ac.uk (I.M.); Suzannah.bell@nhs.net (S.B.); Min.Kim@lshtm.ac.uk (M.K.); Allen.Foster@lshtm.ac.uk (A.F.); Matthew.Burton@lshtm.ac.uk (M.J.B.)

<sup>6</sup> National Institute for Health Research Biomedical Research Centre for Ophthalmology at Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology, London EC1V 9EL, UK

\* Correspondence: Dorothy.Boggs@lshtm.ac.uk



**Citation:** Boggs, D.; Hydera, A.; Faal, Y.; Okoh, J.A.; Olaniyan, S.I.; Sanneh, H.; Ngett, A.; Bah, I.; Aleser, M.; Denis, E.; et al. Estimating Need for Glasses and Hearing Aids in The Gambia: Results from a National Survey and Comparison of Clinical Impairment and Self-Report Assessment Approaches. *Int. J. Environ. Res. Public Health* **2021**, *18*, 6302. <https://doi.org/10.3390/ijerph18126302>

Academic Editor: Paul B. Tchounwou

Received: 14 April 2021

Accepted: 25 May 2021

Published: 10 June 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Abstract:** Few estimates are available of the need for assistive devices (ADs) in African settings. This study aimed to estimate population-level need for glasses and hearing aids in The Gambia based on (1) clinical impairment assessment, and (2) self-reported AD awareness, and explore the relationship between the two methods. The Gambia 2019 National Eye Health Survey is a nationally representative population-based sample of 9188 adults aged 35+ years. Participants underwent standardised clinical vision assessments including the need for glasses (distance and near). Approximately 25% of the sample underwent clinical assessment of hearing and hearing aid need. Data were also collected on self-reported awareness, need and access barriers to vision and hearing ADs. Overall, 5.6% of the study population needed distance glasses (95% CI 5.0–6.3), 45.9% (95% CI 44.2–47.5) needed near glasses and 25.5% (95% CI 22.2–29.2) needed hearing aids. Coverage for each AD was very low (<4%). The agreement between self-report and clinical impairment assessment for AD need was poor. In conclusion, there is high prevalence and very low coverage for distance glasses, near glasses and hearing aids in The Gambia. Self-report measures alone will not provide an accurate estimate of AD need.

**Keywords:** assistive device; surveys; need; access; glasses; hearing aids; vision impairment; hearing impairment

## 1. Introduction

Globally, the World Health Organization (WHO) estimates there are at least one billion people in need of assistive technology (AT). AT includes both assistive devices (ADs) and the systems and services related to AD delivery [1,2]. AT users can include older people, people with disabilities, and people living with chronic health conditions, non-communicable diseases, and communicable diseases [1]. Global AT need is expected to rise to 2 billion by 2030, given population ageing and the increase in non-communicable disease prevalence; however, reliable data on AT need are scarce [2]. For example, the

global need estimate is based upon extrapolations of global burden of disease (GBD) data, and data are especially limited regarding need for individual ADs.

There has been an increase in global initiatives to scale up AT access over the past ten years, including the WHO Global Cooperation on Assistive Technology (GATE) initiative [3] and ATScale [4]. GATE developed a global priority assistive products list (APL) which includes over 50 ADs, and five of these were selected as ATScale priority ADs: glasses, hearing aids, wheelchairs, prosthetics, and digital AT [1,4]. However, reliable data on population-level AD need, coverage and access are required for evidence-based advocacy and planning of programmes to increase provision and access to AT. To address the AT data gap, WHO GATE developed the rapid Assessment of Assistive Technology (rATA), a population-based survey measuring self-reported use, need and barriers to accessing AT for over 30 priority ADs across the six functional domains of vision, hearing, mobility, communication, cognition and self-care [5]. The rATA is relatively rapid, low-cost to administer and collects data in a standardised way; however, the rATA uses self-reported AD measurement only.

There are other approaches to measuring AT need which differ in the way impairment, AT and functioning are defined, conceptualised and measured. For example, clinical impairment assessment (e.g., visual acuity measurement) uses standardised clinical methods to assess the presence of impairment followed by a clinician's assessment of AD needs (e.g., glasses) based on type, cause and severity of the impairment. Clinical assessment provides important information on whether AD or medical treatment is needed, but may be costly to administer, often requires input from clinical staff and may not take into account the participant's perceptions/environment. Previous analysis of surveys in India and Cameroon suggested substantial discrepancy between self-report and clinical assessment approaches [6,7]. However, the sample sizes for these analyses were relatively small and gaps were identified, including a lack of consistency in the collection of data on AD need (for example, standardised AD definitions and pictorial aids were lacking) and disaggregation of AD need by impairment severity [6]. In this paper, we address these gaps and provide further comparisons between self-report and clinical impairment assessment approaches for assessing need for glasses (distance and near) and hearing aids in The Gambia.

The Gambia is a small country in western Africa with a population of 2,335,000 and life expectancy of 62 years in 2018 [8,9]. Given the increase in the proportion of the population who are older, alongside a rise in migration from rural to urban areas and in non-communicable diseases, it is likely that the population will have increasing AT needs; however, data are lacking about impairment prevalence and related functional service needs in this population [10]. In 2019, a National Eye Health Survey was conducted in The Gambia to estimate the prevalence and causes of vision impairment, blindness and its comorbidities [11]. This involved clinical vision assessment of a nationally representative population-based sample of adults 35 years and above, as well as data collection on comorbidities, including hearing impairment, disability, and need for and access to related vision and hearing ADs [11].

In this paper, we conduct an analysis of national-level survey data in The Gambia in adults 35 years and above in order to:

1. Estimate population-level total need, unmet need and coverage for glasses (distance and near glasses) and hearing aids, two of the five ATScale priority ADs.
2. Estimate reported AD awareness, need and access barriers.
3. Explore the relationship between clinical impairment and self-report assessment methods for assessing AD need within population surveys.

## 2. Methods

A National Eye Health survey was conducted in The Gambia in adults 35 years and over from February to July 2019. Hearing assessments were completed in clusters visited by one of the four teams which equated to approximately one-quarter of participants.



The methodology of the full survey is published elsewhere [11]. Using the 2013 census data as the sample frame, multi-stage stratified cluster random sampling with probability proportional to size (PPS) procedures were used to identify a nationally representative sample of adults 35 years and older. The survey was powered to detect eye disease prevalence as low as 0.5%. This required an overall sample size of 10,800 adults 35 years and older in 360 clusters of approximately 30 adults per cluster, assuming an intraclass correlation coefficient of 0.038, a design effect of 2.5, a 20% non-response rate and a margin of error of 20% around the estimate. For the hearing component, the target sample size was 2700 (1/4 overall sample) which was powered to detect a 9% prevalence of hearing impairment [12]. Hearing assessment was conducted in adults aged 35+ in approximately one-quarter of the clusters (90/360 clusters) by one of the four survey teams.

Standard Gambia Bureau of Statistics (GBoS) Census Enumeration Areas (EAs) were used as clusters, and the 360 clusters were randomly selected via PPS. For each cluster, enumerators first undertook a household listing of eligible participants. Using this information, the cluster was then subdivided into segments each including approximately 30 adults aged 35+. One segment was randomly selected, and all adults in the selected segment were invited to a central location the following day for clinical assessments.

Data were collected in a central location on mobile tablets using Open Data Kit (ODK). There were four survey teams each comprised of one ophthalmologist, one optometrist or optometry technician, one senior ophthalmic medical assistant (SOMA), one general nurse, one mental health nurse, and two enumerators. In one team, the one practicing audiology nurse in The Gambia was included. Teams underwent ten days of training which included standardised tests of protocol adherence, practice examinations and pilot testing. Questionnaires were pre-tested and revised where necessary following the pilot. A formal interobserver variability test was completed for vision testing only, with kappa agreement of 0.7 and 0.8 for two teams, while one team achieved a fairly low agreement (0.4) requiring further training review before data collection [11].

All participants completed a general demographic and socioeconomic questionnaire which included use of the EquityTool, an objective tool comprised of 12 country-specific assets that was used to generate a wealth index [13]. All study materials, including the questionnaires, are presented in Supplementary File S1.

### *2.1. Self-Reported Functioning and AD Awareness, Need and Access Barriers*

Before the clinical assessments, data on self-reported level of difficulty in seeing and hearing were collected on all participants using the relevant questions from a modified version of the Washington Group Short Set questions [14,15]. These questions use a four-point response scale: no difficulty, some difficulty, a lot of difficulty and cannot do. Participants who reported “some or worse” difficulty with vision (with or without glasses) or hearing (with or without a hearing aid) were then asked about self-reported AD awareness, use, unmet/undermet need and barriers to access in vision and hearing domains, respectively, using relevant questions from the WHO rATA questionnaire with accompanying pictorial showcards and item descriptions (see Supplementary File S1) [5,7]. Self-reported need included both unmet need (reported not having AD but needing AD) and undermet need (reported having AD, but needing improved AD).

### *2.2. Vision Clinical Assessment*

Distance and near visual acuity (VA) were measured indoors by the team optometrist or optometry technician as follows:

Distance VA: Uncorrected VA and corrected VA (wearing glasses, if available) were measured at 3 metres using Peek Acuity, a validated visual acuity test on tablet devices [16]. All participants with presenting VA (uncorrected VA or corrected VA if wearing glasses) less than 6/12 in either eye underwent (1) a pinhole test in the eye(s) less than 6/12 and (2) objective (retinoscopy) and subjective refraction of both eyes using a trial lens set and fixed wall chart. Best corrected visual acuity (BCVA) was measured with Peek Acuity

following refraction. Participants with uncorrected VA < 6/12 in the better eye which improved to 6/12 or better with corrected VA, pinhole VA or BCVA were classified as “total need” having any refractive error (RE); participants who could see 6/12 or better with their own distance glasses were categorised as having “met need”; participants who could not see 6/12 with their own distance glasses but could be corrected to 6/12 or better were categorised as having “undermet need” and required updated distance glasses; and participants without glasses who could be corrected to 6/12 or better with pinhole or refraction were categorised as having “unmet need”. Uncorrected refractive error (URE) includes both “unmet need” and “undermet need”.

Near vision screening: Presenting near vision (uncorrected or wearing glasses, if available) was screened at N8 threshold. A binary outcome of can or cannot identify 4 out of 5 tumbling E optotypes at 40cm was recorded. Participants who were able to see N8 wearing near vision glasses were categorised as “met need”. Participants unable to see N8 were re-tested using an age-appropriate near add correction in trial frame and classified as needing either new near glasses (unmet need) or updated near glasses (undermet need) depending on glasses ownership.

All participants were assessed for contrast sensitivity and intraocular pressure, and a dilated clinical eye examination (eyelids, anterior and posterior segment eye disease) was undertaken.

For people with vision impairment (VI), the main cause of VI was assigned following WHO protocol of “easiest to treat” [11].

### 2.3. Hearing Clinical Assessment

In one team, the audiology nurse screened for hearing impairment (HI) using the Rapid Assessment of Hearing Loss (RAHL) methodology [12]. All participants completed a questionnaire on clinical history and risk factors for hearing loss, and then underwent a hearing test using HearTest, a validated mobile-based pure tone audiometry application [17]. Hearing was assessed in a separate, private area to minimise ambient noise levels. All participants assessed by this field team with the audiology nurse then had their ears examined by the audiology nurse using an otoscopy to assess for presence of ear diseases. Participants with hearing loss additionally underwent tympanometry. A probable cause of hearing loss was recorded (based on findings from hearing test, otoscopy, tympanometry and clinical history) and grouped in three broad categories as probable conductive, sensorineural, or mixed. For the purposes of this study, participants with bilateral sensorineural or mixed type of hearing loss (HL) (better ear > 25 dB) were categorised as likely “needing a hearing aid following diagnostic audiology review” [12].

### 2.4. Vision and Hearing Clinical Assessment Threshold Definitions

In this paper, “mild/worse VI” will be used to refer to the threshold of VA < 6/12 in the better eye, and “moderate/worse VI” will be used to refer to the threshold of VA < 6/18 in the better eye, based on WHO vision categories. For hearing, based on WHO categories, “mild/worse HI” will be used to threshold of HL > 25 dB in the better ear and “moderate/worse HI” will be used to refer to HL > 40 dB in the better ear.

### 2.5. Data Analysis

Stata 16.0 (StataCorp LP, College Station, TX, USA) was used to analyse the data. The ‘svy’ command was used to derive proportion estimates accounting for cluster sampling. Data from the 2013 population housing census were used to create weights which were then used to adjust the prevalence estimates (of impairment and need/unmet for AD) for age, sex and regional clusters for vision and age and sex only for hearing, to account for differences in the sample and census population.

We calculated AD unmet and total need, coverage and effective coverage separately for mild/worse and moderate/worse vision and hearing impairment thresholds. The exact definitions with vision and hearing thresholds are listed in table footnotes and Supplementary File S2. Broadly, we used the following definitions based on clinical assessment:

- Met need: Needs and observed to be using an appropriate AD/total population examined.
- Undermet need: Needs and observed to be using an AD which did not correct vision/hearing to required threshold/total population examined.
- Unmet need: Needs but not observed to be using the AD/total population examined.
- Total need: (summation of met need + undermet need + unmet need)/total population examined.
- Coverage: (met need + undermet need)/total need.
- Effective coverage [18] (for glasses only): met need/total need.

Socioeconomic status was calculated using the Equity tool wealth quintiles based on national scores. Estimates of “total need” for glasses (distance and near) and hearing aids were stratified by age, sex, socioeconomic status and urban/rural location with logistic regression used to calculate test for trends. These analyses were also calculated to account for the weighting and clustering. Self-reported functional limitations and unmet/undermet need for glasses and hearing aids were compared to AD unmet/undermet need identified through clinical impairment assessment, making the assumption that clinical assessment provides more reliable data (definitions in Supplementary File S2).

### 2.6. Ethical Considerations

Ethical approval was granted by The London School of Hygiene & Tropical Medicine Ethics Committee and The Gambia Government/Medical Research Council Joint Ethics Scientific Coordinating Committee (see Supplementary File S1). All participants were either given or read a participant information sheet in the participant’s respective local language which covered the risks and benefits of taking part in the study. Informed consent in the form of a signature or thumb print was obtained from all research participants. Participants identified as needing vision or hearing ADs and/or other services were referred as appropriate using the survey referral form.

## 3. Results

A total of 11,027 people were enumerated and 9188 participants underwent vision screening (response rate 83.3%). A total of 2935 people were enumerated in the clusters where hearing assessment was included and 1393 participants underwent hearing assessment (response rate 47.5%). Demographic characteristics of the 2013 census population, vision study sample and hearing study sample are presented in Supplementary File S3a. For demographic characteristic comparison specifically regarding the hearing assessment responders versus non-responders, sex and urban/rural location were fairly similar; however, slightly more older people did not respond (see Supplementary File S3b).

Overall vision and hearing clinical impairment (from all causes) and self-reported difficulty results are presented in Table 1. The prevalence of presenting distance VI mild/worse (better eye VA < 6/12, all causes) was 13.4% (95% CI 12.4–14.4, n = 1327), and the prevalence of presenting distance VI moderate/worse (better eye VA < 6/18, all causes) was 10.0% (95% CI 9.2–10.9, n = 1001). Presenting near VI prevalence was 53.4% (95% CI 51.7–55.2, n = 4774). Self-reported “some or worse” visual difficulty was 26.9% (95% CI 25.2–28.7, n = 2530) and for “a lot or worse”, it was 2.0% (1.7–2.4, n = 179).

The prevalence of mild/worse HI (>25 dB) was 28.1% (95% CI 24.6–31.9, n = 402) and moderate/worse HI (>40 dB) was 1.6% (95% CI 1.0–2.6, n = 24). Self-reported “some or worse” hearing difficulty was 1.7% (95% CI 0.9–3.2, n = 385) and for “a lot or worse”, it was 0.2% (0.04–0.5, n = 55).

**Table 1.** Overall prevalence of vision and hearing impairment/difficulty with participants 35+ who completed distance vision, near vision and hearing clinical assessments and self-reported difficulty questioning in The Gambia.

Functional Domain	Total Number Participants		Prevalence ^ % (95% CI)
	Assessed (N)	With Impairment/Difficulty (N)	
VISION			
Vision clinically assessed			
Distance vision			
Mild or worse (VA < 6/12)	9188	1327	13.4 (12.4–14.4)
Moderate or worse (VA < 6/18)	9188	1001	10.0 (9.2–10.9)
Near vision*	9183	4774	53.4 (51.7–55.2)
Self-reported vision difficulties **			
“Some or worse” difficulty	9180	2530	26.9 (25.2–28.7)
“A lot of or worse” difficulty	9180	179	2.0 (1.7–2.4)
HEARING			
Hearing clinically assessed			
Mild or worse (>25 dB)	1393	402	28.1 (24.6–31.9)
Moderate or worse (>40 dB)	1393	24	1.6 (1.0–2.6)
Self-reported hearing difficulties ***			
“Some or worse” difficulty	9185	385	1.7 (0.9–3.2)
“A lot of or worse” difficulty	9185	55	0.2 (0.04–0.5)

^ Crude counts with prevalence adjusted for cluster, age and sex for vision, and adjusted for age and sex for hearing; \* Test not possible with 5 participants; \*\* 8 participants were missing Washington group data, n = total participants who self-reported “some or worse” difficulty seeing either with or without glasses; \*\*\* 3 participants were missing Washington group data, n = total participants who self-reported “some or worse” difficulty hearing either with or without hearing aids.

### 3.1. Estimated Population AD Need and Coverage

Table 2 presents estimated unmet need, total need and coverage of each AD based upon clinical impairment assessment. Effective coverage is presented for glasses only. Population estimates of AD need are presented for people with (i) mild/worse impairment and (ii) moderate/worse impairment only based on gaps identified in previous papers and definitions used to indicate different impairment AD cut-off levels [6]. The exception is near glasses where only a binary cut-off was used.

**Table 2.** Three assistive devices total need, unmet need, coverage and effective coverage estimates in The Gambia <sup>^^</sup>.

Assistive Devices	Total Need <sup>^*</sup>		Unmet Need <sup>^**</sup>		Coverage <sup>^***</sup>	Effective Coverage <sup>^****</sup>
	N	% (95% CI)	N	% (95% CI)	% (95% CI)	% (95% CI)
Distance glasses (mild/worse VI)	546	5.6 (5.0–6.3)	529	5.4 (4.8–6.0)	3.8% (2.3–6.3)	3.3% (1.9–5.8)
Distance glasses (moderate/worse VI)	435	4.3 (3.8–4.9)	421	4.2 (3.6–4.7)	3.5% (2.0–6.0)	2.7% (1.4–5.0)
Near glasses <sup>&amp;</sup>	4013	45.9 (44.2–47.5)	3942	44.9 (43.2–46.5)	2.2% (1.6–3.0)	0.2% (0.09–0.4)
Hearing aids (mild/worse HI)	367	25.5 (22.2–29.2)	366	25.5 (22.1–29.2)	0.1% (0.02–1.0)	-
Hearing aids (moderate/worse HI)	23	1.5 (0.9–2.4)	22	1.5 (0.9–2.4)	2.3% (0.3–15.9)	-

Abbreviations: VI = vision impairment, HI = hearing impairment, CI = confidence interval; <sup>^</sup> Crude counts with prevalence adjusted for cluster, age and sex for vision, and adjusted for age and sex for hearing; <sup>^^</sup> vision total population n = 9188, hearing total population n = 1393; <sup>&</sup> Near glasses missing data on 12 participants; <sup>\*</sup> total need = (met need + undermet need + unmet need)/total population, see manuscript's Methods and Results sections and Supplementary File S2 for details; <sup>\*\*</sup> unmet need: for distance glasses (mild/worse VI), unmet need = participants without glasses who could be corrected to 6/12 or better with pinhole or refraction; for distance glasses (moderate/worse VI), unmet need = participants without glasses who could be corrected to 6/18 or better with pinhole or refraction; for near glasses, unmet need = participants with distance BCVA of  $\geq 6/12$  in at least one eye who do not have correction for near and whose near PVA is  $< N8$  but can be corrected to N8; for hearing aid (mild/worse HI), unmet need = referred to diagnostic audiology and possible hearing aid due to bilateral sensorineural or mixed type of hearing loss (better ear  $>25$ dB) causes; for hearing aid (moderate/worse HI), unmet need = referred to diagnostic audiology and possible hearing aid due to bilateral sensorineural or mixed type of hearing loss (better ear  $>40$  dB) cause; <sup>\*\*\*</sup> coverage = (met need + undermet need)/total need; <sup>\*\*\*\*</sup> effective coverage (for glasses only) = met need/total need.

### 3.1.1. Distance Glasses

Overall, based on mild/worse VI, the prevalence of total need for distance glasses (i.e., any RE) was 5.6% (95% CI 5.0–6.3, n = 546) and unmet need was 5.4% (95% CI 4.8–6.0, n = 529). Only 14 people were observed as having met needs and 3 had an undermet need for glasses. Based on moderate/worse VI, the prevalence of total need for distance glasses was 4.3% (95% CI 3.8–4.9, n = 435) and unmet need was 4.3% (95% CI 3.8–4.9). Only 10 people were observed as having met need and 4 had an undermet need. Coverage was therefore low for both mild/worse VI (3.8%, 95% CI 2.3–6.3) and moderate/worse VI (3.5%, 95% CI 2.0–6.0) cut-offs, and even lower for effective coverage (mild/worse VI: 3.3%, 95% CI 1.9–5.8; moderate/worse VI: 2.7%, 95% CI 1.4–5.0).

### 3.1.2. Near Glasses

The prevalence of total need for near glasses was 45.9% (95% CI 44.2–47.5). The prevalence of unmet near glasses need was 44.9% (95% CI 43.2–46.5, n = 3942). Only 8 people were classified as having met need and 63 as having an undermet need. There was, therefore, low coverage of near glasses (2.2%, 95% CI 1.6–3.0) and even lower effective coverage (0.2%, 95% CI 0.09–0.4).

### 3.1.3. Hearing Aids

Overall prevalence of total need for hearing aids based on mild/worse HI was 25.5% (95% CI 22.2–29.2, n = 367), while based on moderate/worse HI, it was 1.5% (95% CI 0.9–2.4, n = 23). Only one participant was identified as wearing a hearing aid, but they were referred for further diagnostic audiology and possible hearing aid fitting. Therefore, there was no met need and no effective coverage.

### 3.1.4. Total Need for Distance Glasses, Near Glasses and Hearing Aids by Sex, Age, Wealth Quintile and Location

The total need for distance glasses (mild/worse VI and moderate/worse VI), near glasses and hearing aids (both mild/worse HI and moderate/worse HI) all increased significantly with age ( $p < 0.01$ ) (Table 3). The need for distance glasses (mild/worse VI and

moderate/worse VI) and hearing aids (mild/worse HI) was significantly higher among women compared to men ( $p < 0.02$ ). In contrast, the need for near glasses was significantly higher among men compared to women ( $p < 0.001$ ). There were no differences between the socioeconomic categories or urban and rural categories. With adjustment for age and sex, these results were essentially unchanged.

**Table 3.** Total need for distance glasses, near glasses, and hearing aids stratified by sex, age, socioeconomic status and urban/rural in The Gambia.

	Distance Glasses				Near Glasses <sup>^</sup>		Hearing Aids			
	<6/12 (Mild/Worse VI) <sup>^</sup>		<6/18 (Mod/Worse VI) <sup>^</sup>		N	% (95% CI)	>25 dB (Mild/Worse HI) <sup>^</sup>		>40 dB (Mod/Worse HI) <sup>^</sup>	
	N	% (95% CI)	N	% (95% CI)			N	% (95% CI)	N	% (95% CI)
<b>Sex</b>										
Male	178	5.0 (4.2–5.8)	128	3.4 (2.7–4.2)	1440	48.3 (47.5–50.9)	113	20.6 (16.5–25.3)	8	1.3 (0.5–3.1)
Female	368	6.3 (5.6–7.1)	307	5.2 (4.5–5.9)	2573	43.4 (41.8–44.9)	254	30.7 (26.6–35.0)	15	1.7 (1.0–3.1)
<i>p</i> -value	<b>0.01</b>		<b>&lt;0.001</b>		<b>&lt;0.001</b>		<b>&lt;0.001</b>		0.61	
<b>Age groups</b>										
35 to <50 years	101	2.1 (1.6–2.8)	73	1.4 (1.0–2.0)	1283	29.5 (27.5–31.6)	119	12.6 (9.8–16.1)	9	0.8 (0.4–1.9)
50 to <60	114	6.3 (5.2–7.7)	90	4.8 (3.8–6.1)	1240	76.3 (73.4–78.9)	82	29.1 (23.5–35.3)	1	0.3 (0.04–2.4)
60+ years	331	14.0 (12.5–15.6)	272	11.2 (9.8–12.8)	1490	62.2 (59.7–64.6)	166	56.9 (49.5–63.9)	13	4.3 (2.3–8.1)
<i>p</i> -value	<b>&lt;0.001</b>		<b>&lt;0.001</b>		<b>&lt;0.001</b>		<b>&lt;0.001</b>		<b>0.006</b>	
<b>Socioeconomic status *</b>										
1st quintile	49	5.4 (3.9–7.4)	32	3.4 (2.2–5.2)	353	44.1 (39.0–49.2)	28	22.7 (13.3–36.0)	0	-
2nd quintile	72	5.5 (3.9–7.6)	59	4.4 (3.0–6.5)	535	43.9 (40.2–47.7)	63	30.8 (23.6–39.0)	4	1.4 (0.5–3.5)
3rd quintile	122	5.0 (4.0–6.1)	102	4.1 (3.2–5.1)	973	45.0 (41.7–48.5)	78	26.2 (21.0–32.1)	7	2.4 (0.9–6.4)
4th quintile	128	5.9 (4.8–7.1)	113	4.9 (3.9–6.1)	927	46.6 (43.4–49.7)	93	23.6 (18.3–29.8)	5	0.9 (0.4–2.1)
5th quintile	175	6.2 (5.1–7.4)	129	4.3 (3.5–5.2)	1225	47.7 (45.4–49.9)	105	25.3 (19.7–31.7)	7	2.1 (1.0–4.3)
<i>p</i> -value	0.31		0.46		0.08		0.67		0.31	
<b>Location</b>										
Urban	309	5.8 (5.0–6.7)	250	4.5 (3.8–5.2)	2259	47.3 (45.4–49.2)	222	24.1 (20.1–28.6)	14	1.6 (1.0–2.8)
Rural	237	5.4 (4.5–6.4)	185	4.1 (3.2–5.1)	1754	44.1 (41.3–47.0)	145	27.9 (22.3–34.3)	9	1.3 (0.5–3.4)
<i>p</i> -value	0.54		0.49		0.07		0.30		0.66	

Abbreviations: VI = vision impairment, HI = hearing impairment, Mod = moderate, CI = confidence interval. <sup>^</sup> Crude counts and prevalence adjusted for cluster, age and sex weighting for vision, and adjusted age and sex weighting for hearing; the CIs presented are calculated using standard errors that account for the effect of weighting and clustering for vision only, logistic regression was used to calculate test for trends; \* Equity Tool quintile based on national scores.

### 3.2. Self-Reported AD Awareness, Need and Access Barriers

Table 4 presents self-reported awareness, unmet/undermet need and barriers to accessing vision and hearing ADs out of the participants who self-reported “some or worse” difficulty in vision and hearing. As presented in Table 1, for vision, 2530 (26.9%, 95% CI 25.2–28.7) participants self-reported “some or worse” difficulty seeing either with or without glasses, and, for hearing, 385 (1.7%, 95% CI 0.9–3.2) participants reported “some or worse” difficulty in hearing either with or without hearing aids.

#### 3.2.1. Vision ADs, Including Glasses

Of those who self-reported “some or worse” difficulty in vision ( $n = 2530$ ), 72.8% ( $n = 1816$ ) reported awareness of spectacles and 8.3% ( $n = 209$ ) reported awareness of white canes, while awareness was low (<4%) for other vision ADs including talking or touching watch, magnifier or telescope, and braille equipment. Overall, 28.0% ( $n = 709$ ) reported being unaware of any vision AD. In terms of self-reported unmet/undermet need, 66.4% ( $n = 1681$ ) reported an unmet/undermet need for spectacles, while <1% reported needing each of the other vision ADs. Overall, 17.7% ( $n = 447$ ) reported not needing any vision AD. Of those who reported unmet/undermet need for spectacles, the most commonly reported access barriers were AD not locally available (44%), transport not available (43%), and cannot afford (35%).

#### 3.2.2. Hearing ADs, Including Hearing Aids

Of those who self-reported “some or worse” difficulty in hearing ( $n = 385$ ), 86.0% ( $n = 331$ ) were not aware of any hearing AD. Overall, 12.5% ( $n = 48$ ) reported prior awareness of hearing aids, 2.1% ( $n = 8$ ) reported awareness of alarm signallers with light/vibration and <1% ( $n = 2$ ) reported awareness of personal frequency modulation (FM) system. For self-reported unmet/undermet need, 58.0% ( $n = 223$ ) reported needing hearing aids, 8.8% ( $n = 34$ ) needing alarm signallers and 2.6% ( $n = 10$ ) needing personal FM system. Just over a third (34.7%;  $n = 140$ ) reported not needing any hearing AD. Of those who reported unmet/undermet need for hearing aids, most common access barriers were AD not locally available (76%), transport not available (74%), unaware of AD (62%) and no one available to instruct how to use (59%).

**Table 4.** Self-reported awareness, need and barriers to accessing vision and hearing assistive devices amongst participants who self-reported “some or worse” difficulty in vision and hearing, respectively.

Assistive Devices by Domain	VISION						HEARING					
	Spectacles	Talking or Touching Watch	Magnifier or Telescope	White Cane	Braille Equipment	Other	None	Alarm Signallers ^	Hearing Aids and Batteries	Personal Frequency Modulation System	Other	None
<b>Awareness of AD *</b>	1816 (72.8%)	37 (1.5%)	84 (3.3%)	209 (8.3%)	62 (2.5%)		709 (28.0%)	8 (2.1%)	48 (12.5%)	2 (<1%)		331 (86.0%)
<b>Unmet/undermet need *</b>	1681 (66.4%)	12 (<1%)	7 (<1%)	17 (<1%)	1 (<1%)	8 (<1%)	447 (17.7%)	34 (8.8%)	223 (58.0%)	10 (2.6%)	3 (<1%)	140 (36.4%)
<b>Barriers to not having AD ^</b>												
Unaware of AD	544 (32%)	5 (42%)	2 (29%)	8 (47%)	-	4 (50%)		27 (79%)	138 (62%)	7 (70%)	33%	
AP not locally available	741 (44%)	4 (33%)	3 (43%)	8 (47%)	1 (100%)	5 (63%)		6 (18%)	170 (76%)	9 (90%)	33%	
Cannot afford	581 (35%)	5 (42%)	2 (29%)	12 (71%)	1 (100%)	4 (50%)		5 (15%)	122 (55%)	6 (60%)	33%	
Not suitable for home/environment	102 (6%)	-	1 (14%)	1 (6%)	-	2 (25%)		2 (6%)	21 (9%)	1 (10%)	-	
No one available to instruct how to use	567 (34%)	5 (42%)	3 (43%)	6 (35%)	1 (100%)	2 (25%)		5 (15%)	131 (59%)	6 (60%)	33%	
Transport not available	716 (43%)	5 (42%)	3 (43%)	8 (47%)	1 (100%)	4 (50%)		4 (12%)	166 (74%)	8 (80%)	66%	
Do not like appearance	15 (1%)	-	-	-	-	1 (13%)		1 (3%)	4 (2%)	-	-	
People treat users differently	154 (9%)	3 (25%)	1 (14%)	6 (35%)	-	2 (25%)		4 (12%)	40 (18%)	4 (40%)	66%	
Other	47 (3%)	3 (25%)	1 (14%)	5 (24%)	-	2 (25%)		2 (6%)	9 (4%)	3 (30%)	66%	

Abbreviations: AD = assistive device; ^ Alarm signaller is with light/vibration; \* for vision: Washington group data were missing for 8 participants, questions were asked to n = 2530 participants who reported “some or worse” difficulty seeing with or without glasses; for hearing: Washington group data were missing for 3 participants, questions were asked to n = 385 participants who reported “some or worse” difficulty hearing with or without hearing aids; ^ Participants could indicate  $\geq 1$  barrier selecting as many as applied; unmet/undermet need for specific AD is the denominator used for proportion.



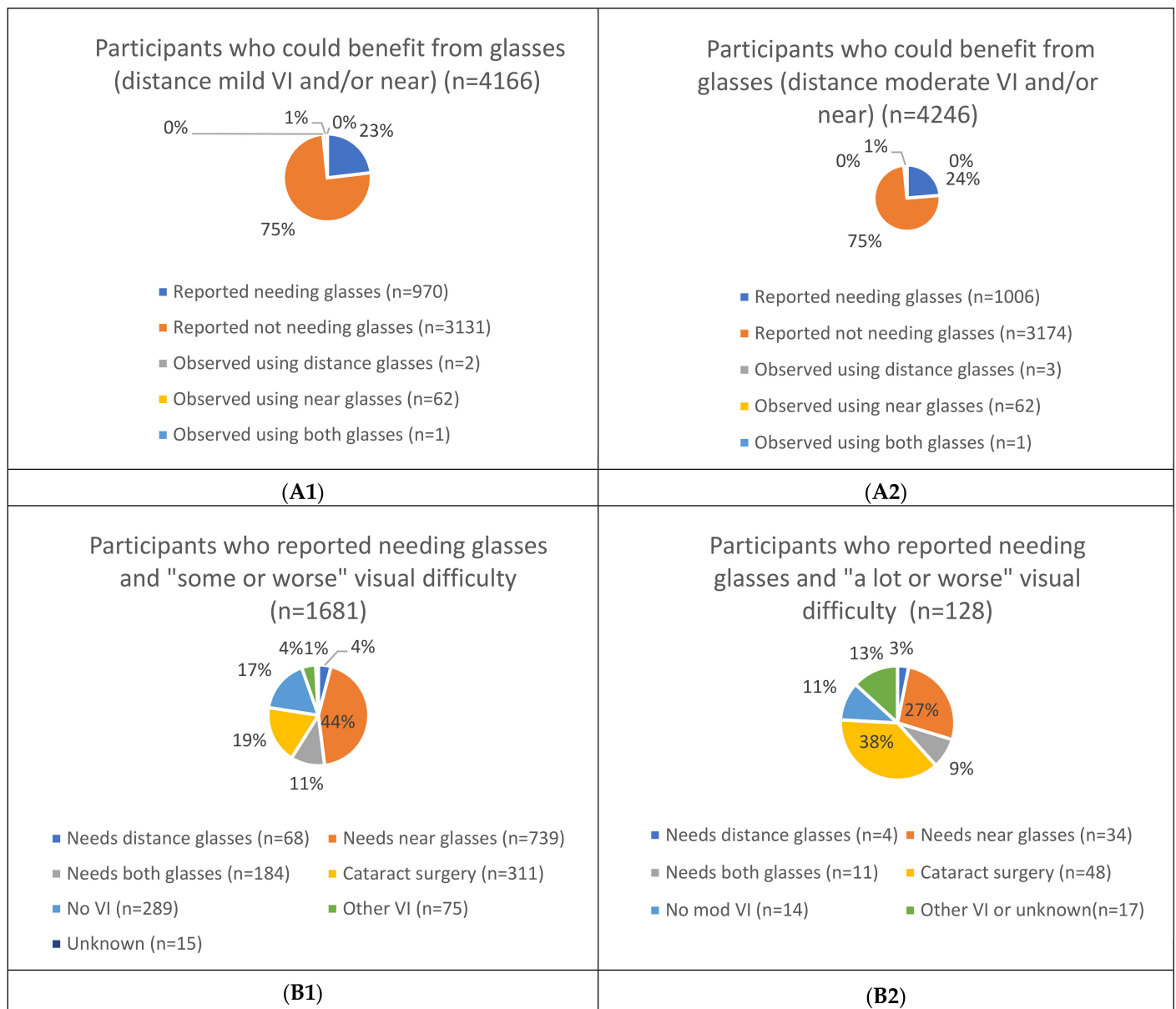
### 3.3. Relationship between AD Need Measurement Approaches

Figures 1 and 2 present the relationship between the two different approaches for assessing near and distance glasses' (mild/worse and moderate/worse VI) and hearing aids' (mild/worse and moderate/worse HI) unmet/undermet need (see Supplementary File S4).

#### 3.3.1. Self-Reported Unmet/Undermet Need for Glasses (Distance and/or Near) among People with Near Vision and/or Distance (Mild/Worse and Moderate/Worse VI) Uncorrected Refractive Error

Of the 4166 people identified as having near and/or distance (mild/worse VI) URE, three-quarters (75%,  $n = 3131$ ) self-reported they did not need glasses (see Figure 1(A1)). Similarly, of the 4246 people identified as having near and/or distance (moderate/worse VI) URE, 3174 (75%) reported not needing distance glasses (see Figure 1(A2)).

Of the 1681 people who self-reported "some or worse" visual difficulty and needing glasses, 991 (60%) actually needed near and/or distance glasses (for mild/worse VI) based on clinical impairment assessment. Of the remaining participants, 311 (19%) needed cataract surgery, 75 (4%) had other causes of VI where glasses would not be of benefit, 15 (1%) had an unknown cause and 289 (17%) did not have VI (see Figure 1(B1)). Of the 128 people who self-reported "a lot or worse" visual difficulty and needing distance glasses only, 49 (38%) actually needed near and/or distance glasses (moderate/worse VI) based on clinical assessment. Of the remaining participants, 48 (38%) needed cataract surgery, 17 (13%) had other or unknown causes of VI and 14 (11%) did not have moderate/worse VI (see Figure 1(B2)).



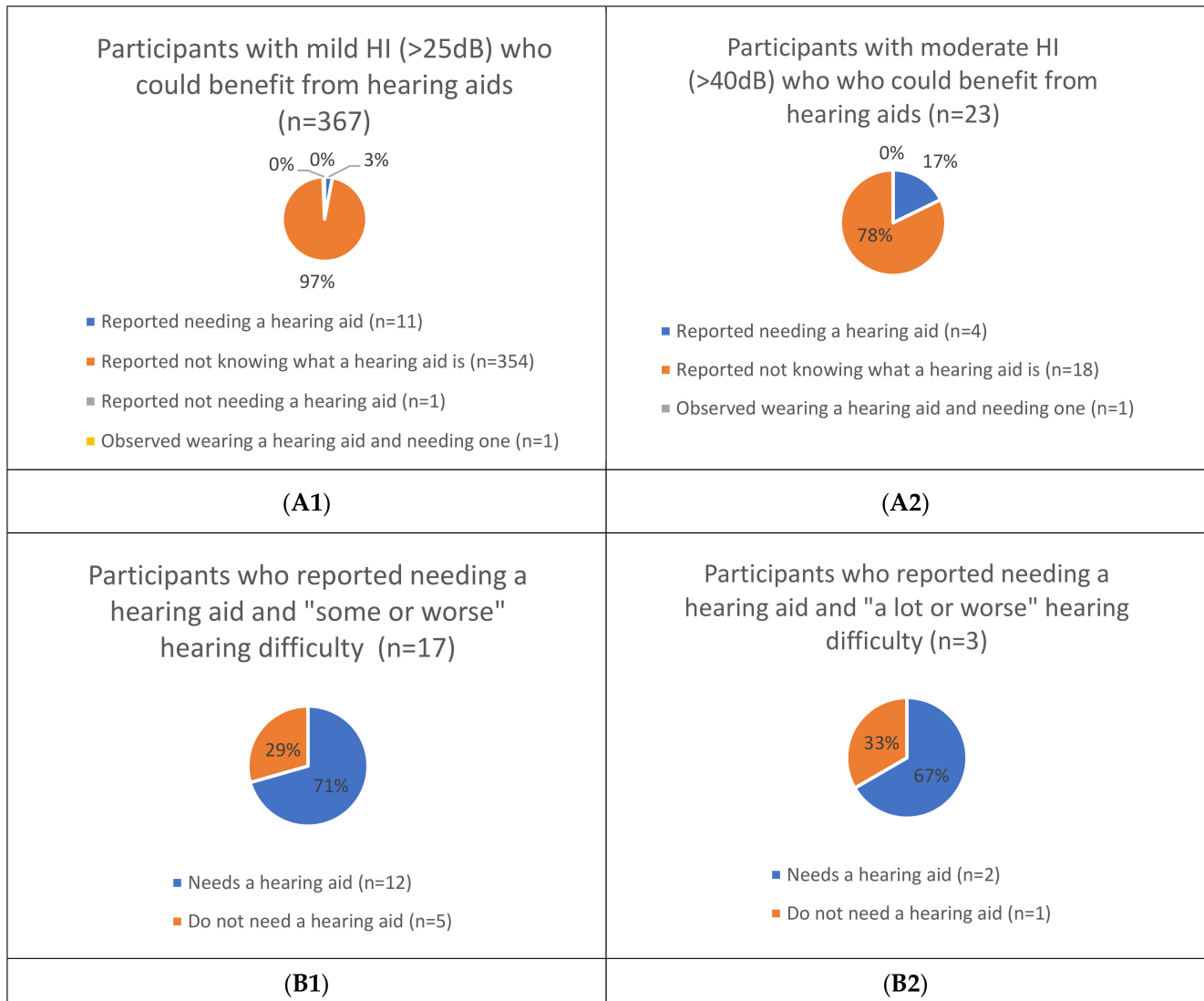
**Figure 1.** Comparing reported versus clinical impairment assessment unmet/undermet need for near and/or distance glasses (mild vs. moderate vision impairment (VI)). (A1): Participants who could benefit from glasses (distance mild VI and/or near) (n = 4166), (A2): Participants who could benefit from glasses (distance moderate VI and/or near) (n = 4246), (B1): Participants who reported needing glasses and “some or worse” visual difficulty (n = 1681), (B2): Participants who reported needing glasses and “a lot or worse” visual worse difficulty (n = 128).

### 3.3.2. Self-Reported Unmet/Undermet Need for Hearing Aids among People with Mild/Worse HI (>25 dB) and Moderate/Worse HI (>40 dB)

Of the 367 people with mild/worse HI (>25 dB) who were clinically assessed to likely need hearing aids, 11 (3%) reported needing one, 354 (97%) reported not knowing what it was and <1% (2 participants) were either observed to be wearing one (n = 1) or reported not needing one (n = 1) (see Figure 2(A1)). Of the 23 people with moderate/worse HI (>40 dB) who were clinically assessed to likely need hearing aids, 4 (17%) reported needing one, 18 (78%) reported not knowing what it was, and 1 (<1%) was observed to be wearing one (see Figure 2(A2)).

Of the 17 people who self-reported needing hearing aids with “some or worse” hearing difficulty, 12 (71%) actually needed hearing aids based on clinical assessment and 5 (29%)

did not (see Figure 2(B1)). Of the three people who self-reported needing hearing aids with “a lot or worse” hearing difficulty, two (67%) actually needed hearing aids based on clinical assessment and one (33%) did not (see Figure 2(B2)).



**Figure 2.** Comparing reported versus clinical impairment assessment unmet/undermet need for hearing aids for both mild and moderate hearing impairment (HI). **(A1):** Participants with mild HI (>25 dB) who could benefit from hearing aids (n = 367), **(A2):** Participants with moderate HI (>40 dB) who could benefit from hearing aids (n = 23), **(B1):** Participants who reported needing a hearing aid with “some or worse” hearing difficulty (n = 17), **(B2):** Participants who reported needing a hearing aid with “a lot or worse” hearing difficulty (n = 3).

#### 4. Discussion

##### 4.1. Estimated Population AD Need and Coverage

This study found evidence of high need and very low coverage of two priority ADs (glasses and hearing aids) among adults aged 35+ years in The Gambia based on clinical impairment assessment. Total need was highest for near glasses (45.9%), followed by hearing aids based on mild/worse HI (25.5%), and distance glasses was lower (mild/worse VI: 5.6%; moderate/worse VI: 4.3%). The total need for all ADs increased significantly with age. Total need was significantly higher among females compared to males for distance glasses (mild/worse VI and moderate/worse VI) and hearing aids (mild/worse HI), and significantly higher among males compared to females for near glasses.

AD coverage was very low with fewer than 4% of people who needed distance glasses, near glasses or hearing aids actually observed wearing them. These findings further indicate that glasses and hearing aid provision services are very limited in The Gambia and need to be scaled up [2]. For example, for vision, the initiative One Sight worked with The Gambian government to support the development of seven vision centres and job creation, but the network of services requires further expansion [19]. For hearing, though some health facilities provide basic ear, nose and throat (ENT) services to treat minor cases, all major cases and anyone with hearing difficulties in the entire country are referred to the Polyclinic to the one Audiology nurse for hearing assessments and hearing aid fittings in collaboration with St Johns School for the Deaf in the capital city Banjul. A lack of audiology service provision is congruent with the findings of a survey conducted to determine the current status of ENT, audiology, and speech therapy services between 2009 and 2015 in 15 sub-Saharan African countries [20]. Human resources especially need to be scaled up so more ENT doctors, audiology nurses and speech therapists are trained and available to provide hearing health services in The Gambia.

Compared to other studies of multi-domain clinically assessed AD need, our findings align with a survey in Cameroon showing high need and low coverage for distance glasses and hearing aids [6]. A survey in India found similarly low coverage of hearing aids, but much higher coverage of distance glasses both for mild/worse VI at 44% and moderate/worse VI at 87% which might indicate a greater access to vision services in that setting [6].

For vision, it is challenging to compare our glasses (distance and near) unmet need results with the previous 1996 Gambia National Eye Health study, given differing definitions and methods of calculating these estimates [21]. Our finding for distance glasses unmet need (5.4%) was slightly lower than the 7.5% estimate reported in a 15+ years old Tanzanian population study, despite the lower population age range, although spectacle coverage was similarly low (distance glasses: 1.69% and near vision glasses: 0.42%) [22]. Our estimate of unmet need for near vision glasses (44.9%) was similar when compared to this same Tanzanian study's population aged 35+ years which found an uncorrected presbyopia prevalence of 46.5% [22] and slightly lower than studies in similar age groups in Ghana (64%) [23] and Nepal (66.1%) [24]. For hearing, the need for hearing aids (25.5%) in this study is lower than estimates from RAHL surveys, which used the same ear/hearing assessment methods, in Malawi (30.8%) [25] and China (54%) [26], likely because the focus was people 35+ compared to 50+ in the other surveys. The low coverage (<1%) is similar across all three studies [25,26].

However, it is also noted that population-based clinical impairment studies often do not explicitly measure or present specific AD need alongside estimates of impairment type, cause and severity. Therefore, to address the AD data gap, it is recommended that future surveys include these estimates on AD need and coverage for vision and hearing as well as the assessment of additional functional domains and related ADs. Additionally, this paper provides comparison between mild and moderate impairments for distance glasses and hearing aids. Though unmet need for moderate/worse VI/HI is more imperative, our analyses show that a high number of people with mild VI and HI might also benefit functionally from distance glasses and hearing aids. It is recommended that the mild/worse threshold is reported as need for these two ADs at a minimum, which is congruent with recent recommendations [18] and will have programme implications given the increase in needs identified.

#### *4.2. Self-Reported AD Awareness, Need and Access Barriers*

Our findings further emphasise that glasses are the most well-known vision AD (72.8%), and that the use of pictorial showcards with item descriptions appears to enhance understanding of the ADs in participants (i.e., for hearing aids among participants who reported "some or more" difficulty hearing, 12.5% were initially aware of this AD compared to 58.0% who reported unmet/undermet need after learning about this AD), so this is

recommended in future self-reported studies [5]. Additionally, the self-reported low AD awareness and unmet/undermet need results are congruent with our low glasses and hearing aid coverage findings, and further reinforce the need for increased AD advocacy, awareness raising activities and service provision. Further, when using the cut-off of “some or worse” difficulty in seeing or hearing, it is possible that participants who reported no problem seeing/hearing were aware of the ADs and/or might self-report still needing ADs; therefore, they might have been missed in our findings. It will be important for future research to explore the accuracy of this cut-off to determine AD need. Finally, there are anecdotal reports of societal stigma associated with use of certain AD such as glasses, especially among younger people. Such views could be explored through qualitative research to explore attitudes and stigma towards ADs that may adversely affect the widespread utilization of ADs.

#### *4.3. Relationship between AD Need Measurement Approaches*

The agreement between AD unmet/undermet need measured by self-report and by clinical impairment assessment, for glasses (near and distance) and hearing aids, was very poor. Additionally, awareness about ADs was low, even with the addition of AD pictures and item descriptions during the survey. Further, AD unmet/undermet need was consistently either under-reported or over-reported. For example, hearing aids were under-reported by people who were clinically assessed to need them given poor awareness of what they were, and 75% of people who were clinically assessed to need near and/or distance (mild/worse VI) glasses did not perceive any need for glasses. At the same time, AD need was over-reported, given at least 40% of those who self-reported needing glasses (distance and/or near) actually did not need them. Our findings are similar to previous findings from the Cameroon and India AD study, even with additional breakdown by level of severity for distance and hearing aids and two types of glasses (distance and near) [6]. Though self-report is a quicker and lower cost method, our findings suggest that when self-report is solely used, estimates will likely be inaccurate, given both the overestimations and underestimations of need.

Research comparing AD need measurement approaches is limited as population surveys typically use either self-reported AD methodology or clinical impairment assessment methodology. For example, Pryor et al.’s study in two districts in Bangladesh solely used WHO GATE’s rATA [5] and SINTEF’s multiple population-based surveys present self-reported AD need only, often in category groupings by functional domain and/or type [27–35].

It is also important to note that our comparative findings rely on clinical impairment assessments as the “gold standard”, and there are limitations with this approach as well. Most notably, impairment assessment methods typically only focus on the more “medical” component of body structure and function in the international classification of functioning, health and disability (ICF) [36]. In order to measure AD need, more comprehensive data are required to be collected about the person’s broader functional needs, incorporating the other ICF components including his/her activities, participation, and personal and environmental factors [6] and may explain some of the disconnect in the data. For example, an individual who is clinically identified to need distance (mild/worse VI) and near glasses living in a rural area of The Gambia who does not drive and is not literate may not perceive his/her visual functioning as a problem, given it does not appear to impact on life activities and/or participation. Additionally, an individual who is illiterate may prefer to obtain their information from auditory sources, such as radio and/or word of mouth, and may not have a need for reading glasses to read a newspaper. Therefore, gathering more of an understanding about what is needed to support activity participation, contextual factors, any necessary social and/or environmental accommodations are essential towards contributing to AD assessment. This further emphasises the need to support the development of hybrid methodology integrating self-report, clinical impairment and functional assessment methodologies. This proposed comprehensive method to determine AD need

is important to inform policy-driven efforts towards achieving Sustainable Development Goal 3 and Universal Health Coverage.

#### 4.4. Study Strength and Limitations

This study provided population-based estimates for three ADs in The Gambia based upon standardised clinical impairment assessment procedures. It also included self-reported AD measures which enabled comparison of the two measurement approaches, including different severity levels. Further, uncorrected VA was measured in addition to presenting which provided more accurate data for met and undermet need, as well as for coverage and effective coverage than using methods that aligned with the recent vision sector indicator [18].

However, there were limitations. There were higher than expected incomplete examinations and non-response rates, and an under-sampling of younger men due to the pre-rainy and rainy/farming season skewing the survey sample towards females, which required sampling weights. Logistical challenges, such as finding adequate space for the central location set up in each cluster, often resulted in delays, and human resource constraints did not allow for continuity of examiners during the survey which potentially led to measurement bias. It was also challenging to find quieter areas for conducting the hearing test and the hearing survey response rate was low (47.5%). This may be related to response burden as the hearing assessment was often conducted at the end of all the other survey assessments [11]. It is important for future multiple functional domain surveys to consider order of assessments and length of data collection. Additionally, it is possible that the unmet need for hearing aids is overestimated, given this estimate is based upon possible cause diagnoses of mixed or sensorineural hearing loss which indicates diagnostic audiology services and *possible* hearing aids fittings, due to difficulties accurately assessing this in the field.

It is noted that AD 'use' was reported in three different sections of the survey by different data collector cadres, and our analysis was based on participants being observed wearing the AD at the time of the clinical assessment conducted at a central point. However, this may have led to underestimates of use as participants might have been unaware they should bring their glasses/hearings aids or expected a new pair of glasses or hearing aid following the exam. It is recommended that future surveys provide clear communication indicating if the AD should be worn at the central location and if there will or will not be provision of free ADs following a survey. Further, for the self-report data, participants were only asked about 'glasses' overall, not separately for distance and near glasses, which limited our comparisons with the clinically assessed glasses need. Given the large difference in need, it is recommended that future surveys using self-report (e.g., rATA) should ask about need for distance and near glasses separately.

Finally, this study explored need in an adult 35+ population for only 2 of the 50 priority ADs. Future studies are needed to assess access for younger age groups, and data on other ADs are lacking and should be included in future data collection efforts when possible. For example, low vision AD need should also be assessed in VI surveys. Specifically, as part of the broader survey, contrast sensitivity impairment was clinically measured; however, it was not fully assessed with regard to AD need [11]. It is recommended in future vision surveys that this, alongside other vision AD needs, are explored and assessed further, including exploring appropriate cut-off points for the AD required, such as for filter glasses with contrast sensitivity. A recommendation to address the data gap is to work with the GBoS to incorporate AT assessment tools into the Demographic and Health Surveillance (DHS), which are conducted every three years, and the next national population census scheduled for 2023.

## 5. Conclusions

In The Gambia, the need for distance glasses, near glasses and hearing aids is high, yet coverage is very low. Our findings generated much-needed data on population-based

AD need in this setting. It will be important for national health, local policy and social services planning to address the barriers identified to accessing ADs, whilst supporting the essential development of vision and hearing AD services, including rehabilitation, with the overall aim to improve functioning and quality of life for individuals in The Gambia. Additionally, our methodological comparison highlights limitations when using self-report alone and further emphasises the need for improved population-level survey methods to estimate AD need. Scheduled GBoS surveys are opportunities that can incorporate AT assessment tools to address this data gap in The Gambia.

**Supplementary Materials:** The following are available online at <https://www.mdpi.com/article/10.3390/ijerph18126302/s1>, File S1: Open Science Framework: Gambia National Eye Health Survey 2019 Study Documents, all the study materials (questionnaires, information and consent forms, show cards, etc.) are available online at <https://osf.io/ekcdt> (accessed on 24 February 2021). File S2: Impairment and assistive device (AD) proportion definitions using WHO vision and hearing impairment definitions. File S3, S3a: Demographic characteristics of the 2013 census population, vision study sample and hearing study sample, S3b: Demographic characteristics of the hearing survey responders and non-responders. File S4, S4a: Clinical impairment assessment and self-reported unmet/undermet need for near and/or distance glasses (both mild and moderate vision impairment), S4b: Clinical impairment assessment and self-reported unmet/undermet need for hearing aids (both mild and moderate hearing impairment).

**Author Contributions:** Conceptualization, D.B., S.P., I.M. (Islay Mactaggart), T.B., M.J.B., A.H. and H.K.; methodology, D.B., S.P., I.M. (Islay Mactaggart), T.B., I.M. (Ian McCormick), A.H., A.F. and M.J.B.; software, S.B., I.M. (Islay Mactaggart), I.M. (Ian McCormick) and T.B.; formal analysis, D.B. with input from M.K., I.M. (Ian McCormick), T.B., I.M. (Islay Mactaggart) and S.P.; investigation, A.H., Y.F., J.A.O., S.I.O., H.S., A.N., I.B., M.A., E.D. and S.B.; data curation, S.B., M.K., I.M. (Islay Mactaggart), and I.M. (Ian McCormick); writing—original draft preparation, D.B. with input from S.P., A.F., I.M. (Islay Mactaggart) and I.M. (Ian McCormick); writing—review and editing, all authors; visualization, D.B. and S.P.; supervision, S.P., A.H. and M.J.B.; funding acquisition, M.J.B., H.K. and S.P. All authors have read and agreed to the published version of the manuscript.

**Funding:** The Gambian National Eye Health Survey was funded mainly by the Queen Elizabeth Diamond Jubilee Trust. The Ministry of Health provided field vehicles and drivers, as well as permission for all the health workers who took part in the exercise. M.J.B is supported by the Wellcome Trust (207472/Z/17/Z). This AT study, including the related analyses and paper writing, were funded by UK Aid through the AT2030 programme led by the Global Disability Innovation Hub, project number: 300815 (previously 201879-108).

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of The Gambia Government/MRC Joint Ethics Scientific Coordinating Committee (SCC, Ref 1635, 9 November 2018) and the LSHTM Observational/Interventions Ethics Committee (Ref 16172, 14 January 2019).

**Informed Consent Statement:** Informed consent was obtained from all participants involved in the study. Written informed consent has been obtained from the participants to publish this paper.

**Data Availability Statement:** The data presented in this study are still undergoing analysis and will be made openly available once complete. The extended data presented in this study are openly available in the Open Science Framework: Gambia National Eye Health Survey 2019 Study Documents at <https://doi.org/10.17605/OSF.IO/EKCDT>, reference number 17 (accessed on 24 February 2021). Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

**Acknowledgments:** We are grateful to Nneka Ramatoulie-Jagne for survey administrative support and to Wally H. Ndow from the Gambia Bureau of Statistics who supervised the enumerators and coordinated data collection in the field. We are also grateful to Anthon Climpson-Stewart who provided administrative support for LSHTM's AT2030 research and Sarah O'Reagan who provided overall LSHTM Gambia National Eye Health Survey administrative support. We also acknowledge Tom Samuel's assistance programming ODK for the self-report AT sections. Further, we acknowledge

Dawda Ceesay, Permanent Secretary at the MoH; Samba Ceesay, Acting Director of Health Services, MoH; Sarjo Kanyi, Programme Manager, NEHP, MoH; Sang Mendy, Transport Foreman, MoH; and Babanding Sabally, Director of National Pharmaceutical Services, MoH—for their facilitation role in supporting the survey; and Nyakassi MB Sanyang, the Statistician General of the Gambia Bureau of Statistics, for fieldworkers and cartography support. Finally, and most importantly, we also thank the survey participants and the broader data collection teams.

**Conflicts of Interest:** The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

## References

- World Health Organization. *Priority Assistive Products List*; WHO: Geneva, Switzerland, 2016.
- World Health Organization. *Policy Brief: Access to Assistive Technology*; WHO: Geneva, Switzerland, 2020.
- World Health Organization. *Assistive Technology: Making Universal Health Coverage Inclusive*; WHO: Geneva, Switzerland, 2016; p. 3.
- ATscale. ATscale: Global Partnership for Assistive Technology. Available online: <https://atscale2030.org/> (accessed on 27 January 2021).
- Pryor, W.; Nguyen, L.; Islam, Q.N.; Jalal, F.A.; Marella, M. Unmet needs and use of assistive products in two districts of bangladesh: Findings from a household survey. *Int. J. Environ. Res. Public Health* **2018**, *15*, 2901. [[CrossRef](#)] [[PubMed](#)]
- Boggs, D.; Kuper, H.; Mactaggart, I.; Murthy, G.; Oye, J.; Polack, S. Estimating assistive product need in Cameroon and India: Results of population-based surveys and comparison of self-report and clinical impairment assessment approaches. *Trop. Med. Int. Health* **2021**, *26*, 146–158. [[CrossRef](#)] [[PubMed](#)]
- Boggs, D.; Kuper, H.; Mactaggart, I.; Murthy, G.; Oye, J.; Polack, S. Estimating assistive technology need through population-based surveys: An analysis of data from Cameroon and India. In *Global Perspectives on Assistive Technology, Proceedings of the GREAT Consultation, Geneva, Switzerland, 22–23 August 2019*; Layton, N., Borg, J., Eds.; World Health Organization: Geneva, Switzerland, 2019; pp. 52–78.
- The Gambia Bureau of Statistics. *The Gambia 2019 Statistical Abstract*; GBoS: Serrekunda, Gambia, 2019.
- World Bank. The World Bank Data: Gambia. 2021. Available online: <https://data.worldbank.org/country/gambia-the?view=chart> (accessed on 5 February 2021).
- Nabaneh, S. Country report: The Gambia. *Afr. Disabil. Rights Yearb.* **2018**, *6*, 232–248.
- Hydara, A.; Bastawrous, A.; Bell, S.; Boggs, D.; Bright, T.; Bobat, H.; Eaton, J.; Faal, H.; Jobe, M.; Kim, M.J.; et al. The Gambia National Eye Health Survey 2019: Survey protocol. *Wellcome Open Res.* **2021**, *6*, 10. [[CrossRef](#)]
- Bright, T.; Mactaggart, I.; Kim, M.; Yip, J.; Kuper, H.; Polack, S. Rationale for a rapid methodology to assess the prevalence of hearing loss in population-based surveys. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3405. [[CrossRef](#)] [[PubMed](#)]
- Chakraborty, N.M.; Fry, K.; Behl, R.; Longfield, K. Simplified asset indices to measure wealth and equity in health programs: A reliability and validity analysis using survey data from 16 countries. *Glob. Health Sci. Pr.* **2016**, *4*, 141–154. [[CrossRef](#)] [[PubMed](#)]
- Madans, J.H.; Loeb, M. Methods to improve international comparability of census and survey measures of disability. *Disabil. Rehabil.* **2013**, *35*, 1070–1073. [[CrossRef](#)] [[PubMed](#)]
- Washington Group on Disability Statistics Secretariat. Washington Group on Disability Statistics. 2020. Available online: <http://www.washingtongroup-disability.com/> (accessed on 2 February 2021).
- Bastawrous, A.; Rono, H.; Livingstone, I.A.T.; Weiss, H.A.; Jordan, S.; Kuper, H.; Burton, M. Development and validation of a smartphone-based visual acuity test (peek acuity) for clinical practice and community-based fieldwork. *JAMA Ophthalmol.* **2015**, *133*, 930–937. [[CrossRef](#)] [[PubMed](#)]
- Swanepoel, D.W.; Myburgh, H.C.; Howe, D.M.; Mahomed, F.; Eikelboom, R.H. Smartphone hearing screening with integrated quality control and data management. *Int. J. Audiol.* **2014**, *53*, 841–849. [[CrossRef](#)] [[PubMed](#)]
- McCormick, I.; Mactaggart, I.; Bastawrous, A.; Burton, M.J.; Ramke, J. Effective refractive error coverage: An eye health indicator to measure progress towards universal health coverage. *Ophthalmic Physiol. Opt.* **2020**, *40*, 1–5. [[CrossRef](#)] [[PubMed](#)]
- OneSight. The Gambia—OneSight. 2021. Available online: <https://onesight.org/the-gambia/> (accessed on 17 March 2021).
- Mulwafu, W.; Ensink, R.; Kuper, H.; Fagan, J. Survey of ENT services in sub-Saharan Africa: Little progress between 2009 and 2015. *Glob. Health Action* **2017**, *10*, 1289736. [[CrossRef](#)]
- Faal, H.; Minassian, D.; Sowa, S.; Foster, A. National survey of blindness and low vision in The Gambia: Results. *Br. J. Ophthalmol.* **1989**, *73*, 82–87. [[CrossRef](#)]
- Mashayo, E.R.; Chan, V.F.; Ramson, P.; Chinanayi, F.; Naidoo, K.S. Prevalence of refractive error, presbyopia and spectacle coverage in Kahama District, Tanzania: A rapid assessment of refractive error. *Clin. Exp. Optom.* **2015**, *98*, 58–64. [[CrossRef](#)] [[PubMed](#)]
- Ntodie, M.; Abu, S.L.; Kyei, S.; Abokyi, S.; Abu, E.K. Near vision spectacle coverage and barriers to near vision correction among adults in the Cape Coast Metropolis of Ghana. *Afr. Health Sci.* **2017**, *17*, 549–555. [[CrossRef](#)] [[PubMed](#)]
- Sapkota, Y.; Dulal, S.; Pokharel, G.P.; Pant, P.; Ellwein, L.B. Prevalence and correction of near vision impairment at Kaski, Nepal. *Nepal. J. Ophthalmol.* **2012**, *4*, 17–22. [[CrossRef](#)] [[PubMed](#)]



25. Bright, T.; Mulwafu, W.; Phiri, M.; Jiang, F.; Swanepoel, D.W.; Kuper, H.; Mactaggart, I.; Yip, J.L.Y.; Polack, S. Field test of the Rapid Assessment of Hearing Loss survey protocol in Ntcheu district, Malawi. *Int. J. Audiol.* **2020**, *59*, 574–582. [[CrossRef](#)] [[PubMed](#)]
26. Bright, T.; Shan, X.; Xu, J.; Liang, J.; Xiao, B.; Ensink, R.; Mactaggart, I.; Polack, S.; Yip, J.L.Y. Field-testing of a rapid survey method to assess the prevalence and causes of hearing loss in Gao'an, Jiangxi province, China. *Arch. Public Health* **2020**, *78*, 16. [[CrossRef](#)] [[PubMed](#)]
27. Eide, A.H.; Neupane, S.; Hem, K. *Living Conditions among People with Disability in Nepal*; SINTEF Rapport A27656; SINTEF Technology and Society: Trondheim, Norway, 2016.
28. Eide, A.H.; Bhekie, J. *Living Conditions among People with Disabilities in Swaziland: A National Representative Study*; SINTEF A20047; SINTEF Technology and Society: Trondheim, Norway, 2011; Available online: [http://www.sintef.no/globalassets/upload/samfunn/finalreportlc\\_swasilandweb.pdf](http://www.sintef.no/globalassets/upload/samfunn/finalreportlc_swasilandweb.pdf) (accessed on 17 February 2021).
29. Eide, A.H.; Kamaleri, Y. *Living Conditions among People with Disabilities in Mozambique: A National Representative Study*; SINTEF Report A9348; SINTEF Health Research: Trondheim, Norway, 2009.
30. Eide, A.H.; Mmatli, T. Living conditions among people with disability in Botswana. *Health Res.* **2016**, 2016.
31. Eide, A.H.; Nanono, N.; Omona, J. *Living Conditions among Persons with Disabilities in Uganda, a National, Representative Household Survey*; SINTEF Report No. 2020–01387; SINTEF Digital: Trondheim, Norway, 2020.
32. Eide, A.H.; Nhiwathiwa, S.; Muderredzi, J.; Loeb, E.M. *Living Conditions among People with Activity Limitations in Zimbabwe. A Representative Regional Survey*; SINTEF Rapport A24710; SINTEF Unimed: Trondheim, Norway, 2003.
33. Eide, A.H.; van Rooy, G.; Loeb, M.E. *Living Conditions among People with Activity Limitations in Namibia: A Representative, National Study*; SINTEF Report STF78 A034503; SINTEF Unimed: Trondheim, Norway, 2003.
34. Loeb, M.; Eide, A.H. *Living Conditions among People with Activity Limitations in Malawi: A National Representative Study*; SINTEF Report STF78 A044511; SINTEF Health research: Trondheim, Norway, 2004.
35. Loeb, M.E.; Eide, A.H.; Mont, D. Approaching the measurement of disability prevalence: The case of Zambia. *ALTER-Eur. J. Disabil. Res. Rev. Eur. Rech. Handicap.* **2008**, *2*, 32–43. [[CrossRef](#)]
36. World Health Organization. International Classification of Functioning, Disability and Health. 2001. Available online: [www.who.int/classification/icf/en](http://www.who.int/classification/icf/en) (accessed on 27 July 2020).

### **5.3 Clinical vision and hearing impairment AP assessment protocol development**

Lessons learned for the development of the clinical vision and hearing impairment AP assessment protocols are outlined below, with each section highlighting the key implications for the development of the AP need survey.

#### 5.3.1 Clinical VI AP assessment

- 1) In Cameroon, vision AP data was limited as only a moderate VI cut-off to determine need for distance glasses was used, compared to India and The Gambia where both mild/worse and moderate/worse VI thresholds were used. It is important for future surveys to gather data using both impairment thresholds to more accurately reflect AP referral need as many people with mild VI can benefit from AP. This measurement approach is congruent with current vision sector recommendations (22, 101) and is therefore recommended for AP need survey methodology.
- 2) In The Gambia study, uncorrected, presenting and corrected distance VA were measured (compared to Cameroon and India which measured presenting and corrected only). This allows for more accurate measurement of total need (met need + undermet need + unmet need) and coverage (met need/total need). For example, unmet need = uncorrected < 6/12, undermet need = with existing correction < 6/12; and met need = 6/12 or better only when wearing existing distance glasses. These distance glasses indicators are well-aligned with the recent effective refractive error coverage measurement recommendations from the eye health sector (101), and using these definitions URE includes both “unmet need” and “undermet need”. It is noted that best corrected VA was also measured in The Gambia survey with refraction (rather than pinhole), however this requires an additional clinical step and expertise and is not considered necessary or feasible for a multi-domain AP need survey.
- 3) In The Gambia study, the mobile application Peek acuity (43) was used to measure distance VA. This app had guidelines for use, provided standardised measurements and minimised the need for carrying additional equipment such as eye charts. It also can be administered by trained non-clinicians. It is recommended that Peek acuity is used to measure distance VA in an AP need survey methodology.
- 4) Learning from these surveys, it is recommended to follow the VA assessment approach used within RAAB methodology for all participants ages >4 years, which would include the following: i) use of Peek acuity, ii) pinhole to assess uncorrected and corrected VA, and iii) followed by eye examination for people with VI, with causes listed according to WHO easiest to treat principal. It is recommended the VI

assessments for ages  $\leq 4$  years old from the Cameroon and India surveys are reviewed further prior to use in an all-age AP need survey.

- 5) The Gambia study measured near VI which provided estimates for the need for near glasses. This is important to include, especially in the adult population of 35+ years old because the need for near glasses is high. It is recommended that near VI and need for near glasses is measured in future surveys, using the standard WHO N6 threshold rather than N8.(22) Additionally, as an alternative to using the tumbling E optotypes card at 40 cm, a mobile data collection application should be considered for this near vision assessment measurement, such as Peek near vision assessment.(43)
- 6) In The Gambia study, an optometrist or optometry technician measured distance and near VA, while an ophthalmologist completed the dilated clinical eye examination and assessment of cause. One clinician cadre will need to administer the AP need vision module and this needs to be well-aligned with RAAB's recommendations.
- 7) In both studies, AP need for other types of VI were not measured, such as the need for a white cane for untreatable blindness and the need for filter glasses for contrast sensitivity. Future surveys should consider wider VI assessments to provide estimates for additional vision domain AP.

#### **Implications for survey development**

- Measure both mild/worse and moderate/worse distance VI thresholds for distance glasses need.
- Measure uncorrected and corrected VA to report met need, unmet need, undermet need and total need for distance glasses indicators, which is well aligned with the vision sector indicator for effective coverage.(101)
- Follow the VA assessment approach used within RAAB methodology for ages  $>4$  years in the vision assessment module and review the VI assessment for ages  $\leq 4$  years old.
- Include near VI and the need for near vision glasses.
- Use both Peek acuity and near vision assessments.
- Ensure the clinician cadre administering the AP need vision module is well-aligned with RAAB methodology recommendations.
- Explore VI and AP need measurement approaches for additional AP.

#### 5.3.2 Clinical HI AP assessment

- 1) Using a bilateral moderate HI cut-off to determine hearing aid referrals limited hearing aid data in both Cameroon and India. Though this was congruent with the original survey method, it will be important for the AP need survey to gather data

- using both mild and moderate impairment thresholds. It will also be important to compare unilateral vs bilateral HI need to more accurately reflect referral needs.
- 2) The Gambia study followed the RAHL methodology (51) for a population of 35+ years old (instead of the recommended 50+ years old) using the mobile application hearTest (52) to measure PTA. This methodology is standardised, provides estimates for both mild/worse and moderate/worse HI and hearing aids, and uses a mobile application which decreased the need for equipment in the field. This methodology, rather than the methods used in Cameroon and India, should be used in future surveys for ages >4 years old. Though survey methods for ≤4 years require further review, Otoacoustic Emissions (OAE) testing with the pass/fail threshold is recommended for participants ≤4 years old which is the HI screening method used in the Cameroon and India surveys.
  - 3) hearTest can be administered by trained non-clinicians, however clinician cadres are needed for the clinical assessment of cause. The Cameroon and India surveys used an ENT nurse and audiologist respectively, and, in The Gambia study, an audiology nurse completed the hearing assessment. One clinician cadre will need to administer the AP need hearing module and this needs to be well-aligned with RAHL's recommendations.
  - 4) These surveys clinically assessed need for hearing aids only. AP need surveys should include assessment of need for other hearing AP as well, such as alarm signallers, which are important functionally for safety considerations.

#### **Implications for survey development**

- Measure both mild/worse and moderate/worse HI thresholds and AP need, and consider estimates for both unilateral and bilateral AP need.
- Follow the HI assessment approach used within RAHL methodology for ages >4 years in the hearing assessment module using hearTest for PTA and review AP need measurement approaches for HI in ages ≤4 years old.
- Ensure the clinician cadre administering the AP need hearing module is well-aligned with RAHL methodology recommendations.
- Explore HI and AP need measurement approaches for additional AP.

#### 5.3.3 AP indicators (vision and hearing)

- 1) In Cameroon and India, the study used the following AP indicator numerator definitions: total need= use + unmet need, and coverage= use (see **Chapter 5.1**). However, in The Gambia, the numerators were better defined, as mentioned above, i.e. total need= met need + undermet need + unmet need, and coverage= met need/total need. It is important that future VI and HI survey methodology collect data for these AP indicators. Undermet need has typically been a neglected

indicator, but it is important, especially for service quality. However, it is also noted that these specific AP need measurements might be too complex to measure in an AP need survey tool, so the feasibility needs to be reviewed depending on time and resources.

- a. For vision, to measure “met need” and “undermet need” *both* uncorrected and corrected VA need to be assessed.
  - b. For hearing, it was acknowledged that PTAs cannot be completed with hearing aids on, however if a participant had a hearing aid and was referred for follow up this was classified as undermet need. It will be important for future surveys to explore these hearing aid measurements, which would be more congruent with effective coverage recommendation.
- 2) Cameroon and India study measured all-age AP need, while in The Gambia survey, clinically assessed AP need was only assessed in adults aged 35+. It is recommended that the AP need survey methodology should assess all age groups, and this will need further studies/data to determine. For example, RAAB and RAHL compared all-age data to 50+ years data and from that determined that 50+ years would capture majority of impairment/causes and is quicker and less expensive to administer. By conducting all-age surveys of AP, similar analysis can be done to assess whether appropriate to develop “Rapid” version (e.g. 40+ years only) to collect majority of data for service planning.
- 3) In the Gambia survey, there was a lack of consistency in participant report of AP use within the survey. The glasses and hearing aid use questions were asked in three different survey sections, and participants’ responses varied across sections with poor agreement. For the purposes of the analysis, the clinician observed use on the day of the assessment was used as the gold standard. To ensure data is more reliable, it is important to pay attention to how this (seemingly simple) question is asked, by who and to explore if there might be any expectations of the participants around provision of AP. It is recommended participants are only asked once about their use of AP, and, if mobile data survey collection technologies are used, ensure any additional “AP use” question has an autofill response. Specifically, for vision, it was noted that the rATA self-report question asked about glasses use in general, instead of separating distance glasses and near glasses. Use of distance glasses and near glasses should be asked separately in the AP need survey.
- 4) Hearing aid awareness was low in all three studies. For example, of those who were clinically assessed to need hearing aids, 10% in India and 29% in Cameroon reported not knowing what one was.(102) In The Gambia study, AP awareness for other hearing AP was low as well, and it is likely awareness will be more limited for

other lesser known AP. Standardised vision and hearing AP item descriptions and pictorial image cards were used in The Gambia study to enhance participants' understanding, so it is recommended that they are used in future AP use self-report sections.

#### **Implications for survey development**

- Ensure vision and hearing AP met need, undermet need and unmet need are measured when feasible and possible, i.e. for vision, distance glasses met need and undermet need *both* uncorrected and corrected VA need to be assessed.
- Assess AP need in all age groups, including younger age groups.
- Improve the reliability of data collected on AP use by ensuring more consistency with the administration of this self-reported question and, for glasses asking specifically about use of distance glasses and near glasses separately.
- Use AP item descriptions and pictorial image cards in self-reported AP use sections.

#### 5.3.4 Data disaggregation (vision and hearing)

- 1) Total need and unmet need indicators for distance glasses and hearing aids were disaggregated by gender and age in the Cameroon and India study, and by gender, age, location and socioeconomic status (SES) in The Gambia study. The Equity Tool (103) was used in The Gambia to measure SES and is recommended for the AP need survey. This data provides important information about predictors of need for informing services and should be collected in an AP need survey.

#### **Implications for survey development**

- Disaggregate vision and hearing AP indicators by age, sex, location and SES ensuring data is collected to enable disaggregation of AP need by these variables.

#### 5.3.5 Additional lessons learned (vision and hearing)

- 1) For the self-reported data, The Gambia study used a WG “some or worse” difficulty seeing and hearing cut offs. It is possible that some participants who reported “no problem seeing” and “no problem hearing” were aware of the AP and/or might self-report still needing AP. Using this cut-off as a first stage screen may underestimate AP need. It is important to explore the accuracy of the “some or worse” difficulty cut-off to determine AP need (see **Chapter 8**).
- 2) Alongside measuring need for vision and hearing AP, a gap noted in both studies was the ability to collect data on the need for related services. It will be important that both service and AP data are measured in future surveys for planning services.

### **Implications for survey development**

- Explore the accuracy of using the WG question cut-off of “some or worse” difficulty seeing and hearing as a first stage screen for assessing AP need.
- In a broader need survey, recommendation to collect data on vision and hearing related service need, alongside AP need data.

## **5.4 Comparison of clinical impairment and self-report AP assessment methods**

Lessons learned following the comparison of clinical impairment and self-report assessment methods are provided below for both vision and hearing, highlighting key implications for the development of the AP need survey.

### 5.4.1 Vision and hearing assessments

- 1) The agreement between moderate or worse clinical VI and self-reported “seeing difficulty” assessment, and clinical HI and self-reported “hearing difficulty” assessment, was poor. Consequently, there was a discrepancy in self-reported and clinical impairment assessed need for distance glasses and hearing aids respectively.
  - a. For example with vision, of those who self-reported a need for distance glasses, only 25% in India and 9% in Cameroon actually needed distance glasses according to clinical VI assessment.(102)
  - b. For example with hearing, of those who self-reported a need for hearing aids, 69% in India and only 18% in Cameroon actually needed hearing aids according to clinical HI assessment.(102)

These findings support the recommendation that self-report AP need is insufficient, and hybrid vision and hearing assessment modules incorporating both clinical impairment and self-report assessment might provide more accurate AP estimates.

- 2) The “gold standard” assessment of need for AP in all three surveys used clinical impairment assessment only based upon the clinician’s assessment. Importantly, this assessment only incorporates one component of the ICF and does not take into account participants’ activities, participation, personal and environmental factors. It will be important to integrate other ICF component assessments, such as hybrid functional assessment modules, into future vision and hearing assessment modules alongside clinical impairment and self-report assessments. The feasibility and practicality of a hybrid multi-domain modular tool for use in a population-based AP need survey will need to be explored, as well as methods for how best to capture the clinicians’ clinical reasoning and analysis, such as by using AP need decision trees following an algorithm.

**Implications for survey development**

- Develop hybrid vision and hearing assessment modules incorporating clinical impairment, functional and self-report assessments.
- Explore the feasibility and practicality of hybrid assessment tool.
- Explore the development of AP need decision trees following an algorithm.



## Chapter 6: Field test and assess feasibility of mobility methodology in one LMIC

This chapter presents a study that was undertaken to explore and advance the population-based RAM survey methodology to estimate MSI and related service and AP need. An overview of the updated RAM methodology is also provided.



A woman standing using two lower limb prostheses and a tripod cane. © Relief International

## **6.1 *Research paper 5: MSI prevalence, cause, diagnoses and related need for services and APs among Syrian refugees living in Sultanbeyli, Turkey using an updated RAM***

### **Preamble**

Following the development and use of the RAM in four LMICs (Rwanda, Cameroon, India and Malawi) since 2007, this study sought to update and test the assessment methodology to estimate prevalence and causes of MSI, and need for services and AP. To do this update, an MSI sub-study was conducted as part of a survey of Disability and Mental Health among Syrian refugees in Turkey. This survey took place between August to October 2019 in collaboration with the Relief International and Mülteciler Derneği Refugee Association. The aim was to review, update and conduct a RAM to estimate the MSI prevalence, causes, diagnoses and related need for services and AP among Syrian refugees living in Sultanbeyli, Turkey. No previous MSI survey had been conducted in this population. I co-led the training and co-supervised the fieldwork and data collection.

This paper presents the updated RAM methodology for estimating MSI prevalence, causes, diagnoses and related need for services and AP, building upon the findings and recommendations of earlier work. The overall findings of the survey are presented, together with information on the use and need for specific mobility-related services and AP, and barriers to access. Finally, the paper provides recommendations for future research, including the development of clinical decision tree algorithms, providing further rationale for a hybrid functional needs assessment tool.

This paper was published in January 2022 in the Conflict and Health. The manuscript was published under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), and the published manuscript is included in full below.

### 6.1.1 List of Tables

**Table 1:** Age and gender distribution of district (database) and study sample population.

**Table 2:** Prevalence of musculoskeletal impairment by age, gender and impairment severity.

**Table 3:** Aetiology of musculoskeletal impairment cases.

**Table 4:** Clinical diagnoses by type in 373 Syrian refugees with musculoskeletal impairment in Sultanbeyli, Turkey.

**Table 5:** Services for individuals with musculoskeletal impairment: need, access, unmet need and barriers.

**Table 6:** Assistive products for individuals with musculoskeletal impairment: need, access, unmet need and barriers.

### 6.1.2 List of Figures

**Figure 1:** Rapid Assessment of Musculoskeletal six screening questions with update changes in red.

**Figure 2:** Rapid Assessment of Musculoskeletal case severity card.

**Figure 3:** Sultanbeyli musculoskeletal survey participant flow chart.

**Figure 4:** Clinical diagnostic categories of musculoskeletal impairment, by age group

### 6.1.3 Supplementary material

The Supplementary material referenced in the paper is available at <https://doi.org/10.1186/s13031-021-00362-9>.

**Additional file 1:** Rapid Assessment of Musculoskeletal (RAM) tool (version 2).

**Additional file 2:** Indicator definitions for services and assistive products proportions calculated.

#### 6.1.4 Citation

Boggs, D; Atijosan-Ayodele, O; Yonso, H; Scherer, N; O'Fallon, T; Deniz, G; Volkan, S; Örüçü, A; Pivato, I; Beck, AH; Akıncı, İ; Kuper, H; Foster, A; Patterson, A; Polack, S; (2021) *Musculoskeletal impairment among Syrian refugees living in Sultanbeyli, Turkey: prevalence, cause, diagnosis and need for related services and assistive products*. *Conflict and health*, 15 (1). 29-. DOI: <https://doi.org/10.1186/s13031-021-00362-9>



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms.
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	Conflict and Health		
When was the work published?	April 2021		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	Yes, This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a>	Was the work subject to peer review?	Yes

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### **SECTION C – Prepared for publication, but not yet published**

Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I co-developed the sub-study, co-led training and was involved in data collection, conducted the analysis and drafted the manuscript with supervision input from Sarah Polack, and considered revisions and comments from other authors.
--	--

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022


<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022

RESEARCH

Open Access



# Musculoskeletal impairment among Syrian refugees living in Sultanbeyli, Turkey: prevalence, cause, diagnosis and need for related services and assistive products

Dorothy Boggs<sup>1\*</sup> , Oluwarantimi Atijosan-Ayodele<sup>2</sup>, Hisem Yonso<sup>3</sup>, Nathaniel Scherer<sup>1</sup>, Timothy O'Fallon<sup>1</sup>, Gülten Deniz<sup>4</sup>, Selin Volkan<sup>3</sup>, Ahmed Örüçü<sup>4</sup>, Isotta Pivato<sup>3</sup>, Ammar Hasan Beck<sup>3</sup>, İbrahim Akıncı<sup>4</sup>, Hannah Kuper<sup>1</sup>, Allen Foster<sup>5</sup>, Andrea Patterson<sup>3</sup> and Sarah Polack<sup>1</sup>

## Abstract

**Background:** Epidemiological data on musculoskeletal impairment (MSI) and related service and assistive product (AP) needs for displaced populations are lacking. This study aimed to estimate the prevalence, aetiology, and specific MSI diagnosis and the need for related services and APs among Syrian refugees living in Sultanbeyli, a district in Istanbul, Turkey.

**Methods:** A population-based survey used probability proportionate to size and compact segment sampling to select 80 clusters ('street') of 50 individuals (aged 2+), for total sample size of approximately 4000 participants. An updated version of the Rapid Assessment of MSI tool (RAM) was used to screen all participants using six questions. Any participant who screened positive underwent a standardised examination by a physiotherapist to assess the presence, aetiology, severity and specific diagnosis of MSI and an assessment of need for related services and APs.

**Results:** The all-age prevalence of MSI was 12.2% (95% CI 10.8–13.7) and this increased significantly with age to 43.8% in people 50 and older. Over half (51%) of MSI was classified as moderate, 30% as mild and 19% as severe. The war in Syria was identified as the direct cause for 8% of people with MSI. The majority (56%) of MSI diagnoses were acquired non-traumatic causes. There was high unmet need for rehabilitation services; for example, 83% of people with MSI could benefit from physiotherapy but were not receiving this service. Overall, 19% of people with MSI had an unmet need for at least one AP. Apart from availability of walking sticks/canes, coverage was low with less than half the people with MSI who needed APs and services had received them. The most common reasons for not seeking services and APs were 'need not felt', lack of service availability and of awareness of services, and financial barriers.

(Continued on next page)

\* Correspondence: [dorothy.boggs@lshtm.ac.uk](mailto:dorothy.boggs@lshtm.ac.uk)

<sup>1</sup>International Centre for Evidence in Disability, London School of Hygiene & Tropical Medicine, London, UK

Full list of author information is available at the end of the article



© The Author(s). 2021 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

(Continued from previous page)

**Conclusions:** MSI is common among the Syrian refugee population living in Sultanbeyli District, particularly older adults, however less than half have been able to access relevant services and APs. These findings can inform the planning of health services for migrant populations, including the essential integration of rehabilitation and APs, and increase access to these vital services.

**Keywords:** Population, Prevalence, Musculoskeletal impairment, Syrian refugee, Survey, Services, Assistive products

## Background

Epidemiological population-based data on musculoskeletal impairment (MSI) and the need for related services and assistive products (APs) are limited in low- and middle-income countries (LMIC) despite evidence that MSI-related difficulties are common [1–3]. In the *World Health Survey*, difficulties with mobility and pain were amongst the most commonly reported functional difficulties for adults aged 18 years and older, with more than 16.5% of respondents reporting mild or greater difficulty with ‘moving around’ [3, 4].

MSI data are particularly lacking for refugee populations despite increasing recognition of and commitment to disability inclusion in humanitarian contexts [5, 6]. A survey among Syrian refugees in Lebanon and Jordan found that 14.4% of adults reported difficulties walking, however these data were based on self-report only and may not capture all functional limitations related to MSI [7]. Conflict and displacement can increase the risk of impairment and disability either directly, such as new trauma and injuries related to war, especially in the context of disrupted health services, or indirectly, such as through the breakdown of infrastructure and social structures and loss/damage of APs. These risks may be especially common in situations of displacement where there can be varying levels of access to health and social care in host countries, which further cause and/or exacerbate impairments [8]. Data on MSI are needed in order to inform and advocate for services to maximise functioning, participation and quality of life among marginalised refugee populations [9].

MSI can result from many different health conditions, such as neurological, musculoskeletal, developmental and pain related conditions [including more than 150 of the 350 Global Burden of Disease (GBD) health conditions]; MSI assessment is therefore complex [1, 10, 11]. The Rapid Assessment of Musculoskeletal Impairment (RAM) is a validated clinical impairment screening tool developed by Oxford University and the International Centre for Evidence in Disability (ICED) to estimate population-based prevalence, aetiology and diagnoses of MSI [12]. It uses a two step-process which includes six initial screening questions to assess self-reported difficulties with the musculoskeletal system, followed by a clinician-led examination. The RAM [12] has been used

in Rwanda, Cameroon and India where all age prevalence of MSI was found to be 5.2%, 11.6% and 19.6%, respectively [12–15]. Experience of using the RAM in these settings has identified a need to review and update the methodology including the screening questions, the method for assigning presence and severity of MSI, and the data collection on service and AP needs to improve utility of the data for health and rehabilitation service planning.

Estimates suggest that Turkey hosts 64% of Syrian refugees, totalling more than 3.6 million people [16]. The vast majority (96%) live among host communities in urban, peri-urban and rural areas [16]. Specifically, at the time of this study, approximately 20,000 Syrian refugees lived in the Sultanbeyli District, a sub-urban area on the outskirts of Istanbul hosting the largest number of refugees in a single district on the Anatolian side of the city [17]. Data on MSI and associated service needs among this displaced population are lacking, which hinders evidence-based advocacy and planning of services for this population. Using an updated version of the RAM tool, this study aims to estimate the prevalence, aetiology and diagnoses of MSI and the need for related services and APs among Syrian refugees living in Sultanbeyli.

## Methods

### Sampling

The study was conducted as part of a wider population-based survey of disability during August to October 2019 in Sultanbeyli District in Istanbul, Turkey. Based on previous surveys, an all-age [disability and] MSI prevalence was conservatively estimated to be 5%. Thus, a sample size of 4000 people aged 2 years and above was required, allowing precision of 20% around the estimates, 95% confidence, 20% non-response, and a design effect of 1.7.

Multi-stage cluster randomised sampling was used to select study participants. The municipality refugee registration database provided by Mülteçiler Derneği, a local non-government organisation providing migrant social and healthcare services for refugees, was used as the sampling frame [18].

A “cluster” was defined as a street within Sultanbeyli and 80 clusters were randomly selected using probability



proportionate to size sampling. Within each cluster, households were randomly selected until at least 50 participants aged 2+ were included. When a street did not contain 50 participants, connecting and adjacent streets were randomly selected until the target number was achieved. For the purposes of this survey, all Syrians aged 2+ within selected households were included in the survey, regardless of ‘Temporary Protection’ status. To maximise the response rate: i) enumeration teams telephoned households in advance when possible to inform them of the survey and arrange a suitable time to visit; ii) at least two repeat visits were attempted if not available; and iii) revisits were scheduled over the phone when possible for weekday evenings and weekends.

**RAM methodology and adaptations**

Building upon lessons learned from previous surveys, the RAM [12] underwent review by a development team of experts in MSI and population-based surveys to address the identified gaps. This section will give an overview of the RAM methodology highlighting the updates/revisions made with RAM tool version 2 provided in Additional file 1.

The RAM tool consists of two stages. Six screening questions ask about difficulty using the limbs or body, use of AP, or experiences of convulsions or loss of consciousness. Participants screen positive if they report yes to any of the questions, with a duration longer than one month or believed to be permanent. Based on existing MSI/pain research [2] and RAM findings in India [14], three of the screening questions were updated to include ‘pain’ in addition to ‘difficulty using’ the musculoskeletal system (see Fig. 1).

Anyone who screens positive then undergoes a standardised assessment by a physiotherapist and a physical examination and observation of activities to assess aetiology, severity of impairment, specific diagnosis and related service and AP needs/unmet needs [12].

First, participants undergo a standardised observation of four sets of activities to assess body functioning and examination of the structure of the affected area. The four sets of activities involve: i) positioning with squat to

stand raising both arms straight over head; ii) mobility by walking along a 11-m rope in less than 10 s with or without limping; and iii) right and iv) left upper limb function by touching nose and picking up a coin to put in cup and tip into bowl. These observations, assessed in the previous version of RAM using a binary can/can’t response, were revised to a graded response: can do easily, can do with difficulty and cannot do.

Second, participants are asked about the timing and aetiology of the impairment and an examination of the affected structure is conducted. In the revised RAM, this section of the tool was simplified from 23 individual body items to five categories of main body areas, with individual items listed within the respective body area grouping. In the previous RAM, data were also collected on the nature of change and magnitude, however these sections were omitted in the revised version as they were considered redundant based on analysis of previous surveys.

Third, based on these interviews and examinations, the participant is then categorised by the physiotherapist as having “no” MSI or a “mild”, “moderate” or “severe” MSI with respect to the musculoskeletal system’s ability to function. In the revised version we developed specific definitions (previously lacking) for these categories to ensure greater consistency within and between surveys (see Fig. 2).

Fourth, the physiotherapist assigns a specific diagnosis within the five clinical categories (congenital, infective, traumatic, acquired non-traumatic or neurological). Up to a maximum of three diagnoses per case could be assigned.

Fifth, participants are asked about their past/current use of services, including treatment or rehabilitation, and APs. Physiotherapists then make referral recommendations based upon their clinical judgement. This section of the tool was updated to include more detailed and structured questions to better inform identification of service and AP needs.

Finally, the tool was programmed using Open Data Kit (ODK) so data could be collected using mobile tablets.

**Data collection**

Data collection tools were forward and back translated into Arabic to assess for accuracy and conceptual

	Yes	No
1. Is any part of your body missing or misshapen?:	O (1)	O (0)
2. Do you have any difficulty <b>or pain</b> using your arms?:	O (1)	O (0)
3. Do you have any difficulty <b>or pain</b> using your legs?:	O (1)	O (0)
4. Do you have any difficulty <b>or pain</b> using any other part of your body?:	O (1)	O (0)
5. Do you need a mobility aid or prosthesis?:	O (1)	O (0)
6. Do you have convulsions, involuntary movement, rigidity or loss of consciousness?:	O (1)	O (0)

**Fig. 1** Rapid Assessment of Musculoskeletal six screening questions with update changes in red

LOWER LIMB AND BACK	UPPER LIMB
<p><b>NOT CASE (Yes to all of a-c)</b> <input type="checkbox"/></p> <p>a) Can stand up straight on natural legs                      b) Can walk 11 m in 10 secs without limping                      c) Can squat/sit and bend knees                      d) Has typical shape limb, feet and toes</p>	<p><b>NOT CASE (Yes to all of a-c)</b> <input type="checkbox"/></p> <p>a) Can touch nose                      b) Can pick up coin and put in cup                      c) Can tip coin into bowl                      d) Has typical shape limb and fingers</p>
<p><b>MILD CASE (yes to at least one of a-d)</b> <input type="checkbox"/></p> <p>Can walk:                      a) but takes longer than 14 seconds                      b) in 10 seconds but limps                      c) in 10 seconds but with walking aid                      d) in 10 seconds but using prosthesis</p>	<p><b>MILD CASE</b> <input type="checkbox"/></p> <p>Handles most objects easily and successfully or with reduced quality or speed</p>
<p><b>MODERATE CASE</b> <input type="checkbox"/></p> <p>Can walk 11m but it takes longer than 14 secs</p>	<p><b>MODERATE CASE</b> <input type="checkbox"/></p> <p>Handles objects with difficulty and needs help to pre-arrange items</p>
<p><b>SEVERE CASE (Yes to one of a-b)</b></p> <p>a) Cannot walk                      b) Can walk but extreme pain/difficulty</p>	<p><b>SEVERE CASE (Yes to one of a-b)</b> <input type="checkbox"/></p> <p>a) Does not handle objects and has limited ability to perform simple actions                      b) Can only handle objects if pre-arranged and have continuous assistance</p>

**Fig. 2** Rapid Assessment of Musculoskeletal case severity card

equivalence and pilot tested with members of the target population.

In each cluster, all eligible survey participants (aged 2+) were documented by an enumerator who then administered the six screening questions for MSI. Participants who screened positive with the questionnaire were visited, at their home, by a trained Syrian physiotherapist who knew the language, either the next day or a later date as convenient for the participant. The physiotherapist re-administered the six initial screening questions and then conducted the RAM as described above. For those cases of MSI for which ‘no specific diagnosis’ was recorded, their assessment data were reviewed by three research clinician authors (DB, TO, OA) who by consensus agreed and recorded specific diagnoses.

Data collection took place in the participant’s own homes. A proxy response was provided by a primary caregiver for children aged 2–10 or for any participants unable to communicate independently, in the presence of the participant where possible.

Survey data were collected on android tablets using LSHTM’s ODK software. Data on each tablet was encrypted and uploaded at the end of each day via Wi-Fi to a secure, password-protected, cloud-based server.

**Training**

The wider disability survey was completed by four teams who underwent ten days of training, which included three days field pilot. Three physiotherapists conducted the RAM. The physiotherapists’ five-day classroom training was led by authors (OA, DB and HY) with lectures, role plays, discussions and observed practise assessments with patients at a physiotherapy centre. Training included

physiotherapists independently completing assessments for the same participant to develop inter-rater agreement.

**Data analysis**

Data were analysed using STATA 16.0 (StataCorp LP, College Station, Texas). The ‘svy’ command was used to derive proportion estimates accounting for cluster sampling.

We calculated proportions for each service and AP to determine, if ever received, current access and location, unmet need and for reasons for not seeking the service/ AP (see Additional file 2).

**Ethical approval**

Ethical approval for the study was provided by: London School of Hygiene & Tropical Medicine Observational Ethics Committee; Istanbul Sehir Univesity Research Ethics Committee; and Republic of Turkey Ministry of Interior: Directorate General of Migration Management.

Informed consent (written or thumbprint) was initially sought from self-identified heads of each household and subsequent consent was sought from all adult household participants who took part in the population-based survey. For participants under the age of 18 or for adults unable to communicate, verbal assent was sought from the participant using a simplified information sheet and written consent was sought from a parent or caregiver.

All participants identified in the survey as having health needs, including rehabilitation and APs, were referred to relevant local services which had been previously identified.

**Results**

Of 4018 eligible participants, 3084 participated in the survey (response rate of 77%). In total, 613 (15%) were unavailable and 321 (8%) refused to participate. Compared to those who took part in the survey, non-participants were, more likely to be male (47% vs 65%,  $p < 0.001$ ). The response rate was slightly lower among adults aged 18–49 (72%) and 50+ (75%) compared to children (82%),  $p < 0.001$ . Out of the 531 people who screened positive for MSI, 470 (89%) underwent MSI assessment, 48 (9%) were unavailable, 13 refused (2%) and 1 (< 1%) was unable to participate. Of the 469 participants who were assessed, 373 were confirmed to have MSI and 96 participants who screened positive were assessed not to have an MSI (see Fig. 3).

As shown in Table 1, the age and sex distribution of the study population was similar to that of the full population of registered refugees in Sultanbeyli. The study population was relatively young; 50% were under 20 years and only 3% were aged 60+ years.

**Prevalence of MSI**

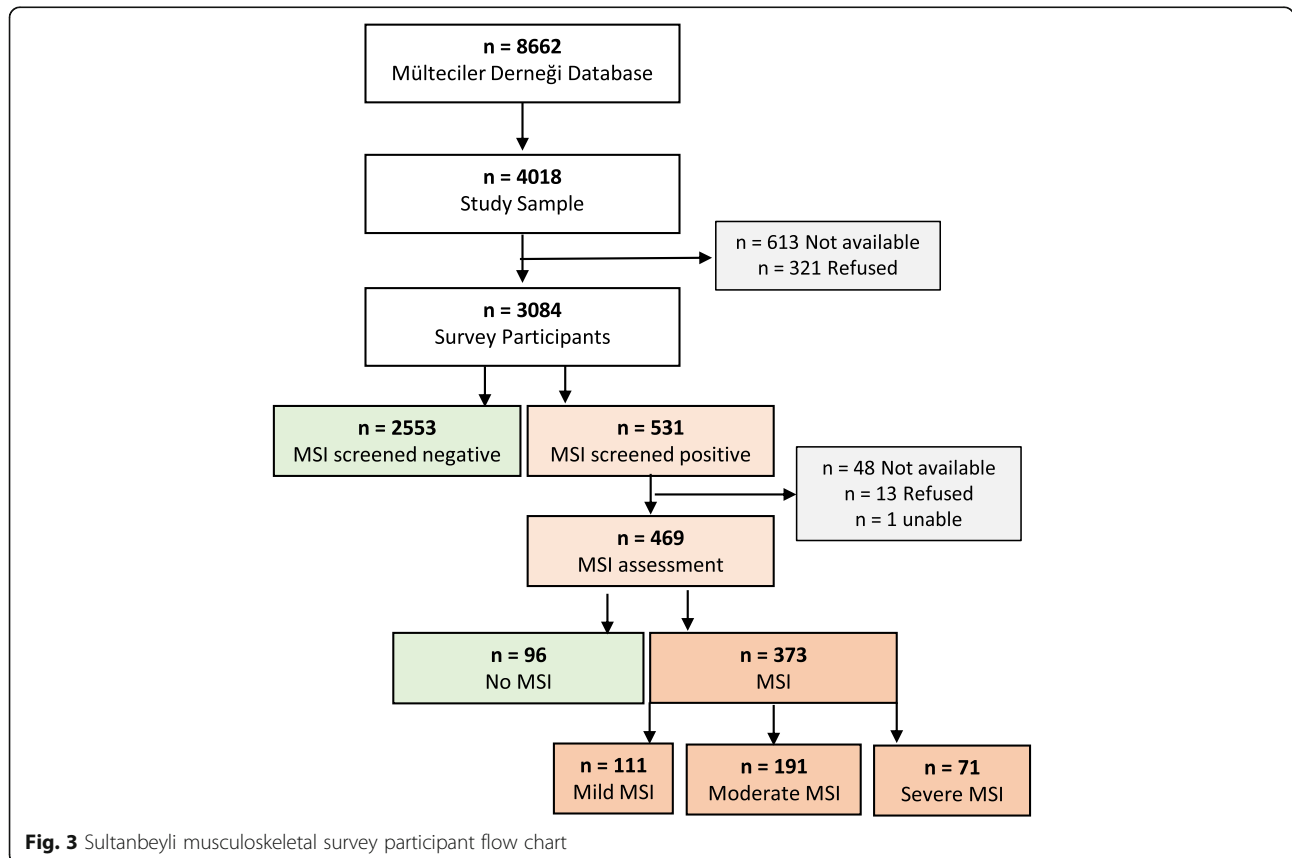
In total, 373 of the 3022 survey participants were identified as having an MSI with overall prevalence of 12.2%

(95% CI 10.8–13.7) (see Table 2). The prevalence increased by age from 3.9% (95% CI 3.0–5.1) in children (2–17 years) to 43.8% (95% CI 37.0–50.9) among adults aged 50+ years ( $p < 0.001$ ). In terms of severity, 30% of MSI cases were mild, 51% moderate and 19% were severe. The overall prevalence of moderate or severe impairment was 8.6% (95% CI 7.5–9.8) and was 14.2% (95% CI 12.3–16.2) in adults aged 18 years and older. The prevalence of mild MSI was higher in females (4.7%, 95% CI 3.5–6.2,  $p$ -value 0.002) than males (2.5%, 95% CI 1.7–3.6), but there was no significant difference in the prevalence of moderate or severe MSI.

Extrapolating the MSI prevalence to the estimated total population of 20,000 Syrian refugees living in Sultanbeyli suggests there are approximately 2560 people with an MSI, and 1790 would have with moderate or severe impairment.

**Aetiology**

As shown in Table 3, trauma was the most common identified aetiology (16%) of MSI. Specifically, the war in Syria was identified as the direct cause for 8% of people with MSI. Developmental or nutritional causes were assigned as the aetiology for 11% of people with MSI. For over 25% of people the aetiology could not be identified.



**Fig. 3** Sultanbeyli musculoskeletal survey participant flow chart

**Table 1** Age and gender distribution of district (database) and study sample population

	Total				Males				Females			
	Registration database		Study sample		Registration database		Study sample		Registration database		Study sample	
Age (years)	N	%	N	%	N	%	N	%	N	%	N	%
2–9	4793	26%	875	28%	2497	26%	442	31%	2296	26%	432	26%
10–19	4440	24%	773	25%	2316	24%	372	26%	2124	24%	401	24%
20–29	3558	19%	509	16%	1735	18%	199	14%	1823	20%	310	19%
30–39	2844	15%	446	14%	1574	16%	207	14%	1270	14%	239	15%
40–49	1545	8%	239	8%	795	8%	107	7%	750	8%	132	8%
50–59	935	5%	161	5%	484	5%	78	5%	451	5%	83	5%
60+	547	3%	81	3%	267	3%	38	3%	280	3%	43	3%
<b>Total</b>	18,662	100	3084	99	9668	100	1443	100	8994	100	1640	100

### Specific diagnoses

There were a total of 519 specific diagnoses for 373 participants with MSI (Table 4). Of the 519 MSI diagnoses over half ( $n = 291$ , 56%) were acquired non-traumatic causes, with spinal pain limiting function being the most common individual specific diagnosis. Nearly one-quarter ( $n = 123$ , 24%) of MSI diagnoses were acquired trauma, 10% ( $n = 53$ ) were neurological, 1% ( $n = 6$ ) were due to infection and 9% ( $n = 46$ ) were congenital.

Diagnoses varied by age (Fig. 4). The prevalence of congenital diagnoses was highest in children (2–17 years) at 2%, while neurological diagnoses was highest in the older age group 50 and older at 8%. Trauma related MSI increased with age from 0.7% among 0–17 years to 14% among the  $\geq 50$  years age group. The proportion of acquired non-traumatic diagnoses also increased substantially with age so that 46% of people with MSI aged  $\geq 50$  years had this diagnosis.

### Service use and need

As shown in Table 5, overall service need, defined as people with MSI who were currently receiving/awaiting the service and those who (according to the physiotherapist) could benefit from a particular service but had not/were not currently receiving it, was high among people with MSI. Physiotherapy had highest service need (86%) among people with MSI, followed by medication (70%), information/exercises (40%), surgery (21%), other rehabilitation (15%), other services (13%) and environmental modifications (12%). Among the total survey population, 11% needed physiotherapy, 9% needed medication and 5% needed information/exercises, with all other assessed service need  $\leq 2.5\%$ .

The most commonly ever received services, among people with MSI, were medication (49%) followed by

physiotherapy (20%) and surgery (18%). Specifically, in Turkey, the government hospital was the most commonly accessed service for medication (33% of those who had accessed services for medication) and surgery (100%). The Migrant Health Centre was most commonly used service for physiotherapy (79%), information/exercises (80%) and environmental modifications (50%).

Unmet need for services, defined as the proportion of people with MSI who (according to the physiotherapist) could benefit from a particular service but had not/were not currently receiving it, was high, with 347 of 373 (93%) people with MSI not receiving *at least* one service related to MSI that they could benefit from. This included 308 (82.6%) people with MSI who could benefit from physiotherapy, 143 (38.3%) people information/exercises, 139 (37.3%) medication, 72 (19.3%) surgery and 53 (14.2%) for other rehabilitation. No difference was found in unmet need for *at least* one service between males and females.

The reasons for not seeking services varied between service type; however, the most common reasons given were ‘need not felt’ (19% to 63%), lack of awareness of services (10% to 53%), financial barriers (16% to 51%) and lack of service availability (17% to 42%).

Applying estimates of unmet need to the overall study population suggests 10% of Syrian refugees living in Sultanbeyli need, but are not receiving physiotherapy, 4.7% information/exercises and 2.4% surgery. Overall, 11.5% ( $n = 347$ ) of the study population needed but were not receiving *at least* one service related to MSI that they could benefit from. Extrapolating to the estimated total population of 20,000 Syrian refugees living in Sultanbeyli suggests there are approximately 2400 people who need, but are not be receiving *at least* one MSI-related service.

Coverage was calculated as the proportion of people who were receiving a service out of those who needed the service (i.e. those receiving a service plus those who

**Table 2** Prevalence of musculoskeletal impairment by age, gender and impairment severity

	TOTAL		2-17		18-34		35-49		50+ years		Male		Female	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
<b>Mild</b>	111	3.7 (2.8-4.7)	11	0.7 (0.4-1.4)	37	4.4 (3.0-6.4)	33	7.7 (5.5-10.6)	30	12.8 (8.9-18.1)	35	2.5 (1.7-3.6)	76	4.7 (3.5-6.2)
<b>Moderate</b>	191	6.2 (5.3-7.3)	30	1.9 (1.3-2.8)	43	4.9 (3.5-6.7)	62	14.7 (11.4-18.6)	56	23.8 (18.8-29.7)	90	6.2 (5.0-7.7)	101	6.2 (4.9-7.9)
<b>Severe</b>	71	2.3 (1.8-3.0)	19	1.3 (0.8-2.0)	20	2.3 (1.4-3.6)	15	3.6 (2.2-5.9)	17	7.2 (4.4-11.8)	38	2.6 (1.9-3.6)	33	2.1 (1.4-2.9)
<b>All MSI</b>	373	12.2 (10.8-13.7)	60	3.9 (3.0-5.1)	100	11.5 (9.0-14.6)	110	26.0 (21.8-30.6)	103	43.8 (37.0-50.9)	163	11.4 (9.7-13.3)	210	13.0 (11-15.2)

**Table 3** Aetiology of musculoskeletal impairment cases

Causes	Total causes <sup>a</sup>	
	N	%
Family history	7	2%
Congenital but no family history	31	8%
Perinatal hypoxia	11	3%
Road traffic accident	13	4%
Trauma <sup>b</sup>	61	16%
War in Syria	28	8%
Other war	2	0.5%
Deliberate self-harm	1	0.3%
Other accidents	30	8%
Developmental / nutritional	42	11%
Infection	22	6%
Neoplasm	4	1%
Iatrogenic	2	0.5%
Unknown	96	26%
Other <sup>c</sup>	132	35%
Herniated disc	57	15%

<sup>a</sup>Some participants had two causes so there were a total of 421 causes for 373 people

<sup>b</sup>A breakdown by type of trauma is provided

<sup>c</sup>A breakdown by 'other' is provided for herniated disc only (note: direct translation was herniated nucleus pulposus)

needed but were not receiving that service). Coverage was relatively low: 47% of the 260 people who needed medication were receiving it, while this was <10% for surgery, physiotherapy, information/exercises, environmental modifications and other services.

#### Assistive product use and need

As shown in Table 6, overall AP need, defined as people with MSI who were currently using the AP and those who (according to the physiotherapist) could benefit from a particular AP but had not/were not currently using it, was much lower than service need among people with MSI. Protective footwear need was highest (7.2%), followed by stick/canes (4.3%), orthotics (3.8%), wheelchairs (3.8%) quad/tripod sticks (3.2%), with other AP need was  $\leq 2.4\%$ . There was no need for ramps. Among the total survey population, overall AP need was  $\leq 0.5\%$  for each one of the APs assessed.

Current AP use was uncommon for people identified as having MSI: 11 (3%) participants with MSI currently used a stick/cane, six (1.6%) used a wheelchair, and four used a toilet/shower chair (1.1%). For other APs, either one or no participants were currently using. Specifically, in Turkey, the Migrant Health Centre was most commonly accessed for APs.

Unmet need for AP was defined as the proportion of those people with MSI who (according to the

physiotherapist) could benefit from a particular AP but were not currently using a particular AP. Overall, 19% ( $n = 70$ ) of people with MSI needed, but were not using, *at least* one AP related to MSI that they could benefit from. Unmet need was highest for protective footwear (27 out of 373, 7.2%) and lower for other APs (see Table 6).

Among people who needed, but were not using an AP, the most common reasons for not using were lack of AP availability (22% to 100%), financial barriers (15% to 100%) and 'need not felt' (8% to 80%).

Applying estimates of unmet need, 2.3% ( $n = 70$ ) of the study population of Syrian refugees needed, but were not receiving, *at least* one AP related to MSI that they could benefit from. Extrapolating to the total population of Syrian refugees living in Sultanbeyli suggests there are approximately 500 people who need, but are not be receiving *at least* one MSI related AP.

Coverage for APs, calculated as the proportion of people who are currently using AP out of those who need (but don't have) or are currently using AP, was very low: there was no coverage for crutches, quad/tripod sticks, protective footwear, upper limb prosthetic and grab bars and less than half for other APs, except walking sticks/canes (69%).

## Discussion

### MSI survey results

This population-based survey of persons aged 2 years and above found that MSI among Syrian refugees living in Sultanbeyli Istanbul was common, with an estimated prevalence of 12.2% of MSI. The prevalence increased significantly by age to 43.8% in adults aged 50 years and older.

Compared to previous studies using the RAM, the prevalence was similar to that found in Cameroon (11.6%) and more than twice the prevalence in Rwanda (5.2%) [13, 15]. The prevalence was lower than the RAM study in India (19.6%) which included an additional screening question on back-pain which may have contributed to the higher estimate [14]. It might also reflect the relatively younger age of the population in the current study where only 8% were >50 years compared to 19% in India. The prevalence of moderate/severe MSI among Syrian refugees (8.6%) was higher than the three previous RAM studies (India 3.5%, Cameroon 3.4%, Rwanda 2.8%), despite the relatively young age of the current study population [13–15]. This may reflect direct or indirect impact of the Syrian war, such as an injury or challenges in accessing services prior, during or after displacement, leading to more severe impairments. However, it is also possible that this may reflect the revisions made to the RAM survey tool in particular the inclusion of pain in the screening questions and the use of

**Table 4** Clinical diagnoses by type in 373 Syrian refugees with musculoskeletal impairment in Sultanbeyli, Turkey

Diagnosis	Number	Total in category <sup>a</sup> N (%)
<b>A. Congenital</b>		<b>46 (9%)</b>
Other congenital hand deformity	1	
Other congenital abnormality of upper limb	6	
Developmental dysplasia of hip	4	
Proximal focal femoral deficiency	2	
Club foot	7	
Other congenital abnormality of lower limb	11	
Congenital deformity of cervical spine	2	
Congenital deformity of thoracolumbar spine	6	
Multiple congenital abnormalities	7	
<b>B. Infection</b>		<b>6 (1%)</b>
Joint infection	4	
Bone infection spine	2	
<b>C. Acquired traumatic</b>		<b>123 (24%)</b>
Fracture non-union	4	
Fracture malunion	7	
Spinal injury	7	
Head injury	3	
Recurrent/chronic dislocation	1	
Post traumatic joint stiffness	28	
Tendon problem	17	
Muscle problem	18	
Peripheral nerve problem	8	
Amputation	3	
Other trauma	27	
<b>D. Acquired non-traumatic</b>		<b>291 (56%)</b>
Degenerative joint disease	86	
Non-infective non-traumatic joint disease	20	
Bow legs	1	
Knock knees	2	
Skin/Soft tissue tumour	1	
Spinal deformity-kyphosis	2	
Spinal deformity-lordosis	1	
Spinal deformity-scoliosis	2	
Spinal pain limiting function	102	
TB spine/spine infection	1	
Limb pain limiting function	51	
Lymphoedema	1	
Other acquired non-traumatic	21	
<b>E. Neurological</b>		<b>53 (10%)</b>
Epilepsy	11	
Developmental delay	1	

**Table 4** Clinical diagnoses by type in 373 Syrian refugees with musculoskeletal impairment in Sultanbeyli, Turkey (*Continued*)

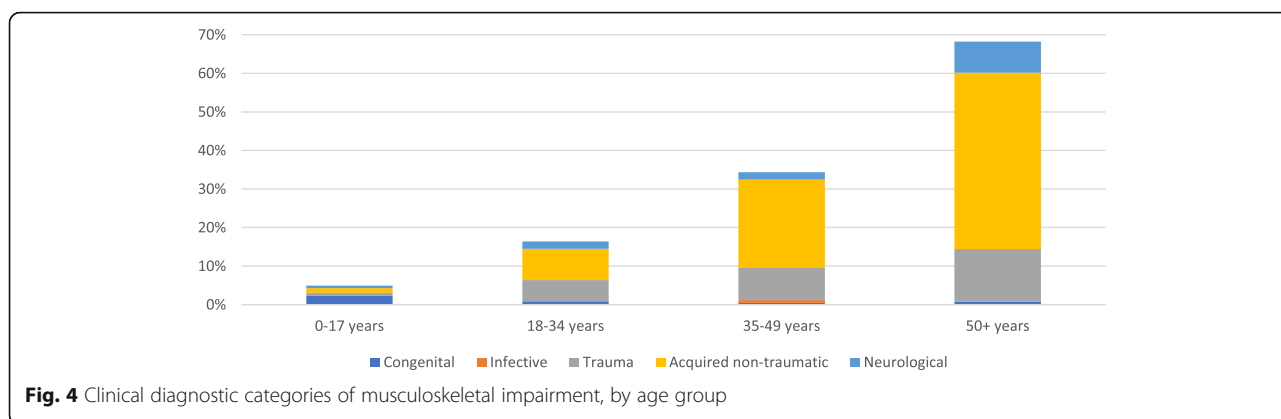
Diagnosis	Number	Total in category <sup>a</sup> N (%)
Cerebral palsy - spastic	3	
Cerebral palsy - other	1	
Paraplegia	2	
Hemiplegia	3	
Peripheral nerve palsy	1	
Other neurological	31	
<b>TOTAL</b>	<b>519</b>	<b>519</b>

<sup>a</sup>Participants could have up to three diagnoses so there were a total of 519 diagnoses for 373 people

the standardised definitions within the case severity matrix which categorised severity into upper and lower limb and gave classification to severity. For example, a case that could walk the prescribed distance but could not complete this in a given time was described as moderate.

Data on MSI among displaced Syrian populations are lacking for comparison. In the survey conducted with Syrian refugees in Lebanon and Jordan, 14.4% of adults self-reported difficulties walking, similar to the 14.2% prevalence of moderate/severe MSI among adults in our study. However, since this study only used a self-report tool and focussed only on walking, any further comparisons are limited [7].

Our study found that 8% of the Syrian refugee population identified the war in Syria as the cause of their MSI. This proportion is similar to Rwanda, the only other post-conflict population with RAM data, where 4% of the participants reported that their trauma-related MSI occurred during the 1994 genocide, and is higher which is likely due to the differences between the two types of conflict and displacement [13, 19]. Though both findings are of note, they were lower than anticipated. In both settings, it is possible that people were hesitant to cite the Syrian war/Rwanda genocide as the cause of their MSI, leading to under-reporting [19]. To try and mitigate this, the study teams, including the physiotherapists, were either Syrian or from other Arabic speaking countries and we ensured privacy by conducting interviews and examinations in the participants' homes to encourage more honest and open responses [19]. Additionally, it might also reflect the simplicity of the question given that underlying conditions that may have been exacerbated by the conflict/displacement might not have been recorded. This is consistent with other findings, such as in post-earthquake Haiti where the biggest factor in disability was ageing not the disaster, and further work is needed to explore this finding [20].



Overall need and unmet need for impairment related services among people with MSI was high, particularly for physiotherapy (83%) despite the fact that physiotherapy services are available at the Migrant Health Centre

in the district, and coverage was low. Further, nearly a fifth (19%) of people with MSI needed, but were not receiving, at least one AP, and coverage was low amongst those needing AP, except for stick/canes (69%).

**Table 5** Services for individuals with musculoskeletal impairment: need, access, unmet need and barriers

	Medication N (%)	Surgery N (%)	Physiotherapy N (%)	Information/ exercises N (%)	Other rehabilitation <sup>+</sup> N (%)	Environmental modifications N (%)	Other services N (%)
<b>Overall service need*</b> (MSI population n = 373)	260 (69.7%)	77 (20.6%)	322 (86.3%)	148 (39.7%)	53 (14.2%)	44 (11.8%)	47 (12.6%)
<b>Ever received service</b>	184 (49.3%)	66 (17.7%)	75 (20.1%)	25 (6.7%)	4 (1.1%)	6 (1.6%)	3 (0.8%)
<b>Ever received service in Turkey</b>	164 (44.0%)	29 (7.8%)	61 (16.4%)	21 (5.6%)	1 (0.3%)	2 (0.5%)	1 (0.3%)
<b>Currently receiving<sup>++</sup></b>	121 (34.4%)	5 (1.3%)	14 (3.8%)	5 (1.3%)	–	2 (0.5%)	1 (0.3%)
<b>Unmet service need**</b> (MSI population n = 373)	139 (37.3%)	72 (19.3%)	308 (82.6%)	143 (38.3%)	53 (14.2%)	42 (11.3%)	47 (12.6%)
<b>Coverage***</b>	47%	6%	4%	3%	0%	5%	2%
<b>Reason not seeking service</b>							
Need not felt by participant	57.6%	38.9%	47.7%	62.9%	32%	23.8%	19.1%
Unaware of available services	15.8%	9.7%	38%	53.1%	25%	23.8%	31.9%
Could not afford	17.3%	26.3%	16.2%	16.8%	26.4%	41.9%	51%
Service not available	16.5%	31.9%	24%	30.8%	41.5%	40.5%	40.4%
Transport not accessible	2.2%	–	3.6%	1.4%	1.9%	2.4%	4.3%
Transport too expensive	3.6%	5.6%	11.4%	14.7%	7.5%	11.9%	10.6%
Service too far away	2.9%	2.8%	4.5%	6.3%	–	–	2.1%
Negative attitude of service providers	3.6%	8.3%	2.6%	0.7%	3.8%	–	6.4%
No translator	4.3%	8.3%	2.6%	1.4%	1.9%	–	2.1%
No one to accompany me	0.7%	–	0.6%	–	1.9%	2.4%	–
Other, please specify:	6.5%	11.1%	8.8%	1.4%	5.7%	–	4.2%

**Abbreviations:** <sup>+</sup>Other rehabilitation included occupational therapy, speech and language therapy and psychosocial support; <sup>\*</sup>Overall need = Need but not receiving + currently receiving/awaiting service; <sup>\*\*</sup>For surgery only, participants were asked 'Currently seeing a surgeon or awaiting a surgical intervention?'; <sup>\*\*</sup>Unmet service need = need but not receiving service; <sup>\*\*\*</sup>Coverage = (currently receiving/awaiting) / (Need but not receiving + currently receiving/awaiting)



**Table 6** Assistive products for individuals with musculoskeletal impairment: need, access, unmet need and barriers

	Wheel-chair	Crutches	Stick/Cane	Quad/Tripod stick	Walking frame	Rollator	LL Pros.	UL Pros.	Orth.	Protective footwear	Toilet/Shower chair	Grab bars
<b>Overall AP need*</b> (MSI population n = 373)	14 (3.8%)	1 (0.3%)	16 (4.3%)	12 (3.2%)	6 (1.6%)	9 (2.4%)	3 (0.8%)	1 (0.3%)	14 (3.8%)	27 (7.2%)	17 (1.9%)	7 (1.9%)
<b>Ever received or currently using</b>	7 (1.9%)	3 (0.8%)	14 (3.8%)	1 (0.3%)	1 (0.3%)	4 (1.1%)	2 (0.5%)	-	7 (1.9%)	6 (1.6%)	5 (1.3%)	1 (0.3%)
<b>Currently using</b>	6 (1.6%)	-	11 (3%)	-	1 (0.3%)	1 (0.3%)	1 (0.3%)	-	1 (0.3%)	-	4 (1.1%)	-
<b>Received in Turkey</b>	6 (1.6%)	-	6 (1.6%)	-	-	1 (0.3%)	-	-	-	-	3 (0.8%)	-
<b>Unmet AP need**</b> (MSI population n = 373)	8 (2.1%)	1 (0.3%)	5 (1.3%)	12 (3.2%)	6 (0.5%)	8 (2.1%)	2 (0.5%)	1 (0.3%)	13 (3.5%)	27 (7.2%)	13 (3.5%)	7 (1.9%)
<b>Coverage***</b>	43%	0%	69%	0%	0%	11%	33%	0%	7%	0%	24%	0%
<b>Reason do not have AP</b>												
Need not felt by participant	12.5%	-	80%	8.3%	-	12.5%	-	-	46.2%	22.2%	-	-
Device is broken/unusable	-	-	-	-	-	-	50%	-	7.7%	3.7%	-	-
Didn't find device helpful	-	-	-	8.3%	-	12.5%	-	-	7.7%	3.7%	-	14.3%
Unaware of available device	-	-	-	16.7%	-	37.5%	-	-	15.4%	29.6%	-	-
Could not afford	37.5%	-	20%	83.3%	66.7%	62.5%	-	100%	15.4%	44.4%	92.3%	71.4%
Service/device not available	75%	-	-	-	50%	25%	50%	100%	46.2%	22.2%	23.1%	42.9%
Transport not accessible	-	-	-	8.3%	-	-	-	-	-	-	-	-
Transport too expensive	12.5%	-	-	8.3%	-	-	-	-	7.7%	3.7%	-	-
Service far away	12.5%	-	-	-	-	-	-	-	-	3.7%	-	-
Negative attitude of service providers	-	100%	-	-	-	-	-	-	7.7%	-	-	-
No translator	-	-	-	-	-	-	-	-	7.7%	3.7%	-	-

Abbreviations: AP assistive product; MSI musculoskeletal impairment, LL lower limb, UL upper limb, pros prosthetic, orth orthosis; \*Overall need = Need but not using + currently using; \*\*Unmet AP need = Need but do not have; \*\*\*Coverage = (currently using) / (Need but not using + currently using)

Overall these findings suggest a significant gap in access to services and related APs to meet the health, rehabilitation and assistive technology needs for this Syrian population living in Sultanbeyli District. These findings are congruent with limited previous research which suggest widespread barriers to accessing impairment specific services for forced displaced populations [7, 21–23]. For example, a study in Lebanon and Jordan found that 25.5% of Syrian refugees with disabilities were unable to access at least one specialised service despite their needs [7]. Another study among Syrian refugees in Jordan found that forced displacement presented major challenges to people with non-communicable diseases and indicated it was important to continue supporting public sector services to adequately meet their expanding needs [21]. Participants, in our study, reported that lack of availability as well as lack of perceived need and awareness of available services were barriers. Physical rehabilitation services do exist in the community, however are limited and primarily are sought through non-government organisation centres. Therefore, efforts to link people to services and increase both capacity and community awareness of these may be important. Home visits have been found to be important in increasing access to services in other settings [7, 24]. Cost was also a common barrier particularly to accessing APs. This echoes previous studies and suggests the need for examining fees and social assistance available.

Access to health and rehabilitation services and APs is a human right [5, 25] supported by international humanitarian law [5, 6], and for some people with MSI these interventions can be instrumental for maximising functioning, quality of life and participation in society [9]. People with impairments and disabilities must be consulted about provision of these services and programmes to best meet their needs, especially in humanitarian settings [6]. To respond to this identified gap, service and AP provision should be consultative and comprehensive inclusive of multiple needs (i.e. surgical and post-operative care, medication, rehabilitation and provision of APs) and multiple functional domain needs [7]. It also is essential that comprehensive funding is planned as well for related health and social costs, including transportation to clinic-based services, follow up service visits and maintenance and repair of APs.

## Strengths and limitations

### Overall survey

This study addresses a gap in MSI data among Syrian refugees and conflict-affected refugee populations more widely. The study used standardised sampling methods and a validated tool. However, limitations exist. The survey response rate was just under 80%. This reflects the complexities of conducting surveys in urban settings and

particularly among displaced populations [26]. The recent re-location policies for Syrians in Turkey may have contributed to relatively high (8%) refusals. It is possible that non-responders who were unavailable (i.e. not at home at the time of the survey team visit) were less likely to have had MSI which may have resulted in some over-estimation of the prevalence. However, the age and sex distribution of the study sample was congruent with the migrant registration database. Additionally, the sample was selected from Sultanbeyli Municipality's refugee registration database so unregistered or undocumented refugees were not included.

### RAM strengths, limitations and further work

This study was the first to use an updated version of the RAM since its validation in Rwanda in 2008 [12]. The addition of the case definitions enabled greater standardisation in the classification of severity and the expanded section on service and AP provided more detailed information on unmet need, coverage and barriers compared to previous RAM surveys.

There are also limitations and areas that could be further developed. First, though the RAM is a structured tool with standardised training and assessment process, the specific diagnosis and needs assessment relies, to some extent, on the clinician's clinical reasoning and assumptions which are likely influenced by their prior training and may introduce some subjectivity in assessment. For example, the clinicians were physiotherapists and it is possible there was bias resulting in an over-estimation of the need for physiotherapy and under-estimation of other services and APs of which the physiotherapists have less experience. Second, the RAM relies on clinical impairment assessment only, without wider consideration of other factors, such as daily activities, perceived need by the participants and environmental and personal contexts [27], which can be important in determining potential need for some services, such as occupational therapy, and APs, such as ramps. For example, it is noted the primary reason identified for not using services/APs was due to "need not felt" and, given the higher prevalence of MSI in the older age group, there could be other cultural and socio-economic factors that might influence their perceived need. Therefore, future versions of this tool should consider participant perceived need as well as assessment of participant functioning and the environment, and capture the clinicians' assessment process through the use of clinical decision trees. Third, a significant proportion of aetiologies and diagnoses, in this survey, were originally marked as 'unknown' by the physiotherapists which was more than previous surveys. The reasons for this are unclear, but may reflect complexities with those sections, translation issues during training or challenges with

filters and skip patterns included in the ODK mobile app for these sections of the tool. Future versions of RAM could be strengthened by inclusion of photographs of different diagnoses to facilitate ease and standardisation of diagnosis. Finally, this was the first study that used tablet-based ODK mobile programming for the RAM as an alternative to paper-based data collection. Further improvements are needed, particularly in the use of skip patterns, and a bespoke mobile app software with customised built-in features such as skips, filters and photos on a web-based data monitoring platform would improve the tablet-based utility of this tool. With these RAM recommendations, further validation studies would be required.

## Conclusion

MSI is common among the Syrian refugee population living in Sultanbeyli District, particularly among older adults. Further, there is a high unmet need for most MSI-related services and low coverage of both services and APs. These estimates indicate a gap in the current service and AP provision for this displaced refugee population. The findings can be used to inform the planning of migrant health and social services regarding rehabilitation services, provision of APs and initiatives to increase access and uptake of these services to improve functioning and quality of life. This study also identified areas for further development of the RAM tool for musculoskeletal and broader mobility-related impairments.

## Abbreviations

AP: Assistive product; GBD: Global Burden of Disease; ICED: International Centre for Evidence in Disability; ICF: International classification of functioning, disability and health; LMIC: Low-and-middle income countries; LSHTM: London School of Hygiene & Tropical Medicine; MSI: Musculoskeletal impairment; ODK: Open Data Kit; RAM: Rapid Assessment of Musculoskeletal impairment

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13031-021-00362-9>.

**Additional file 1.** Rapid Assessment of Musculoskeletal (RAM) tool (version 2).

**Additional file 2.** Indicator definitions for services and assistive products proportions calculated.

## Acknowledgements

We are very grateful for the three physiotherapists- Rukayye Esved, Mohamed Yahya, Muhammet Eyad Sahloul- who were the primary data collectors for this study. We also want to acknowledge the broader study team of enumerators, interviewers, volunteers, and the Relief International Field Coordinator for their work, commitment and dedication to this project. Finally, and most importantly, we are especially grateful to all the participants who took part in this study.

## Authors' contributions

The first draft of the paper and analysis was undertaken by DB with input from SP. SP, OA and DB were expert tool development team, and OA with

DB and HY led training. HY, NS, GD, SV, AO, IP, AHB and IA contributed to methodology, coordination and supervision of data collection in the field. DB, TS and OA reviewed the MSI specific diagnoses. All authors reviewed and contributed to drafts of the manuscript. All authors read and approved the final manuscript.

## Funding

The Disability and Mental Health survey study was funded by was funded by a grant from the United States Department of State to Relief International. The opinions, findings and conclusions stated herein are those of the author [s] and do not necessarily reflect those of the United States Department of State. The MSI tool development, training, analysis and publication was funded by UK Aid through the AT2030 programme led by the Global Disability Innovation Hub, Project number: 300815 (previously 201879–108).

## Availability of data and materials

The dataset used and/or analysed during the current study is available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

Ethical approval for the study was provided by: London School of Hygiene & Tropical Medicine Observational Ethics Committee (Ref 17623); Istanbul Sehir University Research Ethics Committee (Ref 26/2019); and Republic of Turkey Ministry of Interior: Directorate General of Migration Management (Ref 72104824000/72304). Informed consent was provided to all survey participants.

Informed consent (written or oral to account for illiteracy) was initially sought from self-identified heads of each household, then from all adult household participants who took part in the population-based survey. For participants under the age of 18 or for adults unable to communicate, verbal assent was sought from the participant using a simplified information sheet and written consent was sought from a parent or caregiver.

### Consent for publication

Survey participants or proxies for children aged 2–10 or for any participants unable to communicate independently provided consent for publication on the informed consent form.

### Competing interests

None declared.

### Author details

<sup>1</sup>International Centre for Evidence in Disability, London School of Hygiene & Tropical Medicine, London, UK. <sup>2</sup>Maidstone and Tunbridge Wells NHS Trust, Maidstone, UK. <sup>3</sup>Relief International, Istanbul, Turkey. <sup>4</sup>Mülteciler Derneği, Istanbul, Turkey. <sup>5</sup>International Centre for Eye Health, London School of Hygiene & Tropical Medicine, London, UK.

Received: 16 October 2020 Accepted: 1 April 2021

Published online: 20 April 2021

## References

- James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of disease study 2017. *Lancet*. 2018;392(10159):1789–858.
- Blyth FM, Briggs AM, Schneider CH, Hoy DG, March LM. The global burden of musculoskeletal pain—where to from here? *Am J Public Health*. 2019; 109(1):35–40.
- World Health Organization. World report on disability. Geneva: World Health Organization; 2011.
- World Health Organization. International classification of diseases (ICD) 11 Geneva: World Health Organization; [cited 2020 27 April]. Available from: <https://icd.who.int/browse11/-m/en>
- Humanitarian Disability Charter. Charter on inclusion of persons with disabilities in humanitarian action. 2016. Report No.

6. Inter-Agency Standing Committee (IASC) Task Team on Inclusion of Persons with Disabilities in Humanitarian Action. IASC guidelines on the inclusion of persons with disabilities in humanitarian action. Geneva: IASC; 2019.
7. iMMAP, Humanity and Inclusion. Removing barriers: the path towards inclusive access: disability assessment among Syrian refugees in Jordan and Lebanon. 2018.
8. Bradby HH, Newall D, J. P. Public health aspects of migrant health: a review of the evidence on health status for refugees and asylum seekers in the European region. Copenhagen: WHO Regional Office for Europe; 2015.
9. Mactaggart I, Maung NS, Khaing CT, Kuper H, Blanchet K. A case-control study of musculoskeletal impairment: association with socio-economic status, time use and quality of life in post-conflict Myanmar. *BMC Public Health*. 2019;19(1):1502.
10. Joshipura M, Mock C, Gosselin RA. Global burden of musculoskeletal conditions: *Global Orthopedics*: Springer; 2020. p. 9–11.
11. Kyu HH, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of disease study 2017. *Lancet*. 2018;392(10159):1859–922.
12. Atijosan O, Kuper H, Rischewski D, Simms V, Lavy C. Musculoskeletal impairment survey in Rwanda: design of survey tool, survey methodology, and results of the pilot study (a cross sectional survey). *BMC Musculoskelet Disord*. 2007;8(1):30.
13. Atijosan O, Rischewski D, Simms V, Kuper H, Linganwa B, Nuhi A, et al. A national survey of musculoskeletal impairment in Rwanda: prevalence, causes and service implications. *PLoS ONE*. 2008;3(7):e2851.
14. Smythe T, Mactaggart I, Kuper H, Murthy G, Lavy C, Polack S, et al. Prevalence and causes of musculoskeletal impairment in Mahabubnagar District, Telangana state, India: results of a population-based survey. *J Trans R Soc Trop Med PLoS One*. 2017;11(11):512–9.
15. Smythe T, Mactaggart I, Kuper H, Oye J, Sieyen NC, Lavy C, et al. Prevalence and causes of musculoskeletal impairment in Fundong District, north-West Cameroon: results of a population-based survey. *J Trop Med Int Health PLoS one*. 2017;22(11):1385–93.
16. UNHCR. Syria regional refugee response, Turkey. 2019.
17. Balcioglu Z. Sultanbeyli, Istanbul, Turkey: a case study of refugees in towns. Boston: Tufts University; 2018.
18. International Centre for Evidence in Disability (ICED). Survey of disability and mental health among Syrian refugees in Sultanbeyli, Istanbul: research report. London: London School of Hygiene & Tropical Medicine; 2019.
19. Kuper H, Atijosan O, Rischewski D, Simms V, Lavy C. A decade later, how much of Rwanda's musculoskeletal impairment is caused by the war in 1994 and by related violence? *PLoS One*. 2009;4(11):e7720.
20. Danquah L, Polack S, Brus A, Mactaggart I, Houdon CP, Senia P, et al. Disability in post-earthquake Haiti: prevalence and inequality in access to services. *Disabil Rehabil*. 2014;(0):1–8.
21. Doocy S, Lyles E, Akhu-Zaheya L, Oweis A, Al Ward N, Burton A. Health service utilization among Syrian refugees with chronic health conditions in Jordan. *PLoS One*. 2016;11(4):e0150088.
22. Mirza M. Disability-inclusive healthcare in humanitarian camps: pushing the boundaries of disability studies and global health; 2017.
23. Sheppard P, Polack M, McGivern M. Missing millions: how older people with disabilities are excluded from humanitarian response. London: HelpAge International; 2018.
24. Prime Ministry Disaster and Emergency Management Presidency (AFAD). Field survey on demographic view, living conditions and future expectations of Syrians in Turkey. Ankara: AFAD; 2017.
25. United Nations. Transforming our world: the 2030 agenda for sustainable development. Geneva: United Nations General Assembly; 2015.
26. Fuhr D, Acarturk C, McGrath M, Ilkkursun Z, Sondorp E, Sijbrandij M, et al. Treatment gap and mental health service use among Syrian refugees in Sultanbeyli, Istanbul: a cross-sectional survey. *Epidemiol Psychiatr Sci*. 2020;29.
27. World Health Organization. International classification of functioning, disability and health. 2001. [27 April 2020]. Available from: [www.who.int/classification/icf/en](http://www.who.int/classification/icf/en).

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Ready to submit your research? Choose BMC and benefit from:**

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

**At BMC, research is always in progress.**

Learn more [biomedcentral.com/submissions](http://biomedcentral.com/submissions)



## 6.2 Updating RAM methodology

An updated version of the RAM was developed and used in this study as highlighted in the paper. Specific details about the methodological review process, updates implemented with rationale, and any remaining gaps are outlined below. Importantly, improving RAM's methodology provided improved information for the overall assessment, including the identification of MSI-related AP need.

### 6.2.1 Methodological review process

A core review group was established in May 2019 with the following four members. Professor Chris Lavy who is a Professor of Orthopaedic and Tropical Surgery at Oxford University and was instrumental in the development and validation of the RAM in Rwanda in 2008 and the ongoing coordination of the tool.(37) Dr. Oluwarantimi Atijosan-Ayodele who is an UK orthopaedic surgeon and was involved in the RAM development and first implementation in Rwanda. Dr. Sarah Polack who is an Associate Professor at LSHTM ICED and led the research implementation of the RAM in the Cameroon and India surveys. Ms Dorothy Boggs (this PhD candidate) who is an Occupational therapist (OT) and LSHTM Research Fellow leading this PhD study.

The core review group held three RAM development meetings in 2019 (30/05, 25/07 and 5/08) prior to the Turkey MSI survey. At the first meeting, each RAM section was reviewed, and necessary updates and gaps were identified. In the two follow up meetings, the RAM sections were revisited and progress updates were shared. Information on what was changed and the review group's reasoning for implementing these changes are detailed in the section below. Additionally, a separate meeting to explore digital data collection of the RAM on a tablet was held between this PhD candidate and Leonard Banza, an orthopaedic surgeon who lived in Malawi and had used the RAM on a tablet-based form using Apple file maker. From this meeting, it was agreed that LSHTM's Open Data Kit (ODK) software would be used for RAM data collection in the Turkey survey.

### 6.2.2 Updates implemented with rationale and remaining gaps

Prior to commencing the survey in Turkey, changes were implemented in the RAM tool version 2.0 (see [Supplementary File](#)). Feedback and lessons learned were collated by this PhD candidate at multiple points throughout the survey's process including during: i) training; ii) data collection via a WhatsApp group and calls with the physiotherapist data collectors; iii) data analysis; and iv) synthesis and paper writing phase. For each RAM section and overall survey processes and scope, updates that were implemented with rationale and/or any key remaining gaps are highlighted below.

## **RAM sections**

### **Section B. Six screening questions**

*Updates with rationale:* Three of the six screening questions were updated to include “pain” in addition to “difficulty using” the musculoskeletal system. This was based upon existing MSI/pain research (104) and RAM findings in India (35) which emphasised pain as an important cause of MSI. Question prompts were also added to include hands and feet when asking about any difficulty or pain using arms and legs respectively following the need for improved clarity with these questions during training.

*Remaining gap:* Screening question number six should be reviewed since the relationship between convulsions, involuntary movements, rigidity or loss of consciousness and MSI is not clear. These conditions could be used to identify potential falls risk and/or neurological conditions, but more information is needed.

### **Section C. Observation of activities**

*Updates with rationale:* The response options for the standardised observation assessment of four sets of activities were revised from a previous binary “can / can’t” response to a graded response: “can do easily, can do with difficulty and cannot do”. This was done to better assess participants’ activity performance. It was also decided that the four activities should be completed without an AP so all participants with potential MSI are assessed. If the participant is unable to complete the activity without an AP, then it should be recorded as “cannot do”. These changes were implemented following feedback from assessors in the field to better assess body functioning and examination of the structure of the affected area.

*Remaining gaps:* If time and resources allow in a future survey, this section could be completed both with and without use of AP and the results could be compared since the use of an AP may decrease the MSI severity and change their case status. This would provide estimates for impairment with and without AP use. If done, additional fields should be added so the clinician’s recommended and/or participant’s preferred AP for the four specific mobility tasks could be documented.

### **Section D: Seizure history**

*Updates:* none.

*Remaining gaps:* It is recommended that both the seizure section and epilepsy definitions are reviewed. The identification of seizure activity could be helpful to determine aetiology of MSI and/or possible current risks, such as falls risk, but more information about the participants and their environments would be needed to complete a full risk assessment. Additionally, to be classified as epilepsy, the participant must

report having a seizure at least three times and is then included in the analysis as an MSI case. The inclusion of seizures/epilepsy involves more neurological components and screening so this should be reviewed and strengthened with neurological component assessments in future versions of the tool, especially if wider “mobility assessment” focus.

#### Section E: Duration and consanguinity

*Updates:* none.

*Remaining gap:* The age groups for initial MSI onset information are wide and therefore not very informative. They should be reviewed and updated to agreed age groupings.

#### Section F: Aetiology:

*Updates:* none.

*Remaining gap:* Review the use of “traditional” aetiology category. It was found that this category was ambiguous and non-specific upon reviewing the data to determine diagnoses so should either be more clearly defined or omitted.

#### Section G. Structure affected:

*Updates:* The examination of the “affected structure” section of the tool was simplified from 23 individual body items to five categories of main body areas, with individual items listed within the respective body area grouping for simplification. This change was informed by the groupings used when the survey data were analysed. In the previous RAM, data were also collected on the nature of change and magnitude, however these sections were omitted in the revised version. They were considered redundant based on analysis of previous surveys.

*Remaining gaps:* none.

#### Section H: Case severity (of impairment):

*Updates:* Specific MSI severity definitions, which were previously lacking, were developed for “no, mild, moderate and severe” MSI categories to ensure greater consistency within and between surveys using a case severity card. The definitions were directly linked to the assessment results from previous sections regarding the musculoskeletal system’s ability to function and based upon consultation with allied health professionals and review of paediatric tools for upper limb severity definition.

*Remaining gaps:* Consider including the use of pictures on the case severity card, such as upper limb tasks, for determining severity to enable even greater consistency with severity assessment.

### Section I. Diagnosis decision algorithm:

*Updates:* Up to a maximum of three specific diagnoses per case could be assigned per participant across five clinical categories (congenital, infective, traumatic, acquired non-traumatic or neurological). This was a change from the previous version where only two diagnoses could be selected based upon feedback from previous surveys.

*Remaining gaps:* Include use of pictures in the diagnosis section to assist the assessor to determine appropriate diagnoses. This could also help to strengthen and standardise this section of the assessment since a significant proportion of diagnoses in the Turkey survey were originally marked as “unknown” by the physiotherapists.

### Section K and I. (MSI-related) Service and AP use and needs:

*Updates:* This section of the tool was updated to include more detailed and structured questions about MSI service and AP access indicators including: past/current ownership, use, need and access barriers to better inform identification of MSI-related service and AP need. The AP list was reviewed to ensure alignment with the APL.

*Remaining gaps:* The service and/or AP referral may be influenced by the cadre of worker who is administering the survey and their prior training, introducing some subjectivity in assessment. For example, if the assessment is being completed by a physiotherapist, he/she may be more likely to recommend physiotherapy than other services and AP. Standardized functional assessments, decision trees and training on treatment referrals should be included.

### Quality of life sub-component (EQ-5D tool)

*Updates:* The Quality of life EQ-5D tool was omitted from the RAM in version 2.0. It was determined that this tool, or other quality of life tools, could be added if included in the survey’s aim but were not required as part of the tool. Specifically, the Turkey MSI study was included within a broader Disability and Mental Health survey so other sections addressed the measurement of quality of life.

*Remaining gaps:* Potential recommendations/additions of other survey tools, such as the use of the WG ES and CFM which could provide reported multi-domain functional activity limitations, could be explored alongside the RAM, and utility compared with the EQ-5D.

## **Survey processes**

### Data collection and management

*Updates:* The RAM version 2.0 tool was programmed using ODK so data could be collected using mobile tablets. This was a more advanced tool than previously used in Malawi.



*Remaining gaps:* Though the tablet-based ODK mobile programming was preferable to paper-based data collection, further improvements are needed with the use of a mobile data collection application, particularly in the use of skip patterns and filters, systematic naming of the variables and the inclusion of photos. A bespoke mobile app software would improve the mobile-based utility of this tool with customised built-in features on a web-based data monitoring platform.

#### Remaining gaps to consider

- *Test different cadres:* Current RAM guidelines suggest different health professional cadres can be involved in administering the RAM (e.g. orthopaedic surgeons, orthopaedic officers, physiotherapists and occupational therapists). However, evidence is lacking as to the accuracy of these different cadres in identifying presence, severity and diagnosis of MSI. There is a need for a study comparing these outcomes between different cadres.
- *Validation studies:* If these RAM recommendations are implemented, alongside the changes already included in RAM version 2.0, further validation studies are required.
- *Standardised feedback form:* A standardised form should be drafted and used to formally gather lessons learned after each use to incorporate into the tool.
- *Review time period:* A formal review time period should be set for RAM, such as every 5 years, by the expert review group.

#### **Survey scope**

##### Remaining gaps to consider

- *Current symptoms section:* Explore including a section for current symptoms, such as frequency and location of pain, perhaps prior to commencing observation of activities or following the aetiology section. This would provide important initial reported information for the overall assessment to inform MSI diagnosis and severity and could be useful if in the analysis phase the data is reviewed, such as the Turkey MSI study's diagnosis review.
- *Neurological section:* It is possible that MSI could be both under/over-estimated due to neurological diagnoses, including stroke, traumatic brain injury and epilepsy, being included in the RAM. A neurological assessment section should be added to the tool, and the neurological diagnosis section of the tool should be updated. Strengthening the neurological assessment components would provide a more comprehensive pragmatic disaggregated approach to identifying people with mobility impairments by including prevalence estimates of both MSI and

neurological impairments. The feasibility/practicalities of this would need to be considered in a population-based survey.

- *Functional assessment section:* Examine the relationship between the RAM and the ICF to incorporate a more holistic mobility functional assessment. Presently, the RAM examines body function/structures and some elements of activities. Consider the inclusion of participation, and environmental and personal context sections which might identify factors (e.g. rough/smooth terrain) that impact the participants' overall mobility and be helpful for assessing likely need for additional service and AP referrals. Additionally, participants' goals and perceived need should be included within this assessment, and future research is needed to explore ways to better capture the clinicians' clinical reasoning. One way to standardise referral needs within surveys could be through the use of clinical decision trees to more objectively determine service and AP referrals involving both clinical assessment and questions to the participant. The feasibility/practicalities of these recommendations would need to be considered in a population-based survey.
- *Expand tool to Rapid Assessment of Mobility (RAMob):* Although labelled as an MSI tool, the RAM incorporates broader aspects of mobility impairment, such as assessing congenital and neurological diagnoses. If these assessment methods were strengthened, for example by assessing muscle tone, the tool could be used for broader mobility impairment assessment. It would therefore be important to consider broadening the tool's name and scope to "Rapid Assessment of Mobility", within which both MSI and neurological impairment estimates could be obtained.

## Chapter 7: Conducting an AP need self-report survey

This chapter presents the implementation of the WHO AP need survey, rATA, in one district of Guatemala. This was undertaken to explore this AP need focused survey methodology which estimates AP indicators through a self-report only tool. The results of the population-based survey in Guatemala are presented and the lessons learned with implications for methodology are discussed.



Guatemala rATA survey team collecting data. © Ana Cordon/Liliane Foundation

## **7.1 Research paper 6: Measuring access to AT using the WHO rATA questionnaire in Guatemala: results from a population-based survey**

### **Preamble**

A survey was conducted using the recently developed WHO rATA. This tool's main aim is to measure AP need/access indicators as a standalone self-reported AP assessment tool. Working with research consortium colleagues coordinated by Liliane Foundation, a rATA survey was undertaken in Sololá, western Guatemala in 2021. Data collection was completed April to May 2021 to estimate the population level AP use and unmet need.

This paper presents the survey prevalence estimates for self-reported functional difficulties and AP indicators of use, unmet need and total need as well as reported barriers to AP access. In the discussion, the paper explores and critiques the use of the rATA for providing population-based estimates of AP need and concludes by providing recommendations for AP service/programme stakeholders in Sololá to address gaps in AP access.

This paper was published in May 2022 in Disability, Community-based Rehabilitation and Inclusive Development journal. The manuscript was published under a Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>), and the published manuscript is included in full below.

### 7.1.1 List of Tables

**Table 1:** Age and Sex Distribution of Study Sample and Census (2018).

**Table 2:** Prevalence of Functional Difficulty by Age, Sex and Location.

**Table 3:** Proportion reporting Difficulty by Domain.

**Table 4:** Relationship between AP Access and Age, Sex, Location and Level of Functional Difficulty.

**Table 5:** Assistive Product use Information.

### 7.1.2 List of Figures

**Figure 1a:** The 10 APs most commonly reported to be used (% out of study population).

**Figure 1b:** The 10 APs that people most commonly reported needing, but did not have/Needs replacing (% out of study population).

### 7.1.3 Supplementary material

The Supplementary material referenced in the paper is available following the references section.

**Appendix 1:** Guatemala rapid Assessment of Assistive Technology (rATA) research consortium organisations.

### 7.1.4 Citation

Boggs D, Kester A, Córdón A, Naber J, Rota G, Polack S. Measuring Access to Assistive Technology using the WHO rapid Assistive Technology Assessment (rATA) questionnaire in Guatemala: Results from a Population-based Survey. *Disability, CBR & Inclusive Development*. 2022 May 15;33(1).

<https://dcidj.org/articles/abstract/10.47985/dcidj.573/>



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	Disability, CBR & Inclusive Development		
When was the work published?	May 2022		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	<b>Yes</b> , This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license ( <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a> ).	Was the work subject to peer review?	<b>Yes</b>

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I co-designed the study, co-supervised data collection, co-drafted the manuscript with Sarah Polack and considered revisions and comments from other authors.
--	---

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022

<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022

# Measuring Access to Assistive Technology using the WHO rapid Assistive Technology Assessment (rATA) questionnaire in Guatemala: Results from a Population-based Survey

Dorothy Boggs<sup>1\*</sup>, Angelique Kester<sup>2</sup>, Ana Cordon<sup>3</sup>, Jonathan Naber<sup>4</sup>, Gonna Rota<sup>5</sup>, Sarah Polack<sup>1</sup>

1. International Centre for Evidence in Disability, London School of Hygiene and Tropical Medicine, UK

2. Rehabilitation Adviser, Liliane Foundation and Enablement, The Netherlands

3. Doctor, formerly with Wuqu'Kawoq / Maya Health Alliance, Guatemala

4. Chief Programme Officer, Range of Motions Project (ROMP), USA

5. Consultant, Liliane Foundation and CBM, Guatemala

## ABSTRACT

**Purpose:** *Using the World Health Organisation (WHO) rapid Assistive Technology Assessment (rATA) tool, this study aimed to estimate the population level self-reported Assistive Technology use and unmet need in the province of Sololá in Western Guatemala.*

**Method:** *Sixty-one clusters of 50 people, 2+ years of age, were selected using probability proportional to size sampling. Households within clusters were selected using adapted compact segment sampling. Participants were interviewed using the standardised WHO rATA questionnaire.*

**Results:** *A total of 2874 persons were interviewed (response rate 94%). The prevalence of self-reported unmet need for at least one assistive product (AP) was 17.1% (95% CI 14.7-19.8), use was 7.4% (95% CI 5.9-9.3) and overall need was 20.3% (95% CI 17.6-23.2). These indicators all increased significantly with increasing age and level of functional difficulty. The three most common APs used in Guatemala were spectacles (5.8%), canes/sticks/tripods/quadripods (0.8%) and pill organisers (0.3%). The most common APs reported as unmet need were spectacles (13.4%), canes/sticks/tripods/quadripods (3.1%) and hearing aids (2.6%). Among assistive product users, most of them (53%) sourced their APs from private providers and paid out of pocket (58%) and the majority (93%) were quite satisfied/very satisfied with their APs. Cost was the*

\* **Corresponding Author:** Dorothy Boggs, Research Fellow and PhD Candidate, International Centre for Evidence in Disability, London School of Hygiene and Tropical Medicine, UK. Email:dorothy.boggs@lshtm.ac.uk



*most commonly reported barrier to AP use.*

**Conclusion and Implications:** *There was a high total need and unmet need for APs in the province of Sololá in Guatemala, and lower use of APs. These findings highlight an urgent need to strengthen Assistive Technology provision to improve access in this setting, particularly for older people, and to address cost-related barriers and increase public provision. The findings can be used to raise awareness of the AT needs in the population in Guatemala, including for older people and people with functional difficulties, and to advocate and plan at local and national levels to make APs more accessible.*

**Key words:** *surveys, access, self-report, assistive products, Guatemala*

## INTRODUCTION

Assistive Technology (AT) is defined by the World Health Organisation (WHO) as ‘the application of organised knowledge and skills related to Assistive Products (APs), including systems and services’ (World Health Organisation, 2018). Access to AT (e.g., walking aids, hearing aids, prostheses) can be vital for facilitating people to live productive, inclusive and dignified lives (World Health Organisation, 2016, 2018). However, many people do not have access to the AT they need; the WHO estimates that 1 billion people are in need of an AP but only 1 in 10 people have access to them (World Health Organisation, 2018).

A key factor hindering the planning and strengthening of AT is the lack of data on the population-level need and unmet need. To address the AT data gap, WHO’s Global Cooperation on Assistive Technology (GATE) developed a new self-reported AT tool, the rapid Assistive Technology Assessment (rATA) (World Health Organisation, 2021b; Zhang, Eide, Pryor, Khasnabis & Borg, 2021). The rATA is an interview-administered population-based survey tool for collecting standardised data on AT in different contexts in six self-reported areas: use, source, payer, satisfaction, unmet need, and barriers (World Health Organisation, 2021b; Zhang et al, 2021). In addition to contributing to global data, the rATA is also designed to inform AT programme development and monitoring at country or sub-country levels. Following the development of the tool in October 2020, WHO launched a global call for measuring access to AT using the rATA. This will inform the development of the WHO-UNICEF Global Report on Assistive Technology (GReAT) - a report which aims to provide a baseline for the current situation on AT and strengthen support of Member States in achieving better

access and availability of AT at national and community levels.

A National Survey of Disability conducted in Guatemala in 2016, using the self-reported Washington Group question sets for both adults and children, found that 10.2% of people reported severe functional limitations (International Centre for Evidence in Disability, 2016). People with functional limitations faced significantly more challenges in participation in key life areas compared to people without disabilities, including in self-care, livelihoods, education, and social inclusion (International Centre for Evidence in Disability, 2016; Kuper et al, 2018; Pinilla-Roncancio et al, 2020). Approximately 10% of the population reported using glasses, hearing aids or walking aids, although, in general, awareness of rehabilitation services and AT were low. However, detailed data on AT use, unmet need, satisfaction and barriers to use among different populations in Guatemala are lacking, and hinder the planning, strengthening and advocacy for relevant services and programmes.

In response to the WHO call for global rATA survey implementation, a rATA survey was undertaken to estimate the population-level AT use and unmet need in Sololá province, Guatemala. The specific survey objectives, among people aged 2+ years in Sololá province, were:

1. To estimate of the prevalence of self-reported functional difficulties.
2. To estimate the prevalence of self-reported Assistive Product (AP) access indicators (use, unmet need and total need).
3. To identify AP use, access and experiences with APs.
4. To identify barriers to accessing APs.

## **METHOD**

### **Study Design**

A population-based survey was conducted from April to May 2021 in Sololá province, Guatemala. The survey was conducted by a research consortium coordinated by the Liliane Foundation, including local, national and international partners (see Appendix 1).

## Setting

Sololá is located in the western highlands of Guatemala, is predominately rural and the majority (96%) of the population are indigenous.

## Sample

A sample size of 3,050 people aged 2 years and above was required, based on an estimated prevalence of AP use (of at least one AP) of 7% (Pryor, Nguyen, Islam, Jalal & Marella, 2018), a precision of 20% around the estimate, 95% confidence, a design effect of 2, and 15% non-response. Based on previous evidence, it was assumed there was a lower prevalence of AP use compared to unmet need (Pryor et al, 2018). Therefore, the study was powered to estimate the following three AP indicators: use, unmet need and total need of at least one AP.

Two cluster stage sampling was used. Using the Instituto Nacional de Estadística's 2018 census as the sampling frame, 61 clusters were selected through probability proportionate to size sampling. Within each cluster, 50 people (aged 2+ years) were selected using an adapted compact segment sampling (Turner, Magnani & Shuaib, 1996). Maps of each cluster were created, using either the open-access mapping platform Infraestructura de Datos Espaciales de Guatemala (IDEG) Geoportal (Infraestructura de Datos Espaciales de Guatemala), or through consultation with the local health centre and/or community leaders. Using these maps in discussions with local representatives, clusters were divided into segments, each including approximately 50 people. One segment was selected at random and all households in that segment were visited door-to-door until 50 people were included. Where segments included fewer than 40 people, another segment was chosen at random to achieve the target sample size; where they included 41-49 people sampling continued in the adjacent segment. All eligible participants were recorded on a paper-based enumeration form. Participants who were unavailable after two repeat visits to the household were recorded as non-responders.

Five of the originally selected clusters were reselected due to safety concerns; two because of ongoing conflict and three because of high COVID-19 prevalence at the time of the survey.

## Data Collection

Each of the two survey teams included four interviewers, who were all local community workers. Interviewers worked together in pairs to maximise safety. Data collection was regularly monitored by a field supervisor for quality control. The teams underwent three days of training, including a half-day fieldwork practise in a community.

At each eligible household, interviewers asked to speak to the household head or another appropriate adult, to provide information about the study and obtain consent for the household to participate. Participants who had lived in that household for at least 6 months of the past year were eligible for inclusion. Participants aged 15 years and above were interviewed directly. Proxy interviews with a parent, caregiver or other appropriate household member, were conducted for participants aged below 15 years and for people unable to communicate independently.

## Data Collection Tools

The WHO rATA questionnaire was used, programmed on a survey123 mobile app, to collect data on the following:

- Age, sex, urban/rural location.
- Self-reported functioning, using questions adapted from the WG-Short Set of Questions (Washington Group on Disability Statistics Secretariat, 2020) which ask about level of difficulty (none/ some/ a lot / cannot do) with seeing, hearing, mobility (all ages) and communication, cognition, self-care (5+ years only). In contrast to the original WG questions, for rATA the respondents are asked to report on their difficulty **without** the use of AT or other assistance.
- AP access - current use of any APs and types used. Images and descriptions of approximately 50 APs from the WHO AP priority list (World Health Organisation, 2016) were provided to participants, initially on enlarged laminated showcards with WHO images and subsequently in digital form on the Tablet. Participants were also asked to report on APs they need but do not currently use, or use but that are in need of replacement.
- AP use information - AP users were asked about the source, payment, distance travelled to obtain APs and satisfaction with APs and associated services. This information was collected for up to three APs considered most

important to the participant.

- Barriers - Participants with unmet AP needs were asked about reasons for not seeking services from a pre-coded response list.

A Spanish version of the rATA questionnaire was adapted to Guatemalan Spanish for this survey. Members of local Organisations of Persons with a Disability (OPDs) and AT programme staff reviewed the tool to assess language for cultural relevance and appropriateness, and identify relevant terms for different APs. Three Mayan languages (k'iche', kaqchikel, y 'tz'utujil) are commonly used in Sololá province and each of these was represented amongst the study team. Based upon previous survey experience (International Centre for Evidence in Disability, 2016) and lack of widespread familiarity with reading/writing this language in the population, verbal real-time translation was conducted by the relevant interviewer. Accuracy of verbal translation into Mayan languages was covered in detail during training, and a local guide/interpreter was identified in the communities, particularly in those where an indigenous language was predominant. The questionnaire was pilot-tested with 15 people (including different age, sex and language groups) to assess comprehension and equivalence, with adaptations made accordingly.

## Data Analysis

Data was recorded on Tablets using WHO rATA's mobile app and uploaded daily to a secure, password-protected cloud-based server on the Survey123 web-based platform.

Analysis was conducted using Stata Version 16. The svy command function was used to account for the cluster sampling. Prevalence estimates were calculated for self-reported functional difficulty stratified by age, sex and location. Functional difficulty was calculated at two levels: i) some or worse difficulty in at least one domain (referred to herein as 'some difficulty/worse') and, ii) a lot of difficulty or cannot do at least one domain (referred to as 'a lot of difficulty/worse').

The prevalence of AP access indicators were calculated as follows : i) use (proportion of study participants currently using at least one AP), ii) unmet need (proportion of study participants reporting needing a new or replacing an existing AP), and iii) total need (proportion of study participants using and/or having an unmet need for at least one AP). Logistic regression analyses were conducted to assess the association between these three AP access indicators (need, unmet need and use) with sociodemographic characteristics collected in rATA (age,

sex, urban/rural location) and level of functional difficulty, based on previous evidence of relationship between these characteristics and access to AP and related services (Pryor et al, 2018). Calculations were first made for unadjusted Odds Ratios (OR), secondly the OR was adjusted for age, sex and location, and thirdly OR was adjusted for age, sex, location and functional difficulty.

### **Ethical Considerations**

Ethics approval was obtained from ethics committees at the London School of Hygiene and Tropical Medicine and the Instituto de Nutrición de Centro América y Panamá (INCAP).

Informed verbal consent was obtained from all participants in the preferred local language. This method of consent was preferred (and approved by the ethics committees) to maintain infection control measures (e.g., keeping a 2-metre distance). There were no invasive procedures, and names, date of birth and global positioning system points were not recorded in the app. An explanation of the aims, processes, possible consequences and voluntary nature of participation in the study was provided to all participants. For participants under 18 years or adults with profound difficulty in communicating, verbal consent was obtained from parents/caregiver and verbal assent was obtained from the participant using a simplified information sheet.

Since this survey took place during the COVID-19 pandemic, the following precautions were adopted: regular monitoring of official national and regional Ministry of Health statistics for each survey area, following local and international guidance to assess whether appropriate to proceed with research activities, asking all participants COVID-19 screening questions, strict adoption of infection and protection control measures by team members (e.g., use of Personal Protection Equipment, following hygiene/sanitation guidelines, regular testing) and conducting interviews outdoors while maintaining a 2-metre distance.

Mapping of key AT and rehabilitation services was undertaken prior to the survey and participants identified as having unmet needs were informed about available services.

## RESULTS

### Study Population

Data was collected on 2874 people (response rate 94%), while 141 people (5%) refused to participate and 35 (1%) were unavailable. Overall, 55% of the sample was female and the majority (75%) lived in urban areas. The survey sample was broadly similar to the 2018 census in terms of age and sex distribution (see Table 1), although there was slight underrepresentation of 0-9 year-olds.

**Table 1: Age and Sex Distribution of Study Sample and Census (2018)**

	2018 Census		Study Sample	
	N	%	N	%
<b>Age</b>				
0-9	90,358	21%	430	15%
10-19	99,454	24%	656	23%
20-29	79,502	19%	596	21%
30-39	56,126	13%	383	13%
40-49	39,197	9%	274	10%
50-59	25,921	6%	227	8%
60-69	17,087	4%	148	5%
70+	13,938	3%	160	5%
<b>Sex*</b>				
Female	220,318	52%	1577	55%
Male	201,265	48%	1294	45%

\*Sex was not reported for 3 people in the study sample.

Age, sex and location data could only be collected on 53% of non-responders. Based on those with data, non-responders were, on average, significantly older (35.8 years versus 29.6 years  $p=0.003$ ), and the responders were more likely to live in urban areas (43% versus 25%,  $p<0.001$ ) compared to non-responders. There was no significant difference in sex distribution.

### Functional Difficulty

Overall the prevalence of 'some difficulty or worse' in at least one functional domain (without the use of AP/other assistance) was 27.2% (95% CI 24.1-30.6) and 'a lot of difficulty or worse' was reportedly 12.5% (95% CI 10.4-14.9). The prevalence of functional difficulty increased substantially with age (see Table 2). The prevalence of 'some difficulty or worse' was slightly higher among women, though this was borderline significance ( $p=0.05$ ).

In terms of the functional domain, among adults (18+ years) difficulty was most commonly reported with vision, followed by mobility. For children (2-17 years) it was vision, followed by communication (see Table 3).

**Table 2: Prevalence of Functional Difficulty by Age, Sex and Location**

	Total N	Some difficulty or worse in at least one domain			A lot of difficulty or worse in at least one domain		
		N	% (95% CI)	Adjusted p-value <sup>a</sup>	N	% (95% CI)	Adjusted p-value <sup>a</sup>
<b>Overall</b>	2874	782	27.2 (24.1-30.6)		358	12.5 (10.4-14.9)	
<b>Age group</b>							
2-17	964	106	10.9 (8.5-14.1)	Reference	41	4.3 (3.0-6.0)	Reference
18-64	1693	507	29.9 (26.2-34.0)	<0.001	204	12.5 (9.7-14.9)	<0.001
65+	217	169	77.9 (71.1-83.3)	<0.001	113	52.1 (44.8-59.2)	<0.001
<b>Sex</b>							
Male	1294	320	24.7 (21.3-28.5)	Reference	152	11.7 (9.4-14.5)	Reference
Female	1577	462	29.2 (25.8-33.0)	0.05	206	13.1 (10.9-15.6)	0.41
<b>Location</b>							
Rural	2150	565	26.3 (22.6-30.3)	Reference	265	12.3 (9.9-15.3)	Reference
Urban	724	217	30.0 (24.5-36.1)	0.13	93	12.9 (9.7-16.8)	0.44

<sup>a</sup>P-value from logistic regression analysis adjusted for all variables in the Table.

**Table 3: Proportion reporting Difficulty by Domain**

Functional Domain	Child (2-17) n=964	Adult (18+) n=1910
<b>Some difficulty/worse</b>		
Mobility	20 (2.1%)	351 (18.4%)
Vision	55 (5.7%)	483 (25.3%)
Hearing	17 (1.8%)	187 (9.8%)
Communication	15 (1.9%)	63 (3.3%)
Cognition	26 (3.3%)	249 (13.0%)
Self-care	12 (1.5%)	58 (3%)
<b>A lot of difficulty/worse</b>		
Mobility	5 (0.5)	159 (8.3)
Vision	22 (2.3%)	194 (10.2%)
Hearing	8 (0.8%)	81 (4.2%)
Communication	9 (1.2%)*	35 (1.8%)*
Cognition	6 (0.8%)*	61 (3.2%)*
Self-care	6 (0.8%)*	28 (1.5%)*

\*Restricted to children aged 5-17 years only (n=778).



### **Assistive Product Access**

The overall prevalence of use of at least one AP was 7.4% (95% CI 5.9-9.3) and unmet need was 17.1% (95% CI 14.7-19.8). The total population with AP need (uses and / or has unmet need for at least one AP) was 20.3% (95% CI 17.6-23.2).

In terms of use, 214 participants reported using a total of 231 APs; the majority used one device (n=198), 15 people used two devices and 1 person used three devices. Unmet need was reported by 491 participants for a total of 704 APs; 351 people reported an unmet need for one AP, 87 for two APs, 40 for three APs and 13 for four to six APs.

Increasing age and level of functional difficulty were significantly associated with increased use, unmet need and total AP need ( $p < 0.001$ ) (see Table 4). Compared to males, females were slightly more likely to report unmet need (adjusted Odds Ratio (aOR) 1.3, 95% CI 1.1-1.7), and slightly less likely to use APs (aOR 0.7, 95% CI 0.5-1.0) although the latter was of borderline significance. AP use was more common in urban compared to rural locations (2.4 95% CI 1.5-3.7), but unmet need and total need were similar by location. With additional adjustment for functional difficulty, the effect sizes for older adults (65+ years) were reduced but remained large (OR at least 4.0) and statistically significant. Findings for the other socio-demographic variables remained similar with multivariate adjustment.

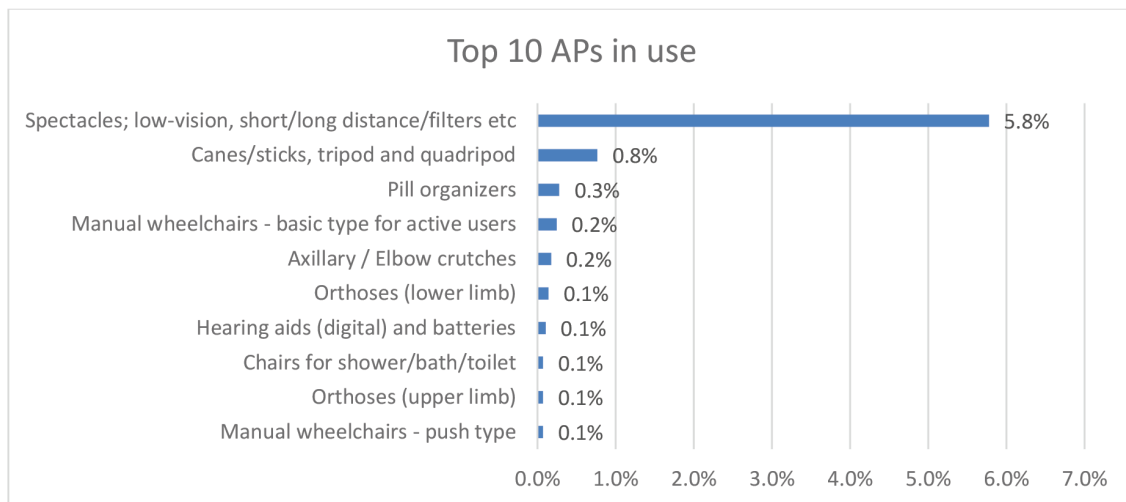
**Table 4: Relationship between AP Access and Age, Sex, Location and Level of Functional Difficulty**

	Use of at least one AP			Unmet need for at least one AP			Total Need <sup>a</sup> for at least one AP		
	Total N	N (%)	Adjusted Odds Ratio (95% CI) <sup>d</sup>	N (%)	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI) <sup>d</sup>	N (%)	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI) <sup>d</sup>
<b>Age group</b>									
2-17	964	23 (2.3%)	Reference	69 (7.2%)	Reference	Reference	81 (8.4%)	Reference	Reference
18-64	1693	144 (8.5%)	3.8 (2.4-6.1)	304 (18.0%)	2.8 (2.1-3.9)	2.2 (1.5-3.0)	371 (21.9%)	3.1 (2.5-4.2)	2.5 (1.8-3.5)
65+	217	47 (21.7%)	11.3 (5.9-21.4)	118 (54.4%)	15.4 (9.8-24.4)	5.1 (2.9-8.8)	130 (59.9%)	16.3 (10.5-25.2)	5.6 (3.0-10.4)
<b>Sex</b>									
Male	1294	104 (8.0%)	Reference	192 (14.8%)	Reference	Reference	238 (18.3%)	Reference	Reference
Female	1577	110 (6.9%)	0.9 (0.6-1.1)	299 (18.9%)	1.3 (1.1-1.6)	1.3 (1.1-1.7)	344 (21.8%)	1.2 (1.1-1.4)	1.2 (1.0-1.5)
<b>Location</b>									
Rural	2150	129 (6.0%)	Reference	374 (17.4%)	Reference	Reference	423 (19.7%)	Reference	Reference
Urban	724	85 (11.7%)	2.1 (1.3-3.2)	117 (16.2%)	0.9 (0.6-1.4)	0.9 (0.5-1.4)	159 (21.7%)	1.1 (0.8-1.6)	1.3 (0.8-1.9)
<b>Functional difficulty</b>									
No difficulty	2092	7 (0.03%)	Reference*	18 (0.9%)	Reference*	Reference*	23 (1.1%)	Reference*	Reference*
Some difficulty <sup>b</sup>	424	207 (23.3%)	9.8 (7.0-13.7)	216 (51.0%)	24.8 (16.5-37.3)	18.6 (12.4-28.0)	257 (60.6%)	43.1 (28.2-65.8)	33.1 (21.3-51.5)
A lot/ cannot do <sup>c</sup>	358	108 (30.2%)	7.9 (5.3-11.6)	257 (71.8%)	-	-	302 (84.4%)	-	-
Full sample	2974	214 (7.4%)	-	491 (17.1%)	-	-	582 (20.3%)	-	-

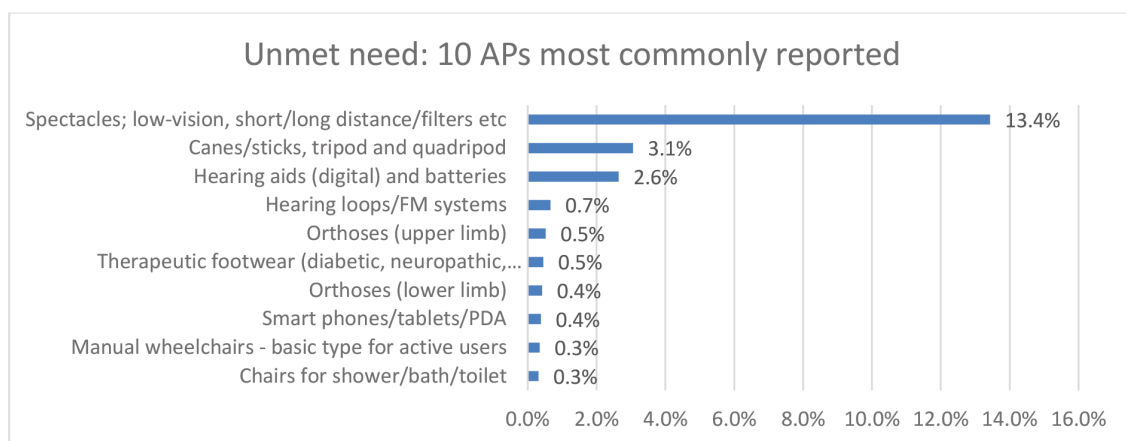
<sup>a</sup> Total Need = participants reporting using and/or needing at least one AP; <sup>b</sup>Some difficulty, but not a lot or cannot do, in at least one domain; <sup>c</sup> A lot of difficulty or cannot do in at least one domain; <sup>d</sup> Odds Ratio from logistic regression analysis adjusted for all variables in the Table.   
<sup>\*</sup>Due to small cell size for ‘no difficulty’, ‘none’ and ‘some difficulty’ are combined as the reference value.

Spectacles were the most commonly used APs (5.8% of total study population), followed by canes/sticks/tripods/quadrupods (0.8%), pill organisers (0.3%) and manual wheelchairs (0.2%; Figure 1a). In terms of unmet need (Figure 1b), spectacles were most commonly reported (13.4%), followed by canes/sticks/tripods/quadrupods (3.1%) and hearing aids (2.6%).

**Figure 1a: The 10 APs most commonly reported to be used (% out of study population)**



**Figure 1b: The 10 APs that people most commonly reported needing, but did not have/needs replacing (% out of study population)**



### Assistive Product Use: Access and Experience

AP users were asked to report about access and experience with the three APs they considered most important. In total, 214 AP users reported on 231 APs. The APs were most commonly obtained from the private sector (e.g., private health facilities/hospitals or shops/stores; 53% of AP users) followed by the non-government organisation (NGO) sector sources (i.e., non-profit facilities; 22%), while only 6% used public sector sources (e.g., government facilities or public hospitals; see Table 5). The majority (58%) paid out-of-pocket for their AP(s) or relied on family/friends (22%) and only 2% used government funding or health insurance. Most AP users travelled less than 5km (39%) or 6-25km (32%) to obtain their AP(s).

More than 90% of AP users reported being quite/very satisfied with their AP over the past month, and with the associated assessment/training they received. Of the 123 participants who had accessed repair/maintenance and/or follow up services, 83% were quite/very satisfied with services received.

Just over three-quarters (76%) felt their AP was 'mostly'/'completely' suitable for their home environment and that their AP(s) 'mostly'/'completely' helped them do what they wanted to in terms of common daily activities. Most AP users (68%) reported they could use their AP 'a lot'/'completely' as much as they liked in environments they wanted or needed to visit, while 20% responded 'not at all'/'not much'.

**Table 5: Assistive Product use Information**

	N%
<b>Source of AP<sup>a</sup></b>	
Private Sector	114 (53%)
NGO Sector	47 (22%)
Friends/family	34 (16%)
Self-made	14 (7%)
Public Sector	12 (6%)
<b>Source of funding<sup>a</sup></b>	
Out-of-pocket payment	125 (58%)
Family/friends	48 (22%)
NGO/Charity	40 (19%)
Insurance	3 (1%)
Government	2 (1%)
<b>Distance travelled<sup>a</sup></b>	

<5km	83 (39%)
6-25km	68 (32%)
26-50km	29 (14%)
51-100km	15 (11%)
>100km	24 (2%)
<b>Satisfaction with AP<sup>a</sup></b>	
Very dissatisfied	6 (3%)
Dissatisfied	13 (6%)
Neither satisfied/dissatisfied	4 (2%)
Quite satisfied	48 (22%)
Very satisfied	152 (71%)
<b>Satisfaction with AP assessment/training<sup>b</sup></b>	
Very dissatisfied	3 (3%)
Dissatisfied	1 (1%)
Neither satisfied/dissatisfied	8 (7%)
Quite satisfied	19 (17%)
Very satisfied	85 (75%)
<b>Satisfaction: repair, maintenance, follow-up services<sup>c</sup></b>	
Very dissatisfied	9 (7%)
Dissatisfied	12 (10%)
Neither satisfied/dissatisfied	5 (4%)
Quite satisfied	20 (16%)
Very satisfied	82 (67%)
<b>Suitability of AP to home surroundings<sup>a,d</sup></b>	
Not at all	5 (2%)
Not much	21 (10%)
Moderately	33 (15%)
Mostly	75 (35%)
Completely	87 (41%)
<b>Extent AP helps persons do what they want<sup>a,e</sup></b>	
Not at all	2 (1%)
Not much	20 (9%)
Moderately	36 (17%)
Mostly	78 (37%)
Completely	83 (39%)
<b>Extent AP is used in different environments/places<sup>a,e</sup></b>	
Not at all	15 (7%)
Not much	27 (13%)
Moderately	28 (13%)
Mostly	35 (16%)
Completely	112 (52%)

<sup>a</sup>Denominator is all AP users (n=214); information was recorded for up to three APs (considered most important to the participant; n=231 APs) therefore column totals add up to >100%. If one participant reported the same source/funding for >1 AP, this source was counted only once. NB: Three AP users did not know the source of their AP and six did not know the distance.

<sup>b</sup>Denominator is all AP users who reported accessing assessment/training for at least one AP (n=113).

<sup>c</sup>Denominator is all AP users who had accessed repair, maintenance and/or follow-up services for at least one AP (n=123).

<sup>d</sup>Extent AP helps persons do what they want in terms of: doing household activities, self-care, going to school, college or work, visiting friends or neighbours or going for leisure and recreation).

<sup>e</sup>Different environments/places such as schools, workplaces, public spaces.

## Barriers to Assistive Product Access

Among the 491 participants reporting an unmet need for at least one AP, the most commonly reported reason was 'cannot afford' (87%), followed by lack of support (35%), lack of time (16%), AP unavailable (8%), transport lacking/too far (7%), stigma/shyness (3%), and AP not suitable (2%).

## DISCUSSION

### Overall Findings

Using the WHO rATA in the province of Sololá in Guatemala, self-reported need and unmet need for at least one AP was high (20.3% and 17.1% respectively), while only 7.4% reported using at least one AP. Overall, these findings highlight limited access and availability of APs among people reporting need for them, especially among older populations and those who experience functional difficulties. Also, females had a higher reported unmet need, and use was over two times higher in urban areas compared to rural areas ( $p=0.001$ ). These findings suggest a need to specifically target older, rural and female populations in efforts to improve AP access. Additionally, satisfaction with AP and related services was reasonably high, which points to the perceived positive value of APs in the lives of people in this area.

The higher use and unmet need of vision- and mobility-related APs (spectacles 5.8% and 13.4%, canes/sticks/tripods/quadrupods 0.8% and 3.1% respectively), compared to other functional domains, is similar to other studies in low- and middle-income country studies (Matter, Harniss, Oderud, Borg & Eide, 2017). These findings could be due to a few factors including availability of these services in Sololá and greater awareness/understanding of vision and mobility needs in the population compared to the other domains, given these functional difficulties are often more well-known and visible.

The study findings also highlighted cost-related factors influencing AP access. For example, among AP users, APs were most commonly sourced from private providers and paid for out of pocket, and cost was the most commonly reported barrier to AP use. This suggests a gap in public provision of AP in this setting, which is congruent with other findings (Borg and Östergren, 2015; World Health Organisation, 2018) and indicates that low/no cost AP provision is still limited despite the presence of 15 Non-Governmental Organisations (NGOs) and OPDs in Sololá province that provide AP services. This may reflect constrained resources and capacity of these organisations to deliver at scale and/or lack of community awareness of these services. Further research is needed to explore this in more detail.

There is limited population-based data from Guatemala or other Latin American countries, with which to compare the study findings. In the 2018 Guatemalan census, 10.4% of the overall population and 9.1% of the population in Sololá reported 'some difficulty or worse' (Instituto Nacional de Estadística Guatemala & UNFPA, 2019) which is much lower than the study's estimate of 27.2%. In the 2016 Guatemala National Disability Survey, 7.3% reported 'a lot of difficulty or worse' using the WG short set of questions, which is slightly lower than the 12.5% in the current study, although similar trends of increasing prevalence by age and among women were found (International Centre for Evidence in Disability, 2016). The differences in functional difficulty prevalence, in part, likely reflect modifications made to the WG questions for the rATA. The standard WG questions ask people to report on their functioning **with** equipment, devices, products or assistance from others (if they use them), while in rATA people are asked to consider their functioning without these supports. Considering glasses are the most commonly used AP, this different WG administration also likely explains why, in the current study, difficulties were most commonly reported for vision, in contrast to other studies using the WG short set (including the Guatemala national disability survey) where difficulty with mobility is most commonly reported (International Centre for Evidence in Disability, 2016; Pryor et al, 2018). The modified version of WG is used to assess levels of functioning without AT; however it limits comparison to other WG data.

Comparable data specifically on AP access is lacking. For example, in the Guatemala national survey 10% of the population reported using equipment, devices or products or assistance from others for vision, hearing or mobility. However, rATA asks about use of AP only and not assistance from others, which

may explain the lower prevalence estimate (7.4%). A survey in Bangladesh, using an earlier version of the rATA, estimated AP use at 7.1% among people aged 18+ years, which is slightly lower than in the current study (11.0% among 18+ years) (Pryor et al, 2018). The reasons for this are unclear, though they may reflect different economic and service provision contexts. The trends of higher AP use and unmet need associated with increasing age and functional difficulty observed in the current study, were also found in Bangladesh (Pryor et al, 2018).

### **Strengths and Limitations of the Survey Tool**

The rATA relies only on participant self-report for assessing AP needs. Self-report assessment is typically lower cost, quicker and requires fewer human resources compared to clinical assessment (Boggs et al, 2019, 2020). It also, importantly, incorporates consumer choice, and individuals' understanding of their need, uptake and benefit from AT which is crucial for developing AT services (Zhang et al, 2021). However, there are limitations of this approach, with evidence suggesting it can both under- and over-estimate AT need (Mactaggart, Kuper, Murthy, Oye & Polack, 2016; Boggs et al, 2019, 2020, 2021b; Boggs, Polack, Kuper & Foster, 2021c). Consumer choice and participation are undeniably important. However, assessing AT need is complex, and self-assessment can be difficult for several reasons. First, the appropriate intervention is often dependent on understanding the clinical cause, diagnosis and prognosis of the functional impairment. A study in India found that among 60 people who self-reported needing distance glasses, 75% actually either required a different intervention (e.g., cataract surgery) or did not have a vision impairment based on clinical assessment (Boggs et al, 2020). Second, awareness of different APs and what they can do is generally limited. For example, a study in The Gambia found that among those participants who self-reported "some difficulty or worse" with hearing, 62% were unaware of hearing APs (Boggs et al, 2021b). Third, assessing appropriateness of APs is also dependent on personal and environmental factors, such as home environment and different types of terrain. These factors are typically assessed during clinical functional assessments by rehabilitation professionals, for example, to determine which referral services and APs are appropriate. When clinical information and problem solving are lacking, and AP awareness is limited, it may be challenging for people to know which factors to consider in self-assessing for APs. The rATA does recommend use of an AP image booklet to enhance participants' understanding of specific APs (Zhang et al, 2021). However, self-assessment of AT need is still challenging and particularly for less familiar APs (e.g., Hearing



loops/ frequency modulation systems) and more complex functional difficulties/ impairments (Boggs et al, 2021a). A hybrid approach which integrates self-report assessment alongside clinical assessments of impairment, functioning and AT needs, should therefore be considered where resources allow (Boggs et al, 2021c).

### **Strengths and Limitations of the Study**

This study contributes to efforts in addressing the AT data gap in Guatemala and globally. The response rate was high (94%), and the finding about prevalence of use of at least one AP was similar to the predicted estimate by the researchers (7%). The age and sex distribution of the study population was well-aligned to the recent census. The rATA survey123 mobile data collection app with an accompanying web platform enabled data monitoring throughout.

There were also limitations. First, although the overall survey response rate was 94%, the response rate in the three clusters was relatively low. These clusters were urban, with many people out at work when the teams visited, and there were some initial challenges in engaging with the communities. The researchers responded to this through better engagement with community leaders and by adjusting data collection times to include weekends and out of typical work hours. This greatly improved the response rate throughout the remainder of the survey. Second, despite efforts made prior to and during the training to ensure appropriate translation into Guatemalan Spanish (written) and Mayan languages (verbal), some language challenges were still faced in the communities. This resulted in increased time spent with participants to ensure understanding. It is recommended that these language and interpretation issues are discussed with the WHO team so they are better addressed in the rATA guidelines during recruitment and translation processes. Third, this study did not include children <2 years old as per rATA methodology. The low prevalence of AT use and needs in that age group would possibly not substantially affect prevalence estimates. However, additional research to identify appropriate tools to assess AT needs for this younger age group is recommended. Fourth, results from this study cannot necessarily be generalised to other settings in Guatemala. In particular, it is noted that the presence of the 15 NGOs and OPDs in Sololá province that provide APs may result in better AT access compared to other provinces. Therefore, it is recommended that future surveys be conducted in other areas of the country. Finally, although data on barriers was collected, in-depth qualitative studies are required for fully understanding reasons for unmet needs and appropriate strategies to address them.

## Implications

Key recommendations for strengthening AT service/programme in Sololá include:

- Develop an AT action plan with relevant stakeholders, including people with functional difficulties and AP users, to improve access and availability of relevant affordable AP services.
- Work with national stakeholders on WHO's AT actions to develop a national Guatemalan priority AP list (World Health Organisation, 2016).
- Scale-up public provision of AP services focusing on vision and mobility; the AP services which were the highest reported functional difficulties and most needed APs.
- Advocate for increased human resources, especially in the public sector, for both training and paid employment positions for AP manufacturing, assessment, provision and repairs.
- Raise awareness amongst potential and current AP users, caregivers and various service providers on the types and purposes of various APs.
- Strengthen appropriate AP service provision specifically addressing the access needs for women, older adults, and those in rural areas.

The findings also highlight areas where additional research is needed. A modified WHO Assistive Technology Capacity Assessment could be conducted using the system-level tool to better understand and assess the capacity for all-age AT provision in Sololá (World Health Organisation, 2021a). For example, this could provide contextual service information about the types of APs available through different providers (e.g., government health services and NGOs). Qualitative research is also needed to further explore the heavy reliance on private sources and how personal and environmental factors of people with functional limitations and/or caregivers influence AP awareness, access, barriers and satisfaction. Additionally, a hybrid assessment survey integrating self-report alongside clinical AP assessment is recommended to further understand AP need and unmet need in this setting.

Finally, the rATA is a new survey tool and there were two lessons learnt that could help inform future rATA surveys. First, it was challenging to track participants who were unavailable when the survey team first visited (and therefore needed revisiting) as this information could not be recorded in

the survey123 app. A paper-based enumeration form was used to track this; however, it is recommended that this option is included in future versions of the app. Second, the researchers initially trialled a handheld AP image booklet to enhance participants' understanding of specific APs; however due to difficulty in administering this in the field, they switched to showing digital AP images on a Tablet while maintaining safe COVID-19 distance from people. It is recommended that this method is reviewed, alongside the use of a large poster with images, to ensure APs are well explained.

## CONCLUSION

There is high self-reported need and unmet need for APs in the province of Sololá in Guatemala. Efforts are needed to improve AP access in this setting, including addressing cost-related barriers and increasing public provision of AP and related services. These findings can be used by policy-makers and service providers (including NGOs) to inform programme/service planning and by OPDs to advocate for improved AT access and provision at local and national levels. The findings also contribute to the WHO data collection efforts for the forthcoming WHO-UNICEF Global Report on Assistive Technology and will inform current and future research, policies and services/programming to ensure no one is left behind, with all AT needs met.

## ACKNOWLEDGEMENT

The authors are grateful for the logistical and administrative support of Asociación de Padres y Amigos de Personas con Discapacidad de Santiago Atitlán (ADISA) throughout the study. They would like to thank their Study Advisory Committee which included the following organisations: ADISA, Guatemala National Council for People with Disabilities (CONADI), Ministerio de Salud Pública y Asistencia Social the Guatemala (MSPAS - Ministry of Health), Consejo Departamental de Seguridad Alimentaria (CODESAN). Thanks are also extended to WHO GATE's global coordination rATA team for their survey support, especially Wei Zhang, Hasheem Mannan and Konstantinos Antypas. The contribution of the enumerator study teams, including the team leaders and local field supervisor, is acknowledged with gratitude for their work, commitment and dedication to this project. Finally, and most importantly, the authors thank all the participants in this study. Written informed consent was obtained from them to publish this paper.

## Funding

This study was funded by the World Health Organisation with the grant awarded to Liliane Foundation, coordinator of the research consortium. The paper drafting and finalisation was led by London School of Hygiene and Tropical Medicine, funded by UK Aid through the AT2030 programme coordinated by Global Disability Innovation Hub, project number: 300815 (previously 201879-108).

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

The data presented in this study is available on request from the corresponding author. The data is not publicly available due to ongoing analyses by World Health Organisation for the WHO-UNICEF Global Report on Assistive Technology (GReAT).

## REFERENCES

- Boggs, D., Atijosan-Ayodele, O., Yonso, H., Scherer, N., O'Fallon, T., Deniz, G., Volkan, S., Örüçü, A., Pivato, I., Beck, A.H., Akinci, I., Kuper, H., Foster, A., Patterson, A., & Polack S (2021a). Musculoskeletal impairment among Syrian refugees living in Sultanbeyli, Turkey: prevalence, cause, diagnosis and need for related services and assistive products. *Conflict and health*, 15(1), 1-14. <https://doi.org/10.1186/s13031-021-00376-3> <https://doi.org/10.1186/s13031-021-00362-9> PMID:33879194 PMCID:PMC8056489
- Boggs, D., Hydera, A., Faal, Y., Okoh, J.A., Olaniyan, S.I., Sanneh, H., Ngett, A., Bah, I., Aleser, M., Denis, E., McCormick, I., Bright, T., Bell, S., Kim, M., Foster, A., Kuper, H., Burton, M.J., Mactaggart, I., & Polack, S. (2021b). Estimating need for glasses and hearing aids in The Gambia: results from a national survey and comparison of clinical impairment and self-report assessment approaches. *International Journal of Environmental Research and Public Health*, 18(12), 6302. <https://doi.org/10.3390/ijerph18126302> PMID:34200769 PMCID:PMC8296105
- Boggs, D., Kuper, H., Mactaggart, I., Oye, J., Murthy, G., & Polack, S. (2019). Estimating assistive technology need through population-based surveys: an analysis of data from Cameroon and India. In N. Layton & J. Borg (Eds.), *Global perspectives on assistive technology: proceedings of the GReAT Consultation*, (Vol. A, pp. 52-78). Geneva: World Health Organization.
- Boggs, D., Kuper, H., Mactaggart, I., Murthy, G., Oye, J., & Polack, S. (2020). Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches. *Tropical Medicine & International Health*, 26 (2), pp 146-158. <https://doi.org/10.1111/tmi.13523> PMID:33166008
- Boggs, D., Polack, S., Kuper, H., & Foster, A. (2021c). Shifting the focus to functioning: essential for achieving Sustainable Development Goal 3, inclusive Universal Health Coverage and supporting COVID-19 survivors. *Global Health Action*, 14(1), 1903214. <https://doi.org/10.1080/17445019.2021.1903214>

1080/16549716.2021.1903214 PMid:33904370 PMCid:PMC8081312

Borg, J., & Östergren, P.O. (2015). Users' perspectives on the provision of assistive technologies in Bangladesh: awareness, providers, costs and barriers. *Disability and Rehabilitation: Assistive Technology*, 10(4), 301-308. <https://doi.org/10.3109/17483107.2014.974221> PMid:25347347

Infraestructura de Datos Espaciales de Guatemala. (n.d.). *Infraestructura de Datos Espaciales de Guatemala (IDEG) Geoportal* [Online]. Retrieved 8 December, 2021, from <https://ideg.segeplan.gob.gt/geoportal/>

Instituto Nacional de Estadística Guatemala, & UNFPA. (2019). *Resultados Censo 2018*. (pp. 58). Guatemala City, Guatemala: Instituto Nacional de Estadística Guatemala.

International Centre for Evidence in Disability. (2016). *Guatemala National Disability Study (ENDIS 2016) Survey Report*. London: London School of Hygiene & Tropical Medicine. [available from <http://disabilitycentre.lshtm.ac.uk>].

Kuper, H., Mactaggart, I., Dionicio, C., Cañas, R., Naber, J., & Polack, S. (2018). Can we achieve universal health coverage without a focus on disability? Results from a national case-control study in Guatemala. *PLoS One*, 13(12), e0209774. <https://doi.org/10.1371/journal.pone.0209774> PMid:30589885 PMCid:PMC6307777

Mactaggart, I., Kuper, H., Murthy, G.V.S., Oye, J., & Polack, S. (2016). Measuring Disability in Population Based Surveys: The Interrelationship between Clinical Impairments and Reported Functional Limitations in Cameroon and India. *PLoS One*, 11(10), e0164470. <https://doi.org/10.1371/journal.pone.0164470> PMid:27741320 PMCid:PMC5065175

Matter, R., Harniss, M., Oderud, T., Borg, J., & Eide, A.H. (2017). Assistive technology in resource-limited environments: A scoping review. *J Disability Rehabilitation: Assistive Technology*, 12(2), 105-114. <https://doi.org/10.1080/17483107.2016.1188170> PMid:27443790

Pinilla-Roncancio, M., Mactaggart, I., Kuper, H., Dionicio, C., Naber, J., Murthy, G., & Polack, S. (2020). Multidimensional poverty and disability: A case control study in India, Cameroon, and Guatemala. *SSM-population health*, 11, 100591. <https://doi.org/10.1016/j.ssmph.2020.100591> PMid:32405529 PMCid:PMC7212179

Pryor, W., Nguyen, L., Islam, Q.N., Jalal, F.A., & Marella, M. (2018). Unmet Needs and Use of Assistive Products in Two Districts of Bangladesh: Findings from a Household Survey. *International journal of environmental research and public health*, 15(12), 2901. <https://doi.org/10.3390/ijerph15122901> PMid:30567357 PMCid:PMC6313454

Turner, A.G., Magnani, R.J., & Shuaib, M. (1996). A not quite as quick but much cleaner alternative to the Expanded Programme on Immunization (EPI) Cluster Survey design. *International journal of epidemiology*, 25(1), 198-203. <https://doi.org/10.1093/ije/25.1.198> PMid:8666490

Washington Group on Disability Statistics Secretariat (2020). *Washington Group on Disability Statistics* [Online]. Retrieved 2 December, 2021, from <http://www.washingtongroup-disability.com/>

World Health Organisation (2016). *Priority assistive products list*. Geneva: World Health Organisation.

World Health Organisation. (2018). Assistive technology factsheet [Online]. Retrieved 27 November, 2021, from <http://www.who.int/news-room/fact-sheets/detail/assistive-technology> <https://doi.org/10.4135/9781071872765.n2>

World Health Organisation. (2021a). Assistive technology capacity assessment (ATA-C): instruction manual. Geneva: World Health Organization.

World Health Organisation (2021b). rapid Assistive Technology Assessment tool (rATA). Geneva: World Health Organization.

Zhang, W., Eide, A.H., Pryor, W., Khasnabis, C., & Borg, J. (2021). Measuring Self-Reported Access to Assistive Technology Using the WHO Rapid Assistive Technology Assessment (rATA) Questionnaire: Protocol for a Multi-Country Study. *International Journal of Environmental Research and Public Health*, 18(24), 13336. <https://doi.org/10.3390/ijerph182413336> PMID:34948945 PMCID:PMC8706997

## **Appendix 1: Guatemala rapid Assessment of Assistive Technology (rATA) research consortium organisations**

<b>Role</b>	<b>Organisation name</b>
Research consortium coordinator	Liliane Foundation
Technical research consortium coordinator	International Centre for Evidence on Disability, London School of Hygiene & Tropical Medicine
Technical and training coordinator	Range of Motion Project
Research consortium logistic and administrative coordinator	Asociación de Padres y Amigos de Personas con Discapacidad de Santiago Atitlán (ADISA)

## 7.2 AP survey methodology development

The rATA is a population-based survey tool that assesses AP need utilising self-report developed by WHO. Some sections from an earlier draft version of the rATA were integrated into The Gambia hearing and vision study (see **Chapter 5.2**), however the updated final version of the rATA was used in this Guatemala study. The lessons learned to help inform future rATA surveys were presented in the research paper (see **Chapter 7.1**). The lessons learned and key implications for development of hybrid AP need survey methodology are discussed below.

### 7.2.1 Review of rATA's AP assessment method

- 1) The self-reported rATA rightly included consumer choice and participation (64); however, there were limitations which made it challenging for participants to know which factors to consider in self-assessing for AP.(105)

For example, participants may have had limited information on clinical diagnosis and prognosis, and awareness of AP. It is possible that people might have needed surgery and/or medicine instead of AP, or that people didn't know which AP were available that they could benefit from. Without these details, self-reported AP need data is less informative. The development of an hybrid approach integrating self-report assessment, including select rATA sections, alongside clinical assessments of impairment, functioning and AP need, is recommended for an AP need survey.(106) This supports the findings from **Chapter 5** which found self-reported AP need insufficient.

#### **Implications for survey development**

- Develop hybrid AP need survey tool incorporating self-report, clinical impairment and functional assessments.

### 7.2.2 AP indicators

- 1) The rATA combines self-reported unmet and undermet AP need by asking if the participant needs any AP that he/she currently does not use, or currently uses but it needs to be replaced. It is recommended that these questions are separated for the purpose of measuring self-reported undermet need to inform service planning.
- 2) AP awareness among participants can be limited which is an important issue to address. It is especially important that a self-report AP need survey gathers this awareness information. The rATA did not have questions to measure awareness of different AP so it is recommended that this is included in the AP need survey.
- 3) It is imperative that participants are enabled to better understand AP and what they can do when responding to questions about need, especially with self-report AP tools. A few methods to show AP images were considered and/or trialled during

the survey including i) the rATA recommendation of AP images by domain printed on large posters, ii) handheld printed AP image booklets and iii) displaying digital AP images on a tablet while maintaining safe COVID-19 distance. The latter was implemented for the majority of the survey due to logistical and contextual concerns, such as carrying items when walking long distances in rural data collection areas. It is recommended that these various methods are reviewed to ensure AP are well explained in AP need survey self-reported sections.

- 4) The rATA provided open text entry for participants to provide up to three other AP that were not listed on the core AP list. Both the AP names and photographs could be included in the survey123 app. Though the numbers were low, this an important consideration to ensure that locally made and sourced AP are included in an AP need survey providing it is feasible.

#### **Implications for survey development**

- Separate unmet and undermet need self-reported AP indicators.
- Ensure the measurement of AP awareness at the beginning of self-reported AP section in an AP need survey.
- Use AP images to facilitate participants' understanding of self-reported AP questions and explore the most feasible method for use (i.e. printed versus electronic).
- Include option to provide up to three additional locally sourced and made AP with possible photos in AP need survey.

#### 7.2.3 Additional survey methods

- 1) The sample size for this AP focused study was calculated based upon the prevalence estimate of using *at least one* AP (e.g. 7%). This proved to provide adequate power for the study which collected data on approximately 50 AP. However, with the exception of glasses, the prevalence of need for individual AP is low and very low for a few specific AP, such as wheelchairs. Sample sizes powered to individual AP would be prohibitively large and expensive to implement in a survey. Therefore, it is recommended that the sample size is calculated on need for *at least one* AP (*other* than glasses), but this should be reviewed and updated as more data are generated. Additionally, the sample size will depend on specific data needs, as well as resources available, so if a study is only interested in a specific domain/AP (e.g. mobile devices) the survey would need to be powered accordingly.
- 2) The rATA uses a modified version of the WG SS questions asking about functional difficulties *without* AP use. This was because rATA is an AP focused survey and wanted to assess functional difficulties without use of AP to assess total functional need. However, this modification in rATA limited the comparability of results to



other surveys using the WG SS and also did not assess participants' everyday activities (i.e. seeing with glasses if they wear them).

This is an important consideration for the development of an AP need survey. In The Gambia survey (see **Chapter 5.2**), a modified version of the WG ES questions was used; participants were first asked about use of glasses/hearing aids and then either about level of functional difficulty with AP (for those who use them) or without AP (for those that didn't use them). This had the benefit of gathering separate self-reported AP use, undermet need and unmet need for vision and hearing, and also was used as a first-stage screen for a self-reported section for those who reported some or worse difficulty and/or wore glasses/hearing aids. The data could also be analysed for comparison to other WG surveys. This modification is recommended for a self-reported AP need survey such as the rATA and could also be important if the WG questions are used as a first stage screen to ensure all participants with AP need (i.e. reported use/undermet/unmet need) are assessed by the relevant second stage assessment.

- 3) Alongside providing self-reported data to measure AP indicators, the rATA also provided data about AP access barriers, payment details, satisfaction and environmental issues which are important for the AP sector to know for planning and policy purposes. The rATA limited the data collected on sources and providers of AP, distance to AP facility, AP satisfaction, suitability, utility and environment, to the three most important products for participants. Limiting the selection to three AP made the survey feasible with decreased administration time. Therefore, it is recommended that four of the rATA sections are integrated into an AP need survey and that the quantity of AP selected is limited to a maximum of three. The proposed sections for integration are:
  - a) AP access barriers.
  - b) AP sources and payers.
  - c) Distance to AP facility.
  - d) AP satisfaction, suitability, utility and environment.

Following an AP need pilot survey, the four sections and limit of three AP should be reviewed for feasibility and time taken to administer.

#### **Implications for survey development**

- Recommend that relevant use of *at least one* AP prevalence estimates are used in sample size calculations to ensure adequate power in an AP need survey until more data is generated.
- Recommend modifications to the WG ES questions to gather self-reported use/undermet/unmet need, while also ensuring that the data collected can be analysed to align with standardised WG reporting.
- Collect AP data on access barriers, payment details, satisfaction and environment in an AP need survey.

#### 7.2.4 AP survey data collection

- 1) A dashboard was programmed in the survey 123 web-based platform which was essential for data monitoring and quality, however an enumeration form was not programmed in the survey 123 app. Therefore, a paper-based form was used to track participants who were unavailable at the survey teams first visit and needed revisiting. This information was then entered into an online form daily by the team leaders, which created additional work and took extra time. This response rate information is vital, so it is recommended AP need survey mobile application includes both electronic versions of a data dashboard and the enumeration form.
- 2) The rATA gathered quantitative data on AP access barriers. Nine options were provided, including an open field text for “other” and “do not know”. This information was useful in the analysis, however, to better understand reasons for unmet needs, and appropriate strategies to address them, it is recommended that in-depth qualitative studies are undertaken alongside the AP need survey.

#### **Implications for survey development**

- Programme electronic versions of web-based data dashboards and app-based enumeration forms when developing an AP need survey mobile application.
- Ensure in-depth qualitative studies are undertaken alongside AP need survey.

## Chapter 8: Exploring use of self-reported screening questions

This chapter presents a study that was undertaken to explore use of the WG question sets as a first stage screening for a population-based survey to identify people with clinical impairment, service and AP referral needs, using different cut-offs. A secondary analysis was undertaken from five survey datasets (Cameroon, Chile, India, The Gambia and Turkey) for four functional domains (vision, hearing, mobility and cognition).



A young girl sitting outside in a wheelchair in front of a house. © Relief International

## **8.1 Research paper 7: Use of WG question sets as screening for functional impairments and related service and AP needs in five countries: Cameroon, Chile, India, The Gambia and Turkey**

### **Preamble**

This paper explores the use of the self-reported WG question sets as a first stage screening tool to identify people with clinical impairments and their need for referral services and AP in four functional domains of vision, hearing, mobility, cognition. Secondary data analysis was undertaken using population-based survey data from five countries, including one national survey (The Gambia) and four regional/district surveys (Cameroon, Chile, India, Turkey).

A total of 19,951 participants were included in the 5 studies (range 538 – 9,188 in individual studies). The WG question sets on functioning were completed for all participants alongside clinical impairment assessments/questionnaires. The paper presents analyses of service and AP need for each impairment domain using different cut-off levels. The paper concludes that the WG questions could be used as an option for a first stage screening tool to identify people needing clinical assessment for AP need, but only with moderate sensitivity and specificity, and recommends to explore additional screening cut-offs and tools.

This paper was published in April 2022 in the International Journal of Environmental Research and Public Health. The manuscript was published under a Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>), and the published manuscript is included in full below.

### 8.1.1 List of Tables

**Table 1:** Survey participants and clinical impairment assessments in Cameroon, Chile, India, The Gambia and Turkey.

**Table 2:** Relationship between self-reported difficulties and clinically assessed impairments by functional domain for vision, hearing, mobility and cognition.

**Table 3:** Proportion of participants assessed to have a clinical impairment and need interventions\* who were identified as having functional difficulties by Washington Group questions.

**Table 4:** Proportion of participants assessed as having a clinical impairment who need \* glasses, hearing aids, wheelchairs and prostheses that were identified by WG some+ difficulty question.

\* “Need” includes both “unmet need” and “undermet need” for each assistive product.

### 8.1.2 Supplementary material

The Supplementary material referenced in the paper is available at

<https://www.mdpi.com/article/10.3390/ijerph19074304/s1>

### 8.1.3 Citation

Boggs, D.; Kuper, H.; Mactaggart, I.; Bright, T.; Murthy, G.; Hydera, A.; McCormick, I.; Tamblay, N.; Alvarez, M.L.; Atijosan-Ayodele, O.; Yonso, H.; Foster, A.; Polack, S. Exploring the Use of Washington Group Questions to Identify People with Clinical Impairments Who Need Services including Assistive Products: Results from Five Population-Based Surveys. *Int. J. Environ. Res. Public Health* **2022**, *19*, 4304. <https://doi.org/10.3390/ijerph19074304>



## RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

### SECTION A – Student Details

<b>Student ID Number</b>	178718	<b>Title</b>	Ms.
<b>First Name(s)</b>	Dorothy		
<b>Surname/Family Name</b>	Boggs		
<b>Thesis Title</b>	Exploring the assessment of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility		
<b>Primary Supervisors</b>	Professor Allen Foster and Dr. Sarah Polack		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

### SECTION B – Paper already published

Where was the work published?	International Journal of Environmental Research and Public Health		
When was the work published?	April 2022		
If the work was published prior to registration for your degree, give a brief rationale for its inclusion.			
Have you retained the copyright for the work?*	<b>Yes</b> , This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license ( <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a> ).	Was the work subject to peer review?	<b>Yes</b>

\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from copyright holder (publisher or other author) to include this work.

### SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorships order:	
Stage of publication	Choose an item.

### **SECTION D – Multi-authored work**

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I designed the study, conducted the analysis, drafted the manuscript, considered revisions and comments from other authors.
--	---

### **SECTION E**

<b>Student signature</b>	Dorothy Boggs
<b>Date</b>	28/11/2022

<b>Supervisors signature</b>	Allen Foster and Sarah Polack
<b>Date</b>	28/11/2022



Article

# Exploring the Use of Washington Group Questions to Identify People with Clinical Impairments Who Need Services including Assistive Products: Results from Five Population-Based Surveys

Dorothy Boggs <sup>1,\*</sup> , Hannah Kuper <sup>1</sup>, Islay Mactaggart <sup>1,2</sup> , Tess Bright <sup>1</sup> , GVS Murthy <sup>2,3</sup>, Abba Hydera <sup>4</sup> , Ian McCormick <sup>2</sup>, Natalia Tamblay <sup>5</sup>, Matias L. Alvarez <sup>6</sup> , Oluwarantimi Atijosan-Ayodele <sup>7</sup>, Hisem Yonso <sup>8</sup>, Allen Foster <sup>2</sup> and Sarah Polack <sup>1</sup>

<sup>1</sup> International Centre for Evidence in Disability, London School of Hygiene & Tropical Medicine, London WC1E 7HT, UK; hannah.kuper@lshtm.ac.uk (H.K.); islay.mactaggart@lshtm.ac.uk (I.M.); brightt@unimelb.edu.au (T.B.); sarah.polack@lshtm.ac.uk (S.P.)

<sup>2</sup> International Centre for Eye Health, London School of Hygiene & Tropical Medicine, London WC1E 7HT, UK; murthy.gvs@iiphh.org (G.M.); ian.mccormick@lshtm.ac.uk (I.M.); allen.foster@lshtm.ac.uk (A.F.)

<sup>3</sup> Indian Institute of Public Health, Hyderabad 122002, India

<sup>4</sup> Sheikh Zayed Regional Eye Care Centre, Banjul P.O. Box 650, The Gambia; ahydera@gmail.com

<sup>5</sup> Department of Otorhinolaryngology, Faculty of Medicine, Universidad de Chile, Santiago 7790680, Chile; ntamblay@gmail.com

<sup>6</sup> Department of Otorhinolaryngology, Faculty of Medicine, Pontificia Universidad Católica de Chile, Santiago 8330077, Chile; mlalvarez@uc.cl

<sup>7</sup> Maidstone and Tunbridge Wells NHS Trust, Maidstone ME16 9QQ, UK; rantimi@gmail.com

<sup>8</sup> Relief International, Istanbul 34087, Turkey; hisem.yonso@ri.org

\* Correspondence: dorothy.boggs@lshtm.ac.uk



**Citation:** Boggs, D.; Kuper, H.; Mactaggart, I.; Bright, T.; Murthy, G.; Hydera, A.; McCormick, I.; Tamblay, N.; Alvarez, M.L.; Atijosan-Ayodele, O.; et al. Exploring the Use of Washington Group Questions to Identify People with Clinical Impairments Who Need Services including Assistive Products: Results from Five Population-Based Surveys. *Int. J. Environ. Res. Public Health* **2022**, *19*, 4304. <https://doi.org/10.3390/ijerph19074304>

Academic Editor: Paul B. Tchounwou

Received: 18 February 2022

Accepted: 30 March 2022

Published: 3 April 2022

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Abstract:** This study analyses the use of the self-reported Washington Group (WG) question sets as a first stage screening to identify people with clinical impairments, service and assistive product (AP) referral needs using different cut-off levels in four functional domains (vision, hearing, mobility and cognition). Secondary data analysis was undertaken using population-based survey data from five countries, including one national survey (The Gambia) and four regional/district surveys (Cameroon, Chile, India and Turkey). In total 19,951 participants were sampled (range 538–9188 in individual studies). The WG question sets on functioning were completed for all participants alongside clinical impairment assessments/questionnaires. Using the WG “some/worse difficulty” cut-off identified people with mild/worse impairments with variable sensitivity (44–79%) and specificity (73–92%) in three of the domains. At least 64% and 60% of people with mild/worse impairments who required referral for surgical/medical and rehabilitation/AP services, respectively, self-reported “some/worse difficulty”, and much fewer reported “a lot/worse difficulty.” For moderate/worse impairment, both screening cut-offs improved identification of service/AP need, but a smaller proportion of people with need were identified. In conclusion, WG questions could be used as a first-stage screening option to identify people with impairment and referral needs, but only with moderate sensitivity and specificity.

**Keywords:** surveys; impairment; functioning; screening; rehabilitation; assistive products; Cameroon; Chile; India; The Gambia; Turkey

## 1. Introduction

In global health, alongside mortality and morbidity data, there is an increasing emphasis on addressing a third health indicator, “functioning” [1,2]. The International Classification of Functioning, Disability and Health (ICF) defines functioning as an umbrella term for body functions, structures, activities and participation; it denotes the interaction between an individual (with a health condition) and the environmental and personal



context in which they live [3]. The World Health Organization (WHO) estimates that at least 2.4 billion people have difficulties functioning with a need for rehabilitation [4], and more than 1 billion people need assistive technology (AT) with this expected to increase to 2 billion by 2050 [5]. These global estimates are based on assumptions and extrapolations from large population-based impairment datasets, such as the global burden of disease data (GBD).

Diverse groups, including people with disabilities, older people and people with chronic conditions, living in different socioeconomic settings, could benefit from well-planned and resourced services for rehabilitation and assistive products (AP) [6,7]. However, there is currently a lack of data to plan these services. Consequently, there is a need to develop and refine existing survey methodologies to provide population-based data at national and local level on functioning and the need for rehabilitation services and assistive products (APs). These data are particularly needed in low- and middle-income country settings where access to both rehabilitation and APs are often limited, so service availability can be improved and barriers can be addressed [8].

Functioning can be measured through different methodologies including “self-reporting” and clinical assessment [2,9,10]. Self-reporting methodologies are questionnaire based, low cost and rapid to administer. For example, the three main Washington Group (WG) question sets (Short Set, Extended Set and Child Functioning Module) are validated and used widely in population-based disability surveys. They provide self-assessment (or proxy reported) data on components of functioning, predominantly reporting activity limitations across functional domains, including vision, hearing, mobility and cognition, using a four-part scaled response of: no difficulty, some difficulty, a lot of difficulty or cannot do at all [11]. Clinical assessment methodologies in population-based surveys are typically impairment focused and rely on clinicians to diagnose impairments and assess the need for medical, surgical and rehabilitation services, including APs. Clinical impairment assessment is time consuming, requires trained clinicians, is expensive, and often focuses on just one ICF component (impairment), lacking a broader assessment of the individual’s functioning. However, this method provides a more accurate assessment of the need for rehabilitation and AP than self-report alone [9,12,13]. Recently, more “rapid” population-based clinical impairment assessment survey methodologies integrating mobile health technology have been developed which overcome some of the disadvantages of traditional clinician-led measures; for example, the Rapid Assessment of Hearing Loss (RAHL) [14] uses the mobile audiometry tool HearTest together with a clinical examination of the ear [15].

A combination of both self-report and broader clinical assessment is required to obtain more holistic estimates of functioning across multiple domains [2,12,13]. Previous research suggested that a first stage screening using the WG questions, followed by clinical impairment assessment on people who reported “some difficulty” or worse in the corresponding functional domain, would identify the majority of people with impairments and activity limitations [10]. However, evidence is lacking on the appropriateness of this two-stage approach within specific functional domains and on the validity of using different cut-off levels for both self-reported difficulty and clinical impairment. Studies in Fiji with school-age children found that using a cut-off of “some difficulty” in at least one WG domain with accompanying clinical assessments could be used to identify children who require services and learning support; however, the study noted there was widespread variability of identification within impairment levels [16–20]. Evidence from all age groups is lacking, and it is also unclear to what extent this two-stage approach would be able to identify people with specific referral needs (e.g., surgery, rehabilitation and AP). This information is critical to inform service and policy planning and the development of future multi-domain population-based survey tools.

This study aims to address these questions through secondary analysis of datasets from five population-based surveys across the four functional domains of vision, hearing, mobility and cognition that used both WG questions and clinical impairment assessment to examine this two-stage approach.

Specifically, we assess:

- (1) the sensitivity and specificity of the WG questions (at different cut-off levels) to identify people with clinically assessed impairments (vision, hearing, mobility and cognitive domains);
- (2) the proportion of people identified by the WG questions (at different cut-off levels) who are in need of surgical/medical and/or rehabilitation/AP services.

## 2. Methods

### 2.1. Population-Based Surveys

This study uses data from five cross-sectional surveys undertaken in Cameroon, Chile, India, The Gambia and Turkey between 2013 and 2020 (Table 1) [12,13,21–32]. Four were regional/district surveys (Cameroon, Chile, India and Turkey) and one was a national survey (The Gambia). All surveys used two-stage cluster random sampling. Three surveys included children aged 2 years and over (Cameroon, India and Turkey); The Gambia survey included adults aged 35 years and over; and the Chile survey included adults aged 50 years and over.

**Table 1.** Survey participants and clinical impairment assessments in Cameroon, Chile, India, The Gambia and Turkey.

	Cameroon	Chile	India	The Gambia	Turkey
<b>Overall</b>					
Place	Fundong Health District (North West)	Province of Santiago	Mahbubnagar District, Telangana	National Survey	Sultanbeyli, District of Istanbul
Year	2013	2019–20	2014	2019	2019
Sample Size	3567	538	3574	9188	3084
Response Rate %	87%	47%	88%	83%	77%
Age Group	2+ years	50+ years	2+ years	35+ years	2+ years
% Female	59%	64%	52%	71%	53%
<b>Clinical Impairment Assessment Method</b>					
<b>Vision Assessment</b>					
Children and Adults	VA plus clinical examination	-	VA plus clinical examination	Children not assessed; VA and near vision plus clinical examination	-
<b>Hearing Assessment</b>					
Children and Adults	OAE, PTA ( $\geq 4$ yo) and clinical examination	Children not assessed; PTA and clinical examination	OAE, PTA ( $\geq 4$ yo) and clinical examination	-	-
<b>Mobility/MSI Assessment</b>					
Children and Adults	Clinical mobility assessment	-	Clinical mobility assessment	-	Clinical mobility assessment
<b>Cognition Assessment</b>					
Adults Only	-	Standardised questionnaire	-	-	-

Abbreviations: VA = visual acuity; OAE = otoacoustic emissions; PTA = pure tone audiometry.

## 2.2. Definitions

See Box 1 for definitions of vision, hearing, mobility, cognitive and WG terms used in this paper.

**Box 1.** Definition of vision, hearing, mobility, cognitive and Washington Group terms used in this paper.

Domain	Definition	Term Used in This Paper
<b>Vision</b>		
Mild or worse vision impairment	Presenting (i.e., with correction, if available) VA < 6/12 in the better eye	Mild+ VI
Moderate or worse vision impairment	Presenting (i.e., with correction, if available) VA < 6/18 in the better eye	Moderate+ VI
Near vision impairment	Cannot see N8 at 40cms with correction, if available	Near VI
<b>Hearing</b>		
Mild or worse hearing impairment	>25 dB PTA in the better ear	Mild+ HI
Moderate or worse hearing impairment	>40 dB PTA in the better ear	Moderate+ HI
<b>Mobility</b>		
Mild or worse musculoskeletal impairment	According to RAM criteria, any participant screening positive underwent clinician assessment to determine presence, severity (mild/moderate/severe) and cause/diagnosis of MSI	Mild+ MSI
Moderate or worse musculoskeletal impairment	According to RAM criteria, any participant screening positive underwent clinician assessment to determine presence, severity (moderate/severe) and cause/diagnosis of MSI	Moderate+ MSI
<b>Cognition</b>		
Cognitive impairment	<13 points in the SCh-MMSE	Mild+ cognitive impairment
<b>Washington Group Questions (with or without assistive product)</b>		
Some difficulty or worse		Some+ difficulty
A lot of difficulty or worse		A lot+ difficulty
Abbreviations: VA = visual acuity; VI = vision impairment; PTA = pure tone audiometry; HI = hearing impairment; RAM = Rapid Assessment of Musculoskeletal Impairment; MSI = musculoskeletal impairment; SCh-MMSE = Short Chilean Mini Mental State Examination (SCh-MMSE).		

## 2.3. Washington Group Question Sets for Four Domains

Participants (or representatives if unable to self-report) were asked a series of questions from the WG sets. Adults > 17 years were asked either the WG Short Set, the Short Set-Enhanced or the Extended Set on functioning, and children aged 2–17 years were asked the Child Functioning Module [11]. See Box 2 for the WG questions analysed in this paper. The question sets also ask about use of glasses, hearing aids and mobility APs/assistance.

For the purpose of our analyses, we used the screening cut-offs of “some difficulty or worse” (herein referred to as some+) and “a lot of difficulty or worse” (a lot+) either without or with the corresponding AP (if the participant used them) in each of the four functional domains.

**Box 2.** Relevant Washington Group functioning question sets for vision, hearing and mobility functional domains [11].

**I. Short Set (SS), Short Set-Enhanced (SS-E) and Extended Question (ES) Set on Functioning Questions (>17 years old) ^**

A. Vision

1. Do you wear glasses? (Yes/No)

2. If yes, do you have difficulty seeing even when wearing your glasses?

(No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

3. If no, do you have difficulty seeing?

(No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

B. Hearing

1. Do you wear a hearing aid? (Yes/No)

2. If yes, do you have difficulty hearing even when using a hearing aid? (No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

3. If no, do you have difficulty hearing? (No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

C. Mobility

1. \* Do you use any equipment or receive help for getting around?

(Yes/No)

2. \* If yes, do you have difficulty walking or climbing steps, even when using your equipment or with help?

(No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

3. Do you have difficulty walking or climbing steps?

(No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

D. Cognition

1. Do you have difficulty remembering or concentrating?

(No difficulty/Some difficulty/A lot of difficulty/Cannot do at all or unable to do)

**II. Child Functioning Module (5–17 years old) and Child Functioning Module (2–4 years old) ^**

A. Vision (same as above applied to the child and asked of the carer)

B. Hearing (same as above applied to the child and asked of the carer)

C. Mobility

1. \*\* Compared with children of the same age, does [name] have difficulty walking?

2. Does (name) use any equipment or receive assistance for walking?

3. Without his/her equipment or assistance, does [name] have difficulty walking 100 m on level ground? That would be about the length of one football field.

4. Without his/her equipment or assistance, does [name] have difficulty walking 500 m on level ground? That would be about the length of five football fields.

5. With his/her equipment or assistance, does [name] have difficulty walking 100 m on level ground?

6. With his/her equipment or assistance, does [name] have difficulty walking 500 m on level ground?

7. Compared with children of the same age, does [name] have difficulty walking 100 m on level ground?

8. Compared with children of the same age, does [name] have difficulty walking 500 m on level ground?

^ Subsets of full questionnaires; \* Questions not asked in Turkey Disability and Mental Health Survey; \*\* Only question asked in Cameroon and India Disability Surveys, all other questions were asked in Turkey Disability and Mental Health Survey only.

## 2.4. Clinical Assessment and Questionnaires

### 2.4.1. Vision

#### Distance vision:

Presenting visual acuity (VA) (i.e., with correction, if available) was assessed using a tumbling E single optotype, on cards in India and Cameroon and on Peek Acuity mobile application in The Gambia [33]. In India and The Gambia mild or worse vision impairment (VI) was defined as presenting VA < 6/12 in the better eye; and in India, The Gambia and Cameroon, moderate or worse VI was defined as presenting VA < 6/18 in the better eye [34]. Pinhole vision was assessed for all participants with VI to identify individuals with uncorrected refractive error (URE), and in The Gambia a refraction was performed to record best corrected visual acuity (BCVA). In all three countries (Cameroon, India and The Gambia), participants with VI were examined by a trained eye care worker to determine the cause using the WHO protocol for the condition that is “easiest to treat” [35]. Those identified with URE were reported as needing distance glasses.

#### Near vision:

Presenting (i.e., with near correction if available) binocular near vision was assessed in The Gambia survey only. A binary outcome of can or cannot see N8 at 40 cm (correctly

identifies 4 out of 5 E optotypes) was recorded. Participants unable to see N8 were re-tested using an age-appropriate correction for near and recorded as needing near glasses (unmet need) or needing a change in prescription of existing near glasses (undermet need).

#### 2.4.2. Hearing

In India and Cameroon, all-age participants were screened using Otoacoustic Emissions (OEA) Testing, and participants aged  $\geq 4$  years old who failed this underwent Pure Tone Audiometry (PTA) at 0.5, 1, 2 and 4 kHz to assess the presence and severity of hearing loss. The definition of moderate or worse hearing impairment (HI) was a pure tone average (at 0.5, 1, 2 and 4 kHz) of  $>31$  dB for children (4 to 17 years) and  $>41$  dB for adults ( $\geq 18$  years) in the better ear [36]. Individuals with HI underwent examination by an ENT specialist to assess the cause and likely service needs, including hearing aids.

In Chile [14], PTA was tested using a mobile-based audiometry system HearTest [37] at 0.5, 1, 2 and 4 kHz in each ear. According to WHO's definition, mild or worse HI was defined as  $>25$  dB in the better ear. All participants had their ears examined by an ENT resident or consultant.

#### 2.4.3. Mobility

In Cameroon, India and Turkey, participants were asked six validated screening questions from the Rapid Assessment of Musculoskeletal Impairment survey tool (RAM) [38]. Anyone who screened positive underwent a standardised examination by a physiotherapist using the RAM protocol which includes head/neck, upper limb, lower limb/pelvis, trunk and spine assessment. The presence, severity (mild/moderate/severe) and cause/diagnosis of MSI, as well as the need for services and APs including wheelchairs and prosthetics (both upper and lower limb) was recorded. In Turkey an updated version of RAM was used [27].

#### 2.4.4. Cognition

The Mini Mental State Examination (MMSE) is a brief neurophysiological test [39]. A short validated Chilean Mini Mental State Examination (SCh-MMSE) was developed by an audiologist in Chile [40] to include populations with low levels of literacy [41]. This includes six questions selected from the original 11 question version. The six questions evaluate:

- spatial and temporal orientation (day, month, year);
- short- and long-term memory (3 word retention);
- attention (inverse repetition of 5 numbers);
- executive capacity (verbal order with 3 steps);
- visual constructive capacities (copy of two circles).

Each of the questions has a score, with a possible maximum of 19 points; a total score  $<13$  is considered "suspected cognitive impairment."

#### 2.5. Data Analysis

Stata version 16.0 (StataCorp LP, College Station, TX, USA) was used to manage and analyse the data. The cluster design was accounted for in the analysis using the "svy" command.

To test whether the WG self-reporting questions, as a first-stage screen, are able to identify people assessed as having clinical impairments, we calculated sensitivity, specificity, positive predictive value and negative predictive values, with clinical impairment assessment being the reference.

To understand the extent to which the WG questions identify people who could benefit from referral for a specific intervention, we calculated the proportion of individuals who by clinical impairment assessment were found to need surgical/medical or rehabilitation/AP interventions who self-reported "some+ difficulty" or "a lot+ difficulty" for both mild+ and moderate+ impairment levels. For the purposes of our analyses, we restricted clinically

assessed service and AP need to only those participants who responded to the corresponding WG question in each domain. Surgical/medical and rehabilitation/AP service needs, and need for five individual APs classified as “priority APs” by ATScale [42] (distance glasses, near glasses, hearing aids, wheelchairs and prosthetics), were clinically assessed according to cause, diagnosis and severity. Domain-specific details, used for our analysis, are provided below.

- Vision: For participants with vision loss due to cataract, surgical intervention was assigned. For participants with URE, distance glasses were assigned as the intervention. For participants with other causes of visual loss, e.g., glaucoma, both medical and rehabilitation services were recorded, and, for causes with no medical or surgical treatment possibilities, only rehabilitation services were assigned.
- Hearing: Following the protocol used in RAHL [14], for participants with hearing loss due to chronic otitis media (dry/wet/possible Cholesteatoma), acute otitis media, otitis media with effusion, otitis externa, impacted wax and foreign body, surgical/medical intervention was assigned. Participants with sensorineural/mixed hearing loss in both ears, or unknown cause, were categorised as needing “referral to audiological rehabilitation services and likely hearing aids”. In Cameroon and India, clinician-assessed hearing aid referrals were used.
- Mobility/MSI: According to the RAM [38], surgical/medical and rehabilitation/AP interventions were clinically assessed based upon the examination with specific referral recommendations recorded by the clinician. For example, rehabilitation services included referrals to physiotherapy and environmental modifications, and APs including up to 11 mobility APs, such as wheelchairs, prosthetics, sticks/canes and orthotics.

In each of the functional domains, some participants were assessed to need both medical/surgical interventions and rehabilitation/AP services. Data on intervention need were not available for the cognition domain.

### 2.6. Ethics and Consent

This secondary analysis study received approval from the London School of Hygiene & Tropical Medicine. Each survey received separate approval from the London School of Hygiene & Tropical Medicine and the relevant ethics committees in each study country [10,27,28,30,31]. Written (signed or fingerprinted) informed consent was obtained from all participants or their proxies.

## 3. Results

### 3.1. Overall Survey Results

Table 1 presents the survey details for each country. The sample size ranged from 538–9188 participants with response rates of 47% to 88%. In all five surveys at least half of the study population were female.

### 3.2. WG Questions to Screen for Clinical Impairment

The association between clinical impairment assessment and self-reported difficulty in functioning for each domain is presented in Table 2 with additional analyses in Supplemental Table S1.

Across the different impairments and study settings, using the WG category “some or worse” difficulty identified people with clinical impairments with a sensitivity range of 44% to 85%, and a specificity range of 65% to 92%. There was one exception of very low specificity (18%) for mild+ cognitive impairment (Chile). Using the more restrictive “a lot or worse” difficulty consistently, across impairment types and studies, reduced sensitivity (range 9–62%) and improved specificity (range 86–99.7%). “Near VI” was only measured in The Gambia and had low/very low sensitivity (39% and 3%) and high specificity (85% and 99.5%) using both WG cut-offs of some+ and a lot+ difficulty, respectively.

**Table 2.** Relationship between self-reported difficulties and clinically assessed impairments by functional domain for vision, hearing, mobility and cognition.

Impairment Severity Levels	N/Total WG Population Assessed	Washington Group Self-Reported Seeing Difficulty Responses							
		Some+ Difficulty				A lot+ Difficulty			
		Sensitivity	Specificity	PPV	NPV	Sensitivity	Specificity	PPV	NPV
<b>Distance Vision Impairment</b>									
Cameroon									
Moderate+	82/3314	79%	80%	9%	99%	30%	99%	46%	98%
India									
Mild+	282/3451	79%	80%	26%	98%	18%	99%	58%	93%
Moderate+	119/3451	85%	77%	12%	99%	39%	99%	52%	98%
The Gambia *									
Mild+	1323/9180	67%	79%	35%	94%	10%	99%	70%	87%
Moderate+	998/9180	70%	78%	28%	96%	11%	99%	63%	90%
<b>Hearing Impairment</b>									
Cameroon **									
Mild+	271/3005	44%	89%	28%	94%	9%	99.7%	73%	92%
Moderate+	103/3005	66%	88%	16%	99%	20%	99.6%	64%	97%
Chile									
Mild+	225/492	61%	73%	66%	69%	14%	98%	86%	57%
Moderate+	82/492	78%	65%	31%	94%	33%	98%	75%	88%
India									
Mild+	312/3253	60%	92%	44%	96%	25%	99.7%	89%	93%
Moderate+	153/3253	83%	90%	30%	99%	50%	99.6%	85%	98%
<b>Mobility Impairment</b>									
Cameroon									
Mild+	423/3308	68%	81%	34%	95%	17%	99%	72%	89%
Moderate+	135/3308	68%	76%	11%	98%	36%	98%	47%	97%
India									
Mild+	694/3439	64%	90%	61%	91%	16%	99.7%	93%	82%
Moderate+	123/3439	84%	81%	14%	99%	62%	98.6%	63%	98.6%
Turkey									
Mild+	365/3014	67%	88%	44%	95%	33%	98.8%	79%	91%
Moderate+	255/3014	70%	86%	32%	97%	33%	97.6%	56%	94%
<b>Cognitive Impairment</b>									
Chile									
Mild+	70/534	83%	18%	13%	88%	31%	86%	25%	89%

Abbreviations: WG = Washington Group; PPV = positive predictive value; NPV = negative predictive value. \* 8 survey participants were missing WG data. \*\* Limited to participants  $\geq 4$  years old with complete PTA; in Cameroon, 11 survey participants were missing WG data.

Specific ranges in each domain were as follows. For distance vision, self-reported WG “some+ difficulty” seeing had good/high sensitivity (67–85%) and specificity (77–80%) when compared to clinical VI. Moving to a cut-off of “a lot+ difficulty” increased the sensitivity (99%) but radically reduced the specificity (10–39%). For hearing, “some+ difficulty” hearing had moderate/high sensitivity (44–83%) and good/high specificity (65–92%) when compared to clinical HI. Moving to a cut-off of “a lot+ difficulty” increased the sensitivity (98–99.7%) but reduced the specificity (9–50%). For mobility, some+ difficulty” walking had good/high sensitivity (64–84%) and specificity (76–90%) when compared to clinical MSI. Moving to a cut-off of “a lot+ difficulty” increased the sensitivity (97.6–99.7%) but reduced the specificity (16–62%).

### 3.3. WG Questions to Screen for Service/Intervention Needs

Table 3 shows the proportion of participants with identified clinical impairment who were assessed to need either medical/surgical interventions (e.g., cataract surgery) and/or rehabilitation/AP services (e.g., hearing aids) who were identified by the WG self-reported questions.

**Table 3.** Proportion of participants assessed to have a clinical impairment and need interventions\* who were identified as having functional difficulties by Washington Group questions.

Domain	Washington Group Questions					
	No Difficulty		Some+ Difficulty		A Lot+ Difficulty	
	Need Medical/Surgical Intervention	Need Rehab. Services/APs	Need Medical/Surgical Intervention	Need Rehab. Services/APs	Need Medical/Surgical Intervention	Need Rehab. Services/APs
Mild VI < 6/12	18–27%	26–38%	73–82%	62–74%	13–33%	5–8%
Moderate VI < 6/18	15–26%	24–35%	74–85%	65–76%	14–40%	10–33%
Mild HI	34%	40%	66%	60%	20%	13%
Moderate HI	4–38%	18–33%	62–96%	67–82%	12–64%	25–50%
Mobility: Mild MSI	30–36%	25–35%	64–70%	65–75%	17–34%	19–34%
Mobility: Moderate MSI	11–32%	14–30%	68–89%	70–86%	34–60%	34–62%

Abbreviations: rehab = rehabilitation; VI = vision impairment; HI = hearing impairment; MSI = musculoskeletal impairment. \* Some participants were assessed to need both surgical/medical and rehab/APs interventions/services.

Over three-fifths of participants (range 62–96%) with impairments who needed a surgical/medical intervention self-reported “some+ difficulty”, whereas much fewer (range 13–64%) reported “a lot+ difficulty” across the studies. Of those who needed rehabilitation services and/or APs, 60–86% of persons with impairments self-reported “some+ difficulty” and much fewer (5–62%) reported “a lot+ difficulty.”

The detailed results for each country and service/intervention need are shown in Supplemental Table S2. Additionally, only 39% of people who were clinically assessed to need functional near vision services reported “some+ difficulty”.

Across all domains and countries, the overall population-level need for rehabilitation/AP services (2–43%) was approximately equal to or greater than the need for surgical/medical services (2–10%), except for moderate+ VI in India and The Gambia (see Supplemental Table S3).

### 3.4. Identification of Persons Needing Specific Assistive Products

The proportion of people who were assessed as having a clinical impairment who needed glasses (distance and near), hearing aids, wheelchairs and prostheses that were identified by WG question “some+ difficulty” is presented in Table 4, with all categories presented in Supplemental Table S4.



**Table 4.** Proportion of participants assessed as having a clinical impairment who need \* glasses, hearing aids, wheelchairs and prostheses that were identified by WG some+ difficulty question.

Impairment Severity Level	Vision		Hearing	Mobility	
	Needs Distance Glasses	Needs Near Glasses	Needs Hearing Aids **	Needs Wheelchair	Needs UL/LL Prosthesis
	Some+/ Total Reported ^ N (%)	Some+/ Total Reported N (%)	Some+/ Total Reported N (%)	Some+/ Total Reported N (%)	Some+/ Total Reported N (%)
<b>Cameroon</b>					
Mild+	-	-	-	4/4 100%	1/1 100%
Moderate+	10/17 59%	-	26/36 72%	4/4 100%	1/1 100%
<b>Chile</b>					
Mild+	-	-	126/211 60%	-	-
Moderate+	-	-	60/78 77%	-	-
<b>India</b>					
Mild+	110/144 76%	-	-	1/2 50%	1/2 50%
Moderate+	13/16 81%	-	85/105 81%	1/2 50%	1/2 50%
<b>The Gambia</b>					
Mild+	315/529 60%	1359/4002 34%	-	-	-
Moderate+	260/423 61%	-	-	-	-
<b>Turkey</b>					
Mild+	-	-	-	9/9 100%	2/2 100%
Moderate+	-	-	-	9/9 100%	2/2 100%

Abbreviations: UL/LL = upper limb/lower limb; \* "Need" includes both "unmet need" and "undermet need" for each assistive product; ^ Denominator includes participants who needed specific assistive products and who completed Washington Group questions in the respective functional domain; \*\* Hearing aid need includes all participants who needed a referral for audiological services and likely hearing aid need.

Of people with mild+ VI who were clinically assessed to need distance glasses, 59–76% reported having "some+ difficulty" seeing, and of those with moderate+ VI, it was 60% to 81%. Of those who were clinically assessed to need near glasses, only 34% of people with near VI reported having "some+ difficulty" seeing. Of the people with mild+ HI who were clinically assessed to likely need hearing aids, 60% reported having "some+ difficulty" hearing, and, of those with moderate+ HI, 72% to 81% reported having "some+ difficulty" hearing. Overall in three countries, 14 of 15 (93%) people clinically assessed as needing wheelchairs, and 4 of 5 (80%) of people who needed a prosthesis reported having "some+ difficulty" walking.

## 4. Discussion

### 4.1. Use of Washington Group Questions for Initial Screening in Population-Based Clinical Assessment Surveys

Overall, using the “some or worse” difficulty cut-off for WG questions demonstrates better agreement with the presence of clinical impairments and service/AP referral needs than using “a lot or worse” difficulty. This pattern remained true for both mild+ and moderate+ impairments in each of the three functional domains of vision, hearing and mobility. Use of “some or worse” WG screening cut-off would identify at least 60% of people with mild+ impairment who could potentially benefit from a service/intervention, but with many false negatives. In contrast, using the cut-off “a lot or worse” difficulty would miss the vast majority of people with service needs. Similarly, the proportion of eligible people identified through WG screening increased when using moderate+ impairment threshold, but a smaller proportion of people with need were identified.

Specifically, our study explored Mactaggart et al.’s recommendation to use a WG cut-off of “some difficulty or worse” as first-stage screening followed by clinical impairment assessment in the same functional domain to identify people with disabilities, based upon a moderate+ impairment threshold [10]. Though our overall findings were congruent with the general recommendation to use “some difficulty or worse” cut-off, Mactaggart et al.’s research anticipated that *at least 80%* of people with disabilities would be identified using this method, whereas our study found much fewer people with impairment (44–79%) and people with service/AP needs (60–82%) would be identified using updated recommended mild+ impairment thresholds [2,12–14,27,43,44]. Therefore, it appears use of this screening recommendation might not be transferrable to a mild+ impairment threshold.

There are few population-based prevalence studies that allow comparison with our findings to ascertain what might be a recommended “minimum” identification screening threshold. A few hearing impairment studies exist, and one study similarly found a self-report screen identified 80% of people with clinically assessed hearing loss [45]. However, regardless of the threshold, it could be argued that using a two-stage screening might indicate the proportion of “service demand” in a given population. Though literature is limited, the rationale for this statement could be that people who report a difficulty in functioning may be more likely to consider that they need services, and therefore uptake related services, creating a “service demand.” In contrast, people who report having no difficulty may be unlikely to uptake referrals for services. For example, a study in New Zealand found that measuring unserved health needs through a patient-initiated general practitioner consultation was directly relevant to service planning because the gaps identified reflected clinically indicated services that patients want and need [46]. Similarly, this relationship has been evidenced for mental health, where perceived mental health need has been shown to be predictive of seeking services [47,48]. However, research has also recognised that demand-based health needs planning could increase access and utilisation service gaps and inequities between social groups in populations; therefore, it is recommended that demand-based health needs planning should also be coupled with need-based allocation of resources and a focus on the empowerment of groups who have greater needs [49]. There is a need to further explore this relationship in the context of collecting population-based data to inform service planning.

Our findings were closely aligned with Sprunt et al.’s findings which found variable sensitivity and specificity overall and by impairment severity (none to severe) when exploring the use of the WG question set CFM “some difficulty” as a screening for school-aged children in Fiji with impairments [16–20]. Following their analysis, Sprunt et al. recommended to use the WG first-stage screening of “some difficulty” *in a minimum of one functional domain*, and that subsequently additional wide-ranging clinical assessments should be administered by the school system in Fiji in order to pick up unidentified and unexpected impairments [16–19]. Therefore, it is recommended that future research explore this additional analysis as an option for population-based multi-domain survey two-stage screening, whilst parallel research should also consider the feasibility, affordability and

acceptability of administration. Further, the Fiji study also specifically highlighted the importance of including environmental factors specific for learning and support needs [19]. Therefore, other potential screening and clinical assessment tools incorporating more environmental factors should be explored.

Our study has shown that the proposed use of the WG “some+ difficulty” as a first stage screening could be a practical and feasible option to reduce the survey duration, cost and response burden compared to conducting multi-domain impairment assessments. However, our findings have also shown that this approach will not capture everyone with impairments and service/AP needs in each domain so it will not be appropriate for surveys that aim to estimate prevalence of impairment and service/AP need.

#### 4.2. Further Gaps in the Survey Measurement Approaches

Our analysis highlighted gaps and recommendations to be considered in the collection of data on functional service needs.

First, rehabilitation/AP needs are often neglected, but this paper highlights that need was at least equal to or higher than the surgical/medical service need across all countries and domains. This further highlights the importance of increased data collection efforts, using robust methodology, to assess need in different settings.

Second, adjustments to the first stage screening questions might be needed. For example, in the vision domain, there was poor identification of near VI service/AP needs using both “some+ difficulty” and “a lot+ difficulty” WG cut-off levels (39% and 3%, respectively). This may be expected as the specific WG question asked in general about difficulty seeing (see Box 2). Therefore, it is recommended that a specific near vision screening question is included for surveys that intend to assess near VI and the need for services and AP to improve the sensitivity. The WG extended question set provides an optional vision question that asks about a functional activity related to use of near vision—difficulty clearly seeing the picture on a coin—so this should be incorporated at a minimum [11]. In the mobility domain, the extended WG questions for difficulty walking over certain distances and/or climbing stairs were compared to MSI (Box 2). Though walking could be one activity limitation for a person with MSI, other possible activity limitations also assessed in WG questions include self-care, upper body, pain and fatigue. Future analysis should explore whether combinations of these questions, in addition to environmental questions, increase identification of people with MSI and service needs by improving the sensitivity and specificity. Furthermore, consideration should be given as to whether additional first-stage screening options might provide better prevalence estimates of need, such as the validated RAM’s six self-reported first-stage screening questions [38].

Third, the development of a multi-domain modular survey tool would allow flexibility, depending on aim of the data collection and time and resources available. For example, this could include options to (i) include or not include the first stage WG screen in the survey and (ii) select which functional domains to include.

Fourth, this paper used secondary analysis of datasets and the analyses were therefore constrained by data that were collected. For example, in the cognitive domain, there was very low specificity (18%) for mild+ cognitive impairment without service recommendations. Though the SCh-MMSE was contextually developed for low literacy populations which is a strength, using this screening tool as a “gold standard” in our study has limitations. Future studies are needed to explore and compare additional cognitive assessment and screening tools which include assessments of cognitive service/AP needs as well.

Fifth, when using the WG questions in service/AP need surveys, consideration could be given to ask about the presence of functional difficulties *without* the use of assistance or APs. For example, Danemayer et al.’s systematic review recommended AP indicators of total need and met need, as well as unmet and undermet need for service/AP need, are collected in population-based surveys [50]. To collect these data, a first-stage screening would also need to capture people who are using services/APs who could then undergo impairment assessment. Future research could consider asking participants about reported

functional difficulties *without* assistance/APs as well which collects important quality of services data. The WHO Rapid Assessment of Assistive Technology [51,52] uses the WG Short Set with this modification and includes an additional survey section which asks about broader AP use; however, this sole modification generates non-comparable WG functioning data so is not a viable approach.

Finally, when exploring options for the second stage of a two-stage survey to estimate participants' functional service and AP needs, it is important not to rely on clinical assessments solely measuring impairments since this more "medical" model of assessment is only estimating one ICF component of functioning. It is key that second-stage assessments integrate broader functioning components when developing survey tools for assessing need, including consideration of environmental factors as highlighted by Sprunt et al. Therefore, alongside clinical impairment assessments, more hybrid clinical assessments measuring broader functional needs should be incorporated through structured observation and demonstration of tasks/activities, in addition to self-reported measures on activities, participation and environmental factors. This integration would ensure enhanced alignment with the ICF's broader definition of functioning and also would provide more detailed data about specific rehabilitation/AP service and human resource needs for evidence-based health and social policy and planning beyond solely surgical and medical needs.

#### 4.3. Strengths and Limitations

The biggest strength is that approximately 20,000 survey participants from five countries are included in these secondary analyses presenting important data on the potential use of WG questions as first-stage screening questions in population-based surveys. We compared two cut-off levels of self-reported WG data to two cut-off levels of clinically assessed impairment data, as well as comparing clinically assessed need for services and select APs with the two methodologies. However, there were limitations. First, the authors acknowledge that the comparison in methodologies is based upon two separate ICF components of functioning—(i) impairment or body structure/function, and (ii) activity limitation—using clinically assessed impairment as the "gold standard." It is possible that some of the variation between the methodologies was due to measuring two separate ICF components. Second, our analyses in this paper were limited to "unmet" and "undermet" need comparing only a proportion of "total need" in the two methodologies to identify those who needed services. Therefore, we did not consider those who "use" services and APs that might actually have/had "met," "overmet" or "undermet" clinically assessed service and AP needs. Third, for the vision and hearing domains service groupings, we allocated participants to medical/surgical and/or rehabilitation/AP services, and often both, using a list of possible diagnoses. This retrospective allocation is likely to have over-estimated the need for both types of services given certain clinical diagnoses were assigned to both categories. Additionally, bilateral moderate+ impairment might be used as the referral threshold in some countries, such as in Chile for government financed hearing aids for people > 65 years. Fourth, the WG may not be the best possible screening tool, but it was used in the five surveys because it is widely endorsed and utilised. It could be interesting for future research to compare other self-reported functioning survey tools, such as the WHO's Disability Assessment Schedule [53] and Brief Model Disability Survey [54], with the WG questions for potential screening questions in multi-domain population-based surveys. Finally, all five surveys were supported by the same research group, the International Centre of Evidence in Disability at the London School of Hygiene & Tropical Medicine, using similar methodologies for clinically assessing vision, hearing and mobility impairments and service/AP need. While this is a strength in terms of comparability of methods, it is also possible that the use of alternate and/or additional methodologies and/or tools incorporating broader functioning components might have provided different results and should be considered in future research.

## 5. Conclusions

This paper explores the use of self-reported WG questions as a first-stage screening in population-based surveys. Our analyses found the WG questions could be used as a first-stage screening *option* to identify people with impairment and referral needs, but only with moderate sensitivity and specificity. If developing a multi-domain hybrid assessment survey tool, it therefore would be important to include options to (i) include or not include the first stage WG screen in the survey and (ii) select which functional domains to include. It is also recommended to explore additional first-stage screening cut-offs and options to provide better prevalence estimates of need, and incorporate assessments for other ICF components, especially personal and environmental factors, for more holistic hybrid methodology assessment of functional needs. Overall, our findings are important for the ongoing development and feasibility testing of population-based survey methodology and survey implementation considerations.

**Supplementary Materials:** The following are available online at <https://www.mdpi.com/article/10.3390/ijerph19074304/s1>, Table S1: Agreement between Washington Group question responses and impairment severity level in each functional domain. Table S2: Proportion of participants assessed to have a clinical impairment who need interventions as identified by Washington Group questions. Table S3: Overall proportion of survey participants who were assessed to have a clinical impairment and need interventions. Table S4: Relationship between clinical impairment assessed need \* for four priority assistive products (glasses, hearing aids, wheelchairs and prostheses) and Washington Group responses in three functional domains.

**Author Contributions:** Conceptualization, D.B., S.P. and H.K.; Methodology, D.B., S.P., H.K., A.F., I.M. ((Islay Mactaggart), T.B., G.M., A.H., I.M. (Ian McCormick), N.T., M.L.A., O.A.-A. and H.Y.; Formal analysis, D.B. with input from S.P.; writing—original draft preparation, D.B., with input from S.P., H.K. and A.F.; writing—review and editing, D.B., H.K., I.M. (Islay Mactaggart), T.B., G.M., A.H., I.M. (Ian McCormick), N.T., M.L.A., O.A.-A., H.Y., A.F. and S.P.; supervision, S.P., A.F. and H.K. Funding acquisition: H.K. and S.P. All authors have read and agreed to the published version of the manuscript.

**Funding:** This secondary analysis study, including analysis and paper writing, was funded by UK Aid through the AT2030 programme coordinated by Global Disability Innovation Hub, project number: 300815 (previously 201879-108). The original surveys were primarily funded as follows: India and Cameroon: CBM Germany (LSHTM grant number: ITCRRH71); Chile: Chile Ministry of Health; The Gambia: The Queen Elizabeth Diamond Jubilee Trust; Turkey: United States Department of State to Relief International.

**Institutional Review Board Statement:** Ethical approval for this secondary analysis study was provided by the London School of Hygiene & Tropical Medicine Observational Ethics Committee (Ref 26695). Each survey received separate approval from the London School of Hygiene & Tropical Medicine and the relevant ethics committees in each study country. The data analysed in this study were from studies conducted according to the guidelines of the Declaration of Helsinki and approved both by LSHTM and the relevant ethics committees from each of the study countries.

**Informed Consent Statement:** Informed consent was obtained from all participants involved in the study.

**Data Availability Statement:** The Gambia data presented in this study are still undergoing analysis and will be made openly available once complete. For the other datasets, we are unable to make the databases publicly available as we do not have participant consent for this. We can, however, share the databases with researchers upon request.

**Acknowledgments:** The authors wish to acknowledge the many collaborators involved in the funding, design and implementation of each of the surveys used in this secondary analysis and their institutions. We also wish to acknowledge the survey teams and, most importantly, the 19,951 participants across five surveys who gave up their time to contribute data to the studies. Acknowledgement of collaborators and participants does not imply endorsement.

**Conflicts of Interest:** The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

## References

1. Stucki, G.; Bickenbach, J. Functioning: The third health indicator in the health system and the key indicator for rehabilitation. *Eur. J. Phys. Rehabil. Med.* **2017**, *53*, 134–138. [\[CrossRef\]](#)
2. Boggs, D.; Polack, S.; Kuper, H.; Foster, A. Shifting the focus to functioning: Essential for achieving Sustainable Development Goal 3, inclusive Universal Health Coverage and supporting COVID-19 survivors. *Glob. Health Action* **2021**, *14*, 1903214. [\[CrossRef\]](#)
3. World Health Organization. International Classification of Functioning, Disability and Health (ICF). 2001. Available online: <http://www.who.int/classifications/icf/en/> (accessed on 27 August 2021).
4. Cieza, A.; Causey, K.; Kamenov, K.; Hanson, S.W.; Chatterji, S.; Vos, T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet* **2020**, *396*, 2006–2017. [\[CrossRef\]](#)
5. World Health Organization. *Policy Brief: Access to Assistive Technology*; WHO: Geneva, Switzerland, 2020.
6. World Health Organization. *Priority Assistive Products List*; WHO: Geneva, Switzerland, 2016.
7. World Health Organization (WHO). *Rehabilitation 2030: A Call for Action*; WHO: Geneva, Switzerland, 2017.
8. Bright, T.; Wallace, S.; Kuper, H. A systematic review of access to rehabilitation for people with disabilities in low-and middle-income countries. *Int. J. Environ. Res. Public Health* **2018**, *15*, 2165. [\[CrossRef\]](#)
9. Boggs, D.; Kuper, H.; MacTaggart, I.; Murthy, G.; Oye, J.; Polack, S. Estimating assistive technology need through population-based surveys: An analysis of data from Cameroon and India. In *Proceedings of the Global Perspectives on Assistive Technology: Proceedings of the GREAT Consultation*; Layton, N., Borg, J., Eds.; World Health Organization: Geneva, Switzerland, 2019; pp. 52–78.
10. MacTaggart, I.; Kuper, H.; Murthy, G.V.S.; Oye, J.; Polack, S. Measuring Disability in Population Based Surveys: The Interrelationship between Clinical Impairments and Reported Functional Limitations in Cameroon and India. *PLoS ONE* **2016**, *11*, e0164470. [\[CrossRef\]](#)
11. Washington Group on Disability Statistics Secretariat. Washington Group on Disability Statistics. Available online: <http://www.washingtongroup-disability.com/> (accessed on 2 September 2021).
12. Boggs, D.; Kuper, H.; MacTaggart, I.; Murthy, G.; Oye, J.; Polack, S. Estimating assistive product need in Cameroon and India: Results of population-based surveys and comparison of self-report and clinical impairment assessment approaches. *Trop. Med. Int. Health* **2020**, *26*, 146–158. [\[CrossRef\]](#)
13. Boggs, D.; Hydera, A.; Faal, Y.; Okoh, J.A.; Olaniyan, S.I.; Sanneh, H.; Ngett, A.; Bah, I.; Aleser, M.; Denis, E.; et al. Estimating need for glasses and hearing aids in The Gambia: Results from a national survey and comparison of clinical impairment and self-report assessment approaches. *Int. J. Environ. Res. Public Health* **2021**, *18*, 6302. [\[CrossRef\]](#)
14. Bright, T.; MacTaggart, I.; Kim, M.; Yip, J.; Kuper, H.; Polack, S. Rationale for a Rapid Methodology to Assess the Prevalence of Hearing Loss in Population-Based Surveys. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3405. [\[CrossRef\]](#)
15. Bright, T.; McCormick, I.; Phiri, M.; Mulwafu, W.; Burton, M.; Polack, S.; MacTaggart, I.; Yip, J.L.Y.; Swanepoel, D.W.; Kuper, H. Rationale and feasibility of a combined rapid assessment of avoidable blindness and hearing loss protocol. *PLoS ONE* **2020**, *15*, e0229008. [\[CrossRef\]](#)
16. Sprunt, B.; Hoq, M.; Sharma, U.; Marella, M. Validating the UNICEF/Washington Group Child Functioning Module for Fijian schools to identify seeing, hearing and walking difficulties. *Disabil. Rehabil.* **2017**, *41*, 201–211. [\[CrossRef\]](#)
17. Sprunt, B.; McPake, B.; Marella, M. The UNICEF/Washington Group Child Functioning Module—Accuracy, Inter-Rater Reliability and Cut-Off Level for Disability Disaggregation of Fiji’s Education Management Information System. *Int. J. Environ. Res. Public Health* **2019**, *16*, 806. [\[CrossRef\]](#)
18. Sprunt, B. *Validating the UNICEF/Washington Group Child Functioning Module as a Method for Disaggregating Fiji’s Education Management Information System*; Publisher: City, State, Country, 2019.
19. Sprunt, B.; Marella, M. Combining Child Functioning Data with Learning and Support Needs Data to Create Disability-Identification Algorithms in Fiji’s Education Management Information System. *Int. J. Environ. Res. Public Health* **2021**, *18*, 9413. [\[CrossRef\]](#)
20. Sprunt, B.; Marella, M. Measurement accuracy: Enabling human rights for Fijian students with speech difficulties. *Int. J. Speech-Lang. Pathol.* **2017**, *20*, 89–97. [\[CrossRef\]](#)
21. Oye, J.; MacTaggart, I.; Polack, S.; Schmidt, E.; Tamo, V.; Okwen, M.; Kuper, H. Prevalence and Causes of Visual Impairment in Fundong District, North West Cameroon: Results of a Population-Based Survey. *Ophthalmic Epidemiol.* **2017**, *24*, 394–400. [\[CrossRef\]](#)
22. Ferrite, S.; MacTaggart, I.; Kuper, H.; Oye, J.; Polack, S. Prevalence and causes of hearing impairment in Fundong Health District, North-West Cameroon. *Trop. Med. Int. Health* **2017**, *22*, 485–492. [\[CrossRef\]](#)
23. Smythe, T.; MacTaggart, I.; Kuper, H.; Oye, J.; Sieyen, N.C.; Lavy, C.; Polack, S. Prevalence and causes of musculoskeletal impairment in Fundong District, North-West Cameroon: Results of a population-based survey. *Trop. Med. Int. Health* **2017**, *22*, 1385–1393. [\[CrossRef\]](#)

24. MacTaggart, I.; Polack, S.; Murthy, G.; Kuper, H. A population-based survey of visual impairment and its correlates in Mahabubnagar district, Telangana State, India. *Ophthalmic Epidemiol.* **2017**, *25*, 238–245. [CrossRef]
25. Bright, T.; Mactaggart, I.; Kuper, H.; Murthy, G.V.; Polack, S. Prevalence of Hearing Impairment in Mahabubnagar District, Telangana State, India. *Ear Hear.* **2019**, *40*, 204–212. [CrossRef]
26. Smythe, T.; MacTaggart, I.; Kuper, H.; Murthy, G.; Lavy, C.; Polack, S. Prevalence and causes of musculoskeletal impairment in Mahabubnagar District, Telangana State, India: Results of a population-based survey. *Trans. R. Soc. Trop. Med. Hyg.* **2017**, *111*, 512–519. [CrossRef]
27. Boggs, D.; Atijosan-Ayodele, O.; Yonso, H.; Scherer, N.; O'Fallon, T.; Deniz, G.; Volkan, S.; Öürücü, A.; Pivato, I.; Beck, A.H.; et al. Musculoskeletal impairment among Syrian refugees living in Sultanbeyli, Turkey: Prevalence, cause, diagnosis and need for related services and assistive products. *Confl. Health* **2021**, *15*, 29. [CrossRef]
28. Hydera, A.; Bastawrous, A.; Bell, S.; Boggs, D.; Bright, T.; Bobat, H.; Eaton, J.; Faal, H.; Jobe, M.; Kim, M.J.; et al. The Gambia National Eye Health Survey 2019: Survey protocol. *Wellcome Open Res.* **2021**, *6*, 10. [CrossRef] [PubMed]
29. Mactaggart, I.; Kuper, H.; Murthy, G.V.S.; Sagar, J.; Oye, J.; Polack, S. Assessing health and rehabilitation needs of people with disabilities in Cameroon and India. *Disabil. Rehabil.* **2015**, *38*, 1757–1764. [CrossRef] [PubMed]
30. Polack, S.; Scherer, N.; Yonso, H.; Volkan, S.; Pivato, I.; Shaikhani, A.; Boggs, D.; Beck, A.H.; Atijosan-Ayodele, O.; Deniz, G.; et al. Disability among Syrian refugees living in Sultanbeyli, Istanbul: Results from a population-based survey. *PLoS ONE* **2021**, *16*, e0259249. [CrossRef]
31. Tamblay, N.; Torrente, M.C.; Huidobro, B.; Tapia-Mora, D.; Anabalon, K.; Polack, S.; Bright, T. Prevalence, risk factors and causes of hearing loss among adults 50 years and older in Santiago, Chile: Results from a rapid assessment of hearing loss survey. *Int. J. Audiol.* **2022**, *17*, 1–9. [CrossRef]
32. Hydera, A.; Mactaggart, I.; Bell, S.J.; Okoh, J.A.; Olaniyan, S.I.; Aleser, M.; Bobat, H.; Cassels-Brown, A.; Kirkpatrick, B.; Kim, M.J.; et al. Prevalence of blindness and distance vision impairment in the Gambia across three decades of eye health programming. *Br. J. Ophthalmol.* **2021**. [CrossRef] [PubMed]
33. Peek Vision Ltd. Peek Vision. Available online: <https://www.peakvision.org/> (accessed on 8 September 2021).
34. World Health Organization. *World Report on Vision*; WHO: Geneva, Switzerland, 2019.
35. Kuper, H.; Polack, S.; Limburg, H. Rapid assessment of avoidable blindness. *Community Eye Health* **2006**, *19*, 68–69. [PubMed]
36. WHO Programme for the Prevention of Blindness and Deafness. *WHO Ear and Hearing Disorders Survey*; World Health Organization: Geneva, Switzerland, 1999.
37. HearX. HearX Group. Available online: <https://www.hearxgroup.com/> (accessed on 8 September 2021).
38. Atijosan, O.; Kuper, H.; Rischewski, D.; Simms, V.; Lavy, C. Musculoskeletal impairment survey in Rwanda: Design of survey tool, survey methodology, and results of the pilot study (a cross sectional survey). *BMC Musculoskelet. Disord.* **2007**, *8*, 30. [CrossRef]
39. Folstein, M.F.; Folstein, S.E.; McHugh, P.R. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J. Psychiatr. Res.* **1975**, *12*, 189–198. [CrossRef]
40. Quiroga, P.; Albala, C.; Klaasen, G. Validación de un test de tamizaje para el diagnóstico de demencia asociada a edad, en Chile. *Rev. Médica Chile* **2004**, *132*, 467–478.
41. Icaza, M.G.; Albala, C. Minimental State Examinations (MMSE) del estudio de demencia en Chile: Análisis estadístico. In *Mini-mental State Examinations (MMSE) del estudio de demencia en Chile: Análisis estadístico*; Organización Panamericana de la Salud: Washington, DC, USA, 1999; p. 18.
42. ATscale. ATscale: Global Partnership for Assistive Technology. Available online: <https://atscale2030.org/> (accessed on 27 August 2021).
43. McCormick, I.; Mactaggart, I.; Bastawrous, A.; Burton, M.J.; Ramke, J. Effective refractive error coverage: An eye health indicator to measure progress towards universal health coverage. *Ophthalmic Physiol. Opt.* **2020**, *40*, 1. [CrossRef]
44. MacTaggart, I.; Limburg, H.; Bastawrous, A.; Burton, M.J.; Kuper, H. Rapid Assessment of Avoidable Blindness: Looking back, looking forward. *Br. J. Ophthalmol.* **2019**, *103*, 1549–1552. [CrossRef] [PubMed]
45. Louw, C.; Swanepoel, D.W.; Eikelboom, R. Self-Reported Hearing Loss and Pure Tone Audiometry for Screening in Primary Health Care Clinics. *J. Prim. Care Community Health* **2018**, *9*, 2150132718803156. [CrossRef] [PubMed]
46. McGeoch, G.; Holland, K.; Kerdelidis, M.; Elliot, N.; Shand, B.; Fink, C.; Dixon, A.; Gullery, C. Unmet need for referred services as measured by general practice. *J. Prim. Health Care* **2017**, *9*, 269–278. [CrossRef] [PubMed]
47. Roberts, T.; Esponda, G.M.; Krupchanka, D.; Shidhaye, R.; Patel, V.; Rathod, S. Factors associated with health service utilisation for common mental disorders: A systematic review. *BMC Psychiatry* **2018**, *18*, 1–19. [CrossRef] [PubMed]
48. LeDoux, T.; Barnett, M.D.; Garcini, L.M.; Baker, J. Predictors of Recent Mental Health Service Use in a Medical Population: Implications for Integrated Care. *J. Clin. Psychol. Med Settings* **2009**, *16*, 304–310. [CrossRef] [PubMed]
49. Burström, B. Market-Oriented, Demand-Driven Health Care Reforms and Equity in Health and Health Care Utilization in Sweden. *Int. J. Health Serv.* **2009**, *39*, 271–285. [CrossRef]
50. Danemayer, J.; Boggs, D.; Ramos, V.D.; Smith, E.; Kular, A.; Bhot, W.; Ramos-Barajas, F.; Polack, S.; Holloway, C. Estimating need and coverage for five priority assistive products: A systematic review of global population-based research. *BMJ Glob. Health* **2022**, *7*, e007662. [CrossRef]
51. World Health Organization. *Rapid Assistive Technology Assessment Tool (rATA)*; World Health Organization: Geneva, Switzerland, 2021.

52. Zhang, W.; Eide, A.H.; Pryor, W.; Khasnabis, C.; Borg, J. Measuring Self-Reported Access to Assistive Technology Using the WHO Rapid Assistive Technology Assessment (rATA) Questionnaire: Protocol for a Multi-Country Study. *Int. J. Environ. Res. Public Health* **2021**, *18*, 13336. [[CrossRef](#)]
53. World Health Organization. WHO Disability Assessment Schedule 2.0 (WHODAS 2.0). Available online: [https://www.who.int/classifications/icf/more\\_whodas/en/](https://www.who.int/classifications/icf/more_whodas/en/) (accessed on 29 October 2021).
54. World Health Organization. Model Disability Survey. Available online: <https://www.who.int/disabilities/data/mds/en/> (accessed on 27 October 2021).



## 8.2 AP survey methodology development

This secondary analysis study highlighted a number of important issues regarding the use of the WG questions as a first-stage screening in an AP need survey. The lessons learned with key implications for the development of AP need survey methodology are discussed below.

### 8.2.1 First-stage screening

- 1) The WG questions could be used as a first stage screening option to identify people with impairment and referral needs for mild/worse impairment using “some or worse” difficulty screening cut-off, but only with moderate sensitivity and specificity. If time and resources allow, a first stage impairment screening would be recommended in a survey. For example, this could include use of Peek acuity screening for vision, hearTest PTA screening for hearing and the six RAM screening questions for mobility which take little time, can be administered on tablet-based applications and do not require trained clinicians. However, where this is not possible, there could be a preliminary screening with WG and then only those who reported “some or worse” difficulty would receive the second stage assessment. It might be reasonable to assume that using WG as first stage screen will generate data on service demand and, because it is quicker, may be important for scaling up data collection in low resource settings. A multi-domain modular AP need survey tool should be developed to include options to i) include or not include the first stage WG screen in the survey and ii) select which functional domains to include depending on the required data, and time and resources available.
- 2) If a set of self-reported screening questions, such as the WG questions, are used in a two-stage screening survey, this might indicate the proportion of “service demand” in a given population. To explore this further, studies are required to investigate the relationship between reporting functional difficulties and the uptake of related services, and if this method of assessing need might increase inequalities and inequities in a given population.
- 3) The WG SS “difficulty seeing” question does not ask specifically about near vision difficulties, and the sensitivity and specificity was low when compared to near VI. If near VI is assessed in a survey, a specific near vision screening question should be included in an AP need survey, such as the WG ES question.

### **Implications for survey development**

- Develop a multi-domain modular AP need survey tool to include options to i) include or not include the first stage WG screen in the survey and ii) select which functional domains to include.
- Design studies to investigate “service demand” and explore if the use of a set of self-reported screening questions, such as the WG questions, in a two-stage screening survey can identify this demand in a given population.
- Include a specific near vision screening question in an AP need survey, such as the WG ES question, if near VI is clinically assessed.

### 8.2.2 Data management

- 1) This study analysed five datasets collected from 2013 to 2020. Though previous syntax was available for reference, a few of the surveys did not have codebooks available for analysis variables which was challenging. It is recommended that codebooks are created for an AP need survey for consistency, especially when multiple team members will be working on large datasets.

### **Implications for survey development**

- Ensure codebooks are created for AP need survey for consistency.

### 8.2.3 Research recommendations

- 1) As per a recommendation from Sprunt et al.’s Fiji study (107-110), research is needed to explore the use of the WG first stage screening of “some or worse difficulty” in a minimum of one functional domain, as another option compared to this study’s findings for population-based multi-domain survey two-stage screening. The feasibility, affordability and acceptability of administration would also need to be considered.
- 2) A gap was identified in terms of measuring “environmental” factors for assessing rehabilitation/AP need, which aligns with the findings from Sprunt et al.’s Fiji study.(110) As options are explored for the second stage of a two-stage survey to estimate participants’ functional AP need, it is critical that assessments integrate broader functioning components when developing survey tools for assessing need, such as environment, in addition to clinical impairment assessment. A scoping review to explore other screening and clinical assessment tools that incorporate environmental factors is needed to assess their suitability.
- 3) The WG first stage screening questions of difficulty walking over certain distances and/or climbing stairs were compared to MSI clinical assessment in the study. Additional research is needed to investigate whether a combination of WG screening questions related to MSI, in addition to environmental questions, might

have improved sensitivity and specificity to identify people with MSI-related service/AP need. The combination of WG questions could include both upper and lower limb mobility functional difficulties, as well as self-care, pain and fatigue.

- 4) AP need indicators, such as met, undermet and unmet AP need, are important for population-level service data. This study only analysed unmet and undermet AP need. It will be important to explore how a first stage screening could best capture people who are using services/AP to ensure data on met need, in addition to undermet and unmet need, are gathered who could then undergo impairment assessment.

#### **Implications for survey development**

- Compare the use of the WG first stage screening of “some or worse difficulty” in a minimum of one functional domain, as well as the feasibility, affordability and acceptability of this approach, to this study’s findings.
- Review other screening and clinical assessment tools incorporating more environmental factors for second stage screening, in addition to clinical impairment assessment.
- Investigate if a combination of WG screening questions related to MSI might have improved sensitivity and specificity to identify people with MSI-related service/AP need.
- Explore how a first stage screening could best capture people who are using AP to gather data on both met and undermet, in addition to unmet AP need.

## Chapter 9: Lessons learned from fieldwork in The Gambia, Turkey and Guatemala

This chapter presents lessons learned about processes and methodology from the fieldwork in The Gambia, Turkey and Guatemala population-based surveys, which will be useful for the development of a population-based survey method to estimate AP need in LMICs. Practical fieldwork recommendations are highlighted for a multi-domain population-based AP need survey suitable for a LMICs.



Guatemala rATA survey team in a rural setting. © Ana Cordon/Liliane Foundation

Three population-based surveys were conducted during this PhD. First, The Gambia AP study was part of a larger National Eye Health survey (111) that measured clinical impairment and AP assessment of vision and hearing, alongside disability with the WG questions, as well as other eye health risk factors and mental health. Second, the Turkey MSI study was undertaken as part of a wider Disability and Mental Health survey (112). Third, the Guatemala study used the WHO rATA self-reported AP survey tool. During the fieldwork for each survey, key lessons were learned according to fieldwork processes and methodology, as outlined below. The Gambia and Turkey studies specifically provided helpful learnings regarding the complexities of coordinating multi-domain surveys.

## 9.1 Planning

- 1) A hybrid AP need survey approach will require clinical staff. These are more expensive and typically have lower availability. For example, in The Gambia survey, volunteer clinicians were utilised, however they were not available throughout the duration of the survey. These human resource challenges were noted given this led to staff turnover, as well as potential measurement bias due to different trainings. This issue could be mitigated in future surveys with adequate planning to employ (i.e. budget for) clinical staff for the whole duration of the survey, ensuring at least one refresher training and rest days are scheduled.
- 2) A multi-domain AP need survey will require a large team with clinical equipment. The team will include at a minimum the following data collector groups: enumerators, interviewers, and separate vision, hearing and mobility clinicians. In The Gambia survey, equipment checklists were used, and it was noted that the addition of one hearing clinician to one of the teams led to consideration of a larger vehicle and additional clinical equipment requirements. It is important to ensure there are checklists for the necessary equipment and that budgets are adequate for appropriate size transport throughout an AP need survey to transport the teams with their equipment.
- 3) In each of the three surveys, referral mappings of AP/services in the population areas were conducted prior to the survey starting. The AP/service providers were contacted so the organisations were aware of the survey and the potential increase in clients. This is especially important in LMICs contexts where referral services might be limited, such as in The Gambia with the hearing referral service. Detailed information about the referral process was included in the training of data collectors so the survey teams were clear about the referral process following the survey assessments. In all three surveys, referral forms were provided to the participants for the relevant AP/service provider. In Guatemala, a referral information pamphlet

was compiled and given to each participant who received a referral so they were aware of the name of the AP/service provider, knew the exact location and had information about what AP/service were offered. It is important to ensure referral links are well established prior to the survey and that data collectors and participants are clear about the AP/service referral information.

- 4) The AP need survey will need to be conducted according to the needs and resources of the population. For example, the Turkey MSI survey was specifically requested by the research partners due to identified need. In addition to the referral mapping and stakeholder engagement, it is recommended that the team could start with a national APL and then refine and adapt the list based on local information needs and resource/service availability in advance of the survey.
- 5) The Guatemala survey was conducted during the ongoing COVID-19 pandemic so it was important to ensure that the AP survey was conducted safely. This included advance planning and preparation for tablet-based and/or laminated AP image and description survey materials to show to the participants while maintaining physical distancing. It also was important to ensure all data collectors routinely cleaned their equipment, clearly understood all precautions, had adequate personal protective equipment (PPE) and could access tests to administer at specific intervals. It was also important for the coordinator to monitor daily COVID-19 levels and ensure links to community leaders before entering the cluster to discuss any safety concerns. It is recommended these processes are carried over to an AP need survey if conducted during a COVID-19 or similar pandemic.

#### **Recommendations for AP need survey development**

- Budget for employing clinical staff for the whole duration of the survey ensuring at least one refresher training and rest days are scheduled.
- Use equipment checklists and ensure budgets are adequate for appropriate size transport throughout the whole survey.
- Ensure AP/service referral mappings are conducted prior to the survey, and that referral information is included in data collector training and in a pamphlet for participants.
- Conduct the AP need survey according to the needs and resources of the population.
- If data collection occurs during a pandemic, such as the COVID-19 pandemic, adapt methods to ensure safety and plan for necessary precautions, such as PPE and testing.

## 9.2 Training and IOV assessment

- 1) Training for multi-domain surveys can be complex since there is a need to train large teams with many different specialties. During the survey training in The Gambia, there were limited clinical trainers for the different cadres of staff and room space was limited for both the joint and parallel training sessions. It is important to ensure enough appointed trainers/supervisors' input per cadre, especially clinical supervision for clinical cadres, and adequate training space available for the parallel sessions.
- 2) Ensuring the data collectors gain a thorough understanding of and knowledge about the AP included in the survey is critical during the training. Generally, AP awareness is typically low, especially for more specific less well-known AP. This was particularly important in the Guatemala survey where the surveyors were asking about approximately 50 AP and did not have clinical backgrounds or domain-specific knowledge. Allowing enough time in the training timetable to discuss AP translations and review AP images, definitions and examples of potential use was important.
- 3) Interobserver variability (IOV) assessments are an important part of training to assess any measurement differences between clinician assessors. Challenges observed organising IOVs in The Gambia and Turkey included difficulty identifying enough patients and insufficient time allocated to this process. For example, in Turkey, due to the additional time required for translation issues, IOV time was limited during the training. The quantitative scoring was not completed, however verbally the correct answers were shared in a group format and any discrepancies were discussed to ensure future agreement amongst the assessors. This highlights the need to ensure adequate time (e.g. 2 days) and sources of patients in advance.

### **Recommendations for AP need survey development**

- Ensure there is adequate training space available for parallel training sessions in a multi-domain survey and that there are appointed trainers/supervisors per cadre.
- Ensure time is allocated for data collectors to gain thorough AP understanding and knowledge.
- Plan in advance for IOV assessment to ensure adequate time and sources of patients.

### 9.3 Logistics

- 1) It is important to consider logistical challenges for surveys, especially with clinical assessment and equipment. In The Gambia survey, where all assessments and questionnaires were conducted at a central location, it often was challenging for the teams to find adequate space and electricity power sources for the clinical equipment in each cluster which led to delays. The central location was beneficial for administering multi-domain assessments and accessible transport was available for people with mobility impairments to limit potential response bias. However, for the hearing testing it was difficult to ensure quiet areas for the testing. In contrast, in the Turkey survey, the physiotherapists completed the RAM in participants' homes the day after the enumeration and encountered a few challenges when assessing in an urban apartment environment, such as needing to locate space outside for the walking assessment. Due to these issues, it is important for an AP need survey to consider the pros and cons of central location versus household visit for the survey setting. Household visits will likely be more feasible for the AP need survey due to anticipated use of simplified mobile app assessments, but this needs to be pilot tested. It would also minimise response bias that can occur, for example, if older people or people with mobility impairments are less able to attend central points.
- 2) It is important for functional multi-domain surveys to consider the order of assessments and length of data collection. In The Gambia survey, the hearing assessment was added to a survey that had a focus on vision which may have led to it being under-prioritised. It was conducted at the end of the other assessments which may have led to the low response rate (47.5%). In a multi-domain AP need survey, it will be important to pilot test for feasibility, ensure all team members are aware of and understand the importance of collection in the other domains and consider rotating the order of testing.
- 3) In survey settings, it is important to prioritise local ownership and work with experienced research partners. These organisations should lead the survey and are best placed to organise logistics, the AP referral mapping and disseminate information and findings. In all three surveys, strong partnerships were formed with local partner organisations who supported each stage of the survey and were key to success. This was particularly important during COVID when international partner organisations were providing remote support, such as the partnership with local organisation Asociación de Padres y Amigos de Personas con Discapacidad de Santiago Atitlán (ADISA) during the Guatemala survey. It is recommended to prioritise working in partnership with local organisations and researchers for



logistical support and local context coordination at each stage of an AP need survey.

#### **Recommendations for AP need survey development**

- Consider the pros and cons of central location versus household visits for AP need survey administration.
- In a multi-domain AP need survey, pilot test for feasibility, ensure each clinician is aware of and understands the importance of collection in the other domains, and consider rotating the order of testing.
- Work in partnership with local partner organisations and researchers who can provide logistical support and local context coordination at each survey stage.

### **9.4 Supervision/support**

- 1) In a hybrid AP need survey, it is critical to provide ongoing supervision and support to ensure that clinical assessments are well understood and consistently done. The domain-specific clinical trainers select survey team leaders for each clinical cadre. These clinician team leaders act as clinical supervisors in the field. They should be available for one-to-one support throughout the survey and should organise refresher trainings with the trainers' support if needed during the scheduled survey break. The clinician team leaders can be clinically supervised by the respective clinical trainers.
- 2) In a multi-domain AP need survey, it is likely that specific cadre data collector groups will be split across different survey teams, i.e. one physiotherapist per survey team. It is important for data collector cadres to maintain connections to gain technical support and share advice and learnings throughout the survey (e.g. through WhatsApp groups and scheduled catch ups with the team leaders and trainers).

#### **Recommendations for AP need survey development**

- Ensure ongoing supervision and support throughout the multi-domain AP need survey through clinical team leaders for each cadre.
- Set up communication groups for each worker cadre, alongside scheduled catch ups with the team leaders and trainers, to facilitate ongoing support throughout.

## 9.5 Data collection

- 1) A data monitoring platform with a dashboard is important for checking and ensuring the completeness and quality of the AP data throughout a survey, including whether referrals are made when needed. Checks should include the following: completion and plausibility of WG data; selection of a sample of participants in each domain to check if the assessment of AP need follows a documented clinical or functional need; and ensuring a referral is always provided and logged for AP need. The Guatemala survey had a dashboard with the rATA web-based Survey123 app which allowed for these consistency checks, however the Turkey survey used ODK mobile-based data collection platform which doesn't have a formal web-based dashboard. It is recommended that an AP need survey web-based and mobile-based platform utilises a dashboard for data monitoring.
- 2) In a hybrid AP need survey, it is important to ensure that the self-reported AP use indicator is collected only once in a survey per participant. If the information is required later in the survey, then an "autofill" feature should be used in the mobile tablet-based data collection programme application. For example, in The Gambia survey, glasses use was collected at three points in the survey with varying responses so the variable that indicated clinician observed use (i.e. worn during the survey assessment) was used as the gold standard. Further, it is important that questions ask about the specific AP that are being assessed. For example, the WG reported glasses questions only asks about glasses in general, rather than specific long-distance glasses and near vision glasses.
- 3) In a multidomain survey, it is important to ensure clear communication and expectations to the participants about which AP are needed during the survey. For example, all participants who reported using glasses did not bring their glasses to the central location survey. It is possible participants might have been unaware they should bring their glasses/hearings aids or expected a new pair of glasses or hearing aid following the examination. It is recommended that research teams provide clear communication and expectation to participants indicating if the AP should be worn at the time of the assessment and whether or not free AP will be provided following a survey.
- 4) In addition to the quantitative AP need survey, it could be important to plan for qualitative data collection both to better understand participants' AP access barriers (113) and the experiences of the different cadres while collecting data. For example, the Guatemala survey research consortium discussed the importance of gathering more formal qualitative data to capture the data collectors' narrative of their experience in the field using a new AP need survey tool and how the community received them. The Guatemala study coordinator initiated a system

where the team leaders and members sent daily summary voice messages via WhatsApp which was helpful for providing feedback and answering queries from the field. This could be formalised through daily field journals (oral or written) in an AP need survey to better capture their feedback and lessons learned using a new tool. It is recommended that qualitative research with both the participants and the data collectors is considered alongside conducting the AP need survey.

#### **Recommendations for AP need survey development**

- Programme a dashboard for AP data monitoring on web-based and mobile-based platforms.
- Provide clear communication to participants indicating if the AP should be worn at the time of the assessment and if free AP will or will not be provided following a survey.
- Ensure the self-reported AP use indicator is collected only once in a survey per participant for each specific AP and that an “autofill” feature is utilised if the data is subsequently if needed.
- Qualitative research with both the participants and the data collectors could be planned alongside conducting the AP need survey.

## SECTION C. DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS



Photos of assistive products from The Gambia. © Dorothy Boggs/ICED

## Chapter 10: Discussion

### 10.1 Overview

This Chapter includes a synthesis of the key research findings according to the study objectives and provides proposed modules for vision, hearing and mobility assessment to be included in an all-age AP need survey tool. The strengths and limitations of both the PhD methodology and research are detailed, and then the implications for ongoing methodology development are discussed.

### 10.2 Synthesis of research findings

This research aimed to inform the development of a population-based survey method to estimate AP need in LMICs in the functional domains of vision, hearing and mobility. The specific objectives with sub-objectives to achieve this aim are outlined below with a synthesis of the key findings.

#### Objective 1: FUNCTIONING

**To review i) AP need estimates and ii) the approaches identified for the assessment of functioning to measure population-level AP need.**

This objective was achieved through a systematic review of AP need and a review of the functional assessment tools identified. In **Chapter 4**, AP indicator definitions are provided, a systematic review of AP need is presented, and seven functional assessment methods identified from the review are evaluated for feasibility for use in an AP survey need tool.

To first address this objective, the AP indicators used in this PhD thesis were defined (presented in **Chapter 4.1**), and 655 AP indicators were identified in the systematic review by Danemayer et al. (72) (presented in **Chapter 4.2**) extracted from 207 studies. The AP indicators reported in the studies demonstrated high unmet need (>60%) for the five priority AP in most settings. The review found high heterogeneity in the approaches used to assess AP indicators, with over half of the studies (n=110) utilising a combination of clinical and self-reported assessment, and also in how AP indicators were reported/defined.

The systematic review identified seven functional assessment tools, which were reviewed (presented in **Chapter 4.3**). The lessons learned with key implications for development of a hybrid functional assessment protocol to assess AP need were presented. Overall, the tool review highlighted a gap in a fit-for-purpose hybrid functional assessment tool for an AP need survey. Of the seven tools, all scored low on

feasibility ratings and only one (ELSA) measured all six ICF components using a variety of clinical and self-report assessment methods. None of these tools were recommended for use in this AP need survey due to:

- a) the majority were exclusively used in high income countries,
- b) existing tools only reported AP use indicators and did not include methods for specifically assessing AP need, and
- c) resource details including equipment, human resource and administration time were either high or unknown.

There were two important findings from the review of assessment tools. First, functional assessment tools assessing wider health, personal, psychosocial and environmental factors need to be systematically identified and reviewed for inclusion in an AP need survey. Though a hybrid tool assessing population-based AP need and unmet need is a gap, other functional assessment tools exist in clinical/individual assessment contexts and may be useful in guiding questions to include in new survey tool.(93-100) During this review, it will be important to agree definitions of assessment approaches and methods, to consider relabelling the studies included in the AP need systematic review to extract additional population-based functional assessment survey tools, and to consider including broader interventions. Second, once these tools are identified, they need to be adapted and methods need to be tested of how best to integrate the hybrid assessment methods to generate a standardised assessment of population-level AP need for a survey (see **Chapter 10.4** Implications section).

## **Objective 2: IMPAIRMENT**

**To explore the measurement of vision, hearing and mobility impairment as a method to estimate AP need through all-age population-based surveys.**

This objective was achieved through three population-based studies that explored impairment measurement approaches. **Chapter 5.1** presented the secondary quantitative analysis of all-age population-based surveys in India and Cameroon for vision, hearing and mobility impairments. **Chapter 5.2** presented the population-based survey conducted in The Gambia for vision and hearing impairments. **Chapter 6** presented the population-based RAM survey conducted in Turkey. All three studies presented estimates of AP need based on an assessment of clinical impairment. **Table 10-1** presents a summary of the estimates of impairment and AP need.

For the Cameroon, India and Gambia surveys, data were compared on AP need measured through self-report versus clinical impairment assessment, and the overall lessons learned with key implications for an AP need survey protocol development

were identified and discussed. The specific findings are discussed below according to each sub-objective of this thesis.

**Table 10-1: Summary of clinical impairment and AP need prevalence estimates by functional domain from the Cameroon, India, The Gambia and Turkey PhD studies**

<b>FUNCTIONAL DOMAIN IMPAIRMENT AND AP NEED</b>	<b>CAMEROON N = 3567 % (95% CI)</b>	<b>INDIA N = 3574 % (95% CI)</b>	<b>THE GAMBIA N = 9188+ % (95% CI)</b>	<b>TURKEY N = 3084 % (95% CI)</b>
<b>VISION</b>				
<b>Distance vision impairment</b>				
- Mild/worse VI	--	--	13.4% (12.4-4.4)	--
- Moderate/worse VI	2.3% (1.8–3.0)	3.5% (2.7–4.4)	10.0% (9.2–10.9)	--
<b>Distance glasses</b>				
Use	0.3% (0.2–0.5)	3.2% (2.4–4.3)	--	--
Unmet need				
- Mild/worse VI	--	4.1% (3.2–5.1)	5.4% (4.8–6.0)	--
- Moderate/worse VI	0.5% (0.3–0.8)	0.5% (0.3–0.9)	4.2% (3.6–4.7)	--
Total need				
- Mild/worse VI	--	7.2% (6.2–8.5)	5.6% (5.0–6.3)	--
- Moderate/worse VI	0.8% (0.5–1.1)	3.7% (2.8–4.7)	4.3% (3.8–4.9)	--
Coverage^				
- Mild/worse VI	--	44% (34.1–54.2)	3.8% (2.3–6.3)	--
- Moderate/worse VI	37% (20.3–57.5)	87% (77.1–93.0)	3.5% (2.0–6.0)	--
Effective coverage^				
- Mild/worse VI	--	--	3.3% (1.9–5.8)	--
- Moderate/worse VI	--	--	2.7% (1.4–5.0)	--
<b>Near vision impairment</b>				
	--	--	53.4% (51.7–55.2)	--
<b>Near glasses need</b>				
Use	--	--	--	--
Unmet need				
	--	--	44.9% (43.2–46.5)	--
Total need				
	--	--	45.9% (44.2–47.5)	--
Coverage				
	--	--	2.2% (1.6–3.0)	--
Effective coverage				
	--	--	0.2% (0.09–0.4)	--
<b>HEARING</b>				
<b>Hearing impairment</b>				
- Mild/worse HI	--	--	28.1% (24.6–31.9)	--
- Moderate/worse HI	3.6% (2.8–4.6)	4.4% (3.7–5.2)	1.6% (1.0–2.6)	--



<b>Hearing aids</b>				
Use	0.1% (0.03–0.3)	0.1% (0.1–0.3)		--
Unmet need				
- Mild/worse HI	--	--	1.5% (0.9–2.4)	--
- Moderate/worse HI	1.1% (0.8–1.5)	3.0% (2.2–4.0)	25.5% (22.1–29.2)	--
Total need				
- Mild/worse HI	--	--	25.5% (22.2–29.2)	--
- Moderate/worse HI	1.2% (0.9–1.6)	3.1% (2.4–4.1)	1.5% (0.9–2.4)	--
Coverage^				
- Mild/worse HI	--	--	0.1% (0.02–1.0)	--
- Moderate/worse HI	7% (2.2–20.3)	4.5% (1.8–10.6)	2.3% (0.3–15.9)	--
<b>MOBILITY</b>				
<b>MSI impairment</b>				
- Mild/worse MSI	--	--	--	12.2% (10.8–13.7)
- Moderate/worse MSI	3.4% (2.7–4.4)	3.5% (2.9–4.3)		8.6% (7.5–9.8)
<b>Wheelchair</b>				
Use	1	1	--	6 (1.6%)^
Unmet need	0.1% (0.04–0.3)	0.1% (0.01–0.2)	--	8 (2.1%)^
Total need			--	14 (3.8%)^
Coverage	0%	33.3% (95% CI 0.1–99.7)	--	43%^
<b>Prosthetic</b>				
Use	--	--	--	1 (0.3%)^
Unmet need	--	--	--	2 (0.5%)^
Total need	--	--	--	3 (0.8%)^
Coverage^	--	--	--	33%^
<b>TOTAL 3 AP*</b>				
Use	0.4% (0.2–0.6)	3.3% (2.5–4.3)	--	--
Unmet need				
- Moderate VI	1.6% (1.2–2.1)	3.5% (2.7–4.5)	--	--
- Mild VI	--	6.3% (5.1–7.7)	--	--
Total need				
- Moderate VI	1.9% (1.5–2.5)	6.5% (5.4–7.9)	--	--
- Mild VI	--	9.3% (8.0–10.9)	--	--
Coverage				
- Moderate VI	18.8% (11.1–30.2)	50.9% (41.5–60.2)	--	--

- Mild VI

--

35.6% (27.7–44.4)

--

--

---

Abbreviations: AP= assistive products; VI= vision impairment; HI= hearing impairment; MSI= musculoskeletal impairment. \* Sample size for the vision survey was N=9188; sample size for hearing survey was N= 1393. \* Total 3 AP include distance glasses, hearing aids and wheelchairs. ^ Presented as proportions.

Objective 2a: To compare clinical impairment vs self-report assessment methodology for measuring AP need.

To address this sub-objective, first clinical impairment and self-report AP need data from the Cameroon and India surveys were compared for distance glasses, hearing aids and wheelchairs. Then, using further developed impairment survey methodologies, clinical impairment and self-reported AP need were compared for glasses (distance and near) and hearing aids in The Gambia. The lessons learned with key implications for an AP need survey were presented in **Chapter 5.4**.

Overall, the studies found that the agreement between both clinical VI and self-reported AP need assessment, and between clinical HI and self-reported AP need assessment, was poor in identifying the need for distance glasses and hearing aids respectively for both moderate or worse, and mild or worse impairment levels. These findings provide evidence that relying solely on self-report assessment will not provide an accurate estimate of AP need. However, these studies all used clinical impairment to be the “gold standard” assessment of need for AP, which only incorporates one component of the ICF and does not take into account participants’ activities, participation, personal and environmental factors, all of which (as explored in **Chapter 2**) are important in determining appropriate AP need. Therefore, it was recommended that other components of the ICF, such as through hybrid functional assessment modules, are explored and integrated into the AP need survey alongside clinical impairment and self-report assessment. The feasibility and practicality of this hybrid AP need assessment tool would need to be tested. Additionally, the findings identified the need to guide the clinicians’ clinical reasoning and analysis, in determining AP need indicators, to maximise standardisation, for example through decision trees following an algorithm (see section **10.4.1** for an example decision tree for prosthetics, a mobility AP).

Objective 2b: To review and advance clinical impairment assessment protocols to estimate AP need for all ages.

To address this sub-objective, the clinical impairment assessment approaches used in Cameroon and India (glasses, hearing aids, wheelchairs), The Gambia (near and distance glasses) and Turkey (12 mobility AP) were presented. The lessons learned with key implications were presented in **Chapter 5.3** for vision and hearing, and in **Chapter 6** for mobility. These findings are synthesised below according to each functional domain and one section common across all three domains. **Table 10-2** summarises the recommended AP clinical impairment methodology, and **Table 10-3** presents the clinical impairment AP need indicator definitions for each of the four priority AP.

- Vision: Overall, the updated VI methodology used in The Gambia survey should be adapted for the AP need survey (see **Table 10-2**). As discussed in **Chapter 5.2** and **5.3**, this measured both mild/worse and moderate/worse distance VI thresholds for distance glasses need, and measured uncorrected and corrected VA to assess met need, unmet need, undermet need and total need for distance glasses indicators. This methodology is well aligned with WHO (22) and the recently updated RAAB7 (44) survey methods, and have also been found to be suitable for younger age groups (ages >4 years old). The recommended glasses (distance and near) indicator definitions to be used in the AP need survey are presented in **Table 10-3**. These vision AP indicator definitions are well aligned with the eye health sector indicator for effective coverage.(101) Other vision AP were not measured and this gap is addressed in **Chapter 10.3**. All vision AP indicators will need to be reviewed following the inclusion of the functional assessment.
  
- Hearing: Overall, the HI methodology used in The Gambia survey, based on methods developed for RAHL (51) should be adapted and implemented in the hearing module of the AP need survey as presented and discussed in **Chapter 5.2** and **5.3** (see **Table 10-2**). This included measuring both mild/worse and moderate/worse HI thresholds and hearing aid need, using the new WHO HL thresholds.(26) The methodology uses hearTest mobile application for PTA which is appropriate for participants aged >4 years old. OAE should be used on younger children <5 years as assessed in the Cameroon and India surveys. The recommended hearing aid indicator definitions to be used in the AP need survey are presented in **Table 10-3**. Other hearing AP were not measured, and this gap is addressed in **Chapter 10.3**. All hearing AP indicators will need to be reviewed following the inclusion of the functional assessment.
  
- Mobility: The updated RAM methodology used in the Turkey survey, RAM tool version 2.0, should be implemented in the AP need survey as presented and discussed in **Chapter 6** (see **Table 10-2**). The process and details regarding the updated RAM methodology were presented in **Chapter 6.2**. Using RAM version 2.0, the AP indicator definitions to be measured in the AP need survey for wheelchairs and prosthetics are presented in **Table 10-3**. Regarding other AP, the AP section provided need estimates for 10 additional mobility AP and an updated RAM services section, alongside detailed self-reported questions about use (past and current) and access barriers. It is recommended that these sections are

included in the AP need survey. All mobility AP indicators will need to be reviewed following the inclusion of the functional assessment.

**Table 10-2: Clinical impairment assessment methodology for the AP need survey**

AP NEED MODULE	TOOL	STAGE	AGE	METHOD	SEVERITY THRESHOLDS	EQUIPMENT
<b>Vision</b>	Adapted Rapid Assessment of Avoidable Blindness (RAAB)(44)	Screen	2-3 years	TBC* Example: Fix and follow.	TBC* Example: Cannot fix and follow.	--
			3-4 years	TBC* Example: Finger counting.	TBC* Example: Cannot count fingers.	--
			≥ 5 years	Distance vision: Peek mobile application visual acuity (VA) test with pinhole to assess uncorrected, corrected and presenting.	Presenting VA in better eye i) No Impairment: ≥ 6/12; ii) Mild: <6/12 but ≥ 6/18; iii) Moderate: <6/18 but ≥ 6/60; iv) Severe: <6/60 but ≥ 3/60 v) Profound (blind): VA <3/60.	Tablet; Peek acuity and near vision mobile apps; pinhole card.
		≥ 40 yrs.	Near vision: Peek near vision screen.	Cannot see using N6 threshold.		
		Impairment assessment	≥ 2 years	Eye examination using ophthalmoscope to assess cause if distance VI.		Ophthalmoscope.
<b>Hearing</b>	Adapted Rapid Assessment of Hearing Loss (RAHL)(51)	Screen	2-4 years	Otoacoustic Emissions (OAE) test.	Fail OAE in both ears.	OAE test.
			≥ 5 years	hearTest mobile application pure tone audiometry (PTA) test at 0.5, 1, 2, and 4 kHz in each ear.	Hearing loss in better ear Children (5-17) and Adult (18+): i) No Impairment: < 20 dB; ii) Mild: 20 dB to <35 dB; iii) Moderate: 35 dB and < 50 dB; iv) Mod-severe ≥50 dB and < 65 dB; Severe: 65 dB and < 80 dB; v) Profound: 80 dB and < 95 dB; vi) ≥95 dB.	Tablet; hearTest mobile application.
		Impairment assessment	≥ 2 years	Questionnaire on clinical history and risk factors. Otoscopy examination if HI to assess ear disease and assign probable cause as conductive, sensorineural or mixed.		Otoscope.
<b>Mobility</b>	Updated Rapid Assessment of Musculoskeletal Impairment (RAM) (Version 2.0)(37, 105)	Screen	≥ 2 years	Six updated RAM screening questions.	Screens positive if answer 'yes' to at least 1 of six screening questions and if >1 month or permanent.	--
		Impairment assessment	≥ 2 years	If screen positive, complete assessment including observation of activities, assignment of case definition using case severity card and up to three diagnoses.	MSI case severity card definitions. i) No impairment; ii) Mild; iii) Moderate; iv) Severe.	Tablet; 11m rope; plastic cup; plastic bowl.

Abbreviations: TBC= to be confirmed; VI= vision impairment; HI= hearing impairment; MSI= musculoskeletal impairment. \* Methods need to be tested/refined further.

**Table 10-3: Clinical impairment assessment AP need indicator definitions for the four priority AP measured in this PhD thesis**

<b>AP NEED INDICATORS By impairment level</b>	<b>DISTANCE GLASSES</b>	<b>READING GLASSES</b>	<b>HEARING AIDS</b>	<b>WHEELCHAIRS/ PROSTHETICS</b>
<b>MET NEED*</b>				
Mild/worse	Corrected VA 6/12 or better only when wearing existing distance glasses.	Can see N6, only when wearing near glasses.	Bilateral sensorineural or mixed type of HI with better ear > 25 dB, uses a hearing aid, and is not referred for services.	Currently using suitable AP with mild/worse MSI.
Moderate/worse	Corrected VA 6/18 or better only when wearing distance glasses.	--	Bilateral sensorineural or mixed type of HI with better ear > 40 dB, uses a hearing aid, and is not referred for services.	Currently using suitable AP with moderate/worse MSI.
<b>UNDERMET NEED*</b>				
Mild/worse	With existing distance correction VA < 6/12	Cannot see N6 when wearing near glasses.	Bilateral sensorineural or mixed type of HI with better ear > 25 dB, uses a hearing aid, and is referred for services.	Needs and currently using unsuitable AP with mild/worse MSI.
Moderate/worse	With existing distance correction VA < 6/18	--	Bilateral sensorineural or mixed type of HI with better ear > 40 dB, uses a hearing aid, and is referred for services.	Needs and currently using unsuitable AP with moderate/worse MSI.
<b>UNMET NEED</b>				
Mild/worse	Uncorrected VA < 6/12	Cannot see N6.	Bilateral sensorineural or mixed type of HI with better ear > 25 dB and does not use a hearing aid.	Needs but does not have AP with mild/worse MSI.
Moderate/worse	Uncorrected VA < 6/18	--	Bilateral sensorineural or mixed type of HI with better ear > 40 dB and does not use a hearing aid.	Needs but does not have AP with moderate/worse MSI.
URE	UNDERMET + UNMET NEED			
<b>TOTAL NEED</b>		<b>MET NEED* + UNDERMET* + UNMET NEED</b>		
<b>COVERAGE</b>		<b>MET NEED* / TOTAL NEED</b>		

Abbreviations: AP= assistive products; VA= visual acuity; HI= hearing impairment; MSI= musculoskeletal impairment; URE= uncorrected refractive error. \* Met and undermet need are recommended for measurement when possible, however if not feasible self-reported AP use indicator could be used.

- All three domains: Similar findings were highlighted in each of the three studies, as detailed in **Chapters 5.3, 5.4 and 6.2**, that were relevant across all three functional domains for advancing the AP need survey methodology. These findings are presented below for inclusion in the AP need survey methodology.
- AP use indicator: In The Gambia survey, there was a lack of consistency on participant report of glasses use asked at different stages during the survey. To improve the reliability of data collected on reported AP use, the question should be asked only once, and should be thoroughly pilot tested. For glasses, use of distance glasses and near glasses should be asked separately. Expectations regarding availability of AP at the survey need to be managed.
- AP awareness: Given evidence in the PhD studies, as well as wider literature that AP awareness is low, the use of AP item text descriptions and pictorial image cards are recommended in the self-reported AP sections.
- AP need indicators: It is important to ensure data is collected to enable disaggregation of AP need by age, sex, location and SES. These variables should be included in the AP need household survey and general questionnaire modules. The Equity tool (103) is recommended for SES.

Hybrid assessment tool: Overall, the findings from all three studies recommended development of hybrid assessment modules incorporating clinical impairment, functional and self-report assessment to provide more accurate AP estimates. This would ensure better alignment with the ICF by incorporating activities, participation, personal and environmental factors. Additionally, the methodology should use of decision trees to capture clinicians' clinical reasoning for referrals and incorporate additional ICF components, such as environmental and personal factors, to enable more standardised assessment of AP need.

### **Objective 3: SELF-REPORT**

#### **To explore self-report assessment as a method to estimate AP need through population-based surveys.**

This objective was achieved through conducting a population-based survey using the rATA (recently developed WHO AP survey protocol), gathering practical lessons learned from survey fieldwork and synthesising the findings. Also, a secondary analysis of population-based survey data for vision, hearing and mobility domains was undertaken. **Chapter 7** presented the rATA conducted in Guatemala. **Chapter 8** presented the results of an analysis exploring the use of functional screening questions



(WG questions) as first-stage screening for an AP need survey tool. The specific findings are discussed below according to each sub-objective.

Objective 3a: To conduct a population-based AP need survey protocol using self-report assessment.

To address this sub-objective, a population-based survey using the recently developed WHO rATA protocol was conducted in Guatemala. The results, including the self-reported AP indicators, are presented in the paper. The lessons learned with key implications for AP survey protocol development were presented in **Chapter 7.2**.

The main findings from this survey are summarised below. First, limitations and gaps were identified in the methodology. The rATA utilised only self-reported assessments. As shown in **Chapter 5**, this method is not accurate. There was limited information on clinical diagnosis and prognosis and awareness of different AP which made it challenging to know which factors to consider in self-assessing for AP. (105) Awareness of specific AP should be included in the AP need survey, and unmet and undermet need self-reported AP indicators should be reported. Second, specific rATA components that worked well were identified and should be included into a hybrid AP need survey tool. In particular, the use of AP images to facilitate participants' understanding of self-reported AP. Third, there were other lessons learnt for other areas of survey methodology. For sample size calculations, an estimate for use of *at least one* AP (e.g. 7%) was used in the Guatemala rATA survey. With the exception of glasses, the prevalence of need for individual AP is low and very low for a few specific AP, such as wheelchairs (see **Table 10-1**). It is recommended that the sample size is calculated on need for *at least one* AP (*other* than glasses), but this should be reviewed and updated as more data are generated. The sample size will also depend on specific data needs as well as resources available. Additionally, the rATA offered consumer choice (62) and collected AP data on access barriers, payment details, satisfaction and environment, which provide useful information for service planning. It is recommended these questions be included in the need survey. Regarding use of the WG questions, the rATA modified the questions so difficulties with activity limitations were gathered without use of AP or assistance. This needs to be reviewed for other modifications to the WG ES questions to ensure that the data collected can be analysed to align with standardised WG reporting. Fourth, lessons were learned about the value of a well-developed web-based platform and mobile application to collect and monitor data, that should be replicated for the AP need survey.

Objective 3b: To explore the use of first-stage self-report screening questions to measure AP need.

Previous research recommended that WG questions could be used as a first stage screen, followed by clinical impairment assessment, to reduce the time and complexity of the survey yet still identify the majority of people with moderate or worse clinical impairments.(58) However, the extent to which these screening questions identified people with AP need was not known. To address this sub-objective, a secondary analysis from five survey datasets (Cameroon, Chile, India, The Gambia and Turkey) for four functional domains (vision, hearing, mobility and cognition) was undertaken to explore use of the WG question sets as a first stage screening for a population-based survey to identify people with clinical impairment, service and AP referral needs using different cut-offs. The lessons learned with key implications for AP need survey protocol development were presented in **Chapter 8.2**.

The main finding from the study was that the WG questions could be used as a first stage screening option to identify people with impairment and referral needs for mild or worse (mild+) impairment using “some or worse” difficulty screening cut-off, but only with moderate sensitivity and specificity. Based on this finding, for the AP need survey it is recommended to develop a multi-domain modular AP need survey tool mobile app to include options to i) include or not include the first stage WG screen in the survey and ii) select which functional domains to include depending on the required data, and time and resources available. If time and resources allow, a first stage impairment screening would be recommended; however, where this is not possible, there could be a preliminary screening with WG and then only those who reported “some or worse” difficulty would receive the second stage assessment. Studies are needed to investigate the extent to which this adequately captures “service demand” in a given population.

Important issues were also recommended for research. As an alternative option for a first-stage screening, it is recommended to explore the use of the WG first stage screening of “some or worse difficulty” in *any* functional domain, as well as the feasibility, affordability and acceptability of using this method. Additionally, a review of other functional assessment tools incorporating more environmental factors should be explored as per Sprunt et al.’s Fiji study recommendation (107-110) in a second stage screening. For MSI specifically, the RAM screening questions should be used and/or a combination of WG screening questions related to MSI should be investigated to explore if this might have improved sensitivity and specificity to identify people with MSI-related AP and service needs. Finally, the level of need for rehabilitation and AP

was at least equal to or higher than surgical and medical services need. This has implications for measuring service need which will be discussed in section **10.4.4**.

**Table 10-4** presents the recommended self-report assessment methodology for the AP need survey.

**Table 10-4: Self-reported assessment methodology for the AP need survey**

AP NEED MODULE	TOOL	STAGE	AGE	METHOD	SEVERITY THRESHOLDS
<b>Household</b>	Equity tool(103)	Screen	≥ 2 years	Socioeconomic self-report question set to be answered by head of household.	Principal component analysis by quintiles completed during data analysis.
<b>General questionnaire</b>	Washington Group (WG)(53) Child Functioning Module	Screen	2-4 years	Caregiver report for 8 functional domains on activity limitations assessed using a reported four-point graded severity scale.	Response categories: i) No difficulty; ii) Some difficulty; iii) A lot of difficulty; iv) Cannot do.
			5-17 years	Caregiver/self-report for 12 functional domains on activity limitations assessed using a reported four-point graded severity scale.	Response categories: i) No difficulty; ii) Some difficulty; iii) A lot of difficulty; iv) Cannot do.
	WG Extended set of questions	Screen	≥ 18 years	Self-report for 10 functional domains on activity limitations assessed using a reported four-point graded severity scale.*	Response categories: i) No difficulty; ii) Some difficulty; iii) A lot of difficulty; iv) Cannot do.
	Rapid Assistive Technology Assessment (rATA)'s AP use and access sections only(64)	Screen	≥ 2 years	Caregiver/self-report questionnaire sections asking about AP use and access barriers, payment details, satisfaction and environment	Response options vary according to question asked (see Appendix 6 for details).
	AP awareness question	Screen	≥ 2 years	Caregiver/self-report question asking about awareness of AP.	Participants report awareness of AP from a list of domain-specific AP.
<b>Optional first stage screen</b>	WG question sets (as above)	Screen	≥ 2 years	Reported difficulty completing activities (seeing, hearing, walking) with or without AP.	Vision: Some/worse difficulty seeing with or without glasses. Hearing: Some/worse difficulty hearing with or without hearing aids. Mobility: Some/worse difficulty walking with or without mobility AP.
	Rapid Assessment of Mobility (RAM) screening questions	Screen	≥ 2 years	Six updated RAM screening questions.	Screens positive if answer 'yes' to six screening and if >1 month or permanent.

\* WG extended set to include optional vision and hearing questions, including specific question for near vision.

#### **Objective 4: HYBRID**

**To provide recommendations for an “AP need survey protocol” for vision, hearing and mobility functional domains in LMICs.**

**Chapter 9** presented lessons learned through review of fieldwork experiences from the three population-based surveys in The Gambia, Turkey and Guatemala. Drawing on lessons learned, this **Chapter** presents an overview of proposed methods for the hybrid AP need survey tool including questionnaire modules on vision, hearing and mobility, and **Chapter 11** provides recommendations. Specific findings are discussed below according to each sub-objective.

##### Objective 4a: To gather practical lessons learned from survey fieldwork.

To address this sub-objective, the lessons learned during fieldwork from three population-based surveys in The Gambia, Turkey and Guatemala were gathered and presented under five headings: (1) planning, (2) training and IOV, (3) logistics, (4) supervision/support and (5) data collection in **Chapter 9**, with recommendations for AP survey protocol development.

##### Objective 4b: To synthesise and provide recommendations for “AP need survey protocol”.

The synthesis of findings from the three objectives and sub-objectives highlighted important findings to implement, develop and validate now, as well as future areas for further research. Following the synthesis of all the findings from the six PhD studies, vision, hearing and mobility survey modules can be drafted for an AP need survey incorporating self-report, clinical impairment, and functional assessment. Draft versions of the three domain modules are presented in **Appendix 6**. The questionnaires include additional AP and related services in each domain given this PhD’s recommendation throughout to collect data on other AP and services. The AP need survey is also given the title of the “Functional Needs Assessment Tool (FNAT)” given this given this PhD’s recommendation throughout to collect data on broader functioning components. The implications of these findings are discussed in section **10.4**, and the recommendations for current and future research are provided in **Chapter 11**.

## **10.3 Strengths and limitations**

### 10.3.1 Strength and limitations of the PhD methodology

The strengths and limitations of each study are examined in each of the relevant chapters of this PhD thesis. The strengths and limitations of the methods used to address each of the PhD objectives are summarised in **Table 10-5**.

**Table 10-5: Main strengths and limitations of PhD methodology by Study objective**

<b>STUDY OBJECTIVE (Chapter)</b>	<b>METHOD</b>	<b>MAIN STRENGTHS</b>	<b>MAIN LIMITATIONS</b>
<b>Objective 1: FUNCTIONING</b>			
(4.2)	Systematic review	<ul style="list-style-type: none"> <li>Large review of more than 200 studies from which more than 650 indicators were extracted.</li> <li>Included five AP across four functional domains.</li> </ul>	<ul style="list-style-type: none"> <li>Limited results for AP in mobility and cognitive domains which could be due to search terms used.</li> </ul>
(4.3)	Tool review	<ul style="list-style-type: none"> <li>Seven functional assessment tools were extracted from a systematic review of 207 studies on AP need.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of clarity how the AP assessment type was assigned in the systematic review so it is possible some functional assessment tools were missed.</li> <li>Research is limited for population-based AP need functional assessment tools.</li> </ul>
<b>Objective 2: IMPAIRMENT</b>			
2a (5.1) 2b (5.1)	Secondary quantitative analysis of survey datasets for vision, hearing and mobility domains.	<ul style="list-style-type: none"> <li>Secondary analysis of population-based survey data from two countries at district level provided need estimates for 3 AP in 3 domains.</li> <li>All-age methodology using validated clinical tools.</li> <li>Methodology developed to compare clinical impairment and self-report AP need assessment.</li> </ul>	<ul style="list-style-type: none"> <li>Surveys conducted in 2013-14 so methodology not recent, i.e. older version of RAAB methodology, use of OAE screening first on all hearing participants.</li> <li>Comparison between two different ICF components (impairment; activity limitations) may account for some of the differences in assessment approaches.</li> </ul>
2a (5.2) 2b (5.2; 6)	Population-based surveys for vision, hearing and mobility domains.	<b>The Gambia</b> <ul style="list-style-type: none"> <li>Large national population-based survey that used multi-stage cluster sampling technique.</li> <li>Near vision AP assessment was included.</li> <li>Provided disaggregated need estimates for glasses (distance and near) and hearing aids, and by sex, age, SES and location.</li> <li>Methodology developed to compare clinical impairment and self-report AP need assessments.</li> </ul>	<b>The Gambia</b> <ul style="list-style-type: none"> <li>Low response rates overall, especially with hearing assessment.</li> <li>Self-report comparison limited by not asking about glasses type (distance, near) separately.</li> <li>Discrepancies in reported versus observed AP use may have led to underestimates.</li> </ul>

**Turkey**

- All-age population-based survey that used two-stage sampling technique.
- Updated RAM improved MSI case definitions, severity classifications and expanded service and AP assessments by assessing need for 12 mobility AP.

**Both**

- Use of updated/new validated clinical methodologies for AP assessments (RAAB, RAHL and RAM).
- Use of tablet-based data collection.

**Turkey**

- High amount of 'unknowns' for aetiologies and diagnoses.
- Updated RAM on advanced tablet-based programming requires validation.

**Both**

- Assessments rely primarily on clinical impairment and do not take into account activities, participation, personal and environmental factors.

**Objective 3: SELF-REPORT****3a (7)**

Population-based survey in Guatemala for vision, hearing and mobility domains.

- AP need focused survey methodology.
- Tool developed by WHO with emphasis for use globally.
- Wider AP data collected on access barriers, payment details, satisfaction and environment recommended.

- Use of self-report AP assessment may have over/under-estimated need.
- AP awareness was not measured.
- Methods to show AP images varied (printed vs. electronic).

**3b (8)**

Secondary analysis of population-based survey data for vision, hearing and mobility domains.

- Population-based survey datasets included from five countries for four functional domains.
- Similar methodology used for vision, hearing and MSI assessments.

- Sample size not powered for specific analysis.
- Lack of near vision screening question.
- Variation between methodologies may have been due to measuring two separate ICF components.
- Retrospective service allocation for vision and hearing may have over-estimated need.

**Objective 4: HYBRID****4a (9)**

Lessons learned from population-based survey fieldwork in The Gambia, Turkey and Guatemala.

- Comprehensive range of methods.
- Use of the WHO ICF framework as a lens.
- Use of datasets from six countries in 4 different world regions, including conducting 3 population-based surveys.
- Protocol developed through evidence-based peer reviewed studies.

- Survey protocol has not yet undergone pilot and/or feasibility testing.

**4b (10; 11)**

Synthesis of findings and



---

recommendations  
for AP need  
survey protocol.

---

Abbreviations: AP= assistive products; RAAB= Rapid Assessment of Avoidable Blindness; OAE= Otoacoustic Emissions; ICF= International Classification of Health, Disability and Functioning; SES= socioeconomic status; RAM= Rapid Assessment of Musculoskeletal Impairment; MSI= musculoskeletal impairment; RAHL= Rapid Assessment of Hearing Loss; WHO= World Health Organization.

### 10.3.2 Strengths and limitations of the research

The main strength of this PhD thesis is the comprehensive range of methods used in the seven studies, building up evidence to inform need and methods for a new AP survey need tool. This included a systematic review of 207 articles on population level estimates of AP need, reviewing functional assessment tools used in surveys of AP need, and five studies analysing population-based survey data from six countries including three primary survey analyses and three secondary survey analyses. Data was from two countries in Africa (The Gambia and Cameroon), two countries in the Americas (Chile and Guatemala), one country each in South East Asia (India) and Europe (Turkey). These analyses therefore provided cross-context data enabling comparisons and lessons learned with key implications towards the development of the AP need survey. Another strength was the use of the ICF as a lens to investigate the development of a methodology for an AP need survey. The ICF was developed by WHO in 2001 and its use will ensure that the survey tool is well-aligned with global and national recommendations, and other measurement approaches. Further, the methodology has been investigated through peer reviewed primary and secondary studies which has provided evidence-based recommendations for the methodology development.

The main limitation of this research is that the proposed method for this hybrid AP need survey (in domains of vision, hearing and mobility) has not yet undergone pilot and/or feasibility testing. As outlined in **Section O**, the COVID-19 pandemic and UK Aid funding cuts significantly impacted our research planning so the pilot and feasibility testing of the protocol in the field was not possible during the course of this PhD. Therefore, the research focused on the *development* (but not field testing) of the protocol methodology which has been achieved in this thesis.

## 10.4 Implications of the findings

This section presents the implications of this PhD's findings. A hybrid functional needs assessment is explored, and the implications for the survey's data collection cadres, an all-age AP need assessment and potential for service need data are detailed. Implications are also outlined for survey development and policy and programming.

### 10.4.1 Hybrid functional needs assessment

Hybrid functional assessment typically includes indirect, observational, and experimental/functional analysis procedures, in addition to impairment and self-report assessments.(60, 61) Presently, functional assessments primarily measure individual-level functioning, are time-intensive and rely on clinicians' reasoning. In order to use functional assessments at the population-level in an AP need survey, it is essential to ensure the different assessment methods are feasible, standardised and systematically *integrated* to provide recommendations for AP need. Therefore, the main recommendation from this study is that hybrid assessment modules incorporating clinical impairment, functional and self-report assessments are needed to measure population-based AP need. This PhD research has specifically explored clinical impairment and self-report assessment approaches, and identified a gap in hybrid functional need assessment.

### Decision tree methodology

In a variety of clinical and non-clinical settings, one method that has been used to standardise and integrate different assessment methods for complex needs are the development of evidence-based decision algorithms, or also commonly referred to as decision trees or decision aids.(114) In 2017, Cochrane reviewed 105 studies of decision aids (pamphlets, videos or web-based tools) for people facing health treatment or screening decisions.(115) The review found that a decision aid can significantly improve knowledge and lead to a higher proportion of people selecting options congruent with their values.(115)

Clinical decision trees have been implemented in individual-level functional assessments. One example is the Functional Impedence Measure (FIM), an 18 item motor and cognition tool developed in the USA primarily used in clinical rehabilitation settings by interdisciplinary teams to assess and grade the functional status of a person based on the level of assistance he or she requires with certain activities, not specific to any diagnosis.(116, 117) The FIM can also be scored with an additional 12 item tool the Functional Assessment Measure (FAM) (118), and a separate UK version (e.g. UK FIM+FAM) also includes an optional module for extended activities of daily

living.(119, 120) The primary assessment method is patient observation during functional tasks. Therefore, in order to standardise the assessment across clinicians, one overall decision tree and task specific decision trees were developed. AP are integrated into these decision trees, however it is to record for the level of assistance only.(117, 121) Though assessment is a helpful functional decision tree model, the methods would need to be developed as a population-based survey tool.

### **AP need decision tree methodology**

Decision trees for determining AP need are general lacking. The few that are available are primarily individual-level in high income countries, such as the clinical evidence-based Continence Product Patient Decision Aid for men post-radical prostatectomy developed by Southampton University (122) and the publicly accessible UK website AskSARA developed by a multidisciplinary team as a self-help guide providing expert advice and information on products and equipment for older and disabled people.(123)

Therefore, due to the lack of AP decision trees applicable in LMICs, WHO GATE as part of our wider AT2030 project formed a Coordination group with UCL GDI Hub and LSHTM, including this PhD candidate, to support the development an AP decision tree that would be widely available online (124), applicable in LMIC contexts and well aligned with WHO GATE's APL list. This WHO project named "Assistive Product Explorer" (ASPRES) (<https://public.asprex.net>) also had an aim to pilot test and implement the integration of select AP decision tree components into the AP need survey. Currently a beta test version of the tool has been developed to present knowledge about AP to feed an artificial intelligence AI-based online system offering guidance to identify and select AP for individual needs.(125) It is based upon ICF-aligned knowledge rules which contain information about indicated and contraindicated goals, impairments, activities, environments and contextual factors for specific AP use. ASPRES is still under development and is *not* able to be integrated at present into an AP need tool. However, the knowledge rules developed by the AP expert consultant group for specific AP have been referenced and included when relevant in the functional assessment (see below). It is anticipated a version of ASPRES, potentially in mobile application format, might be available to be integrated into the AP need survey in the future.

Given the lack of existing decision trees available, as a first step towards an integrated survey assessment, AP decision algorithms integrating the ICF components assessed in the tool have been drafted through this PhD candidate's clinical OT knowledge, domain-specific expert consultation and drawing on ASPRES's knowledge rules. The

sections below present key components of the proposed hybrid functional assessment method to be included in the AP survey, to assess need for vision, hearing and mobility AP. This method will be pilot tested in a survey being planned in Uganda. For the overall proposed survey tool, refer to the FNAT vision, hearing and mobility modules in **Appendix 6**.

**STEP 1: Self-report assessment:** It is important for self-report assessment to be integrated into an overall functional needs assessment. The methods for self-report assessment have been presented in detail in this thesis (see **Table 10.4**).

**STEP 2: Clinical impairment assessment:** It is also important for clinical impairment assessment to be integrated into an overall functional needs assessment. The methods for clinical impairment assessment have been presented in detail in this thesis (see **Table 10.3**).

**STEP 3: Functional assessment cut-off filter:** The information on severity and cause of impairment will be used to determine who is likely to benefit from AP (rather than other surgical and medical interventions) and those participants will undergo further question-based assessment as described below. **Table 10.6** presents the clinical criteria that will be used to determine which participants will require further functional assessment to assess AP need. Anyone meeting these criteria, will undergo further functional assessment. For example, as shown in **Box 10.1** (an example from the mobility module questionnaire), a participant identified as having a mild/moderate/severe MSI and a rehabilitation/AP need, (i.e. they do not have a surgical or medical need only) will undergo functional mobility assessment.

**Table 10-6: AP need survey functional assessment cut-off filter criteria by each domain**

FUNCTIONAL DOMAIN	FUNCTIONAL ASSESSMENT CUT-OFF FILTER CRITERIA
<b>Vision (requires refraction)</b>	Distance vision: less than 6/12 in better eye which improves with pinhole or refraction.
	Near vision ( $\geq 40$ years): cannot read N6.
<b>Vision (requires functional assessment)</b>	Distance vision (5 years +): less than 6/12 – not refractive error or cataract.
	Distance vision (2-4 years): fail fix and follow (2 to <3 years) or finger counting (3-4 years).
<b>Hearing</b>	2-4 years: Fail OAE and sensorineural or mixed hearing loss cause.
	Ages 5+: Mild/worse hearing impairment ( $\geq 20$ dB) and sensorineural or mixed hearing loss cause.
<b>Mobility</b>	$\geq 2$ years: mild/worse MSI and a clinically identified rehabilitation/AP need.

Abbreviations: OAE= Otoacoustic Emissions; MSI= musculoskeletal impairment; AP= assistive products.

**Box 10.1 Example of the Functional mobility assessment**

**E13. Functional Mobility Assessment**



Only complete this section of questionnaire if:

**Ages ≥2 years:** participants with mild, moderate or severe MSI who do not have surgical or medical needs only (i.e. If E8 q2= 1, 2, 3 AND E12 q4=1)



**Preamble:** I am now going to ask you some questions about [your/(child)'s] mobility and everyday life.

**STEP 4: Domain specific functional assessment:** This section will include questions on general function and questions about specific AP. These assessments will be conducted by relevant clinicians, who will use the information collected to determine appropriate AP recommendation.

- Participants’ perspectives: Integrating participants’ perspectives of their activities, participation and environmental and personal factors with clinical assessment is important for determining AP need. For example, one individual-level assessment commonly used by OTs in more than 40 countries for integrated client-centred practice is the Canadian Occupational Performance Measure (COPM).(126, 127) The COPM is an all-age individualised outcome measure for individuals to identify and prioritise issues that restrict their participation in everyday living, and to detect changes over time.(128) Though the full tool is not directly applicable to a cross-sectional population-based AP need survey, two questions (see **Box 10.2** below) that ask participants what activities they would *like* to do, but have difficulty doing due to a clinical impairment, will be included (see **Appendix 6**).

**Box 10.2 AP need functional assessment questions asking participants’ report of activities**

**Question 5:** Ask the participant to report if there are activities that he/she would like to do but cannot do because of mobility problems.

**Question 6:** Pre-coded list and other text answer choices to select activities that the participant has difficulty doing because of his/her mobility.

5. Because of problems with your/[name] mobility, do you/[name] have difficulty doing things you/[name] would like to do?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> No, no difficulty (1)	<input type="checkbox"/> Yes, some difficulty (2)	<input type="checkbox"/> Yes, a lot of difficulty (3)	<input type="checkbox"/> Cannot do at all (4)
6. What are some of these activities? INTERVIEWER. Can prompt, “Is there anything else that might be difficult for you/[name] to do because of your/[name] mobility?”	<input checked="" type="checkbox"/> Select all that apply if q5 = 2,3 or 4	<input type="checkbox"/> Cooking at home (1) <input type="checkbox"/> Cleaning at home (2) <input type="checkbox"/> Eating with others (3) <input type="checkbox"/> Going shopping, such as to the market (4) <input type="checkbox"/> Going to paid work (5) <input type="checkbox"/> Attending school (6) <input type="checkbox"/> Social activities, such as going to church (7) <input type="checkbox"/> Other (8)			
Other, specify	<input checked="" type="checkbox"/> Select if q6=8	_____			

- Home and community environment: The importance of the participants' environment at home and community levels in informing AP need was identified throughout this PhD study, and by research by Sprunt et al.'s in Fiji.(110) **Box 10.3** shows examples of questions on environment that will be included in the FNAT mobility module functional assessment.

<b>Box 10.3 Example outside environment questions from the mobility module's functional assessment section</b>		
5. What type of road surface is outside your/[name] home? READ ANSWER CHOICES ALOUD	<input checked="" type="checkbox"/> Select all that apply	<input type="checkbox"/> Sand (1) <input type="checkbox"/> Dirt (2) <input type="checkbox"/> Pebbles/small rocks (3) <input type="checkbox"/> Concrete/paved (4) <input type="checkbox"/> Other (5)
6. What type of ground is outside your/[name] home? PROMPT: Would you say it is even/flat or uneven/bumpy? IF AT HOUSEHOLD, INTERVIEWER COULD COMPLETE.	<input checked="" type="checkbox"/> Select all that apply	<input type="checkbox"/> Even/flat ground (1) <input type="checkbox"/> Uneven/bumpy ground (2) <input type="checkbox"/> Other (3)
6a. Specify other	☞ text if E13.2 q6=3	_____

- Support available: It also is important to integrate specific questions about the participants' support available when completing daily activities.(67) **Box 10.4** presents examples of questions on assistance/support from the FNAT mobility module functional assessment.

<b>Box 10.4 Example of support available questions for functional mobility assessment module</b>		
1. Who do you/[name] live with? (select all that apply)	<input checked="" type="checkbox"/> Select all that apply	<input type="checkbox"/> No one (1) <input type="checkbox"/> Partner/spouse (2) <input type="checkbox"/> Child/children (3) <input type="checkbox"/> Sibling/s (4) <input type="checkbox"/> Friend/s (5) <input type="checkbox"/> Other family members (6)
2. Because of your/[name]'s mobility, [do/does] you/[name] need help with some of your/[name] daily activities, such as [>17years] cooking, cleaning or fixing items? [5 to 17years] playing and getting dressed? [2 to 4 years] feeding and playing?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
3. Because of your/[name]'s mobility, [do/does] you/[name] need help with some of your/[name] daily activities in your/[name] community, such as [>17years] going to the market? [2 to 17years] playing with friends?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
4. [Is this person/Are these people] who you/[name] live with able to provide help with your/[name] daily activities?	<input checked="" type="checkbox"/> Select one Only if E13.2 q2=1 or 2 and/or E13.2 q3=1 or 2 and E13.2 q1=2 to 6	<input type="checkbox"/> No help (0) <input type="checkbox"/> Some help (1) <input type="checkbox"/> Help all the time (2)

### Sections about specific AP

Functional assessment questions related to specific AP will also be asked. This will include gathering more specific assessment information related to participant's reported difficulties, symptoms and clinical observation using a modified answer scale. (95) **Box 10.5** presents an example of questions that will be asked to assess need for prosthesis (asked to people with a mild or worse MSI with specific amputation-related diagnoses). This includes questions about potential contraindications, for example if swelling is present a prosthesis not (yet) appropriate.

**Box 10.5 Example of specific AP related questions for prosthetic need**

Questions will only be asked to participants who have either a mild, moderate or severe MSI and were diagnosed to have a lower limb amputation/missing.

<b>III. Prosthetics</b> <i>Only ask if lower limb is reported as missing in RAM.</i> <i>If E9.A2=3,4,5,7 or E9.C=11</i> <i>AND IF B4 q3 does not=B(4) or [B4 q3=B(4) AND E13.3 q2=1]</i>							
1. Because of your/[name]'s missing limb [do/does] you/[name] have difficulty moving around?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. [Do/Does] you/[name] have any pain in your missing limb?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
3. IS THE PARTICIPANT'S MISSING LIMB STUMP INTACT, WITHOUT CUTS OR ABRASIONS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
4. DOES THE PARTICIPANT HAVE ANY SWELLING IN HIS/HER STUMP?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			

### AP algorithm

Decision algorithms for each AP have been proposed that will use information from the self-report, clinical impairment and functional assessment questions to assess whether or not a person is likely to benefit from that AP. The proposed decision trees were informed through this PhD candidate's clinical OT knowledge, domain-specific expert consultation and drawing on ASPREX's knowledge rules. **Box 10.6** presents an example of the proposed AP need algorithm for a prosthetic. It is noted that these decision trees may also be useful for practitioners in low resource settings as well as in population-based surveys.



### Box 10.6 Example of a proposed AP need algorithm for a prosthetic

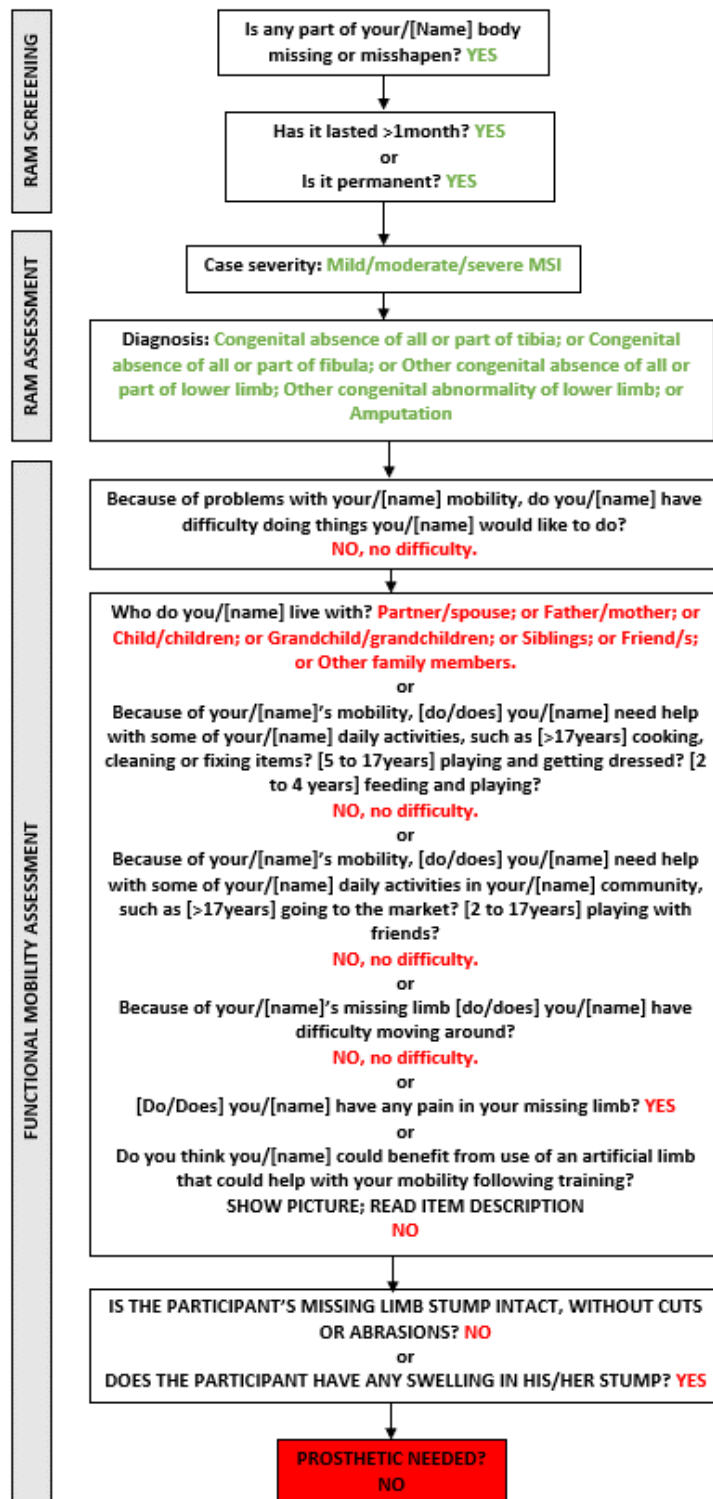
See below for examples of each question from the mobility module's functional assessment section that are included in the AP need assessment algorithm for a prosthetic.

A) Example of the AP need algorithm indicating "YES" for prosthetic AP need. The question's response/s that correspond to "yes" are indicated in bold green.



**Box 10.6 Example of a proposed AP need algorithm for a prosthetic continued**

B) Example of the AP need algorithm indicating “NO” for prosthetic AP need. The question’s response/s that correspond to “no” are indicated in bold red.



*Hybrid assessment comparison for AP indicators*

In the current version of the FNAT survey, the participants’ self-assessment of need for an AP, the recommendation from the questionnaire-based decision algorithm and the clinician assessed AP need will all be recorded. The clinician will know the outcome of the algorithm through a display feature, and the clinician can either agree or not agree. The AP need recommendation and referral will be based on the clinician’s assessment as the “gold standard”.

The data following the pilot and full survey in one LMIC country will be used to:

- i) compare the three assessment methods,
- ii) refine the questionnaires, and
- iii) refine the questionnaire-based decision trees.

See **Box 10.7** below for the same AP example recording the three different assessment methods for prosthetic need.

**Box 10.7 Prosthetic example of the three AP assessment methods to be piloted in an AP need survey**

Question 5, 5a: Participant self-reported assessment of AP need, including open text explanation of why he/she thinks would not benefit.

PROSTHETIC NEED?: Questionnaire-based decision algorithm to determine AP need.

Question 6, 6a, 6b: Clinician-based assessment of need following hybrid clinician impairment, functional and self-reported assessments of AP need, including open text explanation of why the clinician does or does not think the participant would benefit.

5. Do you think you/[name] could benefit from use of an artificial limb that could help with your mobility following training? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
5a. Why don't you think you could benefit?	<input type="checkbox"/> text if E13.3 III q5=0	_____			
PROSTHETIC NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF E13.1 q5=2,3,4 AND E13.2 Q1=1 OR E13.2 Q2=1,2 OR E13.2 Q3=1,2 OR E13.3 III Q1=2,3,4,5 OR E13.3 III Q2=0 E13.3 III Q5=1 AND E13.3 III Q3=1 OR E13.3 III Q4=0			
6. COULD THE PARTICIPANT BENEFIT FROM A PROSTHETIC?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
6a. WHY?	<input type="checkbox"/> text if E13.3 III q6=1	_____			
6b. WHY NOT?	<input type="checkbox"/> text if E13.3 III q6=0	_____			

#### 10.4.2 Cadres for data collection

Implementing the hybrid assessment methodology will require domain-specific clinicians. Due to COVID-19 and the UK Aid funding cuts changes described in **Section 0**, it was not possible to test which cadre should be used for specific domain modules for the AP need survey. Therefore, cadre recommendations for the first FNAT survey will follow standard recommendations for RAAB, RAHL and RAM. **Table 10-7** summarises the data collector cadres that were used in the five clinical PhD studies, and the proposed FNAT survey cadres for each of the modules.

**Table 10-7: Proposed data collector cadres for FNAT survey module administration**

<b>FNAT SURVEY MODULES</b>	<b>CADRES USED IN PHD STUDIES</b>	<b>PROPOSED FNAT SURVEY CADRES</b>
<b>Enumeration</b>	Enumerator	Enumerator
<b>Household</b>	Enumerator	Enumerator
<b>General questionnaire</b>	Enumerators/interviewer	Enumerators/interviewer
<b>Vision</b>		
<i>Visual acuity screening</i>	Optometrist Optometry technician	Ophthalmologist/ Ophthalmologist clinical officer
<i>Eye examination and cause assessment</i>	Ophthalmologist Ophthalmic nurse	
<b>Hearing</b>		
<i>Hearing screening</i>	Audiologist	ENT specialist or ENT clinical officer/nurse
<i>Ear examination and assessment of cause</i>	ENT residents/consultant ENT nurse Audiologist	
<i>Full RAHL assessment</i>	Audiology nurse	
<b>Mobility</b>		
<i>RAM screening</i>	Enumerators/interviewer	Physiotherapist
<i>RAM</i>	Physiotherapist	

Abbreviations: ENT= Ear, Nose and Throat; RAHL= Rapid Assessment of Hearing Loss; RAM= Rapid Assessment of Musculoskeletal Impairment.

Future studies will be important to assess whether other cadres, or even single cadres (e.g. physiatrists) could accurately conduct these assessments, in order to limit cost and impact on local service provision. This would need to be tested through a cadre accuracy testing study. This could follow similar methodology as Bright et al.'s clinic-based diagnostic accuracy study in Malawi, where a "gold standard" cadre is compared against other cadres.(129)

#### 10.4.3 AP need assessment across the life course

This PhD study investigated the development of all-age AP need methodology. Assessing AP need in all ages is underpinned by the life course approach to health which aims to ensure people's wellbeing at all ages by addressing their needs and ensuring access to health services as a human right to health.(26, 130) This views health as developing dynamically over time in an emergent capacity and as being

affected by multiple factors, such as genetic, biological, psychosocial and economic.(130, 131) The life course approach is well aligned with UHC and SDG 3 to “ensure healthy lives and promote wellbeing for all at all ages”.

**Table 10-8** presents the age groups included in each of the primary and secondary analysis population-based survey studies, as well as the year of data collection.

**Table 10-8: Age groups included in the six PhD population-based survey studies**

PHD STUDY	YEAR	AGE GROUP INCLUDED
<b>PRIMARY STUDIES</b>		
The Gambia vision and hearing survey	2019	35+ years
Turkey MSI survey	2019	2+ years
Guatemala rATA survey	2021	2+ years
<b>SECONDARY ANALYSIS STUDIES</b>		
Cameroon vision, hearing and MSI survey	2013	2+ years
India vision, hearing and MSI survey	2014	2+ years
Chile hearing survey	2019-20	50+ years

Abbreviations: MSI= musculoskeletal impairment; rATA= rapid Assistive Technology Assessment.

Based upon the PhD study findings, assessment methodology for ages 2+ has been included in the FNAT survey. This is primarily based upon the WG question sets which include ages 2+ years. Other methodologies exist for screening (132-134), and generating population data on the prevalence and causes of impairment in children (135, 136) that might be more cost-effective. Therefore, in an all-age AP survey, it is important to assess the functional needs of children at their different stages of development (137) and also that over time functional decline is common in older adults (60, 138, 139). In the hearing module only, the functional assessment section for AP is sub-divided into the three different age groupings to pilot more age-appropriate cut-off filters and questions using the WG age groupings of 2 to 4 years, 5 to 17 years and 18+ years. Following an FNAT pilot survey, the age groupings could be replicated for the other functional assessment domain sections and/or subdivided further once findings are reviewed and analysed. Additionally, through conducting all-age surveys of AP, the further data can be used to assess whether it would be appropriate to develop a “Rapid” version (e.g. 40+ years only) to collect the majority of data for service planning, similar to RAAB and RAHL methodology, and/or a “Short” version (i.e. a minimal set of questions required) such as the brief version of the MDS (66).

#### 10.4.4 Service need data

Assessing AP need is one of many broad rehabilitation interventions.(140) This thesis, and existing estimates, showed that the need for rehabilitation services was greater than the need for AP in the different surveys.(141, 142) For example, this was

presented in the PhD's Turkey MSI study which found physiotherapy was the highest assessed unmet service need (11%) among the total survey population, while the unmet need for *at least one* AP was much lower (2.3%).(105) Therefore, it is important to measure rehabilitation need alongside AP need, and this data is also lacking.(141, 143, 144) It is recommended that the FNAT survey is expanded to also include relevant context specific rehabilitation service need indicators. This will provide more accurate estimates of overall rehabilitation service need in the survey area, and will provide important data to inform programming and human resource requirements so service availability can be improved and barriers can be addressed.(145)

Additionally, although this PhD specifically focused on assessing AP need, it recognises the broader definition of “assistive technology” which indicates that AP must be accompanied by related systems and services. This PhD's WG study for the domains of vision, hearing, mobility and cognition reviewed the need for four services, and found that the overall population-level need for rehabilitation/AP services (2–43%) was approximately equal to or greater than the need for surgical/medical services (2–10%) across all domains and countries, except for moderate/worse VI in India and The Gambia.(142) Therefore, when a population-based hybrid functional needs assessment of AP is administered, it should also indicate the need for medical and surgical services, in addition to AP and rehabilitation need indicators.

#### 10.4.5 Implications for survey development

The six studies included in this PhD thesis have investigated and informed the development of a population-based AP need assessment survey tool with a focus on four priority AP – distance and near glasses, hearing aids, wheelchairs and prosthetics. Incorporating the development of a hybrid functional assessment methodology is deemed important. The assessment methods developed in this thesis will form part of a wider tool that will include other functional domains of cognition, communication, self-care and mental health. This survey tool has been titled “Functional Needs Assessment Tool (FNAT)”, and the proposed survey modules for vision, hearing and mobility developed through this PhD's research are presented in **Appendix 6**.

Lessons learned with key implications for survey development from each of the studies were presented in each of the relevant PhD chapters. To summarise, these key implications are collated and presented in a table in **Appendix 7**. The main points from each implications box are grouped according to anticipated survey areas. Each point has been reviewed to indicate if it i) is already included the proposed FNAT survey tool, ii) will be included in the tool before the pilot and survey in Uganda or iii) is a recommendation for future survey consideration.

When conducting this multi-domain survey, it will be important to ensure the specific functional domains assessed in a certain population are determined by the needs of that population. Though potential cost savings were found through a combined vision (RAAB) and hearing (RAHL) survey (146), the specific domains assessed in a multi-domain survey should be dependent on context and availability of personnel and requires further testing for feasibility. The FNAT will be tested and implemented in a survey in Uganda later this year.

Finally, though this PhD has investigated the development of a multidomain tool, the functional domains, and the corresponding assessments, have remained siloed which provides a more fragmented less holistic assessment of functioning. It will be important to integrate the hybrid assessments *across domains* in a future phase of survey tool's development.

#### 10.4.6 Implications for policy and programming

This PhD thesis emphasises the importance of increased data collection efforts, using more robust methodology, to assess AP need in different settings. The studies generated AP data using two different assessment methodologies in six countries and proposed a development of a hybrid assessment tool. Particularly in LMICs, access to AP is limited so there is a need for specific AP service and human resource data for evidence-based health and social policy and planning beyond. Important policy and programming implications have been highlighted and are discussed below.

First, at the district/national level, prior to an AP need survey, it is important for stakeholders to have knowledge and awareness of AP and their roles. It is also important to know what AP are contextually relevant to assess. To support these aims, WHO GATE encourages the development of National APL through participatory workshops and stakeholder surveys (18) and developed the Assistive Technology Capacity Assessment (ATA-C) (147) as a system-level tool providing a situation analysis of the AP sector. These tools are beneficial for raising AP awareness and contributing towards the country's development and coordination of the AP sector in country. When possible, these two tools should be "pre-requisites" for a country prior to administering an AP need survey. The AP list could then be refined and adapted based on local information needs and resource/service availability in advance of the survey.

Second, dissemination and uptake of the study findings is key. The population-based AP indicator estimates in each country should be used for service policy and planning in the survey area, such as at the district/municipality level of Sololá in the Guatemala rATA survey or at the national level for The Gambia vision survey estimates. This

should be done through active engagement with service providers, DPOs and policy makers throughout the planning/implementation/analysis phases of the survey to maximise the use and uptake of findings, as well as holding workshops to discuss the findings and co-develop recommendations. Further, if a survey is done at the district level (or in specific sampling area), then the estimates should be extrapolated to the sampling area population when possible. For example, in the Turkey MSI study, estimates regarding MSI-related service and AP need were extrapolated to the estimated population of Syrian refugees living in Sultanbeyli. AP need indicators are multisectoral and should be used to inform both supply and demand service delivery platforms across the life-course and sectors.

Third, at the global level, there is a need for standards for AP need assessment and definitions. The recent WHO and UNICEF GReAT report is a large commendable step towards this aim, as well as the recommended progress indicators to measure AP access (1) and the recent launch of the WHO Global Health Observatory (GHO) Assistive technology data portal (148). However, it is also noted that GReAT report's AP need estimates are primarily based upon rATA surveys completed in 35 countries using self-report AP assessment only which has limitations as highlighted in this PhD research. Further, unmet need is only reported as a proportion of total need, not prevalence of need out of the total population surveyed. Collaborative action is required for consensus and agreement to ensure AP data gaps are addressed consistently with improved assessment methodology and definitions. This action would also ensure enhanced alignment with the ICF's broader definition of "Functioning" providing more specific data towards this third health indicator.



## Chapter 11: Conclusion and recommendations

### 11.1 Conclusion

Globally, prevalence data on AP need and assessment approaches to measure this data are limited; however, momentum to gather data to measure AP need is increasing. The recent WHO and UNICEF GReAT report (1) published in May 2022, in addition to both the 2019 WHO World Report on Vision (22) and 2020 WHO World Report on Hearing (26), emphasise AP and the importance of assessment methods in the context of functioning.

This PhD research investigated the development of a AP need assessment tool to increase data collection efforts in different settings, which is well-aligned with the GReAT report's recent recommendation to "invest in, collect and analyse relevant population-based data".(1) Critically, the findings presented in this PhD thesis indicate that an all-age hybrid methodology incorporating clinical impairment, functional and self-report assessment is needed. The results from the overall seven studies were synthesised to propose FNAT, a draft AP need survey hybrid methodology for vision, hearing and mobility functional domains.

This PhD, through reviewing and advancing available assessment methodologies, identified the need for and proposed population-based AP need survey tool combining self-report with clinical impairment and including hybrid functional assessment. It is essential to ensure AP education, training and maintenance are also provided, as well as to ensure broader service need data is available to support the ongoing assessment throughout the life course. The most critical next step will be to pilot test the feasibility of this tool in a LMIC. It is then hoped that the development and use of this tool will contribute to the global evidence-base of service and AP need providing much-needed functioning data for cross-sectoral health, social and education policy and planning of services.

### 11.2 Recommendations

The following recommendations have been developed based on this PhD findings.

#### ***For AP need methodology development***

1. AP list expansion: This PhD investigated four priority AP. The survey's AP list should be expanded to collect data on other AP in each domain and well-aligned with the AP lists included in WHO's TAP and the AP specifications with UNICEF for PHC. It will be important for the assessment tool to measure specific

measurements of AP need, i.e. use, unmet need, undermet need, met need and total need AP indicators.

2. AP need algorithm review: Integration of the different assessment methods using a decision algorithm is critical in a hybrid AP need assessment tool to ensure all ICF components, and especially the environment, are taken into account. It is recommended that AP algorithms are developed for the additional AP and are reviewed and refined with domain-specific experts.
3. Service need data: Service need data, such as rehabilitation, is important to include alongside AP need data in a broader hybrid functional needs assessment tool. This tool should gather AP service data to measure i) self-reported use, ii) service unmet need and iii) total need through the hybrid functional needs assessment. These indicators are critical for service policy and planning.
4. FNAT survey pilot and full survey: Conduct a pilot and full survey in one LMIC in 2022. During the pilot, it will be important to test the feasibility and practicality of the multidomain hybrid assessment tool and update/refine accordingly.

***For policy makers:***

1. AP data: AP data was generated as part of this research to inform the policy and programming in the six countries covering four world regions. It is critical this data is disseminated and to ensure the uptake of findings in country.
2. Develop national APLs: Develop and adopt a national APL with relevant stakeholders, including AP users. This will be essential to ensure the AP need indicators that are measured are relevant to country contexts and supply.
3. Conduct a systems level situation analysis: Complete a situation analysis to map the current service/AP gaps and provision capacity. Use of WHO GATE's ATA-C tool (147) is recommended, or WHO's Progress Indicators (1, 148) if time and/or resources are more limited to collect high-level implementation status.

***For future work/research:***

1. Functional assessment tool systematic review: Though this thesis reviewed functional assessment tools, a comprehensive systematic review remains a gap. It is recommended to complete a systematic review of functional assessment tools at both individual- and population-levels and rate tools according to feasibility criteria. It is important that this review focuses on AP outcomes and broader interventions, such as rehabilitation.
2. Clinic-based cadre study: Following the pilot and full survey, a cadre accuracy testing study is recommended to test if one clinician cadre (e.g. physiatrist) could administer the hybrid survey and/or if a non-clinical cadre (e.g. community health

worker) could administer a combined multidomain functional assessment section. It is recommended that could follow similar methodology as Bright et al.'s hearing clinic-based diagnostic accuracy study in Malawi.(129)

3. In-depth qualitative studies: Alongside quantitative service and AP need survey data, it will be important to ensure in-depth qualitative studies are conducted. These studies can provide important information about the access barriers identified, including attitudes and stigma in home and community settings.(113)
4. Explore development of a “Rapid” version and/or “Short” version: Following future all-age AP survey studies, it is recommended to analyse the data to assess whether it would be appropriate to develop a “Rapid” version (e.g. 40+ years only) and/or a “Short” version (i.e. a minimal set of questions required) to collect the majority of data for service planning.
5. Development of wider FNAT for service and AP need: The proposed hybrid AP need assessment survey modules were entitled the FNAT survey tool. When expanding the functional assessment from three domain focus to seven, it will be important to ensure the broader hybrid functional assessment tool measures both service and AP need.

## REFERENCES

1. World Health Organization. Global report on assistive technology. 2022.
2. World Health Organization. Priority assistive products list. Geneva: WHO. 2016.
3. World Health Organization. Assistive technology factsheet: WHO; 2018 [cited 2020 27 April]. Available from: <http://www.who.int/news-room/fact-sheets/detail/assistive-technology>.
4. World Health Assembly 71. Improving access to assistive technology: report by the Director-General. World Health Organization, 2018.
5. United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. Geneva: United Nations General Assembly, 2015.
6. Tebbutt E, Brodmann R, Borg J, MacLachlan M, Khasnabis C, Horvath RJG, et al. Assistive products and the sustainable development goals (SDGs). 2016;12(1):79.
7. Bus SA, Van Deursen R, Armstrong D, Lewis JE, Caravaggi C, Cavanagh P, et al. Footwear and offloading interventions to prevent and heal foot ulcers and reduce plantar pressure in patients with diabetes: a systematic review. Diabetes/metabolism research and reviews. 2016;32:99-118.
8. United Nations. Convention on the Rights of Persons with Disabilities (CRPD) New York: UN; [cited 2022 19 September]. Available from: <https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html>.
9. Borg J, Lindström A, Larsson S. Assistive technology in developing countries: national and international responsibilities to implement the Convention on the Rights of Persons with Disabilities. The Lancet. 2009;374(9704):1863-5.
10. United Nations. Convention of the Rights of Persons with Disabilities and Optional Protocol. New York: United Nations, 2006.
11. World Health Organization. Policy brief: access to assistive technology. 2020.
12. World Health Organization. Assistive technology: making Universal Health Coverage inclusive. Geneva: WHO.
13. World Health Organization. Assistive technology infographic. Geneva: WHO.
14. ATscale. ATscale: global partnership for assistive technology [cited 2020 27 April]. Available from: <https://atscale2030.org/>
15. Global Disability Innovation Hub. AT2030 University College London [cited 2022 19 September]. Available from: <https://at2030.org/>
16. World Health Organization. Regional Office for Europe. Assistive Technology in Tajikistan: Situational Analysis. Copenhagen: WHO Regional Office for Europe, 2019.
17. Leprosy Control Division. Disability Focal Unit. Priority Assistive Product List of Nepal: Improving Access to Assistive Technology for People of Nepal Kathmandu, Nepal: Government of Nepal Ministry of Health and Population, Department of Health Services, 2018.
18. Mishra S, Pupulin A, Ekman B, Khasnabis C, Allen M, Huber M. National priority assistive product list development in low resource countries: lessons learned from Tajikistan. Disability and Rehabilitation: Assistive Technology. 2021;16(8):857-64.
19. Smith EM, Ebuenyi ID, Kafumba J, Jamali-Phiri M, MacLachlan M, Munthali A. An overview of assistive technology products and services provided in Malawi. Disability and Rehabilitation: Assistive Technology. 2020:1-5.
20. World Health Organization. Training in priority assistive products: report from the first pilot. Geneva: WHO, 2018.
21. World Health Organization, UNICEF. Package of Essential Supplies for Primary Health care, Draft 1. Not yet published: 2018 October 2018. Report No.
22. World Health Organization. World report on vision. 2019 9241516577.

23. Bourne R, Steinmetz JD, Flaxman S, Briant PS, Taylor HR, Resnikoff S, et al. Trends in prevalence of blindness and distance and near vision impairment over 30 years: an analysis for the Global Burden of Disease Study. *The Lancet Global Health*. 2021;9(2):e130-e43.
24. Bourne RRA, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *The Lancet Global Health*. 2017;5(9):e888-e97.
25. Fricke TR, Tahhan N, Resnikoff S, Papas E, Burnett A, Ho SM, et al. Global prevalence of presbyopia and vision impairment from uncorrected presbyopia: systematic review, meta-analysis, and modelling. 2018;125(10):1492-9.
26. World Health Organization. World report on hearing. 2021.
27. World Health Organization. Prevention of blindness and deafness: estimates 2018 [cited 2019 27 June]. Available from: <http://www.who.int/pbd/deafness/estimates/en/>.
28. World Health Organization. Grades of hearing impairment Geneva: WHO; 2018 [cited 2019 27 June]. Available from: [https://www.who.int/deafness/hearing\\_impairment\\_grades/en/](https://www.who.int/deafness/hearing_impairment_grades/en/).
29. World Health Organization. International Classification of Diseases (ICD) 11 Geneva: World Health Organization; [cited 2021 27 February]. Available from: <https://icd.who.int/browse11/l-m/en>
30. World Health Organization. World Report on Disability Geneva: World Health Organization; 2011.
31. James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*. 2018;392(10159):1789-858.
32. Joshipura M, Mock C, Gosselin RA. Global Burden of Musculoskeletal Conditions. *Global Orthopedics*: Springer; 2020. p. 9-11.
33. Kyu HH, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*. 2018;392(10159):1859-922.
34. Atijosan O, Rischewski D, Simms V, Kuper H, Linganwa B, Nuhi A, et al. A National Survey of Musculoskeletal Impairment in Rwanda: Prevalence, Causes and Service Implications. *PLoS ONE*. 2008;3(7):e2851.
35. Smythe T, Mactaggart I, Kuper H, Murthy G, Lavy C, Polack S, et al. Prevalence and causes of musculoskeletal impairment in Mahabubnagar District, Telangana State, India: results of a population-based survey. *J Transactions of The Royal Society of Tropical Medicine PLOS One*. 2017;111(11):512-9.
36. Smythe T, Mactaggart I, Kuper H, Oye J, Sieyen NC, Lavy C, et al. Prevalence and causes of musculoskeletal impairment in Fundong District, North-West Cameroon: results of a population-based survey. *J Tropical medicine international health PloS one*. 2017;22(11):1385-93.
37. Atijosan O, Kuper H, Rischewski D, Simms V, Lavy C. Musculoskeletal impairment survey in Rwanda: design of survey tool, survey methodology, and results of the pilot study (a cross sectional survey). *BMC musculoskeletal disorders*. 2007;8(1):30.
38. Matter R, Harniss M, Oderud T, Borg J, Eide AH. Assistive technology in resource-limited environments: A scoping review. *J Disability Rehabilitation: Assistive Technology*. 2017;12(2):105-14.
39. Global Disability Innovation Hub. Assistive technology scoping research executive summary. London: University College of London, 2018 July 2018. Report No.
40. McDonald CL, Westcott-McCoy S, Weaver MR, Haagsma J, Kartin D. Global prevalence of traumatic non-fatal limb amputation. *Prosthetics and orthotics international*. 2021:0309364620972258.

41. World Health Organization. International Classification of Functioning, Disability and Health (ICF): World Health Organization; 2001 [cited 2020 27 August]. Available from: <http://www.who.int/classifications/icf/en/>.
42. International Centre for Eye Health. Open Access Online Course: Global Blindness: Planning and Managing Eye Care 2018.
43. Peek Vision Ltd. Peek Vision: Peek Vision Ltd; 2019. Available from: <https://www.peakvision.org/>.
44. International Centre for Evidence in Disability, PEEK. The Rapid Assessment of Avoidable Blindness (RAAB) world: International Centre for Evidence in Disability; [cited 2021 8 September]. Available from: <https://www.raab.world>.
45. International Centre for Eye Health. The RAAB Repository 2018. Available from: <http://raabdata.info>.
46. Kuper H, Polack S, Limburg H. Rapid assessment of avoidable blindness. *Community Eye Health*. 2006;19(60):68.
47. Mactaggart I, Polack S, Murthy G, Kuper HJOe. A population-based survey of visual impairment and its correlates in Mahabubnagar district, Telangana State, India. 2018;25(3):238-45.
48. Oye J, Mactaggart I, Polack S, Schmidt E, Tamo V, Okwen M, et al. Prevalence and Causes of Visual Impairment in Fundong District, North West Cameroon: Results of a Population-Based Survey. 2017;24(6):394-400.
49. Ferrite S, Mactaggart I, Kuper H, Oye J, Polack S. Prevalence and causes of hearing impairment in Fundong Health District, North-West Cameroon. *Tropical medicine & international health*. 2017.
50. Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. *The European Journal of Public Health*. 2013;23(1):146-52.
51. Bright T, Mactaggart I, Kim M, Yip J, Kuper H, Polack S. Rationale for a rapid methodology to assess the prevalence of hearing loss in population-based surveys. *International journal of environmental research and public health*. 2019;16(18):3405.
52. HearX. HearX Group Pretoria: South Africa [cited 2021 8 September]. Available from: <https://www.hearxgroup.com/>.
53. Washington Group on Disability Statistics Secretariat. Washington Group on Disability Statistics Hyattsville, MD: National Center for Health Statistics; 2020 [cited 2021 2 February]. Available from: <http://www.washingtongroup-disability.com/>.
54. UNICEF. UNICEF/ Washington Group on Disability Statistics Module on Child Functioning Concept Note. Available from: <https://data.unicef.org/wp-content/uploads/2017/03/UNICEF-WG-Module-on-Child-Functioning-Concept-Note.pdf>: 2016.
55. Washington Group on Disability Statistics. Development of Disability Measures for Surveys: The Extended Set on Functioning. Available From: [http://www.cdc.gov/nchs/data/washington\\_group/Development\\_of\\_Disability\\_Measures\\_for\\_Surveys\\_The\\_Extended\\_Set\\_on\\_Functioning.pdf](http://www.cdc.gov/nchs/data/washington_group/Development_of_Disability_Measures_for_Surveys_The_Extended_Set_on_Functioning.pdf): 2011.
56. United Nations Economic and Social Council. Disability Statistics Report of the Secretary-General and the Washington Group. 2016.
57. Washington Group on Disability Statistics. Understanding and interpreting disability as measured using the WG short set of questions. Hyattsville: 2009.
58. Mactaggart I, Kuper H, Murthy G, Oye J, Polack S. Measuring Disability in Population Based Surveys: The Interrelationship between Clinical Impairments and Reported Functional Limitations in Cameroon and India. *PLoS One*. 2016;11(10):e0164470.
59. World Health Organization. WHO Disability Assessment Schedule 2.0 (WHODAS 2.0) Geneva: WHO; [cited 2019 29 June]. Available from: [https://www.who.int/classifications/icf/more\\_whodas/en/](https://www.who.int/classifications/icf/more_whodas/en/).
60. Quinn T, McArthur K, Ellis G, Stott D. Functional assessment in older people. *Bmj*. 2011;343:d4681.

61. Marcie Desrochers M, Fallon M. Instruction in functional assessment; Chapter 2: The Methodology of Functional Assessment: Open SUNY Textbooks; 2013 [cited 2019 29 June]. Available from: [https://milnepublishing.geneseo.edu/instruction-in-functional-assessment/chapter/chapter-2the\\_methodology\\_of\\_functional\\_assessment/](https://milnepublishing.geneseo.edu/instruction-in-functional-assessment/chapter/chapter-2the_methodology_of_functional_assessment/).
62. World Health Organization. ICF Checklist: version 2.1a, Clinician Form for International Classification of Functioning Disability and Health. Geneva: WHO 2003.
63. Mactaggart I, Kuper H, Murthy G, Sagar J, Oye J, Polack S. Assessing health and rehabilitation needs of people with disabilities in Cameroon and India. *Disability and rehabilitation*. 2015;1-8.
64. Zhang W, Eide AH, Pryor W, Khasnabis C, Borg J. Measuring Self-Reported Access to Assistive Technology Using the WHO Rapid Assistive Technology Assessment (rATA) Questionnaire: Protocol for a Multi-Country Study. *International Journal of Environmental Research and Public Health*. 2021;18(24):13336.
65. Pryor W, Nguyen L, Islam Q, Jalal F, Marella MJJoer, health p. Unmet Needs and Use of Assistive Products in Two Districts of Bangladesh: Findings from a Household Survey. 2018;15(12):2901.
66. World Health Organization. Model Disability Survey Geneva: WHO; [cited 2020 27 August]. Available from: <https://www.who.int/disabilities/data/mds/en/>.
67. World Health Organization. Model Disability Survey (MDS): survey manual. Geneva: WHO, 2017.
68. Sabariego C, Fellinghauer C, Lee L, Kamenov K, Posarac A, Bickenbach J, Kostanjsek N, Chatterji S, Cieza A. Generating comprehensive functioning and disability data worldwide: development process, data analyses strategy and reliability of the WHO and World Bank Model Disability Survey. *Archives of Public Health*. 2022 Jan 4;80(1):6.
69. Bourne RR, Cicinelli MV, Sedighi T, Tapply IH, McCormick I, Jonas JB, Congdon NG, Ramke J, Naidoo KS, Fricke TR, Burton MJ. Effective refractive error coverage in adults aged 50 years and older: estimates from population-based surveys in 61 countries. *The Lancet Global Health*. 2022 Dec 1;10(12):e1754-63.
70. Boggs D, Kuper H, Mactaggart I, Oye J, Murthy G, Polack S. Estimating assistive technology need through population-based surveys: an analysis of data from Cameroon and India. In: Layton N, Borg J, editors. *Global perspectives on assistive technology: proceedings of the GReAT Consultation*, . Vol. A. Geneva: World Health Organization; 2019. p. 52-78.
71. Danemayer J, Boggs D, Polack S, Smith EM, Ramos VD, Battistella LR, et al. Measuring assistive technology supply and demand: A scoping review. *Assistive Technology*. 2021;33(sup1):35-49.
72. Danemayer J, Boggs D, Ramos VD, Smith E, Kular A, Bhot W, et al. Estimating need and coverage for five priority assistive products: a systematic review of global population-based research. *BMJ Global Health*. 2022;7(1):e007662.
73. Muga E. Screening for disability in a community: the 'ten questions' screen for children, in Bondo, Kenya. *African health sciences*. 2003;3(1):33-9.
74. Dawes P, Fortnum H, Moore DR, Emsley R, Norman P, Cruickshanks K, et al. Hearing in middle age: a population snapshot of 40–69 year olds in the UK. *Ear and hearing*. 2014;35(3):e44.
75. Sawyer CS, Armitage CJ, Munro KJ, Singh G, Dawes PD. Correlates of hearing aid use in UK adults: Self-reported hearing difficulties, social participation, living situation, health, and demographics. *Ear and Hearing*. 2019;40(5):1061-8.
76. Li C-M, Zhao G, Hoffman HJ, Town M, Themann CL. Hearing disability prevalence and risk factors in two recent national surveys. *American Journal of Preventive Medicine*. 2018;55(3):326-35.
77. Gale CR, Cooper C, Aihie Sayer A. Prevalence of frailty and disability: findings from the English Longitudinal Study of Ageing. *Age and ageing*. 2014;44(1):162-5.

78. Goins RT, Spencer SM, Goli S, Rogers JC. Assistive technology use of older American Indians in a southeastern tribe: the native elder care study. *Journal of the American Geriatrics Society*. 2010;58(11):2185-90.
79. Boggs D, Milner KM, Chandna J, Black M, Cavallera V, Dua T, et al. Rating early child development outcome measurement tools for routine health programme use. *Archives of disease in childhood*. 2019;104(Suppl 1):S22-S33.
80. EMMY AJ. ANALYSIS OF THE FUNCTIONS AND THE CHALLENGES FACED BY EDUCATIONAL ASSESSMENT RESOURCE CENTRES IN FIVE SELECTED COUNTIES IN KENYA: KENYATTA UNIVERSITY; 2020.
81. Fernald LC, Prado E, Kariger P, Raikes A. A toolkit for measuring early childhood development in low and middle-income countries. 2017.
82. UK Biobank. UK biobank category listings: UK Biobank; 2014 [cited 2022 1 March]. Available from: <https://biobank.ctsu.ox.ac.uk/crystal/cats.cgi>.
83. Palmer LJ. UK Biobank: bank on it. *The Lancet*. 2007;369(9578):1980-2.
84. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System (BRFSS) Atlanta, USA: CDC; [cited 2022 24 February]. Available from: <https://www.cdc.gov/brfss/>.
85. Schein JD, Gentile A, Haase KW. Development and evaluation of an expanded hearing loss scale questionnaire. 1970.
86. Centers for Disease Control and Prevention (CDC). 2014 National Health Interview Survey (NHIS) Public Use Data Release: Survey Description. CDC: June 2015.
87. National Center for Health Statistics. National Health Interview Survey Atlanta, GA: Centers for Disease Control and Prevention; [cited 2022 1 March 2022]. Available from: <https://www.cdc.gov/nchs/nhis/index.htm>.
88. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*. 2001;56(3):M146-M57.
89. Turner Goins R, Schure M, Winchester B. Frailty in older american indians: the native elder care study. *Gerontology and Geriatric Medicine*. 2019;5:2333721419855669.
90. Goins RT, Innes K, Dong L. Lower body functioning prevalence and correlates in older American Indians in a southeastern tribe: the Native Elder Care Study. *Journal of the American Geriatrics Society*. 2012;60(3):577-82.
91. Goins RT, Pignataro RM, Dong L, Rogers JC. Handgrip strength among older American Indians: the Native Elder Care Study. *Age and ageing*. 2011;40(4):523-7.
92. Schure MB, Goins RT. An examination of the disablement process among older American Indians: the native elder care study. *The Gerontologist*. 2016;56(5):948-55.
93. Haymes SA, Johnston AW, Heyes AD. Relationship between vision impairment and ability to perform activities of daily living. *Ophthalmic and Physiological Optics*. 2002;22(2):79-91.
94. West SK, Rubin GS, Broman AT, Munoz B, Bandeen-Roche K, Turano K. How does visual impairment affect performance on tasks of everyday life?: The SEE Project. *Archives of Ophthalmology*. 2002;120(6):774-80.
95. Mangione CM, Lee PP, Gutierrez PR, Spritzer K, Berry S, Hays RD, et al. Development of the 25-item national eye institute visual function questionnaire. *Archives of ophthalmology*. 2001;119(7):1050-8.
96. Haymes SA, Johnston AW, Heyes AD. The development of the Melbourne low-vision ADL index: a measure of vision disability. *Investigative ophthalmology & visual science*. 2001;42(6):1215-25.
97. Wales K, Clemson L, Lannin N, Cameron I. Functional assessments used by occupational therapists with older adults at risk of activity and participation limitations: a systematic review. *PloS one*. 2016;11(2):e0147980.



98. Falahati A, Sahaf R, Akbari Kamrani AA, Abolfathi Momtaz Y, Rassafiani M, Fillenbaum G. Validity and reliability of OARS multidimensional functional assessment questionnaire in Iranian elderly. *Iranian Rehabilitation Journal*. 2018;16(2):169-76.
99. Medicare Payment Advisory Commission (MedPAC). Chapter 4: Functional Assessments for Long-Term Services and Support. Report to Congress on Medicaid and CHIP. Washington, DC MedPAC; 2016.
100. Medicare Payment Advisory Commission (MedPAC). Inventory of the State Functional Assessment Tools for Long-Term Services and Supports : MACPAC Chapter 4: Functional Assessments for Long-Term Services and Support. Washington, D.C.: MedPAC; 2016.
101. McCormick I, Mactaggart I, Bastawrous A, Burton MJ, Ramke J. Effective refractive error coverage: an eye health indicator to measure progress towards universal health coverage. *Ophthalmic & Physiological Optics*. 2020;40(1):1.
102. Boggs D, Kuper H, Mactaggart I, Murthy G, Oye J, Polack S. Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches. *Tropical Medicine & International Health*. 2020;26 (2):pp 146–58.
103. Metrics for Management. Equity tool: Metrics for Management; 2019 [cited 2019 28 June]. Available from: <http://www.equitytool.org/>
104. Blyth FM, Briggs AM, Schneider CH, Hoy DG, March LM. The global burden of musculoskeletal pain—where to from here? *American journal of public health*. 2019;109(1):35-40.
105. Boggs D, Atijosan-Ayodele O, Yonso H, Scherer N, O’Fallon T, Deniz G, et al. Musculoskeletal impairment among Syrian refugees living in Sultanbeyli, Turkey: prevalence, cause, diagnosis and need for related services and assistive products. *Conflict and health*. 2021;15(1):1-14.
106. Boggs D, Polack S, Kuper H, Foster A. Shifting the focus to functioning: essential for achieving Sustainable Development Goal 3, inclusive Universal Health Coverage and supporting COVID-19 survivors. *Global Health Action*. 2021;14(1):1903214.
107. Sprunt B. Validating the UNICEF/Washington Group Child Functioning Module as a method for disaggregating Fiji’s Education Management Information System 2019.
108. Sprunt B, Hoq M, Sharma U, Marella M. Validating the UNICEF/Washington Group Child Functioning Module for Fijian schools to identify seeing, hearing and walking difficulties. *Disability and rehabilitation*. 2019;41(2):201-11.
109. Sprunt B, McPake B, Marella M. The UNICEF/Washington Group Child Functioning Module—Accuracy, Inter-Rater Reliability and Cut-Off Level for Disability Disaggregation of Fiji’s Education Management Information System. *International journal of environmental research and public health*. 2019;16(5):806.
110. Sprunt B, Marella M. Combining Child Functioning Data with Learning and Support Needs Data to Create Disability-Identification Algorithms in Fiji’s Education Management Information System. *International Journal of Environmental Research and Public Health*. 2021;18(17):9413.
111. Hydera A, Bastawrous A, Bell S, Boggs D, Bright T, Bobat H, et al. The Gambia National Eye Health Survey 2019: survey protocol. *Wellcome Open Research*. 2021;6(10):10.
112. Polack S, Scherer N, Yonso H, Volkan S, Pivato I, Shaikhani A, et al. Disability among Syrian refugees living in Sultanbeyli, Istanbul: Results from a population-based survey. *Plos one*. 2021;16(11):e0259249.
113. Zuurmond M, Mactaggart I, Kannuri N, Murthy G, Oye JE, Polack S. Barriers and Facilitators to Accessing Health Services: A Qualitative Study Amongst People with Disabilities in Cameroon and India. *International journal of environmental research public health*. 2019;16(7):1126.
114. Blank T, Graves K, Sepucha K, Llewellyn-Thomas H. Understanding treatment decision making: contexts, commonalities, complexities, and challenges. *Annals of Behavioral Medicine*. 2006;32(3):211-7.

115. Stacey D, Légaré F, Lewis K, Barry MJ, Bennett CL, Eden KB, et al. Decision aids for people facing health treatment or screening decisions. *Cochrane database of systematic reviews*. 2017(4).
116. Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC. The reliability of the functional independence measure: a quantitative review. *Archives of physical medicine and rehabilitation*. 1996;77(12):1226-32.
117. Uniform Data System for Medical Rehabilitation. *The FIM System® Clinical Guide, Version 5.2.1*. Buffalo: UDS MR, 2018.
118. McPherson K, Pentland B, Cudmore S, Prescott R. An inter-rater reliability study of the Functional Assessment Measure (FIM+ FAM). *Disability and rehabilitation*. 1996;18(7):341-7.
119. Turner-Stokes L, Nyein K, Turner-Stokes T, Gatehouse C. The UK FIM+ FAM: development and evaluation. *Clinical rehabilitation*. 1999;13(4):277-87.
120. Law J, Fielding B, Jackson D, Turner-Stokes L. The UK FIM+ FAM Extended Activities of Daily Living module: evaluation of scoring accuracy and reliability. *Disability and rehabilitation*. 2009;31(10):825-30.
121. UK FIM+FAM Users Group. *The UK FIM+FAM (Functional Assessment Measure), Version 2.2*. Middlesex, UK: Northwick Park Hospital, 2010.
122. Murphy C, De Laine C, Macaulay M, Fader M. Development and randomised controlled trial of a Continence Product Patient Decision Aid for men postradical prostatectomy. *Journal of Clinical Nursing*. 2020;29(13-14):2251-9.
123. Disabled Living Foundation. AskSARA ([livingmadeeasy.org.uk](http://livingmadeeasy.org.uk)) Oldbury, UK: Disabled Living Foundation - Shaw Trust; [11 August 2022]. Available from: <https://asksara.livingmadeeasy.org.uk/selector>.
124. Hoffman AS, Volk RJ, Saarimaki A, Stirling C, Li LC, Härter M, et al. Delivering patient decision aids on the Internet: definitions, theories, current evidence, and emerging research areas. *BMC medical informatics and decision making*. 2013;13(2):1-12.
125. Andrich R, editor *A model to represent knowledge about assistive products*. International Conference on Computers Helping People with Special Needs; 2022: Springer.
126. Carswell A, McColl MA, Baptiste S, Law M, Polatajko H, Pollock N. The Canadian Occupational Performance Measure: a research and clinical literature review. *Canadian journal of occupational therapy*. 2004;71(4):210-22.
127. Law M, Baptiste S, McColl M, Opzoomer A, Polatajko H, Pollock N. The Canadian occupational performance measure: an outcome measure for occupational therapy. *Canadian Journal of Occupational Therapy*. 1990;57(2):82-7.
128. Law M, Baptiste S, Carswell A, McColl MA, Polatajko H, Pollack N. *Canadian Occupational Performance Measure (COPM)* Ottawa: Canadian Association of Occupational Therapists [cited 2022 19 September]. Available from: <https://www.thecopm.ca>.
129. Bright T, Mulwafu W, Phiri M, Ensink RJ, Smith A, Yip J, et al. Diagnostic accuracy of non-specialist versus specialist health workers in diagnosing hearing loss and ear disease in Malawi. *Tropical Medicine & International Health*. 2019;24(7):817-28.
130. Ben-Shlomo Y, Kuh D. *A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives*. Oxford University Press; 2002. p. 285-93.
131. Halfon N, Forrest CB, Lerner RM, Faustman EM. *Handbook of life course health development*. 2018.
132. Richter L, Black M, Britto P, Daelmans B, Desmond C, Devercelli A, et al. Early childhood development: an imperative for action and measurement at scale. *BMJ global health*. 2019;4(Suppl 4):e001302.
133. Black M, Bromley K, Cavallera V, Cuartas J, Dua T, Eekhout I, et al. The global scale for early development (GSED). *Early childhood matters*. 2019;14:80-4.
134. Gladstone M, Lancaster G, McCray G, Cavallera V, Alves CR, Maliwichi L, et al. Validation of the infant and young child development (IYCD) indicators in three countries:

- Brazil, Malawi and Pakistan. *International journal of environmental research and public health*. 2021;18(11):6117.
135. Tataryn M, Polack S, Chokocho L, Mulwafu W, Kayange P, Banks LM, et al. Childhood disability in Malawi: a population based assessment using the key informant method. *BMC pediatrics*. 2017;17(1):1-12.
  136. Banks LM, Liu J, Kielland A, Tahirou AB, Harouna AKS, Mactaggart I, et al. Childhood disability in rural Niger: a population-based assessment using the Key Informant Method. *BMC pediatrics*. 2022;22(1):1-11.
  137. World Health Organization. *Improving early childhood development: WHO guideline*: World Health Organization; 2020.
  138. Patrizio E, Calvani R, Marzetti E, Cesari M. Physical functional assessment in older adults. *The Journal of frailty & aging*. 2021;10(2):141-9.
  139. Soar J, Yu L, Al-Hakim L, editors. *Older people's needs and opportunities for assistive technologies*. International Conference on Smart Homes and Health Telematics; 2020: Springer.
  140. Rauch A, Negrini S, Cieza A. Toward strengthening rehabilitation in health systems: methods used to develop a WHO package of rehabilitation interventions. *Archives of Physical Medicine and Rehabilitation*. 2019;100(11):2205-11.
  141. Cieza A, Causey K, Kamenov K, Hanson SW, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*. 2020;396(10267):2006-17.
  142. Boggs D, Kuper H, Mactaggart I, Bright T, Murthy G, Hydera A, et al. Exploring the Use of Washington Group Questions to Identify People with Clinical Impairments Who Need Services including Assistive Products: Results from Five Population-Based Surveys. *International journal of environmental research and public health*. 2022;19(7):4304.
  143. World Health Organization (WHO). *Rehabilitation 2030: A call for action*. Geneva, Switzerland: WHO.
  144. Institute for Health Metrics and Evaluation. *WHO Rehabilitation Need Estimator* Seattle, USA: University of Washington. Available from: <https://vizhub.healthdata.org/rehabilitation/>.
  145. Bright T, Wallace S, Kuper H. A systematic review of access to rehabilitation for people with disabilities in low-and middle-income countries. *International journal of environmental research and public health*. 2018;15(10):2165.
  146. Bright T, McCormick I, Phiri M, Mulwafu W, Burton M, Polack S, Mactaggart I, Yip JL, Swanepoel DW, Kuper H. Rationale and feasibility of a combined rapid assessment of avoidable blindness and hearing loss protocol. *PloS one*. 2020 Feb 13;15(2):e0229008.
  147. World Health Organization. *Assistive technology capacity assessment (ATA-C): instruction manual*. 2021.
  148. WHO Global Health Observatory (GHO). *Assistive technology data portal* Geneva: WHO; 2022 [cited 2022 19 September]. Available from: <https://www.who.int/data/gho/data/themes/assistivetech>.

# APPENDICES

## Appendix 1: Glossary of terms

Definitions for terms that are used throughout this PhD are provided below as defined in WHO and World Bank's *World Report on Disability*.

**Table A-1: International Classification of Functioning, Health and Disability (ICF) definitions and terminology used throughout this PhD**

ICF TERM	DEFINITION
<b>Disability</b>	An umbrella term for impairments, activity limitations, and participation restrictions, denoting the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).(30)
<b>Functioning</b>	An umbrella term in the ICF for body functions, body structures, activities, and participation. It denotes the positive aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).(30)
<b>Impairment</b>	Loss or abnormality in body structure or physiological function (including mental functions), where abnormality means significant variation from established statistical norms.(30)
<b>Activity</b>	The execution of a task or action by an individual. It represents the individual perspective of functioning.
<b>Participation</b>	A person's involvement in a life situation, representing the societal perspective of functioning.(30)
<b>Environmental factors</b>	A component of contextual factors within the ICF, referring to the physical, social, and attitudinal environment in which people live and conduct their lives – for example, products and technology, the natural environment, support and relationships, attitudes, and services, systems, and policies.(30)
<b>Personal factors</b>	A component of contextual factors within the ICF that relate to the individual – for example, age, gender, social status, and life experiences.(30)
OTHER TERMS	DEFINITION
<b>Assistive products</b>	Any external product (including devices, equipment, instruments or software), especially produced or generally available, the primary purpose of which is to maintain or improve an individual's functioning and independence, and thereby promote their well-being. AP are also used to prevent impairments and secondary health conditions.(1,2)
<b>Assistive technology</b>	The application of organized knowledge and skills related to assistive products, including systems and services.(1,2)
<b>Clinical assessment</b>	A medical and/or health focused assessment completed by trained and certified clinician. Note: in the context of this PhD, examples include clinical impairment assessment and functional assessment.
<b>Clinical impairment assessment</b>	Clinical assessment of the presence and severity of impairment and likely causes and diagnosis. Note: in the context of this PhD, an example includes vision impairment assessment in Rapid Assessment of Avoidable Blindness (RAAB) survey.
<b>Functional assessment</b>	A hybrid assessment utilising clinical and self-report methods, and indirect, observational, and experimental/functional analysis procedures and approaches, to holistically assess individuals' contexts, health, abilities and daily living skills.(30, 60, 61) Note: in the context of this PhD, example includes common approach used in the rehabilitation sector, administered by therapists to determine treatment plans, interventions, and follow up services.(60, 61)
<b>Rehabilitation</b>	A set of interventions designed to optimise functioning and reduce disability in individuals with health conditions in interaction with their environment.(143)
<b>Self-reported assessment</b>	Assessment completed by participant subjective report. Note: in the context of this PhD, examples include the Washington Group functional activity limitation survey questions and rapid Assistive technology Assessment (rATA)'s AP need survey questions.

## Appendix 2: PhD thesis timetable

ACTIVITY	2017	2018	2019				2020				2021				2022			
	Sep-Dec	Jan-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
PhD registration (25 <sup>th</sup> Sep 2017)																		
Start current PhD research topic (6 <sup>th</sup> Nov 2018)																		
Development of methodology (literature review)																		
Population-based survey in The Gambia																		
Analysis and write up of Cameroon and India data																		
PhD Upgrade (16 <sup>th</sup> July 2019)																		
Population-based survey in Turkey																		
Analysis and write up of Turkey data																		
AP Systematic review																		
Write up of Functioning paper																		
Analysis and write up of The Gambia data																		
Population-based survey in Guatemala																		

Analysis and write up of five population-based survey data																			
Write up of Guatemala paper																			
Write up of PhD thesis																			

## Appendix 3: Ethical approvals

Table A3-1: PhD ethical approvals table

PHD STUDIES	ETHICS COMMITTEES	REFERENCE NUMBERS
<b>Cameroon and India data analysis</b>	Cameroon National Ethics Committee for Research in Human Health	2013/03/084
	Cameroon Baptist Convention Health Board Institutional Review Board	IRB2013-07
	Indian Institute of Public Health Hyderabad Institutional Ethics Committee	84/2012
	The Government of India Health Ministry Screening Committee	Indo-Foreign/ADR/2013-NCD-1
	London School of Hygiene and Tropical Medicine Observational/Interventions Research Ethics Committee	6207
<b>The Gambia survey</b>	The Gambia Government/Medical Research Council Joint Ethics Scientific Coordinating Committee	SCC 1635
	London School of Hygiene and Tropical Medicine Observational/Interventions Research Ethics Committee	16172
<b>Turkey survey</b>	Istanbul Sehir University Research Ethics Committee	26:2019
	Republic of Turkey Ministry of Interior: Directorate General of Migration Management	72104824000/72304
	London School of Hygiene and Tropical Medicine Observational/Interventions Research Ethics Committee	17623
<b>Five survey data analysis</b>	London School of Hygiene and Tropical Medicine Observational/Interventions Research Ethics Committee	26695
<b>Guatemala survey</b>	Istituto de Nutricion de Centro America y Panama (INCAP)	CIE-REV 100/2021
	London School of Hygiene and Tropical Medicine Observational/Interventions Research Ethics Committee	22933

## Cameroon and India study ethical approvals

### COMITE NATIONAL D'ETHIQUE DE LA RECHERCHE POUR LA SANTE HUMAINE

Arrêté N° 0977/A/MINSANTE/SESP/SG/DROS/ du 18 avril 2012 portant création, organisation et fonctionnement des comités d'éthique de la recherche pour la santé humaine au sein des structures relevant du Ministère en charge de la santé publique

N° 2013/03/~~824~~/L/CNERSH/SP

Yaoundé, 21 mars 2013

[Cnetrique\\_minsante@yahoo.fr](mailto:Cnetrique_minsante@yahoo.fr)

### CLAIRANCE ETHIQUE

Le Comité National d'Ethique de la Recherche pour la Santé Humaine (CNERSH), en sa session du 21 mars 2013, a examiné le projet de recherche intitulé «**IMPROVING THE EVIDENCE BASE ON DISABILITY IN CAMEROON**» soumis par le Docteur **Hannah KUPER**, Investigateur Principal, London School of Hygiene and Tropical Medicine et le Docteur **ENYEGUE OYE Joseph** Co-investigateur, SIGHTSAVERS CAMEROON

Le projet est d'un grand intérêt scientifique et social. La procédure de recherche est clairement décrite et présente toutes les étapes de l'étude. La notice d'information et le consentement éclairé sont disponibles. L'autorisation administrative du site de l'étude pour mener cette recherche est présente dans le document. Le projet ne présente aucun risque direct sur la population, l'étude étant basée sur la collecte des informations. La confidentialité des informations collectées est respectée. Les CVs des investigateurs les décrivent comme des chercheurs expérimentés, compétents, capables de mener à bien cette étude. Pour toutes ces raisons, le Comité National d'Ethique approuve, pour une durée de deux ans, la mise en œuvre de la présente version du protocole.

Les Investigateurs sont responsables du respect scrupuleux du protocole approuvé et ne devrait y apporter aucun amendement aussi mineur soit-il sans avis favorable du CNERSH. L'investigateur est appelé à collaborer pour toute descente du CNERSH pour suivi de la mise en œuvre du protocole approuvé. Le rapport final du projet devra être soumis au CNERSH et aux autorités sanitaires du Cameroun

La présente clairance peut être retirée en cas de non respect de la réglementation en vigueur et des recommandations sus-mentionnées.

En foi de quoi, la présente clairance éthique est délivrée pour servir et valoir ce que de droit.

#### Ampliations

- MINSANTE



N.B : cette clairance éthique ne vous dispense pas de l'autorisation administrative de recherche (AAR), exigée pour mener cette étude sur le territoire Camerounais. Cette dernière vous sera délivrée par la Division de la Recherche Opérationnelle en Santé (DROS) du Ministère de la Santé Publique.



**CAMEROON BAPTIST CONVENTION HEALTH BOARD  
INSTITUTIONAL REVIEW BOARD**

Baptist Centre, Nkwen, P.O. Box 1, Bamenda, Northwest Region

25 May 2013  
Hannah Kuper,  
Hannah.Kuper@LSHTM.ac.uk

**Re: IRB2013-07, "Improving the evidence base on disability in Cameroon"**

Dear Ms. Kuper,

Your study protocol was reviewed by two members of the CBC Health Board IRB and was presented to the entire Board on 22 May 2013. Your protocol has received Board approval with the following contingencies:

1. On the consent forms, please add the name and phone number of one IRB member with the information: "To ask questions about your rights as a research participant, contact Dr Nancy Palmer, phone 77 50 04 80." Remove Dr. Chris Nana's name and contact information. Add your name and contact information as the person to contact if they have any question about the study. Also at the beginning of the consent form, give your name as the researcher, the title of the research, and what school you are attending.
2. Your study title needs to be changed to reflect the region and not the Country, for example, ". . . disability in one health district of the Northwest Region of Cameroon."

Upon our receipt of the revised consent forms, we will inform you that you have the IRB approval to begin data collection.

Please understand that this is the ethical and safety approval for your study. You must present this IRB approval letter and the email stating the contingencies have been met to the heads of institution for approval to do the study in those institutions.

It is expected that the research will begin at the time specified in your protocol. If you need to delay the beginning of the research more than one month, please notify the IRB.

If you make any changes in the research protocol, please immediately send the IRB an amendment specifying the changes proposed.

The Board grants approval for this study for a one-year time period. Thereafter, before May 22, 2014, you will complete our renewal form/final report which will be attached to a mail and return it to me. The completed form must be reviewed and approved by the Institutional Review Board prior to the expiration date of the current approval period. The fee to renew a study protocol is 10,000 cfa.

Your protocol has been assigned the above reference IRB protocol number. All correspondence to us should include 1) the IRB protocol number 2) Name of the principal investigator and 3) full title of the study.

Finally, all abstracts, manuscripts, posters and presentations pertaining to the above protocol, must be submitted to the IRB for pre-publication approval.

Please feel free to contact me with any questions and/or concerns regarding the above. Copies of all correspondence regarding this proposal should be sent to me and to Zita Acha secretary, e-mail [CBCHBIRB@gmail.com](mailto:CBCHBIRB@gmail.com).

[Redacted Signature]

Nancy Palmer, Ph.D.



*Nancy Palmer, Ph.D., Chairperson, [palmernancylea@gmail.com](mailto:palmernancylea@gmail.com)  
Mrs. Acha Zita, Secretary, [cbchbirb@gmail.com](mailto:cbchbirb@gmail.com)*



# Institutional Ethics Committee

Indian Institute of Public Health-Hyderabad /  
Public Health Foundation of India

ANV Arcade, Plot No.1, Amar Cooperative Society, Kavuri Hills, Madhapur, Hyderabad - 500081, A.P., INDIA


## Communication of Decision of the IEC<sup>1</sup> Form II

TRC-IEC Application No:	84/2012	Date:	06-09-2012	
Project Title:	Improving the evidence base on disability			
Principal Investigator:	Dr. GVS Murthy			
Review	Full Review <input type="checkbox"/>	Expedited Review	<input checked="" type="checkbox"/>	
Date of review:	Reviewed on 31-08-2012			
Date of previous review:	(In case of re-submitted applications)			
Decision of the IEC:	Approval	<input checked="" type="checkbox"/>	Resubmission	<input type="checkbox"/>
	Conditional Approval	Study can begin <input type="checkbox"/>	Study cannot begin	<input type="checkbox"/>
Requirements to be fulfilled in case of conditional approval:	-			
Suggested alterations in case of resubmission:	-			
In case of approval, recommended for a period of :	This application has been approved by the IEC. Approval valid for one year from the date of issue.			
Comments:	Nil			

**Please note:** Beginning of the research based on this approval implies acceptance of the following conditions:

1. PI will inform the Secretariat of the start date of the study.
2. The PI will inform the IEC in case of any adverse events.
3. The PI will inform the TRC (Technical Review Committee) and IEC in case of any change of study procedure including: changes in the informed consent form, recruitment procedure, potential research participant information, site and investigator.
4. The PI will inform the TRC - IEC Secretariat on termination of the study and submit a final report within 3 months of completion of the study.
5. Members of the IEC have the right to monitor the study with prior intimation.
6. Progress report to be submitted to the TRC-IEC Secretariat every 6 months from the date of start of study.
7. This permission is only for the period mentioned above.

  
Dr. J.K. Lakshmi  
Name and signature of Member Secretary

  
Dr. G. Chandrasekhar  
Chairperson, IEC, IIPH

<sup>1</sup> Adapted from the ICMR form; available at  
<http://www.icmr.nic.in/ethics/Communication%20of%20Decision%20to%20the%20IEC.doc>

Speed Post

Ph.25 88980,25 88707  
Fax: 011-25 88381

web-site :www.icmr.nic.in  
E.mail :icmrhqds@sansad.nic.in



भारतीय आयुर्विज्ञान अनुसंधान परिषद  
**INDIAN COUNCIL OF MEDICAL RESEARCH**

अन्सारी नगर, पोस्ट बॉक्स 4911, नई दिल्ली - 110 029  
ANSARI NAGAR, POST BOX 4911, NEW DELHI - 110 029

No. Indo-Foreign/36/ADR/2013-NCD-I

Dated: 27.06/14

To

✓  
Dr. G.V.S. Murthy,  
Director,  
Indian Institute of Public Health Hyderabad  
Public Health Foundation of India  
ANV Areade  
I, Amar Co-operative Society  
Kavuri Hills, Madhapur, Hyderabad - 500033

Sub: "Improving the evidence base on disability in India" under Dr. G.V.S. Murthy IIPH, Hyderabad.

Dear Sir/Madam,

The proposal has been considered in HMSC held on 11<sup>th</sup> Jun, 2014. The comments of the Screening Committee are reproduced below:-

Approved, Subject to the following :

1. Appropriate State Health officials of the Govt of Andhra Pradesh should be included as a Co-Investigator in the study.
2. The outcome report of the study indicating the value addition of collaborative research to Indian Public Health System should be shared with all concerned agencies through HMSC.

Further action will be taken on receipt of the above information.

Yc [Redacted Signature] 14  
( Ravinder Singh )  
Scientist "C"  
For-Director General



**Observational / Interventions Research Ethics Committee**

Hannah Kuper  
Senior Lecturer / Co-director of International Centre for Evidence in Disability  
CRD/ITD  
LSHTM

16 July 2012

Dear Dr Kuper,

**Study Title:** Improving the Evidence Base on Disability  
**LSHTM ethics ref:** 6207

Thank you for your letter of 16 July 2012, responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval having been received, where relevant.

**Approved documents**

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
LSHTM ethics application	V2	16/07/2012
Improving the Evidence Base on Disability Protocol		16/07/2012
Information Sheet : Household survey		16/07/2012
Information Sheet : Case Control		16/07/2012
Consent form		16/07/2012

**After ethical review**

Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form. All studies are also required to notify the ethics committee of any serious adverse events which occur during the project via form E4. At the end of the study, please notify the committee via form E5.

Yours sincerely,



**Professor Andrew J Hall**  
Chair  
[ethics@lshtm.ac.uk](mailto:ethics@lshtm.ac.uk)  
<http://intra.lshtm.ac.uk/management/committees/ethics/>

## The Gambia study ethical approvals

The Gambia Government/MRCG Joint

### **ETHICS COMMITTEE**

C/o MRC Unit: The Gambia @ LSHTM, Fajara  
P.O. Box 273, Banjul  
The Gambia, West Africa  
Fax: +220 – 4495919 or 4498513  
Tel: +220 – 4495442-6 Ext. 2308  
Email: ethics@mrc.gm

9 November 2018

Dr. Abba Hydera,  
CEO/Senior Consultant Ophthalmologist,  
Sheikh Zayed Regional Eye Care Centre, Kanifing.

Dear Dr. Hydera,

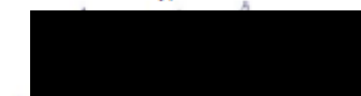
**SCC 1635, The Gambia National Eye Health Survey 2019**

Thank you for submitting your proposal dated 17 September 2018 for consideration by the Gambia Government/MRCG Joint Ethics Committee at its meeting held on 25 October 2018.

Our Committee is pleased to approve your proposed study however you are requested to include Sarjo Kanyi's contact telephone number in the Informed Consent Document.

With best wishes,

Yours sincerely,



Dr. Mohammadou Kabir Cham  
Chair, Gambia Government/MRCG Joint Ethics Committee

#### Documents submitted for review:

- SCC approval letter – 12 October 2018
- SCC reply letter – 4 October 2018
- Cover letter – 17 September 2018
- SCC Application form, version 1.0 – 17 September 2018
- ICD (Adult), version 1.0 – 17 September 2018
- Survey Protocol, version 2.0 – 17 September 2018
- Budget
- CVs: Abba Hydera, Islay Mactaggart, Matthew Burton, Modou Jobe, Omar Badjie, Sarjo Kanyi

#### The Gambia Government/MRCG Joint Ethics Committee:

Dr Mohammadou Kabir Cham, Chair  
Prof Ousman Nyan, Scientific Advisor  
Dr Kalifa Bojang  
Dr Ahmadou Lamln Samateh  
Dr Pamela Esangbedo  
Dr Jane Achan

Prof Umberto D'Alessandro  
Dr Mamady Cham  
Mr Momodou YM Sallah  
Prof Martin Antonio  
Dr Assan Jaye  
Ms Nafte Jobe, Secretary



**Observational / Interventions Research Ethics Committee**

Professor Matthew Burton  
LSHTM

14 January 2019

Dear Dr Burton

**Study Title:** Gambia National Eye Health Survey 2019

**LSHTM Ethics Ref:** 16172

Thank you for your application for the above research project which has now been considered by the Observational Committee via Chair's Action.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval having been received, where relevant.

**Approved documents**

The final list of documents reviewed and approved is as follows:

Document Type	File Name	Date	Version
Investigator CV	Matthew Burton - Short CV - 2017	30/11/2018	1
Investigator CV	Suzannah Bell CV	30/11/2018	1
Investigator CV	CV Islay MacTaggart 2018	30/11/2018	1
Protocol / Proposal	Gambia National Eye Health Survey Protocol v3 Jan 2019	04/01/2019	1
Information Sheet	Gambia Eye Health Survey Info and Consent	04/01/2019	1
Local Approval	SCC MRCG Approval Letter	04/01/2019	1

**After ethical review**

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using the End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://eo.lshtm.ac.uk>.

Further information is available at: [www.lshtm.ac.uk/ethics](http://www.lshtm.ac.uk/ethics).

Yours sincerely,



Professor John DH Porter  
Chair

[ethics@lshtm.ac.uk](mailto:ethics@lshtm.ac.uk)  
<http://www.lshtm.ac.uk/ethics/>




## Turkey study ethical approvals


### ARAŞTIRMA ETİK KURUL KARARLARI

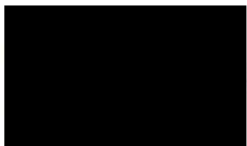
**Toplantı Tarihi** : 12.07.2019  
**Toplantı Sayısı** : 26/2019  
**Toplantı Saati** : 15:00  
**Toplantı Üyeleri** : Doç. Dr. Eda YÜCESOY (Başkan)  
Prof. Dr. Nihat BULUT  
Prof. Dr. Cem BEHAR  
Doç. Dr. Elif ÇELEBİ  
Doç. Dr. Hızır Murat KÖSE  
Doç. Dr. Sinem ELKATİP HATİPOĞLU  
Dr. Öğr. Üyesi Betül NİZAM  
Dr. Öğr. Üyesi Eyyüp Said KAYA


**Karar No : 1-** İstanbul Şehir Üniversitesi Araştırma Etik Kurulu, proje yürütücülere Dr. Ceren Acartürk'ün , "Survey of mental health and disability among Syrian refugees in Sultanbeyli Municipality İstanbul" isimli proje taslağını değerlendirilerek, projenin uygunluğuna karar verilmiştir.


Aşağıda isimleri ve imzaları bulunan İstanbul Şehir Üniversitesi Araştırma Etik Kurulu üyeleri, araştırmacı tarafından kurula sunulan yukarıdaki bilgiler ışığında, ekte belirtilen araştırmanın yürütülmesinde etik açıdan bir sakınca görmemektedir.


  
Doç. Dr. Eda YÜCESOY  
Başkan


  
Prof. Dr. Nihat BULUT  
Üye

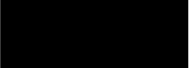
  
Prof. Dr. Cem BEHAR  
Üye

  
Doç. Dr. Elif ÇELEBİ  
Üye

  
Doç. Dr. Hızır Murat KÖSE  
Üye

  
Dr. Betül NİZAM  
Üye

  
Doç. Dr. Sinem ELKATİP HATİPOĞLU  
Üye

  
Dr. Eyyüp Said KAYA  
Üye





T.C.  
İÇİŞLERİ BAKANLIĞI  
Göç İdaresi Genel Müdürlüğü  
Göç Politika ve Projeleri Dairesi Başkanlığı

Sayı : 62103649-000-E.56678  
Konu : İzin Talebi

10/09/2019

D O S Y A

İSTANBUL VALİLİĞİNE  
(İl Göç İdaresi Müdürlüğü)

İlgi : 25.07.2019 tarihli ve 72104824-000/72304 sayılı yazınız.

İlgi yazı ile İstanbul Şehir Üniversitesi, Londra Hijyen ve Tropikal Tıp Okulu ve Mülteciler Derneği ortaklığı ile yürütülecek olan "Sultanbeyli İlçesindeki Suriyeli Mültecilerin Ruh Sağlığı ve Engellilik Durumu Araştırması" proje kapsamında Sultanbeyli ilçesinde geçici koruma altındaki Suriyeliler arasında fiziksel ve zihinsel engelli kişilerin yaygınlığını belirlemek ve bozuklukların nedenlerini incelemek amacıyla araştırma yapmak istediği belirtilmektedir. Aynı proje kapsamında psiko-sosyal desteğe ihtiyacı olan sığınmacıların yaygınlığının belirlemek amacıyla da araştırma talepleri belirtilerek Genel Müdürlüğümüzün izni talep edilmektedir.

Tarafımıza iletilmiş olan anket maddelerinde Genel Müdürlüğümüz konuları kapsamında herhangi bir olumsuz duruma rastlanmamıştır. Buna ek olarak bilgilendirilmiş onam formunda araştırma süresince katılımcıların anketi bırakma hakları önem arz etmektedir. Bu kapsamda bilgilendirilme formuna bu tür bir durum yaşanması ve kişinin psikolojik desteğe ihtiyaç duyması halinde başvurabileceği uygun kanalların ve yönlendirme metodunun eklenmesinin uygun olacağı değerlendirilmektedir.

Söz konusu çalışma, 6458 sayılı Yabancılar ve Uluslararası Koruma Kanunu 94 üncü maddesi ile 2014/6883 karar sayılı Geçici Koruma Yönetmeliği 51 inci maddesinde belirtilen gizlilik ilkelerine gerekli hassasiyetin gösterilmesi; çalışmaya konu kişilerden ve/veya aile üyelerinden yapılacak araştırmanın hiçbir aşamasında ad, soyad, telefon, e-posta adresi, ikametgâh adresi ile uyruk, din, mezhep, etnik gruba mensubiyet gibi hassas bilgilerin istenmemesi, ve çalışmalar esnasında ses/video kaydı alınmaması kaydı ile anket soruları olumlu değerlendirilmiş olup Aile, Çalışma ve Sosyal Hizmetler Bakanlığının da yapılacak çalışma kapsamında bilgilendirilmesi hususunda;

Bilgi ve gereğini rica ederim.

\*Bu belge elektronik imzalıdır. imzalı suretinin aslını görmek için <https://www.e-icisleri.gov.tr/EvrakDogrulama> adresine girerek (vaTH96-MK:DM5-05 kCMO-+4QIB2-giDopr:K0q) kodunu yazınız.

Laleli Çarşıca Mahallesi 122 sk. No: 4, 06370 Yenimahalle/ Ankara  
Telefon No: (312)422 05 00 Faks No: (312)422 09 00  
e-Posta: [gocpolitika@icisleri.gov.tr](mailto:gocpolitika@icisleri.gov.tr) İnternet Adresi: <https://www.goc.gov.tr>

Bilgi için: Mehmet Tolga SAMANCI  
Uzman Yardımcısı  
Telefon No:

Mehmet Sinan YILDIZ  
Bakan a.  
Genel Müdür Yardımcısı

09/09/2019 Göç Uzman Yardımcısı : Mehmet Tolga SAMANCI  
10/09/2019 Daire Başkanı : Muhammet Selami YAZICI

\*Bu belge elektronik imzalıdır. imzalı suretinin aslını görmek için <https://www.e-icisleri.gov.tr/EvrakDogrulama> adresine girerek (vaTH96-MXiDm5-05kCMO-+4QIBZ-gf0bprw0q) kodunu yazınız.

Laleli Çarşıca Mahallesi 122. sk. No: 4, 06370 Yenimahalle/ Ankara  
Telefon No: (312)422 05 00 Faks No: (312)422 09 00  
e-Posta: [gocepilbirenci@icisleri.gov.tr](mailto:gocepilbirenci@icisleri.gov.tr) İnternet Adresi: <https://www.goc.gov.tr>

Bilgi için: Mehmet Tolga SAMANCI  
Uzman Yardımcısı  
Telefon No:

**Observational / Interventions Research Ethics Committee**

Dr Sarah Polack  
 LSHTM

20 August 2019

Dear Sarah

**Study Title:** Survey of disability and mental health among Syrian refugees in Istanbul, Turkey

**LSHTM Ethics Ref:** 17623

Thank you for responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval having been received, where relevant.

**Approved documents**

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Investigator CV	NScherer_CV	29/05/2019	1
Protocol / Proposal	Protocol Turkey v3_FINAL	03/06/2019	1
Protocol / Proposal	Household Roster Questionnaire v2	03/06/2019	1
Protocol / Proposal	Disability Functioning and Impairment_v3	03/06/2019	1
Protocol / Proposal	Case-Control Questionnaire_v2	03/06/2019	1
Protocol / Proposal	Int Guide_Adults	03/06/2019	1
Protocol / Proposal	Int Guide_Children	03/06/2019	1
Protocol / Proposal	FGD topic guide_community members	03/06/2019	1
Investigator CV	S.CV Sarah Polack Short.docx	03/06/2019	1
Information Sheet	Information sheet_household survey_v2	03/06/2019	1
Information Sheet	Information sheet_case control_simplified	03/06/2019	1
Information Sheet	Assent form_household survey + case control_impaired understanding	03/06/2019	1
Information Sheet	Assent form_household survey + case control_child	03/06/2019	1
Information Sheet	Consent form_household survey + case control	03/06/2019	1
Information Sheet	Information sheet_qual	03/06/2019	1
Information Sheet	Assent form_qual_impaired understanding	03/06/2019	1
Information Sheet	Information sheet_qual_simplified	03/06/2019	1
Information Sheet	Information sheet_Stakeholders	03/06/2019	1
Covering Letter	Response to LSHTM ethics 17623	25/07/2019	1
Protocol / Proposal	Protocol_revised	25/07/2019	2
Protocol / Proposal	Information sheet_household survey_v2 revised	25/07/2019	2
Protocol / Proposal	Information sheet_qual revised	25/07/2019	2
Protocol / Proposal	Information sheet_Stakeholders_revised	25/07/2019	2

---

**After ethical review**

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://eo.lshtm.ac.uk>

Additional information is available at: [www.lshtm.ac.uk/ethics](http://www.lshtm.ac.uk/ethics)

Yours sincerely,



Professor Jimmy Whitworth  
Chair

[ethics@lshtm.ac.uk](mailto:ethics@lshtm.ac.uk)

<http://www.lshtm.ac.uk/ethics/>

---

**Improving health worldwide**

## Five survey secondary analysis study

London School of Hygiene & Tropical Medicine  
Keppel Street, London WC1E 7HT  
United Kingdom  
Switchboard: +44 (0)20 7636 8636  
www.lshtm.ac.uk



Observational / Interventions Research Ethics Committee

Ms Dorothy Boggs

LSHTM

11 February 2022

Dear Ms Dorothy Boggs ,

**Study Title:** Exploring the use of Washington Group questions to identify people with clinical impairments who need services including assistive products: results from 5 population-based surveys

**LSHTM ethics ref:** 26695

Thank you for your application for the above research, which has now been considered by the Observational Committee.

### Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

### Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

### Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Local Approval	LSHTM Ethics Approval Letter_Cameroon and India_16 July 2012	16/07/2012	1
Protocol / Proposal	Improving the Evidence Base on Disability Protocol sent to LSHTM ethics	16/07/2012	1
Local Approval	India PFHI Ethics Approval 06 Sept 2012	06/09/2012	1
Local Approval	Cameroon CNERSH Ethical Clearance 21 March 2013	21/03/2013	1
Local Approval	Cameroon IRB Approval 25 May 2013	25/05/2013	1
Local Approval	India PFHI Extension Approval 24 June 2013	24/06/2013	1
Consent form	Cameroon_Information and Consent_HH and Case-Control Questionnaire 22 July 2013	22/07/2013	1
Protocol / Proposal	Cameroon_Disability&Impairment Screening VAR NAMES	22/07/2013	1
Consent form	India_Participant Information Note and Consent Form 2013	15/10/2013	1
Protocol / Proposal	India_Variable Name Questionnaire	15/10/2013	1
Local Approval	India ICMR Approval 27 June 2014	27/06/2014	1
Local Approval	India ICMR Clearance 21 April 2015	21/04/2015	1
Consent form	Gambia Eye Health Survey Info and Consent	17/09/2018	1
Protocol / Proposal	Gambia National Eye Health Survey Protocol 2018	17/09/2018	1
Local Approval	The Gambia_SCC MRCC Approval Letter 9 Nov 2018	09/11/2018	1
Local Approval	The Gambia_LSHTM NEHS Ethics approval letter 14 Jan 2019	14/01/2019	1
Local Approval	Turkey_Sehir University ethics 12 July 2019	12/07/2019	1
Consent form	Chile_informed consent HL	15/07/2019	1

Protocol / Proposal	Chile_Protocol v6 - final	15/07/2019	1
Protocol / Proposal	Chile_form1_chile_bearing	15/07/2019	1
Consent form	Turkey_Information sheets, consent form - ENGLISH	25/07/2019	1
Consent form	Turkey_Information sheets, consent forms ARABIC	25/07/2019	1
Protocol / Proposal	Turkey Survey Questionnaire for translation RI 2 (2)	25/07/2019	1
Protocol / Proposal	Protocol Turkey	25/07/2019	1
Local Approval	LSHTM approval-27639_Chile_6 Aug 2019	06/08/2019	1
Local Approval	Turkey_LSHTM ethics approval 20 August 2019	20/08/2019	1
Local Approval	Turkey_DGMMReport 9 Sept 2019	09/09/2019	1
Local Approval	Chile survey ethics approval certificate_12 Nov 2019	12/11/2019	1
Other	BOGGS Dorothy_LSHTM_Research_Ethics_online_training_certificate	12/05/2020	1
Other	Research_Ethics_online_training_certificate Polack	14/02/2021	1
Investigator CV	Dorothy Boggs CV_4 page_May 2021	18/05/2021	1
Investigator CV	CV Sarah Polack Short 2021	16/12/2021	1
Protocol / Proposal	Use of Washington Group questions as a screening_study protocol_v1	17/12/2021	1

#### After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://leo.lshtm.ac.uk>

Additional information is available at: [www.lshtm.ac.uk/ethics](http://www.lshtm.ac.uk/ethics)

Yours sincerely,



Professor Jimmy Whitworth  
Chair

[ethics@lshtm.ac.uk](mailto:ethics@lshtm.ac.uk)  
<http://www.lshtm.ac.uk/ethics/>

---

Improving health worldwide

## Guatemala study ethical approval



Instituto de Nutrición de Centro América y Panamá  
INCAP



COMITÉ INSTITUCIONAL DE ETICA (CIE)

ACTA No. 94

Aprobación Protocolo de Investigación CIE-REV 100/2021

*"Evaluación Rápida de Tecnología de Apoyo en el Departamento de Sololá, Guatemala"*

En seguimiento a revisión ética efectuada por el grupo revisor conformado por las Licenciadas Sayra Cardona, Ninette López, Laura Ochaeta, América Cruz y Dr. Carlos Quan; al Protocolo de Investigación No. CIE-REV 100/2021 *"Evaluación Rápida de Tecnología de Apoyo en el Departamento de Sololá, Guatemala"* y luego de discutir nuestras observaciones al Protocolo de Investigación, las cuales fueron trasladadas al Investigador Principal del Estudio mediante comunicaciones electrónicas de fechas 4 de marzo de 2021 y 25 de marzo de 2021; y respuesta electrónica del Investigador Principal de fecha 17 de marzo de 2021; el grupo revisor ha manifestado su conformidad con las aclaraciones y adiciones llevadas a cabo por la Investigadora Principal Local, Dra. Ana Cordón, y manifiesta su anuencia conforme la respuesta proporcionada a las observaciones, recomendaciones y comentarios derivados de la revisión que el Comité Institucional de Ética del INCAP llevó a cabo.

Consecuentemente, el grupo de miembros del Comité Institucional de Ética abajo firmantes, en cumplimiento de la normativa aplicable en este caso, certifica:

Que las actividades de investigación involucradas en el estudio *"Evaluación Rápida de Tecnología de Apoyo en el Departamento de Sololá, Guatemala"* que involucran sujetos humanos, fueron examinadas y aprobadas por un Comité de Ética de la Institución, dando como resultado la aprobación de dicho Protocolo el día 26 de marzo de 2021 en las instalaciones del INCAP.

DocuSigned by:

Licda. Sayra Cardona

Licda. Ninette López

Licda. Laura Ochaeta

Dr. Carlos Quan

Licda. América Cruz



Instituto de Nutrición de Centro América y Panamá  
INCAP



Página No. 2  
Acta No. 94

*Aprobación Protocolo de Investigación CIE-REV 100/2021*  
"Evaluación Rápida de Tecnología de Apoyo en el Departamento de Sololá, Guatemala"

El Comité Institucional de Ética estuvo formado por los siguientes miembros:

Nombre y apellidos	Profesión	Cargo actual / institución
Licda. Sayra Cardona	Doctorado en Psicología Aplicada Maestría en Medición, Evaluación e Investigación Educativa	Consultora Universidad Francisco Marroquín
Licda. Ninette López	Licenciada en Nutrición Cursando un Doctorado en Nutrición con énfasis en Obesidad y Síndrome Metabólico Maestría en Salud Pública	Coordinadora de la Cooperación Técnica del INCAP en República Dominicana
Licda. Laura Ochaeta	Licenciada en Psicología	Psicóloga Independiente
Dr. Carlos Quan	Médico y Cirujano	Consultor Subdirector Médico Hospital de Villa Nueva Ministerio de Salud Pública y Asistencia Social
Licda. América Cruz	Licenciada en Ciencias de la Comunicación Social Maestría en Comunicación Organizacional	Comunicadora Unidad de Planificación, INCAP



Licda. Valentina Santa Cruz  
Presidenta del Comité Institucional de Ética



Observational / Interventions Research Ethics Committee

Dr Sarah Polack  
LSHTM

19 February 2021

Dear Dr Sarah Polack ,

**Study Title:** Rapid Assistive Technology Assessment in Solala, Guatemala

**LSHTM ethics ref:** 22933

Thank you for your application for the above research, which has now been considered by the Observational Committee.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

**Conditions of the favourable opinion**

Approval is dependent on local ethical approval having been received, where relevant.

**Approved documents**

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Investigator CV	S.CV Sarah Polack Short 2020	02/01/2021	1
Investigator CV	Dorothy Boggs CV_short_December 2020	02/01/2021	1
Investigator CV	CV_Ana-Corde n-10.20.2020	02/01/2021	1
Protocol / Proposal	rATA Protocol v4	03/01/2021	1
Protocol / Proposal	rATA questionnaire COMBINED 030121	03/01/2021	1
Protocol / Proposal	rATA Information Sheet	03/01/2021	1
Protocol / Proposal	COVID screening questions	03/01/2021	1
Protocol / Proposal	COVID Considerations	03/01/2021	1
Information Sheet	rATA Information Sheet	03/01/2021	1

**After ethical review**

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://leo.lshtm.ac.uk>

Additional information is available at: [www.lshtm.ac.uk/ethics](http://www.lshtm.ac.uk/ethics)

Yours sincerely,



Professor Jimmy Whitworth  
Chair

[ethics@lshtm.ac.uk](mailto:ethics@lshtm.ac.uk)  
<http://www.lshtm.ac.uk/ethics/>

---

Improving health worldwide

## Appendix 4: Functional assessment tool summaries and detailed feasibility rating scores

### Educational Assessment and Resource Center (EARC) Assessment

In Muga's study (73), the EARC assessment was used as the "gold standard" to screen for children with disabilities in Kenya and was conducted in a designated sub location in this survey, i.e. locations included "barazas", churches, markets, health facilities and schools. Though used in a survey in this study, typically EARC assessments are implemented within a centre in an existing special school or unit Kenya to screen children ages 0 to 16 years for disabilities, and presupposes that a child will voluntarily or involuntarily exhibit some behaviour that can either be observed or recorded through psychological and educational assessments.(73, 80)

EARC assessment is a requirement for special school placement in Kenya and assessment methods can include the following: record review (when available); physical, social and emotional observation; vision developmental screen with a Snellen chart; hearing developmental screening with PTA; learning tests/assessments; and caregiver report.(80) The results are then compared with the behaviour of a non-disabled child using criterion/standard referenced data of the same age to determine whether it is "normal", "deviant" or "delayed". The assessment requires a specialist multidisciplinary assessment team. Though this assessment appears comprehensive, it only assesses children and according to Muga is not a practical screen for prevention and treatment since several sets of tools and equipment are needed. Furthermore, only one AP indicator, hearing aid need, was documented, and it is noted that there is a lack literature detailing the specific assessment and outcome details, including wider AP need. Therefore, EARC assessment is unlikely to be useful for assessing AP need in a population-based survey and is given a "poor" feasibility rating for use in AP need survey.

CRITERIA	DETAILS	RATING SCORE	TOTAL SCORE	OVERALL SCORE
<b>1) ICF components</b>	At least $\geq 4$	2 = Good	<b>2/12 (17%)</b>	<b>Poor</b>
<b>2) AP indicators</b>	1: Hearing aid need	0 = Poor		
<b>3) Geographical uptake</b>	1: Kenya	0 = Poor		
<b>4) Resources</b>	See below	0 = Poor		
<b>a) Cost</b>	Unknown	--		
<b>b) Time</b>	Unknown	--		
<b>c) Equipment</b>	Several sets of tools/equipment	0 = Poor		
<b>d) Cadre</b>	Specialist	0 = Poor		

## Ten questions

In the same Muga study, a house-to-house survey was also administered using the “ten questions” screen, a structured interview checklist.(73) Ten questions is a validated (81) parent report screening tool for neurological difficulties in children ages 2-9 years old typically used in low resource settings. The tool screens for risk of epilepsy and for cognitive, motor, vision and hearing impairments by asking caregivers about activity limitations.(81) The questionnaire asks about hearing aid use, is quick to administer (about 5 minutes) during a face-to-face interview, has been translated in multiple languages for use in epidemiological studies, surveys and as a clinical screening tool.

The feasibility rating was “low” (4/12, 33%) for use in AP need surveys. Further, it has been noted to have a high false positive rate and therefore it’s use is recommended as first-stage screening only before more detailed assessments in children. Furthermore, it isn’t recommended given it only measures one AP use indicator and was superseded by the WG CFM which has more items and covers a wider age range (2 to 17 years old).(53)

CRITERIA	DETAILS	RATING SCORE	TOTAL SCORE	OVERALL SCORE
<b>1) ICF components</b>	1: Activity limitations	0 = Poor	<b>4/12 (33%)</b>	<b>Low</b>
<b>2) AP indicators</b>	1: Hearing aid use	0 = Poor		
<b>3) Geographical uptake</b>	Kenya; Bangladesh; Pakistan; Jamaica etc.	3 = High		
<b>4) Resources</b>	See below	1 = Low		
<b>a) Cost</b>	None	3 = High		
<b>b) Time</b>	~ 5 minutes	3 = High		
<b>c) Equipment</b>	Several sets of tools/equipment	0 = Low		
<b>d) Cadre</b>	Specialist	0 = Low		

## UK Biobank questionnaire and physical assessments, including the Digit Triplet Test

Both studies by Dawes et al. (74) and Sawyer et al. (75) used the UK Biobank Data Resource data. Beginning in 2006, the UK Biobank is a National Health Service data archive providing health information across demographics, health, and disease through routinely administering biopsychosocial factors questionnaire and physical assessments on approximately 500,000 people aged 40–69.(82, 83)

The biopsychosocial questionnaire involves a 90-minute computerised battery of questions which ask about biological, psychological and social factors, including a self-reported question on use of hearing aids and glasses/contact lenses.

The physical assessments are collected at an Assessment Centre and include various measures such as blood pressure, anthropometry, hand grip strength, visual acuity testing and refraction, and the Digit Triplet Test (DTT) and clinician assessment for hearing. The DTT objectively measures hearing impairment based on a test of speech recognition in noise. The total test time takes approximately 4 minutes and involves the presentation of 15 sets of 3 spoken monosyllabic digits (e.g., 2-4-9) in a background of noise shaped to match the spectrum of the speech stimuli.(75, 82)

Regarding AP indicators, self-reported hearing aid and glasses/contact lenses use are gathered in the questionnaire, and hearing aid and glasses unmet need are measured at the Assessment Centre.(82) Though mobility and cognitive assessments are also completed at the Assessment Centre, no AP indicators are reported in these domains. The UK Biobank questionnaire and physical assessments are very comprehensive, assessing at least a minimum of four ICF components (i.e. health condition; impairment; activity limitations; personal factors). However, for utility in AP need household survey, the assessment battery scored a “low” feasibility rating (42%) given the long assessment time and high need for resources and equipment; it would not be feasible to use in a household survey in LMIC.

CRITERIA	DETAILS	RATING SCORE	TOTAL SCORE	OVERALL SCORE
<b>1) ICF components</b>	At least ≥ 4	2 = Good		
<b>2) AP indicators</b>	4: Hearing aid use; hearing aid unmet need; glasses/contact lenses use; glasses unmet need.	2 = Good		
<b>3) Geographical uptake</b>	UK	0 = Poor	<b>4/12 (33%)</b>	<b>Low</b>
<b>4) Resources</b>	See below	0 = Poor		
<b>a) Cost</b>	High	0 = Poor		
<b>b) Time</b>	90 minutes	0 = Poor		
<b>c) Equipment</b>	Several sets of tools/equipment	0 = Poor		
<b>d) Cadre</b>	Specialist	0 = Poor		

Li et al.'s study compared data on participants  $\geq 18$  years old from the 2016 Behavioral Risk Factor Surveillance System (BRFSS) which collected data through telephone questionnaires, and the 2014 National Health Interview Survey (NHIS) which collected face-to-face household questionnaire data, including hearing health questions and the Gallaudet Functional Hearing Scale.(76) The survey tools in full are reviewed below.

### **Behavioral Risk Factor Surveillance System (BRFSS)**

The BRFSS is an annual, cross-sectional, state-based telephone survey of non-institutionalised adults residing in the United States.(84) It contains i) core questions, ii) optional modules that include questions on specific topics and iii) state-added questions. The survey notably has included chronic health conditions (core) and a disability module with questions modified from the WG SS, including vision, hearing and mobility related questions<sup>3</sup>, as well as personal assistance questions in a caregiver module, activity questions in a quality of life module and functional vision questions in VI and diabetes modules (note: all answered “when wearing glasses or contacts”). However, the broader survey database search (from 1984-2020) results in only one self-reported grouped AP use question, i.e. “Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?”.(84)

The self-reported BRFSS questionnaire with the optional modules included could be very comprehensive, assessing all six ICF components. However, for utility in AP need household survey, the assessment battery scored a “low” feasibility rating (42%) given only one grouped AP use indicator is reported and the survey is only administered in one country. Further, administration feasibility details (cost, time and cadre) were unknown given the variability in overall administration with the optional modules and by state.

---

<sup>3</sup> Chronic health condition vision question: Do you have trouble seeing, even when wearing glasses or contact lenses?; BRFSS Vision question: Are you blind or do you have serious difficulty seeing even when wearing glasses?; BRFSS hearing question: Are you deaf or do you have serious difficulty hearing?; BRFSS mobility question: Do you have serious difficulty walking or climbing steps?

CRITERIA	DETAILS	RATING SCORE	TOTAL SCORE	OVERALL SCORE
1) ICF components	6: Health condition, Impairment, activity limitations, participation restrictions, personal factors; environment	3 = High		
2) AP indicators	1: Grouped AP use.	0 = Poor		
3) Geographical uptake	US	0 = Poor		
4) Resources	See below	2 = Good	5/12 (42%)	Low
a) Cost	Unknown	--		
b) Time	Unknown; average time variable due to options/modules	--		
c) Equipment	Minimal (i.e. phone system)	2 = Good		
d) Cadre	Unknown; variable (private company to universities)	--		

### National health Interview Survey (NHIS), including 2014 Hearing health questions and the Gallaudet Functional Hearing Scale

The NHIS has been conducted annually since 1957 to provide civilian, non-institutionalised population health information in the United States and contains various questionnaire files, such as income, household and family disability questions.(87) Information is collected through personal household interviews. Previously in 1994 and 1995, a disability module (NHIS-D) was included, and the most recent survey was redesigned in 2019 to include the following: i) Annual Core modules, including a specific “Functioning and Disability” module<sup>4</sup> using modified WG questions and activity and participation questions; ii) Rotating Core Modules, including specific service utilisation<sup>5</sup> modules; iii) Sponsored Content; and iv) Emerging Topics.(87) Self-reported AP use indicators are noted in the 2022 survey for glasses/contact lenses, hearing aids, grouped mobility equipment and specific mobility AP (cane/walker, wheelchair/scooter, someone’s assistance).

Specifically in the 2014 survey analysed in Li et al.’s study, the NHIS expanded the set of hearing health questions with the Hearing Supplement by asking participants to rate their hearing ability and to rank themselves on the Gallaudet Functional Hearing Scale which includes reported activity, environmental and personal hearing questions.(85, 86) It is noted that self-reported hearing ability assessment scales were developed around 1970.

<sup>4</sup> Functioning and Disability Core Module includes: Vision, Hearing, Mobility, Communication, Cognition, Self-care and upper-body limitations, Anxiety, Depression and Social functioning.

<sup>5</sup> Service Utilization: Dental care, Vision care, Therapy (physical, speech, rehabilitative, occupational), Home health care

Overall, the NHIS assesses at least five self-reported ICF components, including health condition, activity limitations, participation restrictions, personal and environmental factors. Five self-reported AP use indicators are recorded, however other AP indicators are not included. The NHIS hearing questionnaire is given a “low” feasibility rating for utility in AP need household survey. It is noted that resource information regarding cost (presumed high cost given sample size) and average administration time (presumed long given survey modules) were not reported.

CRITERIA	DETAILS	RATING SCORE	TOTAL SCORE	OVERALL SCORE
<b>1) ICF components</b>	5: Health condition, Impairment, activity limitations, participation restrictions, personal factors; environment	2 = Good		
<b>2) AP indicators</b>	5: AP use (glasses/contact lenses; hearing aid; mobility grouped; cane/walker; wheelchair/scooter).	2 = Good	<b>6/12 (50%)</b>	<b>Low</b>
<b>3) Geographical uptake</b>	US	0 = Poor		
<b>4) Resources</b>	See below	2 = Good		
<b>a) Cost</b>	Unknown	--		
<b>b) Time</b>	Unknown	--		
<b>c) Equipment</b>	Minimal; Face to face and computer assisted personal interviewing	2 = Good		
<b>d) Cadre</b>	Non-specialist, trained	2 = Good		



## English Longitudinal Study of Ageing Wave 4 assessments

Gale et al.'s study analysed data on people aged 60 to over 90 years from the English Longitudinal Study of Ageing (ELSA) to examine the prevalence of disability and frailty according to Fried criteria (88), and the proportion of people with disabilities who receive help or use AP on a subset of the cohort.(77)

ELSA is a survey completed on people aged 50 and over every two years who live in England to explore the relationships between health, functioning, social networks and economic position. ELSA recruits directly from people who have taken part in the Health Survey for England. Each ELSA wave asks respondents to complete a core self-completion questionnaire which could include the following question groupings: demographic data, economic data, health, disability and health behaviours<sup>6</sup>, psychosocial measures, and cognitive function. A nurse visit has been carried out as well (in waves 2, 4, 6, 8, 9) to complete a physical examination and gather performance data and biological samples collected for analysis. This has included height, weight, body mass index, blood pressure, lung function, grip strength and a walking speed test for assessment. In specific waves, other self-completion modules have been added to the main interview. Specifically for AP, ELSA asks about AP use and sources of help and payment for the following AP: walking stick/cane; zimmer frame/walker; buggy or scooter; manual wheelchair; electric wheelchair; elbow crutches; personal alarm. It is noted other AP indicators are not collected.

For older populations, the ELSA was given a "low" feasibility rating for utility in AP need household survey. Though the survey includes both clinical and self-reported assessments in a home environment covering multiple functional domains and all six ICF components, the total administration time is not known. Further, seven AP use indicators are collected, however other AP indicators are not measured.

CRITERIA	DETAILS	RATING SCORE	TOTAL SCORE	OVERALL SCORE
<b>1) ICF components</b>	6	3 = High	<b>6/12 (50%)</b>	<b>Low</b>
<b>2) AP indicators</b>	7: six mobility AP use; personal alarm use	3 = High		
<b>3) Geographical uptake</b>	England	0 = Poor		
<b>4) Resources</b>	See below	0 = Poor		
<b>a) Cost</b>	High	0 = Poor		
<b>b) Time</b>	Unknown	--		
<b>c) Equipment</b>	Several sets of tools/equipment	0 = Poor		
<b>d) Cadre</b>	Specialist (nurse) and trained interviewer	0 = Poor		

<sup>6</sup> Included self-reported activities of daily living (dressing; walking across a room; bathing or showering; eating; getting out of bed; and using the toilet) and difficulties with instrumental activities of daily living (using a map; preparing a hot meal; making phone calls; managing money; shopping for groceries; taking medications; and doing work around the house).

### **Native Elder Care ADL, psychosocial, health and mobility assessments**

Goins et al.'s study examines the prevalence of AP use, type of assistance used for each ADL limitation, and correlates of AP use among Native Indian aged 55 and older in the United States.(78) Data were collected as part of the Native Elder Care Study through face-to-face administered surveys.

The Native Elder Care Study was more recently conducted between 2006 to 2008 as a cross-sectional study of community-dwelling members of a federally recognized American Indian tribe in the Southeast region of the United States, aged ≥55 years.(89, 92) The study gathered in-depth information on lower body functioning, disability, personal assistance needs, mental and physical health conditions, psychosocial resources, and use of health care and supportive services. Participants who reported difficulty with ADLs, including bathing, dressing, eating, transferring, walking, toileting, grooming, and getting outside, were asked about the assistance/help of someone and the use of a grouped AP. Trained interviewers completed in person assessments as well for grip strength (91) and a lower body function assessment, the Short Physical Performance Battery (90).

This study's assessment set included all six ICF components and measured seven AP use indicators. This assessment set is given a "low" feasibility rating for utility in an AP need survey. Both clinical and self-reported assessments in a home environment were completed however data to measure additional AP indicators were not collected. Additionally, more information is needed about the administration cost.

<b>CRITERIA</b>	<b>DETAILS</b>	<b>RATING SCORE</b>	<b>TOTAL SCORE</b>	<b>OVERALL SCORE</b>
<b>1) ICF components</b>	6	3 = High		
<b>2) AP indicators</b>	1: grouped AP use	1 = Poor		
<b>3) Geographical uptake</b>	1: US	0 = Poor		
<b>4) Resources</b>	See below	0 = Poor	<b>4/12 (33%)</b>	<b>Low</b>
<b>a) Cost</b>	Unknown	--		
<b>b) Time</b>	60 – 90 minutes	0 = Poor		
<b>c) Equipment</b>	Several sets of tools/equipment	0 = Poor		
<b>d) Cadre</b>	Trained interviewer	2 = Good		

## Appendix 5: Copyright license permissions

**Research paper 3:** Estimating AP need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches

Boggs, D; Kuper, H; Mactaggart, I; Murthy, GV; Oye, J; Polack, S; (2020) *Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches*. Tropical medicine & international health : TM & IH, 26 (2). pp. 146-158. ISSN 1360-2276 DOI: <https://doi.org/10.1111/tmi.13523>

- a. Copyright to reproduce the paper in PhD thesis

**JOHN WILEY AND SONS LICENSE  
TERMS AND CONDITIONS**

Jan 19, 2022

---

This Agreement between Ms. Dorothy Boggs ("You") and John Wiley and Sons ("John Wiley and Sons") consists of your license details and the terms and conditions provided by John Wiley and Sons and Copyright Clearance Center.

License Number 5232470469891

License date Jan 19, 2022

Licensed Content  
Publisher John Wiley and SonsLicensed Content  
Publication Tropical Medicine & International HealthLicensed Content  
Title Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approachesLicensed Content  
Author Dorothy Boggs, Hannah Kuper, Islay Mactaggart, et alLicensed Content  
Date Dec 3, 2020Licensed Content  
Volume 26Licensed Content  
Issue 2

Licensed Content Pages	13
Type of use	Dissertation/Thesis
Requestor type	Author of this Wiley article
Format	Print and electronic
Portion	Full article
Will you be translating?	No
Title	Exploring components of functioning: developing a population-based survey method to estimate assistive product need for the domains of vision, hearing and mobility
Institution name	London School of Hygiene and Tropical Medicine
Expected presentation date	Mar 2022
Requestor Location	Ms. Dorothy Boggs Keppel Street London, WC1E 7HT United Kingdom Attn: Dorothy
Publisher Tax ID	EU826007151
Total	0.00 USD
Terms and Conditions	

## TERMS AND CONDITIONS

This copyrighted material is owned by or exclusively licensed to John Wiley & Sons, Inc. or one of its group companies (each a "Wiley Company") or handled on behalf of a society with which a Wiley Company has exclusive publishing rights in relation to a particular work (collectively "WILEY"). By clicking "accept" in connection with completing this licensing transaction, you agree that the following terms and conditions apply to this transaction (along with the billing and payment terms and conditions established by the Copyright Clearance Center Inc., ("CCC's Billing and Payment terms and conditions"), at the time that you opened your RightsLink account (these are available at any time at <http://myaccount.copyright.com>).

### Terms and Conditions

- The materials you have requested permission to reproduce or reuse (the "Wiley Materials") are protected by copyright.
- You are hereby granted a personal, non-exclusive, non-sub licensable (on a stand-alone basis), non-transferable, worldwide, limited license to reproduce the Wiley Materials for the purpose specified in the licensing process. This license, and any **CONTENT (PDF or image file) purchased as part of your order**, is for a one-time use only and limited to any maximum distribution number specified in the license. The first instance of republication or reuse granted by this license must be completed within two years of the date of the grant of this license (although copies prepared before the end date may be distributed thereafter). The Wiley Materials shall not be used in any other manner or for any other purpose, beyond what is granted in the license. Permission is granted subject to an appropriate acknowledgement given to the author, title of the material/book/journal and the publisher. You shall also duplicate the copyright notice that appears in the Wiley publication in your use of the Wiley Material. Permission is also granted on the understanding that nowhere in the text is a previously published source acknowledged for all or part of this Wiley Material. Any third party content is expressly excluded from this permission.
- With respect to the Wiley Materials, all rights are reserved. Except as expressly granted by the terms of the license, no part of the Wiley Materials may be copied, modified, adapted (except for minor reformatting required by the new Publication), translated, reproduced, transferred or distributed, in any form or by any means, and no derivative works may be made based on the Wiley Materials without the prior permission of the respective copyright owner. **For STM Signatory Publishers clearing permission under the terms of the [STM Permissions Guidelines](#) only, the terms of the license are extended to include subsequent editions and for editions in other languages, provided such editions are for the work as a whole in situ and does not involve the separate exploitation of the permitted figures or extracts**. You may not alter, remove or suppress in any manner any copyright, trademark or other notices displayed by the Wiley Materials. You may not license, rent, sell, loan, lease, pledge, offer as security, transfer or assign the Wiley Materials on a stand-alone basis, or any of the rights granted to you hereunder to any other person.
- The Wiley Materials and all of the intellectual property rights therein shall at all times

remain the exclusive property of John Wiley & Sons Inc, the Wiley Companies, or their respective licensors, and your interest therein is only that of having possession of and the right to reproduce the Wiley Materials pursuant to Section 2 herein during the continuance of this Agreement. You agree that you own no right, title or interest in or to the Wiley Materials or any of the intellectual property rights therein. You shall have no rights hereunder other than the license as provided for above in Section 2. No right, license or interest to any trademark, trade name, service mark or other branding ("Marks") of WILEY or its licensors is granted hereunder, and you agree that you shall not assert any such right, license or interest with respect thereto

- NEITHER WILEY NOR ITS LICENSORS MAKES ANY WARRANTY OR REPRESENTATION OF ANY KIND TO YOU OR ANY THIRD PARTY, EXPRESS, IMPLIED OR STATUTORY, WITH RESPECT TO THE MATERIALS OR THE ACCURACY OF ANY INFORMATION CONTAINED IN THE MATERIALS, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, ACCURACY, SATISFACTORY QUALITY, FITNESS FOR A PARTICULAR PURPOSE, USABILITY, INTEGRATION OR NON-INFRINGEMENT AND ALL SUCH WARRANTIES ARE HEREBY EXCLUDED BY WILEY AND ITS LICENSORS AND WAIVED BY YOU.
- WILEY shall have the right to terminate this Agreement immediately upon breach of this Agreement by you.
- You shall indemnify, defend and hold harmless WILEY, its Licensors and their respective directors, officers, agents and employees, from and against any actual or threatened claims, demands, causes of action or proceedings arising from any breach of this Agreement by you.
- IN NO EVENT SHALL WILEY OR ITS LICENSORS BE LIABLE TO YOU OR ANY OTHER PARTY OR ANY OTHER PERSON OR ENTITY FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR PUNITIVE DAMAGES, HOWEVER CAUSED, ARISING OUT OF OR IN CONNECTION WITH THE DOWNLOADING, PROVISIONING, VIEWING OR USE OF THE MATERIALS REGARDLESS OF THE FORM OF ACTION, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, INFRINGEMENT OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, DAMAGES BASED ON LOSS OF PROFITS, DATA, FILES, USE, BUSINESS OPPORTUNITY OR CLAIMS OF THIRD PARTIES), AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY PROVIDED HEREIN.
- Should any provision of this Agreement be held by a court of competent jurisdiction to be illegal, invalid, or unenforceable, that provision shall be deemed amended to achieve as nearly as possible the same economic effect as the original provision, and the legality, validity and enforceability of the remaining provisions of this Agreement shall not be affected or impaired thereby.
- The failure of either party to enforce any term or condition of this Agreement shall not

constitute a waiver of either party's right to enforce each and every term and condition of this Agreement. No breach under this agreement shall be deemed waived or excused by either party unless such waiver or consent is in writing signed by the party granting such waiver or consent. The waiver by or consent of a party to a breach of any provision of this Agreement shall not operate or be construed as a waiver of or consent to any other or subsequent breach by such other party.

- This Agreement may not be assigned (including by operation of law or otherwise) by you without WILEY's prior written consent.
- Any fee required for this permission shall be non-refundable after thirty (30) days from receipt by the CCC.
- These terms and conditions together with CCC's Billing and Payment terms and conditions (which are incorporated herein) form the entire agreement between you and WILEY concerning this licensing transaction and (in the absence of fraud) supersedes all prior agreements and representations of the parties, oral or written. This Agreement may not be amended except in writing signed by both parties. This Agreement shall be binding upon and inure to the benefit of the parties' successors, legal representatives, and authorized assigns.
- In the event of any conflict between your obligations established by these terms and conditions and those established by CCC's Billing and Payment terms and conditions, these terms and conditions shall prevail.
- WILEY expressly reserves all rights not specifically granted in the combination of (i) the license details provided by you and accepted in the course of this licensing transaction, (ii) these terms and conditions and (iii) CCC's Billing and Payment terms and conditions.
- This Agreement will be void if the Type of Use, Format, Circulation, or Requestor Type was misrepresented during the licensing process.
- This Agreement shall be governed by and construed in accordance with the laws of the State of New York, USA, without regards to such state's conflict of law rules. Any legal action, suit or proceeding arising out of or relating to these Terms and Conditions or the breach thereof shall be instituted in a court of competent jurisdiction in New York County in the State of New York in the United States of America and each party hereby consents and submits to the personal jurisdiction of such court, waives any objection to venue in such court and consents to service of process by registered or certified mail, return receipt requested, at the last known address of such party.

## WILEY OPEN ACCESS TERMS AND CONDITIONS

Wiley Publishes Open Access Articles in fully Open Access Journals and in Subscription journals offering Online Open. Although most of the fully Open Access journals publish open access articles under the terms of the Creative Commons Attribution (CC BY) License only, the subscription journals and a few of the Open Access Journals offer a choice of Creative Commons Licenses. The license type is clearly identified on the article.



### **The Creative Commons Attribution License**

The [Creative Commons Attribution License \(CC-BY\)](#) allows users to copy, distribute and transmit an article, adapt the article and make commercial use of the article. The CC-BY license permits commercial and non-

### **Creative Commons Attribution Non-Commercial License**

The [Creative Commons Attribution Non-Commercial \(CC-BY-NC\)License](#) permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.(see below)

### **Creative Commons Attribution-Non-Commercial-NoDerivs License**

The [Creative Commons Attribution Non-Commercial-NoDerivs License \(CC-BY-NC-ND\)](#) permits use, distribution and reproduction in any medium, provided the original work is properly cited, is not used for commercial purposes and no modifications or adaptations are made. (see below)

### **Use by commercial "for-profit" organizations**

Use of Wiley Open Access articles for commercial, promotional, or marketing purposes requires further explicit permission from Wiley and will be subject to a fee.

Further details can be found on Wiley Online Library <http://olabout.wiley.com/WileyCDA/Section/id-410895.html>

### **Other Terms and Conditions:**

**v1.10 Last updated September 2015**

Questions? [customercare@copyright.com](mailto:customercare@copyright.com) or +1-855-239-3415 (toll free in the US) or +1-978-646-2777.

## b. Copyright to post PhD thesis in institutional repository



### Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches

Author: Sarah Polack, Joseph Oye, GVS Murthy, et al

Publication: Tropical Medicine & International Health

Publisher: John Wiley and Sons

Date: Dec 3, 2020

© 2020 John Wiley & Sons Ltd

#### Quick Price Estimate

##### Content Delivery:

A copy of this content may be purchased following completion of your permissions order.  
High Res Image files - please contact Wiley

I would like to...	<input type="text" value="post in an institutional repository"/>	Circulation	<input type="text"/>
Requestor Type	<input type="text" value="Author of this Wiley article"/>	Select your currency	<input type="text" value="GBP - £"/>
Format	Electronic	Quick Price	Click Quick Price
		<input type="button" value="QUICK PRICE"/>	<input type="button" value="CONTINUE"/>



### Estimating assistive product need in Cameroon and India: results of population-based surveys and comparison of self-report and clinical impairment assessment approaches

Author: Sarah Polack, Joseph Oye, GVS Murthy, et al

Publication: Tropical Medicine & International Health

Publisher: John Wiley and Sons

Date: Dec 3, 2020

© 2020 John Wiley & Sons Ltd

#### Please check the terms of the Copyright Transfer Agreement or Exclusive License Form

Authors of articles using the standard Copyright Transfer Agreement for this journal may:

Share or self-archive the submitted (pre-print) or accepted (postprint) versions on their personal website, in their company/institutional repository or archive, or in recognized/approved not for profit subject-based pre-print servers or repositories.

Certain conditions and in some cases embargo periods apply.

Posting the final published version (Version of Record) is not permitted.

Please read the Copyright Transfer Agreement and [Wiley's Self Archiving Policy](#), which provides further information and definitions of the above terms, prior to posting your article.

Dorothy Boggs

---

From: Wiley Global Permissions <permissions@wiley.com>  
Sent: 09 May 2022 13:38  
To: Dorothy Boggs  
Subject: RE: Published: Your article is published in an issue

\*\*\* This message originated outside LSHTM \*\*\*

---

Dear Dorothy

Thank you for your email

The terms of the journal's copyright transfer agreement (CTA) allow authors to self-archive submitted (pre-print) and accepted (peer-reviewed) versions of articles on their own personal website, in a company/institutional repository or archive, and in approved not-for-profit subject-based repositories. Self-archiving of the accepted version is subject to an embargo.

The accepted (peer-reviewed) version may be self-archived after an embargo period of 12 months for scientific, technical, and medical (STM) journals, and 24 months for social science and humanities (SSH) journals following publication of the final article.

You can read more about our policies, including details on our embargo periods, at these links:

<http://olabout.wiley.com/WileyCDA/Section/id-828039.html>

<https://authorservices.wiley.com/author-resources/Journal-Authors/licensing-and-open-access/open-access/author-compliance-tool.html>

Articles may be deposited into repositories on acceptance, but access to the article is subject to the embargo period.

The version posted must include the following notice on the first page:

*"This is the peer reviewed version of the following article: [FULL CITE], which has been published in final form at [Link to final article using the DOI]. This article may be used for non-commercial purposes in accordance with [Wiley Terms and Conditions for Self-Archiving](#)."*

The version posted may not be updated or replaced with the final published version (the Version of Record). If you have any further queries then please contact us.

Kind regards

**Mary O'Connell**  
Sales Co-Ordinator, GSP

Chichester, United Kingdom



**WILEY**

## **Appendix 6: Draft AP need survey questionnaire modules**

# [COUNTRY NAME] FNAT SURVEY 2022

## DRAFT Study Questionnaire Modules

Note: vision, hearing and mobility functional domains are presented

A. HOUSEHOLD ROSTER QUESTIONNAIRE					
<b>A1. Enumeration and Demographics</b>					
<i>Completed by enumerator alongside a paper-based household roster. Questions to be asked of the household head or proxy household head.</i>					
1. Date	☞ Day / Month / Year (dd/mm/yyyy)	dd	mm	yyyy	
2. Interviewer id	<input checked="" type="checkbox"/> Select one (list to be generated in app)	_____			
3. Region number	☞ 2 digit number 01 – 09 copied from participant slip	_____			
4. Cluster Number	☞ 3 digit number 001-100 copied from household roster	_____			
5. Household Number	☞ 2 digit number 01-30 copied from household roster	_____			
6. Area/Street name	☞ open alphanumerical text entry	_____			
7. GPS coordinates	Autofill IF possible				
8. Availability for household survey	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Available (1) <input type="checkbox"/> Not currently available, revisit (2) <input type="checkbox"/> Unavailable (will not be available for duration of survey) (3) <input type="checkbox"/> Refused (4) <input type="checkbox"/> Unavailable after revisit (5)			
9. Reason for refusal	☞ open alphanumerical text entry Complete only if A8=4	_____			
10. Visit number	<input checked="" type="checkbox"/> Select drop down options 1-10	_____			
11. Name of household Key Informant	☞ text confirmed from participant slip	_____			
12. Telephone number 1	☞ number entry up to 12 digits	_____			
13. Whose telephone is this?	 text entry				
14. Telephone number 2	☞ number entry up to 12 digits	_____			
15. Whose telephone is this?					
16. Consent obtained	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			


## A2. Socio-economic status household questionnaire

*(Note: example now 12 questions from Equity tool Uganda, this will change according to country context, usually ~10 questions)*

1. Does your household have electricity?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
2. Does your household have a cassette/CD/DVD player?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
3. Does your household have a radio?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
4. Does your household have a television?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
5. Does your household have a cupboard?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
6. Does your household have a sofa set?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
7. Does any member of your household own a watch?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
8. Does any member of your household have a bank account?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
9. What type of fuel does your household mainly use for cooking?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Wood (1) <input type="checkbox"/> Charcoal (2) <input type="checkbox"/> Other fuel type (3)	
10. What is the main material of the floor of your dwelling?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Cement (1) <input type="checkbox"/> Other material (2)	
11. What is the main material of the roof of your dwelling?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Thatch / palm leaf (1) <input type="checkbox"/> Other material (2)	
12. What is the main material of the exterior walls of your dwelling?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Burnt bricks with cement (1) <input type="checkbox"/> Other material (2)	

### A3. Eligible Household member list

<i>Electronic version of roster</i>  [+] entries to be added	<b>First name</b> ✎ text	<b>Last name</b> ✎ text	<b>Sex</b> <input checked="" type="checkbox"/> Select one	<b>Age (years)</b> ✎ <1 write '0'	<b>Relationship to interviewee</b> <input checked="" type="checkbox"/> Select one	<b>How long has this participant lived in the household in the past year?</b> <input checked="" type="checkbox"/> Select one	<b>Survey status *</b> <input checked="" type="checkbox"/> Select one	<b>Telephone</b> <input checked="" type="checkbox"/> Number entry up to 2 mobile numbers	<b>Notes</b> <input checked="" type="checkbox"/> Open text one
01			<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)		<input type="checkbox"/> HH head/respondent (1) <input type="checkbox"/> Spouse (2) <input type="checkbox"/> Father/mother (3) <input type="checkbox"/> Grandparent (4) <input type="checkbox"/> Son/daughter (5) <input type="checkbox"/> Grandchild (6) <input type="checkbox"/> Other blood relation (9) <input type="checkbox"/> Unrelated (8)	<input type="checkbox"/> Less than 6 months (1) <input type="checkbox"/> 6 months or more (2)	<input type="checkbox"/> Available (1) <input type="checkbox"/> Unavailable, but local (2) <input type="checkbox"/> Unavailable (for whole survey duration) (3) <input type="checkbox"/> Refused (4) <input type="checkbox"/> Unavailable After Revisit (5)	<hr/> <hr/>	
02			<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)		<input type="checkbox"/> HH head/respondent (1) <input type="checkbox"/> Spouse (2) <input type="checkbox"/> Father/mother (3) <input type="checkbox"/> Grandparent (4) <input type="checkbox"/> Son/daughter (5) <input type="checkbox"/> Grandchild (6) <input type="checkbox"/> Other blood relation (7) <input type="checkbox"/> Unrelated (8)	<input type="checkbox"/> Less than 6 months (1) <input type="checkbox"/> 6 months or more (2)	<input type="checkbox"/> Available (1) <input type="checkbox"/> Unavailable, but local (2) <input type="checkbox"/> Unavailable (for whole survey duration) (3) <input type="checkbox"/> Refused (4) <input type="checkbox"/> Unavailable After Revisit (5)	<hr/> <hr/>	
03			<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)		<input type="checkbox"/> HH head/respondent (1) <input type="checkbox"/> Spouse (2) <input type="checkbox"/> Father/mother (3) <input type="checkbox"/> Grandparent (4) <input type="checkbox"/> Son/daughter (5) <input type="checkbox"/> Grandchild (6) <input type="checkbox"/> Other blood relation (9) <input type="checkbox"/> Unrelated (8)	<input type="checkbox"/> Less than 6 months (1) <input type="checkbox"/> 6 months or more (2)	<input type="checkbox"/> Available (1) <input type="checkbox"/> Unavailable, but local (2) <input type="checkbox"/> Unavailable (for whole survey duration) (3) <input type="checkbox"/> Refused (4) <input type="checkbox"/> Unavailable After Revisit (5)	<hr/> <hr/>	

04									
[ + ]									
							* Reason for refusal	<input checked="" type="checkbox"/> Select one if any participant exam status = (4)	<input type="checkbox"/> Too busy (1) <input type="checkbox"/> Not interested (2) <input type="checkbox"/> Too sick (3) <input type="checkbox"/> Other (4)**
							**Specify other	 text if reason for refusal = (4)	_____
Household questionnaire complete. The next step is General questionnaire for each eligible individual in the house.									



## B. GENERAL QUESTIONNAIRE


### B1. Enumeration and Demographics


<b>1. Date</b>	☞ Day / Month / Year (dd/mm/yyyy)	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
<b>2. Interviewer id</b>	☒ Select one (list to be generated in app)	_____		
<b>3. Region number</b>	☞ 2 digit number 01 – 09 copied from participant slip, autofill	_____		
<b>4. Cluster Number</b>	☞ 3 digit number 001-100 copied from household roster, autofill	_____		
<b>5. Household Number</b>	☞ 2 digit number 01-30 copied from household roster, autofill	_____		
<b>6. Individual Number</b>	☞ 2 digit number 01-30 [LINE NUMBER FROM HOUSEHOLD ROSTER], autofill	_____		
<b>7. Study ID Number</b>	☞ Cluster Number –HH- Individual Number, autofill	--	--	
<b>8. Date of the interview</b>	☞ Day / Month / Year (dd/mm/yyyy)	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
<b>9. First name</b>	☞ text confirmed from participant slip, autofill	_____		
<b>10. Last name</b>	☞ text confirmed from participant slip, autofill	_____		
<b>11. Common name</b>	☞ text	_____		
<b>12. Mother's First name</b>	☞ text	_____		
<b>13. Mother's Last name</b>	☞ text	_____		
<b>14. Village name</b>	☞ text	_____		
<b>15. Telephone number</b>	☞ 12 digit number, autofill			
<b>16. Whose telephone is this?</b>	☞			
<b>17. Telephone number 2</b>	☞ 12 digit number, autofill			
<b>18. Whose telephone is this?</b>	☞			
<b>19. Sex</b>	☒ Select one	<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)		
<b>20. ID Number</b>	☞ from ID Card if available			
<b>21. Date of birth</b>	Date / Month / Year from ID Card if available If year only known enter 99/99/YYYY	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
<b>22. Age</b>	☒ Select one each	<input type="checkbox"/> (Year 0-105)		<input type="checkbox"/> (Months 1-12)
<b>23. Marital status</b>	☒ Select one each, if B1 q22 >15 years	<input type="checkbox"/> Married/living together (1) <input type="checkbox"/> Divorced/separated (2) <input type="checkbox"/> Widowed (3) <input type="checkbox"/> Single (4)		
<b>CONSENT</b>	☒ Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)		
<b>24. Responder</b>	☒ Select one	<input type="checkbox"/> Participant (1) <input type="checkbox"/> Proxy (2)		

<b>25. Specify proxy name and relationship to person</b>	☞ text if A1.24=2	_____
<b>26. Can you/[name] read well, a little or not at all?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Well (1) <input type="checkbox"/> A little (2) <input type="checkbox"/> Not at all (3)
<b>27. Can you/[name] write well, a little or not at all?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Well (1) <input type="checkbox"/> A little (2) <input type="checkbox"/> Not at all (3)
<b>28. What is the highest level of education you completed or are currently attending?</b>	<input checked="" type="checkbox"/> Select one if participant age B1.22 18+ years	<input type="checkbox"/> None (1) <input type="checkbox"/> Attended but did not complete primary school (2) <input type="checkbox"/> Completed primary school (3) <input type="checkbox"/> Attended but did not complete secondary school (4) <input type="checkbox"/> Completed secondary school (5) <input type="checkbox"/> Vocational/technical school (6) <input type="checkbox"/> Tertiary education (7)
<b>29. Do you/[name] currently attend or have you ever attended school?</b>	<input checked="" type="checkbox"/> Select one if participant age B1.22 <18 years	<input type="checkbox"/> Never attended (1) <input type="checkbox"/> Ever previously attended (2) <input type="checkbox"/> Currently attending (3)
<b>30. What best describes your/[name]'s current work situation?</b>	<input checked="" type="checkbox"/> Select one if participant age B1.22 18+ years	<input type="checkbox"/> Looking after housework, children/elderly (1) <input type="checkbox"/> In regular paid work (2) <input type="checkbox"/> In irregular paid work (3) <input type="checkbox"/> Retired (old age/disability) (4) <input type="checkbox"/> Self-employed (5) <input type="checkbox"/> Unemployed seeking work (6) <input type="checkbox"/> Unemployed not seeking work (7) <input type="checkbox"/> Volunteer (8) <input type="checkbox"/> Student (9) <input type="checkbox"/> Other (10)
<b>31. Specify other</b>	☞ text if A1.30=10	_____

## B2. Self-reported functioning

### B2.1 Washington Group Question Extended Set

 Only complete if participant is >17 years old (B1.22 >17 years old)



 **Preamble: Now I am going to ask you some questions about your ability to do different activities, and how you have been feeling.**

1. [Do/Does] [you/he/she] wear glasses?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused (88) <input type="checkbox"/> Don't know (99)			
2. [Do/Does] [you/he/she] have difficulty seeing, even when wearing [your/his/her] glasses	<input checked="" type="checkbox"/> Select one if B2.1 q1 = (1)	No, no difficulty (1)	Yes, some difficulty (2)	Yes, a lot of difficulty (3)	Cannot do at all (4)
3. [Do/Does] [you/he/she] have difficulty seeing?	<input checked="" type="checkbox"/> Select one if B2.1 q1 = (0)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. [Do/does] [you/he/she] have difficulty clearly seeing someone's face across a room [If B2.1 q1 = (1):even when wearing [your/his/her] glasses]?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. [Do/does] [you/he/she] have difficulty clearly seeing the picture on a coin [If B2.1 q1 = (1):even when wearing [your/his/her] glasses]?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. [Do/Does] [you/he/she] use a hearing aid?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know			
7. [Do/Does] [you/he/she] have difficulty hearing, even when using a hearing aid?	<input checked="" type="checkbox"/> Select one if B2.1 q6 = (1)	No, no difficulty (1)	Yes, some difficulty (2)	Yes, a lot of difficulty (3)	Cannot do at all (4)
8. [Do/Does] [you/he/she] have difficulty hearing?	<input checked="" type="checkbox"/> Select one if B2.1 q6 = (0)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Do/does] [you/he/she] have difficulty hearing what is said in a conversation with one other person in a quiet room [If B2.1 q6=(1): even when using [your/his/her] hearing aid(s)]?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. [[Do/does] [you/he/she] have difficulty hearing what is said in a conversation with one other person in a noisier room [If B2.1 q6=(1): even when using [your/his/her] hearing aid(s)]?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. [Do/Does] [you/he/she] have difficulty walking or climbing steps? Would you say... <i>[Read response categories]</i>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. [Do/does] [you/he/she] use any equipment or receive help for getting around?	<input checked="" type="checkbox"/> Select one If B2.1 q12= (0), refused or don't know skip to q14	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused (88) <input type="checkbox"/> Don't know (99)			

<b>13. [Do/does] [you/he/she] use any of the following?</b> <b>Interviewer: Read the following list and record all affirmative responses:</b>	<input checked="" type="checkbox"/> Select as many as apply	Yes (1)	No (0)	Refused (88)	Don't know (99)
<b>a. Cane or walking stick?</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>b. Walker or Zimmer frame?</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>c. Crutches?</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>d. Wheelchair or scooter?</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>e. Artificial limb (leg/foot)?</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>f. Someone's assistance?</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>g. Other (please specify):</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>14. [Do/Does] [you/he/she] have difficulty walking 100 meters on level ground, that would be about the length of one football field or one city block [If q12 = 1: without the use of [your/his/her] aid]? Would you say... [Read response categories] [Note: Allow national equivalents for 100 metres.]</b>	<input checked="" type="checkbox"/> Select one If B2.1 q14= (4), skip to q16	No, no difficulty (1)	Yes, some difficulty (2)	Yes, a lot of difficulty (3)	Cannot do at all (4)
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>15. [Do/Does] [you/he/she] have difficulty walking half a km on level ground, that would be the length of five football fields or five city blocks [If q12 = 1: without the use of [your/his/her] aid]? Would you say... [Read response categories] [Note: Allow national equivalents for 500 metres.]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>16. [Do/Does] [you/he/she] have difficulty walking up or down 12 steps? Would you say... [Read response categories]</b>	<input checked="" type="checkbox"/> Select one If q12= (0), skip to q19 If q13=d(1) skip to q19	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>17. [Do/Does] [you/he/she] have difficulty walking 100 meters on level ground, that would be about the length of one football field or one city block, when using [your/his/her] aid? Would you say... [Read response categories]</b>	<input checked="" type="checkbox"/> Select one If q17= (4), skip to q19	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>18. [Do/Does] [you/he/she] have difficulty walking half a km on level ground, that would be the length of five football fields or five city blocks, when using [your/his/her] aid? Would you say... [Read response categories]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>19. Using [your/his/her] usual language, [do/does] [you/he/she] have difficulty communicating, for example understanding or being understood? Would you say... [Read response categories]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>20. [Do/does] [you/he/she] use sign language?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused (88) <input type="checkbox"/> Don't know (99)			
<b>21. [Do/does] [you/he/she] have difficulty remembering or concentrating? Would you say... [Read response categories]</b>	<input checked="" type="checkbox"/> Select one	No, no difficulty (1)	Yes, some difficulty (2)	Yes, a lot of difficulty (3)	Cannot do at all (4)
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>22. [Do/Does] [you/he/she] have difficulty remembering or concentrating or both? Would you say... [Read response categories]</b>	<input checked="" type="checkbox"/> Select one If q21=2,3,4 If q22=2, skip to q25	Difficulty remembering only (1)	Difficulty concentrating only (2)	Difficulty with both remembering and concentrating (3)	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

23. How often [do/does] [you/he/she] have difficulty remembering? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one If q22=1,3	Sometim es (1)	Often (2)	All the time (3)	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
24. [Do/Does] [you/he/she] have difficulty remembering a few things, a lot of things, or almost everything? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one If q22=1,3	A few things (1)	A lot of things (2)	Almost everything (3)	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
25. [Do/does] [you/he/she] have difficulty with self care, such as washing all over or dressing? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. [Do/Does] [you/he/she] have difficulty raising a 2 liter bottle of water or soda from waist to eye level? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. [Do/Does] [you/he/she] have difficulty using [your/his/her] hands and fingers, such as picking up small objects, for example, a button or pencil, or opening or closing containers or bottles? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>INTERVIEWER: IF RESPONDENT ASKS WHETHER THEY ARE TO ANSWER ABOUT THEIR EMOTIONAL STATES AFTER TAKING MOOD-REGULATING MEDICATIONS, SAY: "Please answer according to whatever medication [you were/he was/she was] taking."</b>					
28. How often [do/does] [you/he/she] feel worried, nervous or anxious? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Daily (1) <input type="checkbox"/> Weekly (2) <input type="checkbox"/> Monthly (3) <input type="checkbox"/> A few times a year (4) <input type="checkbox"/> Never (5) <input type="checkbox"/> Refused (6) <input type="checkbox"/> Don't know (7)			
29. [Do/Does] [you/he/she] take medication for these feelings?	<input checked="" type="checkbox"/> Select one If q28= (5) and q29= (0), skip to q31	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know			
30. Thinking about the last time [you/he/she] felt worried, nervous or anxious, how would [you/he/she] describe the level of these feelings? Would [you/he/she] say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> A little (1) <input type="checkbox"/> A lot (2) <input type="checkbox"/> Somewhere in between a little and a lot (3) <input type="checkbox"/> Refused (4) <input type="checkbox"/> Don't know			
31. How often [do/does] [you/he/she] feel depressed? Would [you/he/she] say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Daily (1) <input type="checkbox"/> Weekly (2) <input type="checkbox"/> Monthly (3) <input type="checkbox"/> A few times a year (4) <input type="checkbox"/> Never (5) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know			
32. [Do/Does] [you/he/she] take medication for depression?	<input checked="" type="checkbox"/> Select one If q31= (5) and q32= (0), skip to q34	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know			
33. Thinking about the last time [you/he/she] felt depressed, how depressed did [you/he/she] feel? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> A little (1) <input type="checkbox"/> A lot (2) <input type="checkbox"/> Somewhere in between a little and a lot (3) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know			

<i>Interviewer: If respondent asks whether they are to answer about their pain when taking their medications, say: "Please answer according to whatever medication [you were/he was/she was] taking."</i>					
34. In the past 3 months, how often did [you/he/she] have pain? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one If q34= (1), skip to q36	Never (1)	Some days (2)	Most days (3)	Every day (4)
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Thinking about the last time [you/he/she] had pain, how much pain did [you/he/she] have? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	A little (1)	A lot (2)	Somewhere in between a little and a lot (3)	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
36. In the past 3 months, how often did [you/he/she] feel very tired or exhausted? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one If q36= (1), skip to Section B3	Never (1)	Some days (2)	Most days (3)	Every day (4)
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. Thinking about the last time [you/he/she] felt very tired or exhausted, how long did it last? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	Some of the day (1)	Most of the day (2)	All of the day (3)	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
38. Thinking about the last time [you/he/she] felt this way, how would you describe the level of tiredness? Would you say... [Read response categories]	<input checked="" type="checkbox"/> Select one	A little (1)	A lot (2)	Somewhere in between a little and a lot (3)	
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	


<b>B2.2 Child functioning module 5-17 years</b>					
 <b>Only complete if participant is 5-17 years (B1.22 = 5-17 years old)</b>					
 <b>Preamble: Now I am going to ask you some questions about [you/] your child's] ability to do different activities.</b>					
1. Does [name] wear glasses?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			
		No, no difficulty (1)	Yes, some difficulty (2)	Yes, a lot of difficulty (3)	Cannot do at all (4)
2. Does [name] have difficulty seeing?	<input checked="" type="checkbox"/> Select one If B2.2 q1 = (0), then skip to q4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. When wearing his/her glasses does [name] have difficulty seeing?	<input checked="" type="checkbox"/> Select one if B2.2 q1 = (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Does [name] use a hearing aid?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			
5. Does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one Only if B2.2 q4 = (0), then skip to q7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. When using his/her hearing aid does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one only if B2.2 q4 = (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Does [name] use any equipment or receive assistance for walking?	<input checked="" type="checkbox"/> Select one If response is B2.2. q7= (0), skip to 12	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			
8. Without using his/her equipment or assistance, does [name] have difficulty walking 100 meters on level ground? That would be about the length of 1 football field.	<input checked="" type="checkbox"/> Select one Only if B2.2 q7 = (1) IF B2.2 q8= (3) or (4) then skip to q10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Without using his/her equipment or assistance, does [name] have difficulty walking 500 meters on level ground? That would be about the length of 5 football fields.	<input checked="" type="checkbox"/> Select one if B2.2 q7 = (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. When using his/her equipment or assistance, does [name] have difficulty walking 100 meters on level ground? That would be about the length of 1 football field.	<input checked="" type="checkbox"/> Select one if B2.2 q7 = (1) IF B2.2 q10= (3) or (4) then skip to q14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. When using his/her equipment or assistance, does [name] have difficulty walking 500 meters on level ground? That would be about the length of 5 football fields.	<input checked="" type="checkbox"/> Select one if B2.2 q7 = (1) IF B2.2 q11= (1), (2), (3) or (4) then skip to q14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Compared with children of the same age, does [name] have difficulty walking 100 meters on level ground? That would be about the length of 1 football field.	<input checked="" type="checkbox"/> Select one if B2.2 q7 = (0) IF B2.2 q12=(3) , (4) then skip to q14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Compared with children of the same age, does [name] have difficulty walking 500 meters on level ground? That would be about the length of 5 football fields.	<input checked="" type="checkbox"/> Select one if B2.2 q7 = (0)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Does [name] have difficulty with self-care such as feeding or dressing him/herself?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. When [name] speaks, does he/she have difficulty being understood by people inside of this household?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. When [name] speaks, does he/she have difficulty being understood by people outside of this household?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Compared with children of the same age, does [name] have difficulty learning things?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Compared with children of the same age, does [name] have difficulty remembering things?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Does [name] have difficulty concentrating on an activity that he/she enjoys doing?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Does [name] have difficulty accepting changes in his/her routine?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. Compared with children of the same age, how much difficulty does [name] have controlling his/her behaviour?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Does [name] have difficulty making friends?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. How often does [name] seem very anxious, nervous or worried?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Daily (1) <input type="checkbox"/> Weekly (2) <input type="checkbox"/> Monthly (3) <input type="checkbox"/> A few times a year (4) <input type="checkbox"/> Never (5) <input type="checkbox"/> Refused (88) <input type="checkbox"/> Don't know (99)			

24. How often does [name] seem very sad or depressed?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Daily (1) <input type="checkbox"/> Weekly (2) <input type="checkbox"/> Monthly (3) <input type="checkbox"/> A few times a year (4) <input type="checkbox"/> Never (5) <input type="checkbox"/> Refused (88) <input type="checkbox"/> Don't know (99)
---	--	---

**B2.3 Child functioning module 2-4 years**

 **Only complete if participant is 2-4 years (B1.22 = 2-4 years)**

 **Preamble: Now I am going to ask you some questions about your child's ability to do different activities.**


1. Does [name] wear glasses?	<input checked="" type="checkbox"/> Select one (If yes, skip to q3)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			
		No, no difficulty (1)	Yes, some difficulty (2)	Yes, a lot of difficulty (3)	Cannot do at all (4)
2. Does [name] have difficulty seeing?	<input checked="" type="checkbox"/> Select one if B2.3 q1 = (0), then skip to q4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. When wearing his/her glasses does [name] have difficulty seeing?	<input checked="" type="checkbox"/> Select one if B2.3 q1 = (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Does [name] use a hearing aid?	<input checked="" type="checkbox"/> Select one (If yes, skip to q6)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			
5. Does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one if B2.3 q4 = (0), then skip to q7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. When using his/her hearing aid does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one if B2.3 q4 = (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Does [name] use any equipment or receive assistance for walking?	<input checked="" type="checkbox"/> Select one if B2.3 q7 = (0) skip to q10	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)			
8. Without using his/her equipment or assistance, does [name] have difficulty walking?	<input checked="" type="checkbox"/> Select one if B2.3 q7 = (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. When using his/her equipment or assistance, does [name] have difficulty walking?	<input checked="" type="checkbox"/> Select one if B2.3 q9 = (1), (2), (3), (4) go to q11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Compared with children of the same age, does [name] have difficulty walking?	<input checked="" type="checkbox"/> Select one if B2.3 q7 = (0)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Compared with children of the same age, does [name] have difficulty picking up small objects with his/her hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Does [name] have difficulty understanding you?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. When [name] speaks, do you have difficulty understanding him/her?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Compared with children of the same age, does [name] have difficulty learning things?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Compared with children of the same age, does [name] have difficulty playing?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Compared with children of the same age, how much does [name] kick, bite or hit other children or adults?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Not at all (1) <input type="checkbox"/> The same or less (2) <input type="checkbox"/> More (3)			



		<input type="checkbox"/> A lot more (4) <input type="checkbox"/> Refused (5) <input type="checkbox"/> Don't know (6)
--	--	--



### B3 Rapid Assessment of Musculoskeletal Impairment screening questions


All participants

		Yes	No
		(1)	(0)
 <b>Preamble: We will ask you questions now to ascertain whether you experience any problems with your body that affect your mobility.</b>			
1. Is any part of your/[Name] body missing or misshapen?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you/[Name] have any difficulty or pain using your arms? (including hands)	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you/[Name] have any difficulty or pain using your legs? (including feet)	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
4. Do you/[Name] have any difficulty using any other part of your body?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
5. Do you/[Name] need a mobility aid or prosthesis?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
6. Do you/[Name] have convulsions, involuntary movement, rigidity or loss of consciousness?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
7. If yes to any of the above: has it lasted >1 month?	<input checked="" type="checkbox"/> Select one if any one B3 q1 – B3 q6 = (1)	<input type="checkbox"/>	<input type="checkbox"/>
8. If yes to any of the above: is it permanent?	<input checked="" type="checkbox"/> Select one if any one B3 q1 – B3 q6 = (1)	<input type="checkbox"/>	<input type="checkbox"/>
9. CONFIRM MOBILITY MODULE NEEDED? MOBILITY MODULE IS NEEDED IF ANSWER TO AT LEAST ONE Q 1-6 IS YES AND ANSWER TO AT LEAST ONE "DURATION" QUESTION IS YES.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>

### B4 Self-report Assistive product use

All participants

 <b>Preamble: We will ask you some questions now about items that may help with you/[name]. These are called assistive products and we will show you examples to help you answer the questions.</b>		
<p>1. Have you/[name] ever heard of any of these assistive products that can help some people manage health problems?</p>	 Show images and read aloud the items and descriptions if needed in the list  <input checked="" type="checkbox"/> Select as many as apply	<p><b>A. VISION</b></p> <input type="checkbox"/> Long distance glasses (1) <input type="checkbox"/> Reading glasses (2) <input type="checkbox"/> Low vision glasses (3) <input type="checkbox"/> Magnifying glasses, telescopes (4) <input type="checkbox"/> White cane (5) <input type="checkbox"/> Audio players* (6) <input type="checkbox"/> Talking and touching watches* (7)  <p><b>B. HEARING</b></p> <input type="checkbox"/> Alarm signallers (1) <input type="checkbox"/> Hearing aids (2)  <p><b>C. MOBILITY</b></p>

		<input type="checkbox"/> Canes, Sticks, tripod and quadripod (1) <input type="checkbox"/> Crutches (2) <input type="checkbox"/> Orthoses (3) <input type="checkbox"/> Prostheses (4) <input type="checkbox"/> Therapeutic/protective footwear (5) <input type="checkbox"/> Walking frame or rollators (6) <input type="checkbox"/> Wheelchairs (7)  <b>D. COMMUNICATION</b> <input type="checkbox"/> Communication boards or books (1)  <b>E. COGNITION</b> <input type="checkbox"/> Pill organisers (1) <input type="checkbox"/> White boards- simple memory supports (2)  <b>F. SELF-CARE AND ENVIRONMENT</b> <input type="checkbox"/> Toilet chair/commode (1) <input type="checkbox"/> Shower/bath chair (2) <input type="checkbox"/> Incontinence products, absorbent (3) <input type="checkbox"/> Ramps (4) <input type="checkbox"/> Grab bars (5)  <b>G.ALL</b> <input type="checkbox"/> Smart phones/tablets/PDA (1)
<b>2. [Do/does] you/[name] use any assistive products to help you/him/her manage any health problems?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) → SKIP to end of general questionnaire
<b>3. If yes, which ones [do/does] you/[name] use?</b>	 Show images and read aloud the items and descriptions if needed in the list.  <input checked="" type="checkbox"/> Select as many as apply	<b>A. VISION</b> <input type="checkbox"/> Long distance glasses (1) <input type="checkbox"/> Reading glasses (2) <input type="checkbox"/> Low vision glasses (3) <input type="checkbox"/> Magnifying glasses, telescopes (4) <input type="checkbox"/> White cane (5) <input type="checkbox"/> Audio players* (6) <input type="checkbox"/> Talking and touching watches* (7)  <b>B. HEARING</b> <input type="checkbox"/> Alarm signallers (1) <input type="checkbox"/> Hearing aids (2)  <b>C. MOBILITY</b> <input type="checkbox"/> Canes, Sticks, tripod and quadripod (1) <input type="checkbox"/> Crutches (2) <input type="checkbox"/> Orthoses (3) <input type="checkbox"/> Prostheses (4) <input type="checkbox"/> Therapeutic/protective footwear (5) <input type="checkbox"/> Walking frame or rollators (6) <input type="checkbox"/> Wheelchairs (7)  <b>D. COMMUNICATION</b> <input type="checkbox"/> Communication boards or books (1)  <b>E. COGNITION</b>

		<input type="checkbox"/> Pill organisers (1) <input type="checkbox"/> White boards- simple memory supports (2)  <b>F. SELF-CARE AND ENVIRONMENT</b> <input type="checkbox"/> Toilet chair/commode (1) <input type="checkbox"/> Shower/bath chair (2) <input type="checkbox"/> Incontinence products, absorbent (3) <input type="checkbox"/> Ramps (4) <input type="checkbox"/> Grab bars (5)  <b>G.ALL</b> <input type="checkbox"/> Smart phones/tablets/PDA (1) <input type="checkbox"/> Other (2)								
<b>4. Specify if other</b>	<del>if</del> B4.q3= (G2)	_____								
<b>5. Do you/[name] face any problems using any of [your/his/her] assistive products?</b>	<input checked="" type="checkbox"/> Select one if B4 q2=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Don't Know (88) <input type="checkbox"/> Refused (99)								
		} <span style="border: 1px solid black; padding: 2px;">SKIP to B4 q7</span>								
<b>6. Which of the following problems do you/[name] currently face with any of your/his/her assistive products?</b>		<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>No</th> <th>Yes</th> <th>Don't know</th> <th>Refused</th> </tr> </thead> <tbody> <tr> <td>(0)</td> <td>(1)</td> <td>(88)</td> <td>(99)</td> </tr> </tbody> </table>	No	Yes	Don't know	Refused	(0)	(1)	(88)	(99)
No	Yes	Don't know	Refused							
(0)	(1)	(88)	(99)							
<b>6.1 Assistive product is not the right size or is not comfortable</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.2 Assistive product is not suitable for your/[name]'s home or surroundings</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.3 Assistive product is broken or needs replacement parts</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.4 You/[name] [do/does] not know how to use the assistive product</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.5. You/[name] need/s help to use your/his/her assistive product</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.6. You/[name] feel like people treat you/[name] differently when you/[name] use your assistive product</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.7. Are there any other problems that you/[name] face using any of your/his/her assistive products?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>								
<b>6.8 Specify if Other</b>	<del>if</del> B4 q6.7= (1)	_____								
<b>Repeat questions 5 &amp; 6 for each assistive product selected in q3</b>										
<b>7. Where did you/[name] get your/his/her assistive products from?</b>	<input checked="" type="checkbox"/> Select as many as apply	<input type="checkbox"/> Public sector: government facility, public hospital (1) <input type="checkbox"/> NGO sector: non-profit facility (2) <input type="checkbox"/> Private sector: private facility/hospital/clinic/shop/store (3) <input type="checkbox"/> Family and friends (4) <input type="checkbox"/> Self-made (5) <input type="checkbox"/> Other (specify) (6) <input type="checkbox"/> Don't know (88)								
<b>7a. Specify if Other</b>	<del>if</del> B4 q7a= (1)	_____								
<b>8. Who paid for your/his/her assistive products?</b>	<input checked="" type="checkbox"/> Select as many as apply	<input type="checkbox"/> Government (1) <input type="checkbox"/> NGO/Charity (2) <input type="checkbox"/> Employer/School (3) <input type="checkbox"/> Insurance (4) <input type="checkbox"/> Paid out of pocket (self) (5) <input type="checkbox"/> Family/friends (6) <input type="checkbox"/> Other (specify) (7)								

		<input type="checkbox"/> Don't know (88)
<b>8a. Specify if Other</b>	<input checked="" type="checkbox"/> if B4 q8= (7)	_____
<b>9. How far did you/[name] have to travel to get your/his/her assistance products?</b>	<input checked="" type="checkbox"/> Select as many as apply	<input type="checkbox"/> Less than 5km (1) <input type="checkbox"/> 6-25km (2) <input type="checkbox"/> 26-50km (3) <input type="checkbox"/> 51-100km (4) <input type="checkbox"/> More than 100km (5) <input type="checkbox"/> Don't know (88)
<b>10. Over the last month how satisfied are you/[name] with your/his/her assistive products/s?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Very dissatisfied (1) <input type="checkbox"/> Dissatisfied (2) <input type="checkbox"/> Neither satisfied or dissatisfied (3) <input type="checkbox"/> Quite satisfied (4) <input type="checkbox"/> Very satisfied (5) <input type="checkbox"/> Refused/Don't know (88)
<b>11. You mentioned you were dissatisfied with a product. What are the reasons?</b>	<input checked="" type="checkbox"/> Only if B4 q10=1 or 2, select as many as apply	<input type="checkbox"/> Fit / size / shape (1) <input type="checkbox"/> Pain / discomfort (2) <input type="checkbox"/> Weight (3) <input type="checkbox"/> Appearance (4) <input type="checkbox"/> Safety (5) <input type="checkbox"/> Durability (6) <input type="checkbox"/> Other (Specify) (7)
<b>11a. Specify if Other</b>	<input checked="" type="checkbox"/> if B4 q11= (7)	_____
<b>12. Thinking about your/his/her assistive products, how satisfied are you/[name] with the assessment and training received?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Very dissatisfied (1) <input type="checkbox"/> Dissatisfied (2) <input type="checkbox"/> Neither satisfied or dissatisfied (3) <input type="checkbox"/> Quite satisfied (4) <input type="checkbox"/> Very satisfied (5) <input type="checkbox"/> NOT APPLICABLE (DO NOT READ) (ASSESSMENT/TRAINING NOT NEEDED) (6) <input type="checkbox"/> Refused/Don't know (88)
<b>13. You mentioned you were dissatisfied with services, what were the reasons?</b>	<input checked="" type="checkbox"/> Only if B4 q12=1 or 2, select as many as apply	<input type="checkbox"/> Procedure (1) <input type="checkbox"/> Waiting time (2) <input type="checkbox"/> Quality of care (3) <input type="checkbox"/> Staff (4) <input type="checkbox"/> Rights (5) <input type="checkbox"/> Distance/time (6) <input type="checkbox"/> Costs (7) <input type="checkbox"/> Other (Specify) (8)
<b>13a. Specify if Other</b>	<input checked="" type="checkbox"/> if B4 q13= (8)	_____
<b>14. How satisfied are you/[name] with the repair, maintenance and follow up services based on your/his/her last experience?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Very dissatisfied (1) <input type="checkbox"/> Dissatisfied (2) <input type="checkbox"/> Neither satisfied or dissatisfied (3) <input type="checkbox"/> Quite satisfied (4) <input type="checkbox"/> Very satisfied (5) <input type="checkbox"/> NOT APPLICABLE (HAVE NOT NEEDED FOLLOW UP) – DO NOT READ (6) <input type="checkbox"/> Refused/Don't know (88)
<b>15. Is your/his/her assistive product suitable for your/his/her home and surroundings?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Not at all (1) <input type="checkbox"/> Not much (2) <input type="checkbox"/> Moderately (3) <input type="checkbox"/> Mostly (4)

		<input type="checkbox"/> Completely (5) <input type="checkbox"/> REFUSED/DON'T KNOW (DO NOT READ) (88)
<p><b>16. To what extent does your/his/her assistive product help you do what you/[name] want?</b></p> <p><i>In terms of doing household activities, self-care, going to school, college or work, visiting friends or neighbours or going for leisure or recreation.</i></p>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Not at all (1) <input type="checkbox"/> Not much (2) <input type="checkbox"/> Moderately (3) <input type="checkbox"/> Mostly (4) <input type="checkbox"/> Completely (5) <input type="checkbox"/> REFUSED/DON'T KNOW (DO NOT READ) (88)
<p><b>17. You mentioned that your/his/her products do not always help you/[name] do what you/[name] want. What are the reasons?</b></p>	<input checked="" type="checkbox"/> Only if B4 q16=1 or 2, select as many as apply	<input type="checkbox"/> Fit/size/shape (1) <input type="checkbox"/> Pain/discomfort (2) <input type="checkbox"/> Weight (3) <input type="checkbox"/> Appearance (4) <input type="checkbox"/> Safety (5) <input type="checkbox"/> Durability (6) <input type="checkbox"/> Road/transport accessibility (7) <input type="checkbox"/> Accessibility at home (8) <input type="checkbox"/> Accessibility at work/school (9) <input type="checkbox"/> Accessibility public facilities (10) <input type="checkbox"/> Attitudes of other people (11) <input type="checkbox"/> Other (Specify) (12)
<p><b>17a. Specify if Other</b></p>	<input checked="" type="checkbox"/> if B4 q17= (12)	<hr/>
<p><b>18. Thinking about the places you/[name] need to visit like schools, workplaces, public spaces, can you/[name] use the assistive products as much as your/his/her want in those places?</b></p> <p><i>PROMPT TO ASK WHAT THE PROBLEM IS. DISCUSS THAT THIS QUESTION IS ASKING ABOUT THE PLACE/ENVIRONMENT/BARRIERS, NOT THE PERSON OR PRODUCT.</i></p>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Not at all (1) <input type="checkbox"/> Not much (2) <input type="checkbox"/> Moderately (3) <input type="checkbox"/> A lot (4) <input type="checkbox"/> Completely (5) <input type="checkbox"/> REFUSED/DON'T KNOW (DO NOT READ) (88)

## C. VISION MODULE



### OPTION 1

All participants should complete the vision questionnaire.



### OPTION 2

Only complete Vision questionnaire if:


- Participant >17yo: B2.1 q1=1 (wears glasses) or some or more difficulty seeing to B2.1 q2=2/3/4 or B2.1 q3=2/3/4 in Washington Group Extended Set
- Participant 4-17yo: B2.2 q1=1 (wears glasses) or some or more difficulty seeing to B2.2 q2=2/3/4 or B2.2 q3=2/3/4 in Washington Group CFM
- Participants 2 to 4yo: B2.3 q1=1 (wears glasses) or some or more difficulty seeing to B2.3 q2=2/3/4 or B2.3 q3=2/3/4 in Washington Group CFM
- Participants 0<2yo: tbc

### C1. Enumeration linking data


1. Date	☞ Day / Month / Year (dd/mm/yyyy)	<i>dd</i>	<i>mm</i>	<i>yyyy</i>							
2. Interviewer id	☒ Select one (list to be generated in app)	_____									
3. Region number	☞ 2 digit number 01 – 09 copied from participant slip, autofill	_____									
4. Cluster Number	☞ 3 digit number 001-100 copied from household roster, autofill	_____									
5. Household Number	☞ 2 digit number 01-30 copied from household roster, autofill	_____									
6. Individual Number	☞ 2 digit number 01-30 [LINE NUMBER FROM HOUSEHOLD ROSTER], autofill	_____									
7. Study ID Number	☞ Cluster Number –HH- Individual Number, autofill				--				--		
8. Date of the interview	☞ Day / Month / Year (dd/mm/yyyy), autofill	<i>dd</i>	<i>mm</i>	<i>yyyy</i>							
9. First name	☞ text confirmed from participant slip, autofill	_____									
10. Last name	☞ text confirmed from participant slip, autofill	_____									
11. Common name	☞ text, autofill	_____									
12. Telephone number	☞ 12 digit number, autofill										
13. Whose telephone is this?	☞ autofill	_____									
14. Telephone number 2	☞ 12 digit number, autofill										
15. Whose telephone is this?	☞ autofill	_____									
16. Sex	☒ Select one, autofill	<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)									
17. Age	☒ Select one each, autofill	<input type="checkbox"/> (Year 0-105)					<input type="checkbox"/> (Months 1-12)				


<b>CONSENT</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>18. Availability for VISION module</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Available (1) <input type="checkbox"/> Not currently available, revisit (2) <input type="checkbox"/> Will not be available for duration of survey (unavailable) (3) <input type="checkbox"/> Refused (4)
<b>18a. Scheduling notes</b>	text	_____
<b>18b. Reason for refusal</b>	text	_____
<b>19. Responder</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Participant (1) <input type="checkbox"/> Proxy (2)
<b>20. Specify proxy name and relationship</b>	text if C1.19=2	_____

<b>C2. Distance Visual Acuity</b>			
<b>Only complete this vision section if participant age <math>\geq 5</math></b>			
<b>Preamble:</b> First, I will ask you a few questions and then test your vision.			
<b>PARTICIPANT REPORTED ALREADY USING THESE ASSISITIVE PRODUCTS</b>	<input checked="" type="checkbox"/> Autofill from B4 q3	<b>A. VISION</b> <input type="checkbox"/> Long distance glasses (1) <input type="checkbox"/> Reading glasses (2)	
<b>1. Do you/[name] have your glasses to help you see things far away?</b>	<input checked="" type="checkbox"/> Select one IF B4 q3A=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	
<b>2. What is the age of your distance glasses?</b>	<input checked="" type="checkbox"/> Select one IF B4 q3A=1	<input type="checkbox"/> Less than 2 years (1) <input type="checkbox"/> 2 to 5 years (2) <input type="checkbox"/> More than 5 years (3)	
<b>3. Do you/[name] have your glasses to help you see things up close?</b>	<input checked="" type="checkbox"/> Select one IF B4 q3A=2	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	
<b>SELECT ACUITY TEST METHOD</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Peek Acuity (1) <input type="checkbox"/> E Chart (2)	
<b>Please take off any glasses that you are wearing</b>			
<b>4. Uncorrected distance visual acuity</b>	Auto-Recorded LogMAR result from Peek Acuity via Android plug in or radio button by threshold.	<b>R</b>	<b>L</b>
<b>Please put your distance or aphakic glasses on</b>			
<b>5. Corrected distance visual acuity</b>	If C2 q1=(1), auto-Recorded LogMAR result from Peek Acuity via Android plug in or radio button by threshold.	<b>R</b>	<b>L</b>

<b>6. Presenting distance visual acuity</b>	Auto-populate: IF C2 q1=(0) then display C2 q4re and C2 q4le result, OR IF C2 q1=(1) then display C2 q5re result and C2 q5le	<b>R</b>	<b>L</b>
<b>7. Pinhole distance visual acuity</b>	Auto-Recorded LogMAR result from Peek Acuity via Android plug in if (C2 q4>0.3 & C2 q1=(0)) or (C2 q5>0.3)	<b>R</b>	<b>L</b>
<b>8. IS PRESENTING &lt;6/12 AND PINHOLE IS 6/12 USING PEEK ACUITY 6/6?</b>	<input checked="" type="checkbox"/> Select one	<b>R</b> <input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1)	<b>L</b> <input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1)
 <b>9. DOES THIS PARTICIPANT NEED A REFERRAL FOR DISTANCE GLASSES?</b>	<input checked="" type="checkbox"/> Select one and complete participant slip with referral details if YES	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1)	

### C3. Presenting Near Vision (if participant has near vision glasses, put these on)

 Only complete this vision section if participant age  $\geq 50$

<b>SELECT ACUITY TEST METHOD</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Peek Near Vision (1) <input type="checkbox"/> E Chart (2)
<b>1. Presenting binocular near vision</b>	Using Peek near vision auto-recorded result from Peek via Android plug at 40 cm	
<b>2. Presenting binocular near vision result</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Pass (1) <input type="checkbox"/> Did not pass (0) <input type="checkbox"/> Test not possible (99)
 <b>3. DOES THIS PARTICIPANT NEED A REFERRAL FOR NEAR VISION GLASSES?</b>	<input checked="" type="checkbox"/> Select one and complete participant slip with referral details if YES	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1)




### C4. Anterior Segment Brief Examination with torch and Direct Ophthalmoscope only




Only complete this vision section if participant age  $\geq 5$

<b>1. Lens Status</b>	<input type="checkbox"/> Examine with torch or direct ophthalmoscope only <input checked="" type="checkbox"/> Select one	<b>R</b> <input type="checkbox"/> Normal lens / minimal lens opacity (1) <input type="checkbox"/> Obvious lens opacity (2) <input type="checkbox"/> Lens absent (aphakia) (3) <input type="checkbox"/> Pseudophakia without PCO (4) <input type="checkbox"/> Pseudophakia with PCO (5) <input type="checkbox"/> No view of lens (6)	<b>L</b> <input type="checkbox"/> Normal lens / minimal lens opacity (1) <input type="checkbox"/> Obvious lens opacity (2) <input type="checkbox"/> Lens absent (aphakia) (3) <input type="checkbox"/> Pseudophakia without PCO (4) <input type="checkbox"/> Pseudophakia with PCO (5) <input type="checkbox"/> No view of lens (6)
<b>2. Presenting VA threshold</b>	Auto-populate: IF C2 q1=(0) then display C2 q4re and C2 q4le result, OR IF C2 q1=(1) then display C2 q5re result and C2 q5le	DISPLAY	DISPLAY
<b>3. Main cause of presenting vision &lt;6/12</b>	<input type="checkbox"/> Examine with torch or direct ophthalmoscope only <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Not examined: can see 6/12 (13) <input type="checkbox"/> Refractive error (1) <input type="checkbox"/> Aphakia, uncorrected (2) <input type="checkbox"/> Cataract, untreated (3) <input type="checkbox"/> Cataract surgical Complications (4) <input type="checkbox"/> Trachoma corneal opacity (5) <input type="checkbox"/> Other corneal opacity (6) <input type="checkbox"/> Phthisis (7) <input type="checkbox"/> Glaucoma (8) <input type="checkbox"/> Diabetic retinopathy (9) <input type="checkbox"/> ARMD (10) <input type="checkbox"/> Other posterior segment (11) <input type="checkbox"/> All globe/CNS abnormalities (12)	<input type="checkbox"/> Not examined: can see 6/12 (13) <input type="checkbox"/> Refractive error (1) <input type="checkbox"/> Aphakia, uncorrected (2) <input type="checkbox"/> Cataract, untreated (3) <input type="checkbox"/> Cataract surgical Complications (4) <input type="checkbox"/> Trachoma corneal opacity (5) <input type="checkbox"/> Other corneal opacity (6) <input type="checkbox"/> Phthisis (7) <input type="checkbox"/> Glaucoma (8) <input type="checkbox"/> Diabetic retinopathy (9) <input type="checkbox"/> ARMD (10) <input type="checkbox"/> Other posterior segment (11) <input type="checkbox"/> All globe/CNS abnormalities (12)

<b>4. Principal cause of presenting vision &lt;6/12 in person</b>	<input type="checkbox"/> Examine with torch or direct ophthalmoscope only <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Not examined: can see 6/12 (13) <input type="checkbox"/> Refractive error (1) <input type="checkbox"/> Aphakia, uncorrected (2) <input type="checkbox"/> Cataract, untreated (3) <input type="checkbox"/> Cataract surgical Complications (4) <input type="checkbox"/> Trachoma corneal opacity (5) <input type="checkbox"/> Other corneal opacity (6) <input type="checkbox"/> Phthisis (7) <input type="checkbox"/> Glaucoma (8) <input type="checkbox"/> Diabetic retinopathy (9) <input type="checkbox"/> ARMD (10) <input type="checkbox"/> Other posterior segment (11) <input type="checkbox"/> All globe/CNS abnormalities (12)
---	---	--

<b>C5. PEDIATRIC VISION SCREEN</b>  <b>Only complete this section if participant age &lt; 5</b>		
<b>C5.1 Age 3-4 years</b>		
<b>1. Can [name] count/copy fingers from 6 meters with both eyes open?</b>	<input checked="" type="checkbox"/> Select one and complete participant slip with referral details if NO	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1) <input type="checkbox"/> Unable to examine (2)
<b>C5.2 Age 0-2 years</b>		
<b>1. Can [name] look at and follow a moving object?</b>	<input checked="" type="checkbox"/> Select one and complete participant slip with referral details if NO	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1) <input type="checkbox"/> Unable to examine (2)

<b>C6. Self-reported vision: service and assistive product use</b>		
<b>All participants</b>		
 <b>Preamble:</b> "I am now going to ask you about any use of health or other support services for these difficulties."		
<b>C6.1 Self-reported vision: service use</b>		
<b>1. Have you ever received any health or other support services for vision difficulties?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>1a. Have you received any of the following services?          READ ALOUD SERVICE LIST AND TICK RELEVANT SERVICES</b>	<input checked="" type="checkbox"/> Select as many apply if C6.1 q1=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision service (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6)

		<input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only if q1a=9	_____
<b>2. Have you received any health or other support services within the past year for your vision?</b>	<input checked="" type="checkbox"/> Select one if C6.1 q1=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>2a. If yes, have you received any of the following services? READ ALOUD SERVICE LIST AND TICK RELEVANT SERVICES</b>	<input checked="" type="checkbox"/> Select as many apply if C6.1.q2=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision service (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only if q2a=9	_____
<b>3. Are you currently receiving any health or other support services for your vision?</b>	<input checked="" type="checkbox"/> Select one if C6.1 q2=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>3a. Which services are you currently receiving?</b>	<input checked="" type="checkbox"/> Select as many apply if C6.1 q3=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision service (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only if q3a=9	_____
<b>C6.2 Self-reported vision: assistive product use</b>		
<b>3. PARTICIPANT REPORTED ALREADY USING THESE ASSISTIVE PRODUCTS</b>	<input checked="" type="checkbox"/> Autofill from B4 q3	A. VISION <input type="checkbox"/> Long distance glasses (1) <input type="checkbox"/> Reading glasses (2) <input type="checkbox"/> Low vision glasses (3) <input type="checkbox"/> Magnifying glasses, telescopes (4) <input type="checkbox"/> White cane (5) <input type="checkbox"/> Audio players* (6) <input type="checkbox"/> Talking and touching watches* (7) C. MOBILITY (1) Canes/sticks E. COGNITION <input type="checkbox"/> Pill organisers (1) F. SELF-CARE AND ENVIRONMENT <input type="checkbox"/> Grab bars (5) G.ALL <input type="checkbox"/> Smart phones/tablets/PDA (1)

## C7. Functional Vision Assessment



Only complete this section of questionnaire if:

**Ages  $\geq 5$ : Presenting vision** <6/12 in the better eye and any of the following causes from C4 q4 = Refractive error (1), Aphakia, uncorrected (2), Cataract surgical Complications (4), Trachoma corneal opacity (5), Other corneal opacity (6), Phthisis (7), Glaucoma (8), Diabetic retinopathy (9), AMD (10), Other posterior segment (11), All globe/CNS abnormalities (12) **or C3q1=0**

**Ages 3 to 4: C5.1 q1=0**

**Ages 0 to 2: C5.2 q1=0**

**Preamble:** I am now going to ask you some questions about your vision loss and everyday life.

### C7.1 History

1. [Do/Does] you/[name] read well, little or not at all?

Select one, autofill

- Well (1)  
 Little (2)  
 Not at all (3)

2. [Do/Does] you/[name] you write well, little or not at all?

Select one, autofill

- Well (1)  
 Little (2)  
 Not at all (3)

3. What is the highest level of education you/[name] completed or are currently attending?

Select one if participant age B1.22 18+ years, autofill

- Never attended (1)  
 Attended but did not complete primary school (2)  
 Primary School (3)  
 Middle School (4)  
 Secondary School/High School (5)  
 Vocational School/Technical Certificate (6)  
 Bachelor's Degree (7)  
 Master's Degree (8)  
 Doctorate (9)

4. [Do/Does] you/[name] currently attend or have you/[name] ever attended school?

Select one if participant age B1.22 <18 years, autofill

- Never attended (1)  
 Ever previously attended (2)  
 Currently attending (3)

5. What best describes your/[name]'s current work situation?

Select one, autofill

- Looking after housework, children/elderly (1)  
 In regular paid work (2)  
 In irregular paid work (3)  
 Retired (old age/disability) (4)  
 Self-employed (5)  
 Unemployed seeking work (6)  
 Unemployed not seeking work (7)  
 Volunteer (8)  
 Student (9)  
 Other (10)

6. Specify other

text if C7.1 q5=10, autofill

\_\_\_\_\_

7. Because of problems with your/[name] vision, do you have difficulty doing things you would like to do?	<input checked="" type="checkbox"/> Select one only IF C4 q4 does not = (1)	<input type="checkbox"/> No, no difficulty (1)	<input type="checkbox"/> Yes, some difficulty (2)	<input type="checkbox"/> Yes, a lot of difficulty (3)	<input type="checkbox"/> Cannot do at all (4)
8. What are some of these activities? INTERVIEWER. Can prompt, "Is there anything else that might be difficult for you/[name] to do because of your/[name] vision?"	<input checked="" type="checkbox"/> Select all that apply only IF C4 q4 does not = (1)	<input type="checkbox"/> Cooking at home (1) <input type="checkbox"/> Cleaning at home (2) <input type="checkbox"/> Eating with others (3) <input type="checkbox"/> Going shopping, such as to the market (4) <input type="checkbox"/> Going to paid work (5) <input type="checkbox"/> Attending school (6) <input type="checkbox"/> Social activities, such as going to church (7) <input type="checkbox"/> Other (8)			

## C7.2 Home environment

 **Preamble:** I am now going to ask you about your/[name]'s home environment.

1. Who [do/does] you/[name] live with? (select all that apply)	<input checked="" type="checkbox"/> Select all that apply	<input type="checkbox"/> No one (0) <input type="checkbox"/> Partner/spouse (1) <input type="checkbox"/> Child/children (2) <input type="checkbox"/> Sibling/s (3) <input type="checkbox"/> Friend/s (4) <input type="checkbox"/> Other family members (5)
--	---	---

2. Because of your/[name]'s vision, [do/does] you/[name] need help with some of your/[name] daily activities, such as [>17years] cooking and cleaning or fixing items? [5 to 17years] playing and getting dressed? [2 to 4 years] feeding and playing? READ OUT ALL RESPONSE OPTIONS	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help s always needed (2) <input type="checkbox"/> No help is needed (0)
--	--	--

2. Because of your/[name]'s vision, [do/does] you/[name] need help with some of your/[name] daily activities in your/[name] community, such as [>17years] going to the market? [2 to 17years] playing with friends? READ OUT ALL RESPONSE OPTIONS	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
--	--	---

4. [Is this person/Are these people] who you/[name] live with able to provide help with your/[name] daily activities?	<input checked="" type="checkbox"/> Select one If C7.2q2 =1 or 2 and/or C7.2q3 =1 or 2 and C7.2q1=2 to 6	<input type="checkbox"/> No help (0) <input type="checkbox"/> Some help (1) <input type="checkbox"/> Help all the time (88)
---	---	---

5. [Do/Does] you/[name] or a family member have a mobile phone with smart technology? PROMPT: Such as mobile applications?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)
---	--	--

6. [Do/Does] your/[name]'s household have a television?	<input checked="" type="checkbox"/> Autofill from A2q4	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
---	--	---

## C7.3 Functional activities by assistive product

In this section, I am going to ask you/[name] about some daily activities and how much difficulty, if any, you/[name] have doing certain activities because of your/[name]'s vision. I will read out a choice of either yes or no or a choice of six answers and you will choose the one that describes you/[name] best.  
We are also going to ask about APs that may be helpful. [We are not able to provide these, but will refer you/[name] to services that can.] OR [This information will be helpful for service providers to know what products they should provide.]





2. Because of your vision, do you/[name] have difficulty seeing items in the distance, such as recognising faces names?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you/[name] think you/[name] could benefit from a pair of glasses with a filter that might make it easier to recognise faces and/or see things in the distance? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		If q3=0, go to q3a	
3a. Why don't you think you/[name] could benefit?	<del>/</del> text if C7.3.III q2=0	_____					
LOW VISION GLASSES NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
4.COULD THE PARTICIPANT BENEFIT FROM LOW VISION GLASSES?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
4a. WHY?	<del>/</del> text if C7.3 III q4=1	_____					
4b. WHY NOT?	<del>/</del> text if C7.3 III q4=0	_____					
IV. Magnifying glasses or telescope <b>ONLY ask IF C4 q4 does not = (1) AND mild to severe VA (&lt;6/12 - 1/60) in better eye OR if C3 q1=0</b>		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
1. Because of your/[name] vision, how much difficulty do you/[name] have in seeing close objects (e.g. making out differences in coins or notes, reading newspaper)?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Because of your/[name] vision, how much difficulty do you/[name] have doing activities that require you to see well close up (e.g. sewing, cooking, using hand tools)?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Can you/[name] read this newspaper (if can read) or describe this picture (can't read)? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Do you/[name] have difficulty holding objects in your/[name] right hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
5. Do you/[name] have difficulty holding objects in your/[name] left hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
6. Do you think you/[name] could benefit from a hand-held device with a lens that would make it easier to see things up close? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		If q6=0, go to q6a	
6a. Why don't you think you/[name] could benefit?	<del>/</del> text if C7.3 IV q6=0	_____					
7. Do you think you/[name] could benefit from a device that you could wear over	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		If q7=0, go to q7a	





6. Do you/[name] have difficulty using your/[name] right hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)				
7. Do you/[name] have difficulty using your/[name] left hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)				
8. Do you think you/[name] could benefit from a device that would read written text aloud? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)	If q12=0, go to q12a			
8a Why don't you think you/[name] could benefit?	<input type="checkbox"/> text if C7.3 V q8=0	_____					
AUDIOPLAYER NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
9. COULD THE PARTICIPANT BENEFIT FROM AN AUDIOPLAYER?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)				
9a. WHY?	<input type="checkbox"/> text if C7.3 V q9=1	_____					
9b. WHY NOT?	<input type="checkbox"/> text if C7.3 V q9=0	_____					
<b>VI. Talking watch</b> <b>Only ask IF mild to severe VA (&lt;6/12 - 1/60) in better eye and IF C4 q4 does not = (1)</b>							
1. Do you you/[name] own/use a watch or phone to tell the time?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)	If 0, go to q7 in this section			
2. What type of watch do you/[name] wear, an analog watch with a clock face or a digital watch or phone?	<input checked="" type="checkbox"/> Specify	<input type="checkbox"/> Analog with clock face (1)	<input type="checkbox"/> Digital (2)	<input type="checkbox"/> Phone (3)			
		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
3. Because of your/[name] vision, do you/[name] have difficulty seeing the time on a wrist watch?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Can you/[name] tell me the time on this watch? <b>INTERVIEWER: SHOW PICTURE OF WRIST WATCH AND ASK PARTICIPANT TO TELL THE TIME.</b> <b>Only ask if can read IF C9.1 q1= 1 or 2</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
5. Because of your/[name] vision, do you/[name] have difficulty seeing the time on a digital wrist watch or phone?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Can you/[name] tell me the time on this digital watch?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			

INTERVIEWER: SHOW WRIST WATCH AND ASK PARTICIPANT TO READ THE EXACT TIME. <i>Only ask if can read IF C9.1 q1= 1 or 2</i>							
7. Do you think you/[name] could benefit from a device that would tell you/[name] the time on the watch out loud? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)	If q7=0, go to q7a			
7a. Why don't you think you/[name] could benefit?	<del>/</del> text if C7.3.VI q7=0	_____					
TALKING WATCH NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
8. COULD THE PARTICIPANT BENEFIT FROM A TALKING WATCH?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)				
8a. WHY?	<del>/</del> text if C7.3 VI q8=1	_____					
8b. WHY NOT?	<del>/</del> text if C7.3 VI q8=0	_____					
VII. White cane <i>ONLY ask if mod or worse VA&lt;6/18 and C4 q4 does not = (1)</i>		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
1. Because of your/[name] vision, how much difficulty do you/[name] have when walking around your home?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Because of your/[name] vision, how much difficulty do you/[name] have in going down steps or stairs?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Because of your/[name] vision, how much difficulty do you have noticing objects off to the side while you/[name] are walking along?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Because of your/[name] vision, how much difficulty do you/[name] have going to activities outside of the house (e.g. sporting events, shopping, religious events)?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Because of your/[name] vision, how much difficulty do you/[name] have in seeing irregularities in the path when walking (e.g. potholes)?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Can you/[name] walk to the door and back to the chair [ <i>if owned: using the cane</i> ]? <b>NOTE: TRIALING FUNCTIONAL MOBILITY</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
7. Do you think you/[name] could benefit from a long walking cane that that might	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		If q7=0, go to q7a.	

make it easier for you move around in your home and the community? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>							
7a. Why don't you think you/[name] could benefit?	✍ text if C7.3.VII q7=0	_____					
WHITE CANE NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
8. COULD THE PARTICIPANT BENEFIT FROM A WHITE CANE?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)				
8a. WHY?	✍ text if C7.3 VII q8=1	_____					
8b. WHY NOT?	✍ text if C7.3 VII q8=0	_____					
<b>VIII. Pill organisers</b> <i>Only ask IF mild to severe VA (&lt;6/12 - 1/60) in better eye and IF C4 q4 does not = (1)</i>		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
1. Because of your/[name] vision, do you/[name] have difficulty seeing labels on medicine bottles?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Can you/[name] read this medicine label? SHOW MEDICINE LABEL AND ASK PARTICIPANT TO READ THE NAME, DOSAGE AND INSTRUCTIONS. <b>ONLY ASK IF CAN READ IF C7.1 Q1= 1 OR 2</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
3. Do you think you/[name] could benefit from a device that might make it easier for you to organise and take your pills? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)	If q3=0, go to q3a			
3a. Why don't you think you/[name] could benefit?	✍ text if C7.3.VIII q3=0	_____					
PILL ORGANISER NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
4. COULD THE PARTICIPANT BENEFIT FROM A PILL ORGANISER?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)				
4a. WHY?	✍ text if C7.3 VIII q4=1	_____					
4b. WHY NOT?	✍ text if C7.3 VIII q4=0	_____					
<b>IX. Smart PDAs &amp; Tablets with accessible software/applications</b> <i>Only ask IF C4 q4 does not = (1) OR if C3 q1=0</i>							
1. [Do/Does] you/[name] or a family member have a mobile phone with smart technology?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)			If 0, go to q4 in this section		


		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
2. Because of your/[name] vision, do you/[name] have difficulty using your phone?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Can you show me how you/[name] make a call on your/[name]'s mobile phone? INTERVIEWER: SHOW MOBILE PHONE AND ASK PARTICIPANT TO DEMONSTRATE MAKING A CALL	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, able to complete a call without accessibility features (1)		<input type="checkbox"/> Yes, able to complete a call with accessibility features (2)		<input type="checkbox"/> No, not able to complete a call (0)	
4. Do you think you/[name] could benefit from applications that would make it easier for you to use your mobile phone? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		If q4=0, go to q4a	
4a. Why don't you think you/[name] could benefit?	<i>≠</i> text if C7.3.IX q4=0	_____					
SMART PDA/TABLET WITH ACCESSIBLE SOFTWARE/APPLICATIONS NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
5. COULD THE PARTICIPANT BENEFIT FROM A SMART PDAs & TABLETS WITH ACCESSIBLE SOFTWARE/APPLICATIONS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
5a. WHY?	<i>≠</i> text if C7.3 IX q5=1	_____					
5b. WHY NOT?	<i>≠</i> text if C7.3 IX q5=0	_____					
X. Canes/sticks <b>ONLY ask if mild to severe VA (&lt;6/12 - 1/60) in better eye and C4 q4 does not = (1)</b>		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
1. Because of your/[name] vision, how much difficulty do you/[name] have going down steps, stairs, or curbs in dim light or at night?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you think you/[name] could benefit from a device that might help make it safer	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		If q2=0, go to q2a.	

for you to go up and down steps, stairs, or curbs in dim light or at night? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>							
2a. Why don't you think you/[name] could benefit?	☞ text if C7.3.X q2=0	_____					
CANE/STICK NEEDED?	<input checked="" type="checkbox"/> Autofill	☐ Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
3. COULD THE PARTICIPANT BENEFIT FROM A CANE/STICK?	<input checked="" type="checkbox"/> Select one	☐ Yes (1)	☐ No (0)				
3a. WHY?	☞ text if C7.3 X q3=1	_____					
3b. WHY NOT?	☞ text if C7.3 X q3=0	_____					
XI. Hand rail/grab bar <i>Only ask if mild/worse VA (&lt;6/12) in better eye and C4 q4 does not = (1)</i>		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of vision	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
1. Because of your/[name] vision, how much difficulty do you/[name] have moving around your house, such as when toileting, bathing or going up or down steps?	<input checked="" type="checkbox"/> Select one	☐	☐	☐	☐	☐	☐
2. Do you think you/[name] could benefit from a rail that you could hold onto that might make it safer for you to do some activities, such as go to the toilet, bathing or up or down steps? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	☐ Yes (1)		☐ No (0)		If q2=0, go to q2a.	
2a. Why don't you think you/[name] could benefit?	☞ text if C7.XII q2=0	_____					
HAND RAIL/GRAB BAR NEEDED?	<input checked="" type="checkbox"/> Autofill	☐ Yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
3. COULD THE PARTICIPANT BENEFIT FROM HAND RAIL/GRAB BAR?	<input checked="" type="checkbox"/> Select one	☐ Yes (1)	☐ No (0)				
3a. WHY?	☞ text if C7.3 XI q3=1	_____					
3b. WHY NOT?	☞ text if C7.3 XI q3=0	_____					

<b>C8. Vision service and assistive product need</b>			
PRESENTING VA THRESHOLD	<input checked="" type="checkbox"/> Autofill C4 q2	<b>L</b>	<b>R</b>
CAUSE VA<6/12 PERSON	<input checked="" type="checkbox"/> Autofill C4 q4		
<b>C8.1 Vision service need</b>			

<b>FOR CLINICAN REVIEW ONLY</b>			
<b>SERVICES PREVIOUSLY RECEIVED</b>	<input checked="" type="checkbox"/> Autofill from C6.1 q1a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision service (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9)	
<b>SERVICES RECEIVED IN PAST YEAR</b>	<input checked="" type="checkbox"/> Autofill from C6.1 q2a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision service (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9)	
<b>SERVICES CURRENTLY RECEIVING</b>	<input checked="" type="checkbox"/> Autofill from C6.1 q3a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision service (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9)	
<b>1. PLEASE SPECIFY ANY ADDITIONAL INFORMATION YOU NEED TO KNOW TO DETERMINE VISION SERVICE NEEDS:</b>			
<b>2. THE FOLLOWING VISION SERVICES ARE RECOMMENDED FOR THE PARTICIPANT:</b>	Autofill if possible	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision rehabilitation (4) <input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No treatment (9)	
<b>3. DO YOU AGREE WITH THE SERVICE/S RECOMMENDED?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)
<b>4. DO YOU RECOMMEND DIFFERENT/ADDITIONAL SERVICE/S FOLLOW UP FOR THE PARTICIPANT?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) go to q4a	<input type="checkbox"/> No (0) Go to text
<b>4a. IF YES: PLEASE SPECIFY ALL SERVICES FOR REFERRAL (CAN CHOOSE MORE THAN ONE)</b>	<input checked="" type="checkbox"/> Select as many as apply ONLY IF C8.1 q4=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Eye examination (3) <input type="checkbox"/> Low vision rehabilitation (4)	


<b>NOTE: IF NOT RECEIVED/CURRENTLY RECEIVING, WHAT SERVICES COULD THE PARTICIPANT BENEFIT FROM?</b>		<input type="checkbox"/> Vision rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Other rehabilitation (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> Other (9) <input type="checkbox"/> No service follow up (10)
<b>4b. SPECIFY OTHER</b>	✍ text if C8.1 Q4a = (9)	_____
<b>INTERVIEWER READ:</b> IF NO FOLLOW UP: We do not recommend any follow up services for your vision. IF SURGICAL OR MEDICAL SERVICE REFERRAL: We are recommending that you have [insert services] for follow up service/s for your vision. IF EYE EXAMINATION SERVICE: We are recommending that you have [insert services] for follow up service/s for your vision. IF LOW VISION REHABILITATION, VISION REHABILITATION, OCCUPATIONAL THERAPY, OTHER REHABILITATION AND/OR ENVIRONMENTAL MODIFICATION: We are recommending that you have [insert services] for follow up service/s for your vision.  <b>INTERVIEWER NOTE: THIS IS A RECOMMENDATION, BUT TEXT TO BE READ ALOUD WILL BE MODIFIED ACCORDING TO WHAT IS AVAILABLE.</b>		

<b>C8.2 Barriers to services</b>					
 <b>RELEVANT IF C8.1 q3=1 and q2=1 to 8 OR C8.1 q4a= 1 to 9 specific service</b> <b>This section to be repeated for each service reported in C8.1 q2 and/or C8.1 q4a</b>					
<b>We would like to understand why you haven't received this service.</b>					
<b>1. Why [haven't/hasn't] you/[name] received the service you/he/she need/s? You may answer 'yes' to as many questions as you like.</b> <b>READ ALOUD ALL ANSWER OPTIONS.</b>		No	Yes	Don't know	Refused
		(0)	(1)	(88)	(99)
1.1 You/[name] were not aware of the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 You/[name] were aware of the [service] but didn't know you needed it.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3 The service is not available locally.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4 The service was too far away.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 You/[name] cannot afford the cost of the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6 Service providers have negative attitudes.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7 Suitable transportation is not available/accessible to get to the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.8 Transportation is too expensive to get to the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.9 You/[name] need/s assistance to access the service, but no one was available to accompany.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.10 People would treat you/[name] differently if you/he/she sought the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.11 Are there any other reasons why you/[name] [have/has] not sought the service?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.12 Specify if other	✍ if C8.2 q.1.11= (1)	_____			



<b>C8.3 Vision assistive product need</b>			
<b>PLEASE SPECIFY ANY ADDITIONAL INFORMATION YOU NEED TO KNOW TO DETERMINE VISION ASSISTIVE PRODUCT NEEDS:</b>			
<hr/> <hr/>			
<b>PARTICIPANT REPORTED ALREADY USING THESE ASSISTIVE PRODUCTS</b>	<input checked="" type="checkbox"/> Autofill from B4 q3	A. VISION <input type="checkbox"/> Long distance glasses (1) <input type="checkbox"/> Reading glasses (2) <input type="checkbox"/> Low vision glasses (3) <input type="checkbox"/> Magnifying glasses, telescopes (4) <input type="checkbox"/> White cane (5) <input type="checkbox"/> Audio players* (6) <input type="checkbox"/> Talking and touching watches* (7) C. MOBILITY <input type="checkbox"/> Canes/Sticks (1) E. COGNITION <input type="checkbox"/> Pill organisers (1) F. SELF-CARE AND ENVIRONMENT <input type="checkbox"/> Grab bars (5) G.ALL <input type="checkbox"/> Smart phones/tablets/PDA (1)	
<b>1. THE FOLLOWING ASSISTIVE PRODUCTS ARE RECOMMENDED FOR THE PARTICIPANT:</b>	Autofil if possible	<input type="checkbox"/> Long distance glasses (1) IF V_FMAap_ldg_needC=1 <input type="checkbox"/> Near glasses (2) IF V_FMAap_ng_needC=1 <input type="checkbox"/> Low vision glasses (3) IF V_FMAap_lvg_needC=1 <input type="checkbox"/> Magnifying glasses or telescope (4) IF V_FMAap_mag_needC=1 or V_FMAap_tele_needC=1 <input type="checkbox"/> White cane (5) IF V_FMAap_whitec_needC=1 <input type="checkbox"/> Audio player (6) IF V_FMAap_audio_needC=1 <input type="checkbox"/> Talking or touching watch (7) IF V_FMAap_watch_needC=1 <input type="checkbox"/> Pill organiser (8) IF V_FMAap_pillorg_needC=1 <input type="checkbox"/> Canes/sticks (9) IF V_FMAap_cane_needC=1 <input type="checkbox"/> Hand rail/grab bar (10) IF V_FMAap_grabbar_needC=1 <input type="checkbox"/> Smart PDAs & Tablets with accessible software/applications (11) IF V_FMAap_smarttech_needC=1 <input type="checkbox"/> No follow up (12) IF C5 q4=13	
<b>2. DO YOU RECOMMEND (ADDITIONAL) ASSISTIVE PRODUCT/S FOR THE PARTICIPANT?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) go to q3a	<input type="checkbox"/> No (0) Skip to text
<b>3a. IF YES: PLEASE SPECIFY ALL ASSISTIVE PRODUCTS YOU ARE</b>	<input checked="" type="checkbox"/> Select as many as apply		
	VISION	<input type="checkbox"/> Long distance glasses (1)	

RECOMMENDING (Can choose more than one)		<input type="checkbox"/> Reading glasses (2) <input type="checkbox"/> Low vision glasses (3) <input type="checkbox"/> Magnifying glasses or telescope (4) <input type="checkbox"/> Talking or touching watch (5) <input type="checkbox"/> Audio player (6) <input type="checkbox"/> White cane (7)
	SELF-CARE	<input type="checkbox"/> Pill organiser (7)
	MOBILITY	<input type="checkbox"/> Canes/sticks (9)
	SELF-CARE AND ENVIRONMENT	<input type="checkbox"/> Hand rail/grab bar (10)
	ALL DOMAINS	<input type="checkbox"/> Smart PDAs & Tablets with accessible software/applications (i.e. Accessible mobile applications) (11) <input type="checkbox"/> Other (12) (if C8.3 q3a11=1 then go to C8 q3b) <input type="checkbox"/> No AP (13)
3b. SPECIFY OTHER	✍ text if C8.3 Q3a11 = (1)	_____
<b>INTERVIEWER READ:</b> IF NO ASSISTIVE PRODUCTS: We do not recommend any assistive products for your vision. IF ASSISTIVE PRODUCTS: We are recommending that you might benefit from <i>[insert assistive products]</i> your vision. <b>INTERVIEWER NOTE: THIS IS A RECOMMENDATION, BUT TEXT TO BE READ ALOUD WILL BE MODIFIED ACCORDING TO WHAT IS AVAILABLE.</b>		

C8.4 Barriers to assistive products					
 <b>RELEVANT IF C8.3 q1= 1 to 11 specific products and q2=1 OR q3a =1 to 12 specific products</b> <b>This section to be repeated for any assistive product reported in C8.3 q1 and q3a and 3b</b>					
1. Why [don't/doesn't] you/[name] have the assistive products you/he/she need/s? You may answer 'yes' to as many questions as you like. READ ALOUD ALL ANSWER OPTIONS.	No	Yes	Don't know	Refused	
	(0)	(1)	(88)	(99)	
1.1 You/[name] were not aware of the [assistive product]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.2 You/[name] were aware of the [assistive product] but didn't know you needed it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.3 Assistive product is not available locally	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.4 You/[name] cannot afford the cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.5 Available assistive products are not suitable for your/is/her home or surroundings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.6 No one is available to show you/[name] how to use the [assistive product]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.7 Suitable transportation is not available to get the [assistive product]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.8 You/[name] need/s assistance to use it, but assistance is not available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.9 You/[name] [don't/doesn't] like the appearance of the [assistive product]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1.10 People would treat you/[name] differently if you/he/she had the [assistive product]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

1.11 Are there any other reasons why you/[name] [do/does] not have the [assistance products] you need?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.12 Specify if other	☞ if C8.4 q.1.11= (1)				

**INTERVIEWER READ:**  
Thank you for your participation and this vision assessment is now complete.

**INTERVIEW NOTES:** ☞ text

**END of vision module questionnaire**

## D. HEARING MODULE

### **OPTION 1**

All participants should complete the hearing questionnaire.

### **OPTION 2**

Only complete Hearing questionnaire if:

- Participant >17yo: B2.1 q4=1 (uses hearing aid) or some or more difficulty hearing to B2.1 q5=2/3/4 or B2.1 q6=2/3/4 in Washington Group Extended Set
- Participant 4-17yo: B2.2 q4=1 (uses hearing aid) or some or more difficulty hearing to B2.2 q5=2/3/4 or B2.2 q6=2/3/4 in Washington Group CFM
- Participants 2 to 4yo: B2.3 q4=1 (uses hearing aid) or some or more difficulty hearing to B2.3 q5=2/3/4 or B2.3 q6=2/3/4 in Washington Group CFM
- Participants 0<2yo: tbc

### D1. Enumeration linking data

1. Date	☞ Day / Month / Year (dd/mm/yyyy)	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
2. Interviewer id	☒ Select one (list to be generated in app)	_____		
3. Region number	☞ 2 digit number 01 – 09 copied from participant slip, autofill	_____		
4. Cluster Number	☞ 3 digit number 001-100 copied from household roster, autofill	_____		
5. Household Number	☞ 2 digit number 01-30 copied from household roster, autofill	_____		
6. Individual Number	☞ 2 digit number 01-30 [LINE NUMBER FROM HOUSEHOLD ROSTER], autofill	_____		
7. Study ID Number	☞ Cluster Number –HH- Individual Number, autofill	_	_	_
8. Date of the interview	☞ Day / Month / Year (dd/mm/yyyy), autofill	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
9. First name	☞ text confirmed from participant slip, autofill	_____		
10. Last name	☞ text confirmed from participant slip, autofill	_____		
11. Common name	☞ text, autofill	_____		
12. Telephone number	☞ 12 digit number, autofill	_	_	_
13. Whose telephone is this?	☞ autofill	_____		
14. Telephone number 2	☞ 12 digit number, autofill	_	_	_
15. Whose telephone is this?	☞ autofill	_____		
16. Sex	☒ Select one, autofill	<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)		
17. Age	☒ Select one each, autofill	<input type="checkbox"/> (Year 0-105)		<input type="checkbox"/> (Months 1-12)
CONSENT	☒ Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)		

<b>18. Availability for HEARING module</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Available (1) <input type="checkbox"/> Not currently available, revisit (2) <input type="checkbox"/> Will not be available for duration of survey (unavailable) (3) <input type="checkbox"/> Refused (4)
<b>18a. Scheduling notes</b>	text if D1 q18=4	_____
<b>18b. Reason for refusal</b>	text if D1 q18=5	_____
<b>19. Responder</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Participant (1) <input type="checkbox"/> Proxy (2)
<b>20. Specify proxy name and relationship</b>	text if D1.19=2	_____

## D2. Hearing test

All participants

**Preamble:** Now, I will test your/[name]'s hearing.

### D2.1 hearTest

Only complete if participant is  $\geq 5$  years old

<b>1. Open hearTest app</b>	hearTest button to be clicked in app (people aged 5+ only)		
		<b>Left ear</b>	<b>Right ear</b>
<b>2. Threshold at 500Hz (dB)</b>	hearTest integer (automatic input)		
<b>3. Threshold at 1000Hz (dB)</b>	hearTest integer (automatic input)		
<b>4. Threshold at 2000Hz</b>	hearTest integer (automatic input)		
<b>5. Threshold at 4000Hz</b>	hearTest integer (automatic input)		
<b>6. Pure tone average</b>	hearTest integer (automatic input)		
<b>7. Any problems with test-retest at 1000Hz?</b>	hearTest integer (automatic input)		

8. Noise concerns at 500Hz	hearTest integer (automatic input)		
9. Noise concerns at 1000Hz	hearTest integer (automatic input)		
10. Noise concerns at 2000Hz	hearTest integer (automatic input)		
11. Noise concerns at 4000Hz	hearTest integer (automatic input)		
12. Total test duration	hearTest integer (automatic input)		
13. False response rate (%)	hearTest integer (automatic input)		
14. DID YOU HAVE TO REPEAT THE HEARING TEST DUE TO RELIABILITY CONCERNS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (2)	
15. EXAM STATUS	<input checked="" type="checkbox"/> Select one. Initially select complete, attempt hearing test, and if unable to select unable to test.	<input type="checkbox"/> Complete (1) <input type="checkbox"/> Unable to test (2)	
16. IF THE PARTICIPANT COULD NOT BE TESTED, ASK A RELATIVE OR NEIGHBOUR 'Is the participant is believed to have a hearing loss?'	<input checked="" type="checkbox"/> Select one if selected q1 =2, then END section	<input type="checkbox"/> No hearing loss (1) <input type="checkbox"/> Hearing loss in one ear (2) <input type="checkbox"/> Hearing loss in both ears (3) <input type="checkbox"/> Unknown (4)	

## D2.2 OAE test



Only complete if participant is <5 years old


		Left ear	Right ear
<b>NOTE: HEARING TESTER: BRIEFLY EXAMINE EARS, THEN PERFORM OAE IF THERE ARE NO CONTRAINDICATIONS</b>			
1. OAE results	OAE machine <input checked="" type="checkbox"/> Select one for children aged 0-4 years 11 months only	<input type="checkbox"/> Pass (1) <input type="checkbox"/> Fail (2) <input type="checkbox"/> Unable to test (3)	<input type="checkbox"/> Pass (1) <input type="checkbox"/> Fail (2) <input type="checkbox"/> Unable to test (3)
2. Reason could not test OAE	<input checked="" type="checkbox"/> Select one if q16 = 3	<input type="checkbox"/> Crying (1) <input type="checkbox"/> Too much background noise (2) <input type="checkbox"/> Contraindication to performing test (3)	<input type="checkbox"/> Crying (1) <input type="checkbox"/> Too much background noise (2) <input type="checkbox"/> Contraindication to performing test (3)


3. DID YOU HAVE TO REPEAT THE HEARING TEST DUE TO RELIABILITY CONCERNS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	
4. EXAM STATUS	<input checked="" type="checkbox"/> Select one.	<input type="checkbox"/> Test completed (1) <input type="checkbox"/> Unable to test (2)	
5. IF THE PARTICIPANT COULD NOT BE TESTED, ASK A RELATIVE OR NEIGHBOUR 'Is the participant is believed to have a hearing loss?'	<input checked="" type="checkbox"/> Select one if selected q2 =2	<input type="checkbox"/> No hearing loss (1) <input type="checkbox"/> Hearing loss in one ear (2) <input type="checkbox"/> Hearing loss in both ears (3)	

Hearing test end

### D3. Hearing health history

All participants

 **Preamble:** First, I will ask you a few questions about your/[name]'s hearing history.


1. How long have you/[name] experienced difficulties with your hearing?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Since birth (1) <input type="checkbox"/> Since childhood (<18 years) (2) <input type="checkbox"/> Since age 18-59 years (3) <input type="checkbox"/> Since old age (60+) (4)
2. Does anyone in your/[name]'s immediate family have a hearing loss since childhood?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
3. Was your/[name]'s hearing loss gradual or sudden?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Gradual (1) <input type="checkbox"/> Sudden (2)
4. In the past 12 months, have you/[name] been bothered by ringing or buzzing noises in your/[name]'s ears that lasts for 5 minutes or more?	<input checked="" type="checkbox"/> Select one if participant aged 18+	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
5. In the past 12 months, how often have you/[name] experienced this ringing?	<input checked="" type="checkbox"/> Select one if q4=1	<input type="checkbox"/> Almost always (1) <input type="checkbox"/> Once a day (2) <input type="checkbox"/> Once a week (3) <input type="checkbox"/> Once a month (4) <input type="checkbox"/> Less often than once a month (5)
6. Did anything happen around the time your/[name]'s hearing loss started?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
7. Can you specify what happened?	 text if q6 = (1)	


8. Have/has you/[name] had surgery on your ears in the past?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
9. When was the surgery?	<input checked="" type="checkbox"/> Select one if q8 = (1)	<input type="checkbox"/> 3 months ago or less (1) <input type="checkbox"/> More than 3 months ago (2)
10. Do/does you/[name] have a history of head injury?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
11. Did you notice a change in your/[name]'s hearing after your injury?	<input checked="" type="checkbox"/> Select one if q10 = (1)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
12. Do/does you/[name] have a history of discharging ears?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
13. Do/does you/[name] experience dizziness at all?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
14. Have/has you/[name] recently experienced a cough or a cold in the past 2 weeks?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
15. Do you/[name] own a hearing aid?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, for the right ear only (1) <input type="checkbox"/> Yes, for the left ear only (2) <input type="checkbox"/> Yes, for both ears (3) <input type="checkbox"/> No (0)
16. In the past month, how often have/has you/[name] worn your hearing aid(s) (on a daily basis)?	<input checked="" type="checkbox"/> Select one if q15 (hearing_aid) = (1) (2) or (3)	<input type="checkbox"/> Most of the day (8-16 hours) (1) <input type="checkbox"/> Half of the day (4-8 hours) (2) <input type="checkbox"/> Less than half the day (1-4 hours) (3) <input type="checkbox"/> Less than one hour per day (1-4 hours) (4) <input type="checkbox"/> None (0)
17. Overall, how satisfied are/is you/[name] with your/his/her hearing aid(s)?	<input checked="" type="checkbox"/> Select one if q15 (hearing_aid) = (1) (2) or (3)	<input type="checkbox"/> Very satisfied (1) <input type="checkbox"/> Satisfied (2) <input type="checkbox"/> Neutral (3) <input type="checkbox"/> Dissatisfied (4) <input type="checkbox"/> Very dissatisfied (5)
18. Other than domestic work in the household, have [you/name] done any work in the last 4 weeks that contributes to household income?	<input checked="" type="checkbox"/> Select one if participant age 18+	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
19. Did you do any of the following activities during the last 4 weeks?	<input checked="" type="checkbox"/> Select one if participant age 18+ [response options can be edited]	<input type="checkbox"/> Farming/rearing animals/fishing (1) <input type="checkbox"/> Services (2) <input type="checkbox"/> Selling (3) <input type="checkbox"/> Factory work (4) <input type="checkbox"/> Houseworker at someone's house (5)





## D4. Ear examination

All participants



 **Preamble:** Now, I will look at your/[name]'s ear using this [SHOW OTOSCOPE].



<b>1. DOES THE PARTICIPANT HAVE ANY OTHER PHYSICAL FEATURES ON HEAD AND NECK ASSOCIATED WITH HEARING LOSS (E.G. SKIN TAGS, EYE COLOUR)?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	
<b>2. Specify</b>	 text if D4 q1 = (1)		
		<b>Left ear</b>	<b>Right ear</b>
<b>3. Do you/[name] have/has any ear pain?</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>4. Have/has you/[name] been feeling any fullness in your ear?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>5. IS THE PINNA NORMAL OR ABNORMAL?</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Normal (1) <input type="checkbox"/> Abnormal (2)	<input type="checkbox"/> Normal (1) <input type="checkbox"/> Abnormal (2)
<b>6. EAR CANAL INFLAMMATION</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>7. IMPACTED WAX</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>8. FOREIGN BODY</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>9. DISCHARGE</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>10. How long have/has you/[name] had discharge?</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one if D4 q9 = (1)	<input type="checkbox"/> Less than 2 weeks (1) <input type="checkbox"/> 2 weeks or more (2)	<input type="checkbox"/> Less than 2 weeks (1) <input type="checkbox"/> 2 weeks or more (2)
<b>11. CAN THE TM BE SEEN?</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>12. PERFORATION</b>	<input type="checkbox"/> Otoscopy <input checked="" type="checkbox"/> Select one if D4 q11 = (1)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>13. SHAPE</b>	<input type="checkbox"/> Otoscopy	<input type="checkbox"/> Normal (1) <input type="checkbox"/> Bulging (2)	<input type="checkbox"/> Normal (1) <input type="checkbox"/> Bulging (2)

	<input checked="" type="checkbox"/> Select one if D4 q11 = (1)	<input type="checkbox"/> Retracted (3)	<input type="checkbox"/> Retracted (3)
<b>14. COLOUR</b>	 Otoscopy <input checked="" type="checkbox"/> Select one if D4 q11 = (1)	<input type="checkbox"/> Pearly white (1) <input type="checkbox"/> Red (2) <input type="checkbox"/> Dull/opaque (3)	<input type="checkbox"/> Pearly white (1) <input type="checkbox"/> Red (2) <input type="checkbox"/> Dull/opaque (3)
<b>15. LIGHT REFLEX VISIBLE</b>	 Otoscopy <input checked="" type="checkbox"/> Select one if D4 q11 = (1)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>16. FLUID PRESENT BEHIND THE MIDDLE EAR</b>	 Otoscopy <input checked="" type="checkbox"/> Select one if D4 q11 = (1)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>17. SUMMARISE THE EAR EXAMINATION</b>	 Otoscopy <input checked="" type="checkbox"/> Select one if D4 q11 = (1)	<input type="checkbox"/> Normal (1) <input type="checkbox"/> Abnormal (2)	<input type="checkbox"/> Normal (1) <input type="checkbox"/> Abnormal (2)
<b>18. IS THE ABNORMALITY THE LIKELY CAUSE OF HEARING LOSS IN THIS EAR</b>	<input checked="" type="checkbox"/> Select one if D4 q17 (left or right) $\geq 20$ dB or OAE fail	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)

**PROMPTS: BASED ON THE RESULTS OF EAR EXAMINATION, PROMPTS MAY APPEAR WHICH PREDICT THE CAUSE OF HEARING LOSS (AMONGST THOSE WITH HEARING LOSS) OR TYPE OF EAR CONDITION (AMONGST THOSE WITHOUT HEARING LOSS).**

**HERE THE EXAMINER WILL BE ABLE TO REVIEW THE RESULTS OF THE EAR EXAMINATION, AND CLINICAL HISTORY PRIOR TO MAKING A JUDGEMENT ON THE DIAGNOSIS AND CAUSES OF HEARING LOSS.**

<b>19. SUMMARY OF RESULTS</b>  <b>HERE YOU HAVE A SUMMARY OF CLINICAL HISTORY AND EXAMINATION BEFORE DECIDING THE CAUSE OF HEARING LOSS.</b>	<input checked="" type="checkbox"/> Autofill- see variables	Hearing aid: hearing_aid Family history: family Onset: duration_difficult Tinnitus: tinnitus Events: event_spec Previous surgery: surgery Discharge: discharge Dizziness: dizzy URTI: urti	
		<b>Left ear</b>	<b>Right ear</b>
		Hearing loss result left: average_l Pain: pain_l Fullness: fullness_l Pinna: pinna_l Canal inflammation: inflamm_l Impacted wax: wax_l Foreign body: fb_l Discharge: discharge_l Perforation: perf_l TM shape: shape_l TM colour: colour_l TM light reflex: light_l	Hearing loss result right: average_r Pain: pain_r Fullness: fullness_r Pinna: pinna_r Canal inflammation: inflamm_r Impacted wax: wax_r Foreign body: fb_r Discharge: discharge_r Perforation: perf_r TM shape: shape_r TM colour: colour_r

			TM light reflex: light_r
<b>20. IN YOUR OPINION, WHAT IS THE PROBABLE CAUSE OF HEARING LOSS?</b>	<input checked="" type="checkbox"/> Select one if D2.1 q6 (left or right) $\geq$ 20dB or OAE fail	<input type="checkbox"/> Acute otitis media (1) <input type="checkbox"/> Otitis media with effusion (2) <input type="checkbox"/> Chronic suppurative otitis media – wet perforation (3) <input type="checkbox"/> Chronic suppurative otitis media – dry perforation (4) <input type="checkbox"/> Impacted wax (5) <input type="checkbox"/> Foreign body (6) <input type="checkbox"/> Otitis externa (7) <input type="checkbox"/> Acquired sensorineural (8) <input type="checkbox"/> Congenital sensorineural (9) <input type="checkbox"/> Mixed – outer/middle ear disease and sensorineural component (10) <input type="checkbox"/> Other (specify) (11)	<input type="checkbox"/> Acute otitis media (1) <input type="checkbox"/> Otitis media with effusion (2) <input type="checkbox"/> Chronic suppurative otitis media – wet perforation (3) <input type="checkbox"/> Chronic suppurative otitis media – dry perforation (4) <input type="checkbox"/> Impacted wax (5) <input type="checkbox"/> Foreign body (6) <input type="checkbox"/> Otitis externa (7) <input type="checkbox"/> Acquired sensorineural (8) <input type="checkbox"/> Congenital sensorineural (9) <input type="checkbox"/> Mixed – outer/middle ear disease and sensorineural component (10) <input type="checkbox"/> Other (specify) (11)
<b>21. Specify</b>	 text if 20 = (9)		
<b>22. WHAT IS THE DIAGNOSIS IN THIS EAR?</b>	<input checked="" type="checkbox"/> Select one if D2.1 q6 (left or right) $<$ 20dB or OAE pass	<input type="checkbox"/> Acute otitis media (1) <input type="checkbox"/> Otitis media with effusion (2) <input type="checkbox"/> Chronic otitis media – wet perforation (3) <input type="checkbox"/> Chronic otitis media – dry perforation (4) <input type="checkbox"/> Impacted wax (5) <input type="checkbox"/> Foreign body (6) <input type="checkbox"/> Otitis externa (7) <input type="checkbox"/> Other (specify) (8) <input type="checkbox"/> Normal ear and normal hearing (9)	<input type="checkbox"/> Acute otitis media (1) <input type="checkbox"/> Otitis media with effusion (2) <input type="checkbox"/> Chronic otitis media – wet perforation (3) <input type="checkbox"/> Chronic otitis media – dry perforation (4) <input type="checkbox"/> Impacted wax (5) <input type="checkbox"/> Foreign body (6) <input type="checkbox"/> Otitis externa (7) <input type="checkbox"/> Other (specify) (8) <input type="checkbox"/> Normal ear and normal hearing (9)
<b>Specify</b>	 text if 22 = (8)		
<b>PROMPTS: BASED ON THE CAUSE OF HEARING LOSS (AMONGST THOSE WITH HEARING LOSS PRESENT) AND DIAGNOSIS (AMONGST THOSE WITHOUT HEARING LOSS), PROMPTS WILL APPEAR ON THE MOST APPROPRIATE FIELD MANAGEMENT FOR EACH EAR</b>			
<b>23. WHAT ACTIONS DID YOU TAKE IN THE FIELD FOR THIS EAR?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Removed wax or foreign body (1) <input type="checkbox"/> Gave medication (2) <input type="checkbox"/> Dry mop, ear drops, and referral (3) <input type="checkbox"/> Referral/functional assessment (4) <input type="checkbox"/> No action (5)	<input type="checkbox"/> Removed wax or foreign body (1) <input type="checkbox"/> Gave medication (2) <input type="checkbox"/> Dry mop, ear drops, and referral (3) <input type="checkbox"/> Referral/functional assessment (4) <input type="checkbox"/> No action (5)
<b>24. Did your hearing improve following wax or foreign body removal?</b>	<input checked="" type="checkbox"/> Select one if D4.2 q23= 1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)

## D5. Self-reported hearing: service and assistive product use



Only complete this section of questionnaire if:

**Ages  $\geq 5$ : Hearing loss  $\geq 20$  dB in either ear**



**Ages  $< 5$ : Hearing loss FAIL OAE in either ear**

**Preamble:** "I am now going to ask you about any use of health or other support services for these difficulties."

### D5.1 Self-reported hearing: service use


<b>1. Have you ever received any health or other support services for hearing difficulties?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>1a. Have you received any of the following services? READ ALOUD SERVICE LIST AND TICK RELEVANT SERVICES</b>	<input checked="" type="checkbox"/> Select as many apply if D5.1 q1=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only if q1a=9	<hr/>
<b>2. Have you received any health or other support services within the past year for your hearing?</b>	<input checked="" type="checkbox"/> Select one if D5.1 q1=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>2a. If yes, have you received any of the following services? READ ALOUD SERVICE LIST AND TICK RELEVANT SERVICES</b>	<input checked="" type="checkbox"/> Select as many apply if D5.1.q2=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only if q2a=9	<hr/>
<b>3. Are you currently receiving any health or other support services for your hearing?</b>	<input checked="" type="checkbox"/> Select one if D5.1 q2=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>3a. Which services are you currently receiving?</b>	<input checked="" type="checkbox"/> Select as many apply if D5.1 q3=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9)

Other, specify	<input checked="" type="checkbox"/> text only if q3a=9	_____
<b>D5.2 Self-reported hearing: assistive product use</b>		
<b>PARTICIPANT REPORTED USING THESE ASSISTIVE PRODUCTS</b>	<input checked="" type="checkbox"/> Autofill from B4 q3	<b>B. HEARING</b> <input type="checkbox"/> Alarm signallers (1) <input type="checkbox"/> Hearing aids (2) <b>G. ALL</b> <input type="checkbox"/> Smart phones/tablets/PDA (1) <input type="checkbox"/> Other assistive product (Specify) (99)
<b>SPECIFIC HEARING AID</b>	<input checked="" type="checkbox"/> Autofill from D3 q15	<input type="checkbox"/> Yes, for the right ear only (1) <input type="checkbox"/> Yes, for the left ear only (2) <input type="checkbox"/> Yes, for both ears (3) <input type="checkbox"/> No (4)

<b>D6. Functional Hearing Assessment</b>		
 <b>Only complete this section of questionnaire if:</b> <b>Ages ≥5: Hearing loss</b> ≥20 dB in either ear with normal ear examination <b>Ages &lt;5: Hearing loss</b> FAIL OAE in either ear with normal ear examination		
 <i>Preamble:</i> I am now going to ask you some questions about your/[name]'s hearing loss and everyday life.		
<b>D6.1 History</b>		
1. [Do/Does] you/[name] read well, little or not at all?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/> Well (1) <input type="checkbox"/> A little (2) <input type="checkbox"/> Not at all (3)
2. [Do/Does] you/[name] write well, little or not at all?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/> Well (1) <input type="checkbox"/> A little (2) <input type="checkbox"/> Not at all (3)
3. What is the highest level of education you/[name] completed or are currently attending?	<input checked="" type="checkbox"/> Select one if participant age B1.22 18+ years, autofill	<input type="checkbox"/> None (1) <input type="checkbox"/> Attended but did not complete primary school (2) <input type="checkbox"/> Completed primary school (3) <input type="checkbox"/> Attended but did not complete secondary school (4) <input type="checkbox"/> Completed secondary school (5) <input type="checkbox"/> Vocational/technical school (6) <input type="checkbox"/> Tertiary education (7)
4. [Do/Does] you/[name] currently attend or have you/[name] ever attended school?	<input checked="" type="checkbox"/> Select one if participant age B1.22 <18 years, autofill	<input type="checkbox"/> Never attended (1) <input type="checkbox"/> Ever previously attended (2) <input type="checkbox"/> Currently attending (3)
5. What best describes your/[name]'s current work situation?	<input checked="" type="checkbox"/> Select one, autofill if participant age B1.22 18+ years	<input type="checkbox"/> Looking after housework, children/elderly (1) <input type="checkbox"/> In regular paid work (2) <input type="checkbox"/> In irregular paid work (3) <input type="checkbox"/> Retired (old age/disability) (4) <input type="checkbox"/> Self-employed (5)

		<input type="checkbox"/> Unemployed seeking work (6) <input type="checkbox"/> Unemployed not seeking work (7) <input type="checkbox"/> Volunteer (8) <input type="checkbox"/> Student (9) <input type="checkbox"/> Other (10)
<b>6. Specify other</b>	text if D6.1 q5=10, autofill	_____
<b>7. Because of problems with your/[name] hearing, [do/does] you/[name] have difficulty doing things you would like to do?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> No, no difficulty (1) <input type="checkbox"/> Yes, some difficulty (2) <input type="checkbox"/> Yes, a lot of difficulty (3) <input type="checkbox"/> Cannot do at all (4)
<b>8. What are some of these activities? INTERVIEWER READ OUT THE LIST OF ACTIVITIES. PROMPT: "Is there anything else that might be difficult for you/[name] to do because of your/[name]'s hearing?"</b>	<input checked="" type="checkbox"/> Select all that apply if D6.1 q7 = 2,3 or 4	<input type="checkbox"/> Cooking at home (1) <input type="checkbox"/> Cleaning at home (2) <input type="checkbox"/> Eating with others (3) <input type="checkbox"/> Going shopping, such as to the market (4) <input type="checkbox"/> Going to paid work (5) <input type="checkbox"/> Attending school (6) <input type="checkbox"/> Social activities, such as going to church (7) <input type="checkbox"/> Other (8)
<b>Other, specify</b>	<input checked="" type="checkbox"/> Select if q8=8	_____
<b>D6.2 Home environment</b>		
<b>Preamble: I am now going to ask you about you/[name]'s home environment.</b>		
<b>1. Who [do/does] you/[name] live with? READ ALOUD ANSWER OPTIONS, SEELECT ALL THAT APPLY</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> No one (1) <input type="checkbox"/> Partner/spouse (2) <input type="checkbox"/> Child/children (3) <input type="checkbox"/> Sibling/s (4) <input type="checkbox"/> Friend/s (5) <input type="checkbox"/> Other family members (6)
<b>2. Because of your/[name]'s hearing, [do/does] you/[name] need help with some of your/[name] daily activities in the home, such as [ &gt;17years] cooking, cleaning or fixing items? [5 to 17years] playing and getting dressed? [2 to 4 years] feeding and playing?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
<b>3. Because of your/[name]'s hearing, [do/does] you/[name] need help with some of your/[name] daily activities in your/[name] community, such as [ &gt;17years] going to the market? [2 to 17years] playing with friends?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
<b>4. [Is this person/Are these people] who you/[name] live with able to provide help with your/[name] daily activities?</b>	<input checked="" type="checkbox"/> Select one Only If D6.2q2 =1 or 2 and/or D6.2q3 =1 or 2 and D6.2q1=2 to 6	<input type="checkbox"/> No help (0) <input type="checkbox"/> Some help (1) <input type="checkbox"/> Help all the time (2)
<b>5a. [ &gt;17 years old] [Do/does] you/he/she use sign language?</b>	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>5b. [2 to 17 years old] [Do/does] you/[name] use sign language?</b>	<input checked="" type="checkbox"/> Select one if participant age B1.22 <18 years	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
<b>6. [Do/Does] you/[name] or a family member have a mobile phone with smart technology? PROMPT: Such as mobile applications?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)
<b>D6.3 Functional activities by assistive product</b>		
<b>ADULTS &gt;17 years old</b>		

**Skip to Section D6.4 if <18 years old.**

 **Preamble:** In this section, I am going to ask you about some daily activities and how much difficulty, if any, you/[name] have doing certain activities because of your/[name]'s hearing. I will read out a choice of either yes or no or a choice of six answers and you will choose the one that describes you/[name] best. We are also going to ask about APs that may be helpful. [We are not able to provide these, but will refer you/[name] to services that can.] OR [This information will be helpful for service providers to know what products they should provide.]

**PARTICIPANT REPORTED ALREADY USING THESE ASSISTIVE PRODUCTS**

Autofill from B4 q3

**B. HEARING**

Alarm signallers (1)

Hearing aids (2)

**G. ALL**

Smart phones/tablets/PDA (1)

Other assistive product (Specify) (99)

**SPECIFIC HEARING AID**

Autofill from D3 q15

Yes, for the right ear only (1)

Yes, for the left ear only (2)

Yes, for both ears (3)

No (0)

**1. Do you/[name] have any problems using your hearing aid/s?**

Select one if B4 q3=B(2) or D2 q15=1,2,3

Yes (1)

No (0)

**I. Alarm signallers with light/sound/vibration**  
**Not if B4 q3 =B(1) AND D6.3 q1=0**

No, no difficulty

Yes, some difficulty

Yes, a lot of difficulty

Cannot do at all

Stopped doing this because of hearing

Stopped doing this because of other reasons or not interested in doing this

(1)

(2)

(3)

(4)

(5)

(6)

**1. Does a hearing problem cause you/[name] difficulty to know when something needs your/[name]'s attention, such as telephone, textphone or smoke alarm?**

Select one

**2. Do you think you/[name] could benefit from a device that could make it easier for you/[him/her] to know when something needs your/[him/her] attention, such as telephone, textphone or smoke alarm?**  
**SHOW PICTURE; READ ITEM DESCRIPTION**


Select one

Yes (1)

No (0)

If q2=0, go to q2a.

**2a. Why don't you think you/[name] could benefit?**

 text if D6.3 l q2=0

**ALARM SIGNALER NEEDED?**

Autofill

Yes (1) IF  
D6.1 q7=2,3,4 AND  
D6.2 q1=1 OR  
D6.2 q2=1,2 OR  
D6.2 q3=1,2 OR  
D6.2 q4=0 or 1 OR  
D6.3 l q1=2,3,4,5  
OR D6.3 l q2=1

<b>3. COULD THE PARTICIPANT BENEFIT FROM ALARM SIGNALLERS?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
<b>3a. WHY?</b>	<del>/</del> text if D6.3 I q3=1	_____				
<b>3b. WHY NOT?</b>	<del>/</del> text if D6.3 I q3=0	_____				
<b>II Hearing aids digital and batteries</b> <b>Not if D6.3 q1=0 AND B4 q3 =B(2) or D3 q15=1,2,3</b>						
<b>1. Does a hearing problem cause you/[name] difficulty when visiting friends, relatives, or neighbours?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Do you/[name] have difficulty hearing when someone speaks in a whisper or low voice?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. Do/does] [you/he/she] have difficulty hearing what is said in a conversation with one other person in a quiet room [If B2.1 q6=(1): even when using [your/his/her] hearing aid(s)]?</b>	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>4. [[Do/does] [you/he/she] have difficulty hearing what is said in a conversation with one other person in a noisier room [If B2.1 q6=(1): even when using [your/his/her] hearing aid(s)]?</b>	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>5. Do you think you/[name] could benefit from a hearing device that could be worn in your ear to make it easier for you/[name] to hear others?</b> <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
<b>5.1 Why don't you think you could benefit?</b>	<del>/</del> text if D6.3 II q5=0	_____				
<b>HEARING AID NEED?</b>	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF D6.1 q7=2,3,4 AND D6.2 q1=1 OR D6.2 q2=1,2 OR D6.2 q4=0,1 OR D6.3 II q1=2,3,4,5 OR D6.3 II q2=2,3,4,5; D6.3 II q3=2,3,4 OR D6.3 II q4=2,3,4 OR D6.3 II q5=1				
<b>6. COULD THE PARTICIPANT BENEFIT FROM HEARING AIDS?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
<b>6a. WHY?</b>	<del>/</del> text if D6.3 II q6=1	_____				
<b>6b. WHY NOT?</b>	<del>/</del> text if D6.3 II q6=0	_____				
<b>III. Accessible mobile application</b>						
<b>1. [Do/Does] you/[name] or a family member have a mobile phone with smart technology? PROMPT: Such as mobile applications?</b>	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2) <input type="checkbox"/> No (0)			If 0, go to q5 in this section	
<b>2. Because of your/[his/her] hearing, [do/does] you/[name] have difficulty using your/[his/her] mobile phone?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>




3. Do you/[name] use any special feature to help hear better on the phone?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
4. Can you/[name] show me how you/[he/she] make/s a call on the <b>mobile phone</b> ? SHOW MOBILE PHONE AND ASK PARTICIPANT TO DEMONSTRATE MAKING A CALL	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, able to complete call without use of accessibility features (1)	<input type="checkbox"/> Yes, able to complete call using accessibility features (2)	<input type="checkbox"/> Not able to complete call (0)		
5. Do you think you/[name] could benefit from applications that would make using a mobile phone more accessible for you/[him/her] because of your/[his/her] hearing difficulties, such as voice to text features for phone calls? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
5a. Why don't you think you/[name] could benefit?	<del>/</del> text if D6.3 III q5=0	_____				
ACCESSIBLE MOBILE APPLICATION NEED?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) IF D6.3 III q2=2,3,4,5 OR D6.3 III q4=0 OR D6.3 III q5=1				
6. COULD THE PARTICIPANT BENEFIT FROM ACCESSIBLE MOBILE DEVICES?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
6a. WHY?	<del>/</del> text if D6.3 III q6=1	_____				
6b. WHY NOT?	<del>/</del> text if D6.3 III q6=0	_____				

**SKIP TO SECTION D7**


### D6.4 Functional activities by assistive product for CHILDREN 5 to 17 years old

**Skip to D6.5 V if <5 years old.**

 **Preamble:** In this section, I am going to ask you about some daily activities and how much difficulty, if any, you/[name] [have/has] doing certain activities because of your/[his/her] hearing. I will read out a choice of either yes or no or a choice of six answers and you will choose the one that describes you/[name] best. We are also going to ask about AP that may be helpful. [We are not able to provide these, but will refer you/[name] to services that can.] OR [This information will be helpful for service providers to know what products they should provide.]

1. Alarm signalers with light/sound/vibration		No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of hearing	Stopped doing this because of other reasons or not interested in doing this
		(1)	(2)	(3)	(4)	(5)	(6)
1. Does a hearing problem cause you/[name] difficulty to know when something needs your/[his/her] attention, such as telephone, textphone or smoke alarm?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you think you/[name] could benefit from a device that could make it easier for you/[him/her] to know when something needs your/[his/her] attention, such as	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			

telephone, textphone or smoke alarm? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>						
2a. Why don't you think you could benefit?	☞ text if D6.4 I q2=0	_____				
ALARM SIGNALER NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF D6.1 q7=2,3,4 AND D6.2 q1=1 OR D6.2 q2=1,2 OR D6.2 q3=1,2 OR D6.2 q4=0 or 1 OR D6.4 I q1=2,3,4,5 OR D6.4 I q2=1				
3. COULD THE PARTICIPANT BENEFIT FROM ALARM SIGNALLERS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
3a. WHY?	☞ text if D6.4 I q3=1	_____				
3b. WHY NOT?	☞ text if D6.4 I q3=0	_____				
<b>II. Hearing aids digital and batteries</b> <b>Not if D6.3 q1=0 AND B4 q3 =B(2) or D3 q15=1,2,3</b>						
1. Does a hearing problem cause you/[name] difficulty when playing with friends or visiting relatives or neighbours?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. [Do/Does] you/[name] have difficulty hearing when someone speaks in a whisper or low voice?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. When using his/her hearing aid does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. Do you think you/[name] could benefit from a hearing device that could be worn in your ear to make it easier for you/[him/her] to hear others? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		
5a. Why don't you think you could benefit?	☞ text if D6.4 II q5=0	_____				
HEARING AID NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF D6.1 q7=2,3,4 AND D6.2 q1=1 OR D6.2 q2=1,2 OR D6.2 q4=0,1 OR D6.4 II q1=2,3,4,5 OR D6.4 II q2=2,3,4,5; D6.4 II q3=2,3,4 OR D6.4 II q4=2,3,4 OR D6.3 III q5=1				
6. COULD THE PARTICIPANT BENEFIT FROM HEARING AIDS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)			
6a. WHY?	☞ text if D6.3 II q6=1	_____				
6b. WHY NOT?	☞ text if D6.3 II q6=0	_____				

<b>III. Accessible mobile application</b>							
<b>1. [Do/Does] you/[name] or a family member have a mobile phone with smart technology? PROMPT: Such as mobile applications?</b>	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)				If 0, go to q5 in this section	
<b>2. Because of your/[name]'s hearing, [do/does] you/[name] have difficulty using a mobile phone?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. Do you/[name] use any special feature to help hear better on the phone?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
<b>4. Can you/[name] show me how you/[he/she] use the <b>mobile phone</b>? SHOW MOBILE PHONE AND ASK PARTICIPANT TO DEMONSTRATE MAKING A CALL</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, able to use phone without use of accessibility features (1)		<input type="checkbox"/> Yes, able use mobile using accessibility features (2)		<input type="checkbox"/> Not able to use phone (0)	
<b>5. Do you think you/[name] could benefit from applications that would make using a mobile phone more accessible for you/[him/her] because of your/[his/her] hearing difficulties, such as voice to text features for phone calls? SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
<b>5a. Why don't you think you/[name] could benefit?</b>	<i>✍</i> text if D6.4 III q5=0	_____					
<b>ACCESSIBLE MOBILE APPLICATION NEED?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) IF D6.4 III q2=2,3,4,5 OR D6.4 III q4=0,2 OR D6.4 III q5=1					
<b>6. COULD THE PARTICIPANT BENEFIT FROM ACCESSIBLE MOBILE DEVICES?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
<b>6a. WHY?</b>	<i>✍</i> text if D6.3 III q6=1	_____					
<b>6b. WHY NOT?</b>	<i>✍</i> text if D6.3 III q6=0	_____					
<b>SKIP TO SECTION D7</b>							
<b>D6.5 Functional activities by assistive product ONLY IF &lt;5 years old</b>							
 <b>Preamble:</b> In this section, I am going to ask you about some daily activities and how much difficulty, if any, [name] has doing certain activities because of [his/her] hearing. I will read out a choice of either yes or no or a choice of six answers and you will choose the one that describes [name] best. We are also going to ask about APs that may be helpful. [We are not able to provide these, but will refer [name] to services that can.] OR [This information will be helpful for service providers to know what products they should provide.]							
<b>I. Alarm signallers with light/sound/vibration</b>	No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of hearing	Stopped doing this because of other reasons or not interested in doing this	
	(1)	(2)	(3)	(4)	(5)	(6)	



1. Does a hearing problem cause [name] difficulty to know when something needs [his/her] attention, such as an alarm?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you think [name] could benefit from a device that could make it easier for [him/her] to know when something needs [his/her] attention, such as an alarm? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
2a. Why don't you think [name] could benefit?	<del>text</del> if D6.5 I q2=0	_____					
ALARM SIGNALER NEEDED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF D6.1 q7=2,3,4 AND D6.2 q1=1 OR D6.2 q2=1,2 OR D6.2 q3=1,2 OR D6.2 q4=0 or 1 OR D6.5 I q1=2,3,4,5 OR D6.5 I q2=1					
3. COULD THE PARTICIPANT BENEFIT FROM ALARM SIGNALLERS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			
3a. WHY?	<del>text</del> if D6.5 I q3=1	_____					
3b. WHY NOT?	<del>text</del> if D6.5 I q3=0	_____					
<b>II. Hearing aids digital and batteries</b> <b>Not if D6.3 q1=0 AND B4 q3 =B(2) or D3 q15=1,2,3</b>							
1. Does a hearing problem cause [name] difficulty when playing with friends?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Does [name] have difficulty hearing when someone speaks in a whisper or low voice?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. When using his/her hearing aid does [name] have difficulty hearing sounds like people's voices or music?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Do you think [name] could benefit from a hearing device that could be worn in your ear to make it easier for [him/her] to hear others? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
5a. Why don't you think [name] could benefit?	<del>text</del> if D6.5 II q5=0	_____					
HEARING AID NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> Yes (1) IF D6.1 q7=2,3,4 AND D6.2 q1=1 OR D6.2 q2=1,2 OR D6.2 q4=0,1 OR D6.4 II q1=2,3,4,5 OR D6.4 II q2=2,3,4,5; D6.4 II q3=2,3,4 OR D6.4 II q4=2,3,4 OR D6.4 II q5=1					
6. COULD THE PARTICIPANT BENEFIT FROM HEARING AIDS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)			

6a. WHY?	✍ text if D6.3 II q6=1	_____				
6b. WHY NOT?	✍ text if D6.3 II q6=0	_____				
<b>III. Accessible mobile application</b>						
1. [Do/Does] you/[name] or a family member have a mobile phone with smart technology? PROMPT: Such as mobile applications?	<input checked="" type="checkbox"/> Select one, autofill	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)				If 0, go to q5 in this section
2. Because of [name]'s hearing, does [he/she] have difficulty using a mobile phone or tablet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you[[name] use any special feature to help hear better on the phone?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		
4. Can [name] show me how [he/she] uses the <b>mobile phone or tablet</b> ? SHOW MOBILE PHONE AND ASK PARTICIPANT TO DEMONSTRATE MAKING A CALL	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, able to use phone without use of accessibility features (1)		<input type="checkbox"/> Yes, able use mobile using accessibility features (1)		<input type="checkbox"/> Not able to use phone (0)
5. Do you think [name] could benefit from applications that would make using a mobile phone more accessible for [him/her] because of [his/her] hearing difficulties, such as voice to text features for phone calls? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		
5a. Why don't you think you/[name] could benefit?	✍ text if D6.5 III q5=0	_____				
ACCESSIBLE MOBILE DEVICE NEED?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) IF D6.5 III q2=2,3,4,5 OR D6.5 III q4=0.2 OR D6.5 III q5=1				
6.COULD THE PARTICIPANT BENEFIT FROM ACCESSIBLE MOBILE DEVICES?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)		<input type="checkbox"/> No (0)		
6a. WHY?	✍ text if D6.3 III q6=1	_____				
6b. WHY NOT?	✍ text if D6.3 III q6=0	_____				

<b>D7. Hearing need: services and assistive products</b>			
PURE TONE AVERAGE	<input checked="" type="checkbox"/> Autofill D2 q9	average_l	average_r
PROBABLE CAUSE OF HEARING LOSS	<input checked="" type="checkbox"/> Autofill D.4 q20	cause_l	cause_r
EAR DIAGNOSIS	<input checked="" type="checkbox"/> Autofill D.4 q22	diagnosis_l	diagnosis_r
<b>D7.1 Hearing service need</b>			
<b>FOR CLINICAN REVIEW ONLY</b>			
SERVICES PREVIOUSLY RECEIVED	<input checked="" type="checkbox"/> Autofill from D5.1 q1a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3)	

		<input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9)	
<b>SERVICES RECEIVED IN PAST YEAR</b>	<input checked="" type="checkbox"/> Autofill from D5.1 q2a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9)	
<b>SERVICES CURRENTLY RECEIVING</b>	<input checked="" type="checkbox"/> Autofill from D5.1 q3a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9)	
<b>1. PLEASE SPECIFY ANY ADDITIONAL INFORMATION YOU NEED TO KNOW TO DETERMINE HEARING SERVICE NEEDS:</b>			
<hr/>			
<b>2. THE FOLLOWING HEARING SERVICES ARE RECOMMENDED FOR THE PARTICIPANT:</b>	Autofill if possible	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5) <input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> No service follow up (9)	
<b>3. DO YOU AGREE WITH THE SERVICE/S RECOMMENDED?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)
<b>4. DO YOU RECOMMEND DIFFERENT/ADDITIONAL SERVICE/S FOLLOW UP FOR THE PARTICIPANT?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) go to q4a	<input type="checkbox"/> No (0) Go to text
<b>4a. IF YES: PLEASE SPECIFY ALL SERVICES FOR REFERRAL (CAN CHOOSE MORE THAN ONE)</b>	<input checked="" type="checkbox"/> Select as many as apply ONLY IF D7.1 q4=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Ear examination (3) <input type="checkbox"/> Hearing test (4) <input type="checkbox"/> Hearing rehabilitation (5)	

<b>NOTE: IF NOT RECEIVED/CURRENTLY RECEIVING, WHAT SERVICES COULD THE PARTICIPANT BENEFIT FROM THIS?</b>		<input type="checkbox"/> Occupational therapy (6) <input type="checkbox"/> Speech therapy (7) <input type="checkbox"/> Counselling/psychosocial support (8) <input type="checkbox"/> Other (9) <input type="checkbox"/> No service follow up (10)
<b>4b. SPECIFY OTHER</b>	✍ text if D7.1 Q4a = (9)	_____
<b>INTERVIEWER READ:</b> IF NO FOLLOW UP: We do not recommend any follow up services for your hearing. IF SURGICAL OR MEDICAL SERVICE REFERRAL: We are recommending that you have [insert services] for follow up service/s for your hearing. IF EAR EXAMINATION OR HEARING TEST SERVICE: We are recommending that you have [insert services] for follow up service/s for your hearing. IF HEARING REHABILITATION, OCCUPATIONAL THERAPY, PSYCHOSOCIAL SUPPORT, AND/OR SPEECH THERAPY: We are recommending that you have [insert services] for follow up service/s for your hearing. <b>INTERVIEWER NOTE: THIS IS A RECOMMENDATION, BUT TEXT TO BE READ ALOUD WILL BE MODIFIED ACCORDING TO WHAT IS AVAILABLE.</b>		

<b>D7.2 Barriers to services</b>					
 <b>RELEVANT IF D7.1 q3=1 and q2=1 to 8 OR D7.1 q4a= 1 to 9 specific service</b> <b>This section to be repeated for each service reported in D7.1 q2 or D7.1 q4a</b>					
 <b>Preamble: We would like to understand why you haven't received this service.</b>					
<b>1. Why [haven't/hasn't] you/[name] received the service you/he/she need/s? You may answer 'yes' to as many questions as you like. READ ALOUD ALL ANSWER OPTIONS.</b>	No	Yes	Don't know	Refused	
	(0)	(1)	(88)	(99)	
1.1 You/[name] were not aware of the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 You/[name] were aware of the [service] but didn't know you needed it.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3 The service is not available locally.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4 The service was too far away.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 You/[name] cannot afford the cost of the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6 Service providers have negative attitudes.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7 Suitable transportation is not available/accessible to get to the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.8 Transportation is too expensive to get to the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.9 You/[name] need/s assistance to access the service, but no one was available to accompany.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.10 People would treat you/[name] differently if you/he/she sought the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.11 Are there any other reasons why you/[name] [have/has] not sought the service?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.12 Specify if other	✍ if D7.2 q.1.11= (1)	_____			

D7.3 Hearing assistive product referrals			
PLEASE SPECIFY ANY ADDITIONAL INFORMATION YOU NEED TO KNOW TO DETERMINE HEARING ASSISTIVE PRODUCT NEEDS:			
PARTICIPANT REPORTED ALREADY USING THESE ASSISTIVE PRODUCTS	<input checked="" type="checkbox"/> Autofill from B4 q3	<b>B. HEARING</b> <input type="checkbox"/> Alarm signallers (1) <input type="checkbox"/> Hearing aids (2) <b>G. ALL</b> <input type="checkbox"/> Smart phones/tablets/PDA (1) <input type="checkbox"/> Other assistive product (Specify) (99)	
SPECIFIC HEARING AID	<input checked="" type="checkbox"/> Autofill from D3 q15	<input type="checkbox"/> Yes, for the right ear only (1) <input type="checkbox"/> Yes, for the left ear only (2) <input type="checkbox"/> Yes, for both ears (3) <input type="checkbox"/> No (4)	
1. THE FOLLOWING ASSISTIVE PRODUCTS ARE RECOMMENDED FOR THE PARTICIPANT:		<input type="checkbox"/> Alarm signallers (1) if D6.3 I q3=1 OR D6.4 I q3=1 OR D6.5 I q3=1 <input type="checkbox"/> Hearing aids (2) if D6.3 II q6=1 OR D6.4 II q6=1 OR D6.5 II q6=1 <input type="checkbox"/> Smart phones/tablets/PDA (3) if D6.3 III q6=1 OR D6.4 III q6=1 OR D6.5 III q6=1 <input type="checkbox"/> No AP (4)	
2. DO YOU RECOMMEND (ADDITIONAL) ASSISTIVE PRODUCT/S FOR THE PARTICIPANT?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) go to q3a	<input type="checkbox"/> No (0) Skip to text
3a. IF YES: PLEASE SPECIFY ALL ASSISTIVE PRODUCTS YOU ARE RECOMMENDING (CAN CHOOSE MORE THAN ONE)	<input checked="" type="checkbox"/> Select as many as apply ONLY IF D7.3 q3=1		
	HEARING	<input type="checkbox"/> Alarm signallers with light/sound/vibration (1) <input type="checkbox"/> Hearing aids digital and batteries (2)	
	ALL DOMAINS	<input type="checkbox"/> Smart phones/tablets/PDA (3)	
		<input type="checkbox"/> Other (4) (if D7.2 q3a7=1 then go to D7.2 q3b) <input type="checkbox"/> No AP (5)	
3b. SPECIFY OTHER	<i>✍</i> text if D7.3 Q3a=4	_____	
<b>INTERVIEWER READ:</b> IF NO ASSISTIVE PRODUCTS: We do not recommend any assistive products for your hearing. IF ASSISTIVE PRODUCTS: We are recommending that you might benefit from <i>[insert assistive products]</i> your hearing. <b>INTERVIEWER NOTE: THIS IS A RECOMMENDATION, BUT TEXT TO BE READ ALOUD WILL BE MODIFIED ACCORDING TO WHAT IS AVAILABLE.</b>			

## D7.4 Barriers to assistive products





**RELEVANT IF D7.3 q2= 1,2,3 and q3=0 OR D7.3 q3a = 1 to 4 specific products**  
**This section to be repeated for each assistive product reported in D7.3 q2 or q3a**



**Preamble: We would like to understand why you don't have the product/s.**

1. Why [don't/doesn't] you/[name] have the assistive products you/he/she need/s? You may answer 'yes' to as many questions as you like. READ ALOUD ALL ANSWER OPTIONS.		No	Yes	Don't know	Refused
		(0)	(1)	(88)	(99)
1.1 You/[name] were not aware of the [assistive product]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 You/[name] were aware of the [assistive product] but didn't know you needed it.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3 Assistive product is not available locally	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4 You/[name] cannot afford the cost	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 Available assistive products are not suitable for your/is/her home or surroundings	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6 No one is available to show you/[name] how to use the [assistive product]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7 Suitable transportation is not available to get the [assistive product]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.8 You/[name] need/s assistance to use it, but assistance is not available	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.9 You/[name] [don't/doesn't] like the appearance of the [assistive product]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.10 People would treat you/[name] differently if you/he/she had the [assistive product]	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.11 Are there any other reasons why you/[name] [do/does] not have the [assistance products] you need?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.12 Specify if other	<i>☞</i> if D7.4 q.1.11= (1)				

INTERVIEW NOTES: *☞* text

**END of hearing module questionnaire**

## E. MOBILITY MODULE



### OPTION 1

All participants should complete the mobility questionnaire.



### OPTION 2

Only participants should complete the mobility questionnaire if B3 q9=1

### E1. Enumeration linking data

1. Date	☞ Day / Month / Year (dd/mm/yyyy)	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
2. Interviewer id	☒ Select one (list to be generated in app)	_____		
3. Region number	☞ 2 digit number 01 – 09 copied from participant slip, autofill	_____		
4. Cluster Number	☞ 3 digit number 001-100 copied from household roster, autofill	_____		
5. Household Number	☞ 2 digit number 01-30 copied from household roster, autofill	_____		
6. Individual Number	☞ 2 digit number 01-30 [LINE NUMBER FROM HOUSEHOLD ROSTER], autofill	_____		
7. Study ID Number	☞ Cluster Number –HH- Individual Number, autofill	--	--	
8. Date of the interview	☞ Day / Month / Year (dd/mm/yyyy), autofill	<i>dd</i>	<i>mm</i>	<i>yyyy</i>
9. First name	☞ text confirmed from participant slip, autofill	_____		
10. Last name	☞ text confirmed from participant slip, autofill	_____		
11. Common name	☞ text, autofill	_____		
12. Telephone number	☞ 12 digit number, autofill			
13. Whose telephone is this?	☞ autofill			
14. Telephone number 2	☞ 12 digit number, autofill			
15. Whose telephone is this?	☞ autofill			
16. Sex	☒ Select one, autofill	<input type="checkbox"/> Male (1) <input type="checkbox"/> Female (2) <input type="checkbox"/> Prefer not to say (3)		
17. Age	☒ Select one each, autofill	<input type="checkbox"/> (Year 0-105)		<input type="checkbox"/> (Months 1-12)
CONSENT	☒ Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)		
18. Availability for MOBILITY module	☒ Select one	<input type="checkbox"/> Available (1) <input type="checkbox"/> Not currently available, revisit (2) <input type="checkbox"/> Will not be available for duration of survey (unavailable) (3) <input type="checkbox"/> Refused (4)		
18a. Scheduling notes	☞ text	_____		
18b. Reason for refusal	☞ text	_____		
19. Responder	☒ Select one	<input type="checkbox"/> Participant (1) <input type="checkbox"/> Proxy (2)		

20. Specify proxy name and relationship	☞ text if E1.19=20	_____
---	--------------------	-------

## E2. Rapid Assessment of Musculoskeletal Impairment screening questions

<b>Preamble: We will ask you questions now to ascertain whether you experience any problems with your body that affect your mobility.</b>		Yes	No
		(1)	(0)
1. Is any part of your/[Name] body missing or misshapen?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you/[Name] have any difficulty or pain using your arms? (including hands)	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you/[Name] have any difficulty or pain using your legs? (including feet)	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
4. Do you/[Name] have any difficulty using any other part of your body?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
5. Do you/[Name] need a mobility aid or prosthesis?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
6. Do you/[Name] have convulsions, involuntary movement, rigidity or loss of consciousness?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>
7. If yes to any of the above: has it lasted >1 month?	<input checked="" type="checkbox"/> Select one if any one E2.1 – E2.6 = (1)	<input type="checkbox"/>	<input type="checkbox"/>
8. If yes to any of the above: is it permanent?	<input checked="" type="checkbox"/> Select one if any one E2.1 – E2.6 = (1)	<input type="checkbox"/>	<input type="checkbox"/>
9. CONFIRM MOBILITY EXAM NEEDED? MOBILITY EXAM IS NEEDED IF ANSWER TO AT LEAST ONE Q 1-6 IS YES AND ANSWER TO AT LEAST ONE "DURATION" QUESTION IS YES.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>

## E3. Observation of activities

**Only complete if E2.q9=1**

**Preamble: We will now test your mobility by asking you to complete a few activities and questions.**

		Can do easily	Can do with difficulty	Cannot do
I. Position	Squat/sit bending knees:	O (1)		O (2)
	Stand up straight on natural legs:	O (1)		O (2)
	Hold arms straight above head, fingers straight:	O (1)		O (2)
II. Mobility	Walk along the 11 metre rope:	O (1)		O (2)
	Do it in less than 10 secs:	O (1)		O (2)
	Do it without limping:	O (1)		O (2)
III. Right hand function	Touch Nose:	O (1)	O (2)	O (3)
	Pick up coin and put in cup:	O (1)	O (2)	O (3)
	Tip coin into bowl:	O (1)	O (2)	O (3)

IV. Left hand function

		<input type="radio"/>	0				
	Touch Nose:	<input type="radio"/>	(1)	<input type="radio"/>	(2)	<input type="radio"/>	(3)
		<input type="radio"/>	0				
	Pick up coin and put in cup:	<input type="radio"/>	(1)	<input type="radio"/>	(2)	<input type="radio"/>	(3)
		<input type="radio"/>	0				
	Tip coin into bowl:	<input type="radio"/>	(1)	<input type="radio"/>	(2)	<input type="radio"/>	(3)

## E4. Seizure history



Only complete if E2.q9=1

1 Have you ever had a seizure?

No history of seizure:  (0)

History of seizure:  (1)

2 Number of episodes in last year:

0:  (1)

1-2:  (2)

3-10:  (3)

>10:  (4)

Not applicable (never had seizure):  (5)

3 Type of seizure (tick one only)

Absences:  (1)

Convulsions:  (2)

Not applicable (never had seizure):  (3)

## E5. Duration and consanguinity



Only complete if E2.q9=1

1 Age at impairment:

Since birth:  (1)

after birth-1 year:  (2)

1-4 years:  (3)

5-17 years:  (4)

18-39 years:  (5)

40-64 years:  (6)

65+ years:  (8)

Not applicable (No impairment):  (7)

2 How long ago did you start having difficulties with [INSERT CONDITION] /did this condition start?

<1 month:  (1)

1-6 months:  (2)

7<12 months:  (3)

1-3 years:  (4)

4-10 years:  (5)

11+ years:  (6)

3 Consanguinity: No  (0) Yes  (1)

## E6. Aetiology



Only complete if E2.q9=1

Tick one only for each cause

Trauma

Cause no:	1	2	
Family history:	<input type="checkbox"/>	<input type="checkbox"/>	(1)
Congenital but no family history:	<input type="checkbox"/>	<input type="checkbox"/>	(2)
Perinatal hypoxia:	<input type="checkbox"/>	<input type="checkbox"/>	(3)
RTA:	<input type="checkbox"/>	<input type="checkbox"/>	(4)
War:	<input type="checkbox"/>	<input type="checkbox"/>	(5)
Civil violence:	<input type="checkbox"/>	<input type="checkbox"/>	(6)
Domestic violence:	<input type="checkbox"/>	<input type="checkbox"/>	(7)
Deliberate self harm:	<input type="checkbox"/>	<input type="checkbox"/>	(8)
Other inc accidents:	<input type="checkbox"/>	<input type="checkbox"/>	(9)
			(9a) Specify.....
Developmental /			
Nutritional:	<input type="checkbox"/>	<input type="checkbox"/>	(10)
Infection:	<input type="checkbox"/>	<input type="checkbox"/>	(11)
Neoplasm:	<input type="checkbox"/>	<input type="checkbox"/>	(12)
Iatrogenic:	<input type="checkbox"/>	<input type="checkbox"/>	(13)
Traditional	<input type="checkbox"/>	<input type="checkbox"/>	(14)
Unknown:	<input type="checkbox"/>	<input type="checkbox"/>	(15)
Other:	<input type="checkbox"/>	<input type="checkbox"/>	(16)
			(16a) Specify.....
Not applicable (No impairment:)	<input type="checkbox"/>	<input type="checkbox"/>	(17)

## E7. Structure affected



Only complete if E2.q9=1

Yes	No
1	0
1	0
1	0

1. Head and Neck

2. Whole body

3. Upper Limb

Maximum 3 or whole arm

(if yes ->3A)

3A Structure affected	Yes	No	Laterality		
			L	R	Both
a. Shoulder region	1	0	1	2	3
b. Upper arm	1	0	1	2	3
c. Elbow Joint	1	0	1	2	3
d. Forearm	1	0	1	2	3
e. Wrist Joint	1	0	1	2	3
f. Hand	1	0	1	2	3
g. Hand/Finger Joints	1	0	1	2	3
h. Whole arm	1	0	1	2	3

4. lower Limb and Pelvis

Yes	No
1	0

(if yes ->4A)

Maximum 3 or whole leg

4A Structure affected	Yes	No	Laterality		
			L	R	Both
a. Pelvis	1	0	1	2	3
b. Hip joint	1	0	1	2	3
c. Knee Joint	1	0	1	2	3
d. Lower leg	1	0	1	2	3
e. Ankle Joint	1	0	1	2	3
f. Foot	1	0	1	2	3
g. Foot/Toe Joints	1	0	1	2	3
h. Whole Leg	1	0	1	2	3

5. Trunk and Spine

Yes	No
1	0

(if yes ->5A)

5A

Structure affected

a. Trunk

b. C-spine

c. T-spine

d. L-spine

e. Whole spine

	Yes	No
a. Trunk	1	0
b. C-spine	1	0
c. T-spine	1	0
d. L-spine	1	0
e. Whole spine	1	0

## E8. Case severity



Only complete if E2.q9=1

1. Is this person a case? (Refer to case severity card)

Yes  
(1)

No  
(0)

2. Is this person?


Mid (1)  
 Moderate (2)  
 Severe (3)

### LOWER LIMB AND BACK

### UPPER LIMB

**NOT CASE (Yes to all of a-d)**

- a) Can stand up straight on natural legs
- b) Can walk 11 m in 10 secs without limping
- c) Can squat/sit and bend knees
- d) Has typical shape limb, feet and toes

**MILD CASE (yes to at least one of a-d)**

Can walk:

- a) but takes longer than 14 seconds
- b) in 10 seconds but limps
- c) in 10 seconds but with walking aid
- d) in 10 seconds but using prosthesis

**MODERATE CASE**

Can walk 11m but it takes longer than 14 secs

**SEVERE CASE (Yes to one of a-b)**

- a) Cannot walk
- b) Can walk but extreme pain/difficulty

**NOT CASE (Yes to all of a-d)**

- a) Can touch nose
- b) Can pick up coin and put in cup
- c) Can tip coin into bowl
- d) Has typical shape limb and fingers

**MILD CASE**

Handles most objects easily and successfully or with reduced quality or speed

**MODERATE CASE**

Handles objects with difficulty and needs help to pre-arrange items

**SEVERE CASE (Yes to one of a-b)**

- a) Does not handle objects and has limited ability to perform simple actions
- b) Can only handle objects if pre-arranged and have continuous assistance

## E9. Diagnosis decision algorithm (MAXIMUM 3 DIAGNOSES OVERALL)



Only complete if E2.q9=1

**VIEW IMAGES AS RELEVANT**

**IS IT CONGENITAL?**

**A. CONGENITAL/GENETIC**

**A1. UPPER LIMB**

- (1) Polydactyly
- (1) Syndactyly
- (3) Other congenital hand deformity
  
- (4) Other congenital absence of all or part of upper limb
  
- (5) Other congenital abnormality of upper limb

**A2. LOWER LIMB**

- (1) Developmental dysplasia of hip
- (2) Proximal focal femoral deficiency
- (3) Congenital absence of all or part of tibia
- (4) Congenital absence of all or part of fibula
  
- (5) Other congenital absence of all or part of lower limb
  
- (6) Club foot
- (7) Other congenital abnormality of lower limb

**A3. UPPER AND LOWER LIMB**

- (1) Amniotic bands
- (2) Arthrogryphosis

**A4. SPINE**

- (1) Congenital deformity of cervical spine
- (2) Congenital deformity of thoracolumbar spine

**A5. HEAD AND NECK**

- (1) Cleft lip
- (2) Cleft lip and palate
- (3) Other congenital deformity of head or face

**IS IT DUE TO INFECTION?**

**B. INFECTIVE**

- (01) Joint Infection
- (02) Bone infection limb
- (03) Bone infection spine
- (03) Skin/soft tissue infection/wound

**IS IT DUE TO TRAUMA?**

**C. ACQUIRED TRAUMA**

- (01) Burn contracture
  
- (02) Fracture non union
- (03) Fracture malunion
- (04) Spinal injury
- (05) Head injury
  
- (06) Recurrent/chronic dislocation
- (07) Post traumatic joint stiffness
  
- (08) Tendon problem
- (09) Muscle problem
- (10) Peripheral nerve problem
- (11) Amputation
- (12) Other Trauma

**IS IT NEUROLOGICAL IN CAUSE OR NATURE?**

**D. NEUROLOGICAL**

- (01) Epilepsy
- (02) Leprosy
  
- (03) Developmental delay
- (04) Cerebral palsy - spastic
- (05) Cerebral palsy - other

**E. ACQUIRED NON TRAUMATIC**

- (01) Degenerative joint disease
- (02) Non infective non traumatic joint disease
- (03) Bow legs
- (04) Knock knees
  
- (05) Other joint deformity
  
- (06) Bone tumour (benign or malignant)
- (07) Hydrocephalus
- (08) Skin/Soft tissue tumour
  
- (09) Spinal deformity-kyphosis
- (10) Spinal deformity-lordosis
- (11) Spinal deformity-scoliosis
- (12) Spinal pain limiting function
- (13) TB spine/spine infection
  
- (14) Limb pain limiting function
  
- (15) Lymphoedema
- (16) Other acquired non traumatic

**F. NO DIAGNOSIS**

- (01) No Diagnosis



A6. GENERAL

- (1) Multiple congenital abnormalities
- (2) Sickle cell disease
- (3) Osteogenesis imperfecta
- (4) Haemophilia
- (5) Muscular Dystrophy

- (06) Paraplegia
- (07) Hemiplegia
- (08) Quadriplegia
- (09) Facial weakness
- (10) Peripheral nerve palsy
- (11) Polio
- (12) Other neurological
- (13) Spina Bifida

## E10. Case diagnosis



Only complete if E2.q9=1

### J. CASE DIAGNOSIS

AUTOFILL  
VARIABLE

Diagnosis 1 \_\_\_\_\_

--	--	--	--

Diagnosis 2 \_\_\_\_\_


--	--	--	--

Diagnosis 3 \_\_\_\_\_

--	--	--	--

## E11 Self-reported mobility: services and assistive products use

All participants

 **Preamble:** "I am now going to ask you about any use of health or other support services for these difficulties."

### E11.1 Service use

<b>1. Have you ever received any health or other support services for these difficulties?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>1a. Have you received any of the following services?</b> <b>READ ALOUD SERVICE LIST AND TICK RELEVANT SERVICES</b>	<input checked="" type="checkbox"/> Select as many apply if E11.1 q1=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Physiotherapy (3) <input type="checkbox"/> Occupational therapy (4) <input type="checkbox"/> P & O services (5) <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No treatment (9) <input type="checkbox"/> Other (10)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only is q1a=10	_____
<b>2. Have you received any health or other support services within the past year?</b>	<input checked="" type="checkbox"/> Select one if E11.1 q1=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>2a. If yes, have you received any of the following services?</b> <b>READ ALOUD SERVICE LIST AND TICK RELEVANT SERVICES</b>	<input checked="" type="checkbox"/> Select as many apply if E11.1 q2=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Physiotherapy (3) <input type="checkbox"/> Occupational therapy (4) <input type="checkbox"/> P & O services (5) <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No treatment (9) <input type="checkbox"/> Other (10)
<b>Other, specify</b>	<input checked="" type="checkbox"/> text only is q2a=10	_____
<b>3. Are you currently receiving any health or other support services?</b>	<input checked="" type="checkbox"/> Select one if E11.1 q2=1	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0) <input type="checkbox"/> Refused <input type="checkbox"/> Don't know
<b>3a. Which services are you currently receiving?</b>	<input checked="" type="checkbox"/> Select as many apply if E11.1 q3=1	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Physiotherapy (3) <input type="checkbox"/> Occupational therapy (4) <input type="checkbox"/> P & O services (5) <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No treatment (9) <input type="checkbox"/> Other (10)

Other, specify	<input checked="" type="checkbox"/> text only is q3a=10	
<b>E11.2 Assistive product use</b>		
3. PARTICIPANT REPORTED ALREADY USING THESE ASSISTIVE PRODUCTS	<input checked="" type="checkbox"/> Autofill from B4 q3	<p><b>C. MOBILITY</b></p> <p><input type="checkbox"/> Canes, Sticks, tripod and quadripod (1)</p> <p><input type="checkbox"/> Crutches (2)</p> <p><input type="checkbox"/> Orthoses (3)</p> <p><input type="checkbox"/> Prostheses (4)</p> <p><input type="checkbox"/> Therapeutic/protective footwear (5)</p> <p><input type="checkbox"/> Walking frame or rollators (6)</p> <p><input type="checkbox"/> Wheelchairs (7)</p> <p><b>F. SELF-CARE AND ENVIRONMENT</b></p> <p><input type="checkbox"/> Toilet chair/commode (1)</p> <p><input type="checkbox"/> Shower/bath chair (2)</p> <p><input type="checkbox"/> Incontinence products, absorbent (3)</p> <p><input type="checkbox"/> Ramps (4)</p> <p><input type="checkbox"/> Grab bars (5)</p> <p><b>G.ALL</b></p> <p><input type="checkbox"/> Smart phones/tablets/PDA (1)</p> <p><input type="checkbox"/> Other assistive product (Specify) (99)</p>

<b>E12. Surgical and medical services need</b>		
<b>All participants</b>		
1. PLEASE SPECIFY ANY ADDITIONAL INFORMATION YOU NEED TO KNOW TO DETERMINE MOBILITY SURGICAL, MEDICAL OR OTHER SERVICE NEEDS: _____		
<b>FOR CLINICAN ONLY, MORE THAN ONE SERVICE CAN BE SELECTED</b>		
2. DOES THIS PARTICIPANT NEED SURGERY?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
3. DOES THIS PARTICIPANT NEED MEDICAL SERVICES, INCLUDING PRESCRIPTIONS FOR MEDICATION?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)
4. DOES THIS PARTICIPANT (ALSO) NEED OTHER SERVICES, INCLUDING REHABILITATION AND ASSISTIVE PRODUCTS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)

## E13. Functional Mobility Assessment



Only complete this section of questionnaire if:

**Ages  $\geq 2$  years:** participants with mild, moderate or severe MSI who do not have surgical or medical needs only (i.e. If E8 q2= 1, 2, 3 AND E12 q4=1)



**Preamble:** I am now going to ask you some questions about [your/(child)'s] mobility and everyday life.

### E13.1 History

1. What is the highest level of education you/[name] completed or are currently attending?

Select one if participant age B1.22 18+ years, autofill

- None (1)  
 Attended but did not complete primary school (2)  
 Completed primary school (3)  
 Attended but did not complete secondary school (4)  
 Completed secondary school (5)  
 Vocational/technical school (6)  
 Tertiary education (7)

2. [Do/Does] you/[name] currently attend or have you/[name] ever attended school?

Select one if participant age B1.22 <18 years, autofill

- Never attended (1)  
 Ever previously attended (2)  
 Currently attending (3)

3. What best describes your/[name]'s current work situation?

Select one, autofill if participant age B1.22 18+ years

- Looking after housework, children/elderly (1)  
 In regular paid work (2)  
 In irregular paid work (3)  
 Retired (old age/disability) (4)  
 Self-employed (5)  
 Unemployed seeking work (6)  
 Unemployed not seeking work (7)  
 Volunteer (8)  
 Student (9)  
 Other (10)

4. Specify other

text if E13.1 q3=10, autofill

5. Because of problems with your/[name] mobility, do you/[name] have difficulty doing things you/[name] would like to do?

Select one

No, no difficulty (1)

Yes, some difficulty (2)

Yes, a lot of difficulty (3)

Cannot do at all (4)

6. What are some of these activities? INTERVIEWER. Can prompt, "Is there anything else that might be difficult for you/[name] to do because of your/[name] mobility?"

Select all that apply if q5 = 2,3 or 4

- Cooking at home (1)  
 Cleaning at home (2)  
 Eating with others (3)  
 Going shopping, such as to the market (4)  
 Going to paid work (5)  
 Attending school (6)  
 Social activities, such as going to church (7)  
 Other (8)

Other, specify

Select if q6=8

### E13.2 Home and community environment


**Preamble:** I am now going to ask you about your/[name] home and community environment.

1. Who do you/[name] live with? (select all that apply)

Select all that apply

- No one (1)  
 Partner/spouse (2)  
 Child/children (3)  
 Sibling/s (4)  
 Friend/s (5)  
 Other family members (6)

<p>2. Because of your/[name]'s mobility, [do/does] you/[name] need help with some of your/[name] daily activities, such as  [&gt;17years] cooking, cleaning or fixing items??  [5 to 17years] playing and getting dressed?  [2 to 4 years] feeding and playing?</p>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
<p>3. Because of your/[name]'s mobility, [do/does] you/[name] need help with some of your/[name] daily activities in your/[name] community, such as  [&gt;17years] going to the market?  [2 to 17years] playing with friends?</p>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, sometimes help is needed (1) <input type="checkbox"/> Yes, help is always needed (2) <input type="checkbox"/> No help is needed (0)
<p>4. [Is this person/Are these people] who you/[name] live with able to provide help with your/[name] daily activities?</p>	<input checked="" type="checkbox"/> Select one Only if E13.2 q2=1 or 2 and/or E13.2 q3=1 or 2 and E13.2 q1=2 to 6	<input type="checkbox"/> No help (0) <input type="checkbox"/> Some help (1) <input type="checkbox"/> Help all the time (2)
<p>5. What type of road surface is outside your/[name] home?  <b>READ ANSWER CHOICES ALOUD</b></p>	<input checked="" type="checkbox"/> Select all that apply	<input type="checkbox"/> Sand (1) <input type="checkbox"/> Dirt (2) <input type="checkbox"/> Pebbles/small rocks (3) <input type="checkbox"/> Concrete/paved (4) <input type="checkbox"/> Other (5)
<p>6. What type of ground is outside your/[name] home?  <b>PROMPT: Would you say it is even/flat or uneven/bumpy?</b>  <b>IF AT HOUSEHOLD, INTERVIEWER COULD COMPLETE.</b></p>	<input checked="" type="checkbox"/> Select all that apply	<input type="checkbox"/> Even/flat ground (1) <input type="checkbox"/> Uneven/bumpy ground (2) <input type="checkbox"/> Other (3)
<p>6a. Specify other</p>	<del>text</del> if E13.2 q6=3	<hr/>
<p>7. [Do/Does] you/[name] or a family member have a mobile phone with smart technology?</p>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)
<p><b>E13.3 Functional activities by assistive product</b></p>		
<p><b>PARTICIPANT REPORTED ALREADY USING THESE ASSISITIVE PRODUCTS</b></p>	<input checked="" type="checkbox"/> Autofill from B4 q3	<p><b>C. MOBILITY</b></p> <input type="checkbox"/> Canes, Sticks, tripod and quadripod (1) <input type="checkbox"/> Crutches (2) <input type="checkbox"/> Orthoses (3) <input type="checkbox"/> Prostheses (4) <input type="checkbox"/> Therapeutic/protective footwear (5) <input type="checkbox"/> Walking frame or rollators (6) <input type="checkbox"/> Wheelchairs (7) <p><b>F. SELF-CARE AND ENVIRONMENT</b></p> <input type="checkbox"/> Toilet chair/commode (1) <input type="checkbox"/> Shower/bath chair (2) <input type="checkbox"/> Incontinence products, absorbent (3) <input type="checkbox"/> Ramps (4) <input type="checkbox"/> Grab bars (5) <p><b>G.ALL</b></p> <input type="checkbox"/> Smart phones/tablets/PDA (1) <input type="checkbox"/> Other assistive product (Specify) (99)
<p>1. Do you/[name] have any problems using your wheelchair?</p>	<input checked="" type="checkbox"/> Select one if B4 q3=B(7)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)

2. Do you/[name] have any problems using your prosthetic/prostheses?	<input checked="" type="checkbox"/> Select one if B4 q3=B(4)	<input type="checkbox"/> Yes (1) <input type="checkbox"/> No (0)					
 <b>Preamble:</b> In this section, I am going to ask you about some daily activities and how much difficulty, if any, you have doing certain activities because of your mobility. I will read out a choice of either yes or no or a choice of six answers and you will choose the one that describes you best. We are also going to ask about APs that may be helpful. [We are not able to provide these, but will refer you to services that can.] OR [This information will be helpful for service providers to know what products they should provide.]							
<b>I. Wheelchairs</b> <i>Ask mild, mod and severe mobility impairment only</i> <b>AND IF B4 q3 does not=B(7) or [B4 q3=B(7) AND E13.3 q1=1]</b>	No, no difficulty	Yes, some difficulty	Yes, a lot of difficulty	Cannot do at all	Stopped doing this because of mobility	Stopped doing this because of other reasons or not interested in doing this	
	(1)	(2)	(3)	(4)	(5)	(6)	
1. Does a mobility problem cause you/[name] difficulty moving around household distances, such as from one side of a room to the other?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Does a mobility problem cause you/[name] difficulty moving around community distances?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. [Do/Does] you/[name] get tired easily when moving around household distances?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
4. Do you think you/[name] could benefit from a device that would allow you/[name] to sit and wheel around, such as a wheelchair to make it easier for you/[name] to move around in the house? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
4a. Why don't you think you could benefit?	✍ text if E13.3 l q4=0	_____					
5. [Do/Does] you/[name] get tired easily when moving around community distances?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
6. Do you think you/[name] could benefit from a device that would allow you/[name] to sit and wheel around, such as a wheelchair to make it easier for you to move around in the community? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
6a. Why don't you think you could benefit?	✍ text if E13.3 l q6=0	_____					
<b>WHEELCHAIR NEED?</b>	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF E13.1 q5=2,3,4 AND E13.2 Q1=1 OR E13.2 Q2=1,2 OR E13.2 Q3=1,2 OR E13.3.l q1=2,3,4,5 OR E13.3.l q2=2,3,4,5 OR E13.3.l q3=1 OR E13.3.l q4=1 OR E13.3.l q5=1 OR E13.3.l q6=1					
7. COULD THE PARTICIPANT BENEFIT FROM A WHEELCHAIR?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			

7a. WHY?	<i>✍</i> text if E13.3 I q7=1	_____					
7b. WHY NOT?	<i>✍</i> text if E13.3 I q7=0	_____					
<b>II. Walking aids</b> <i>Ask mild or mod mobility impairment only; or missing one lower limb</i> <i>If E8 q2= 1 or 2 or If E9.A2=3,4,5,7 or E9.C=11</i>							
1. [Do/Does] you/[name] have difficulty walking household distances, such as from one side of a room to the other?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. [Do/Does] you/[name] have difficulty walking community distances?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. [Do/Does] you/[name] have difficulty keeping your/[his/her] balance when walking?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. [Do/Does] you/[name] have difficulty lifting [right/left/both] legs when walking?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. [Do/Does] you/[name] have difficulty using both hands?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. [Do/Does] you/[name] have difficulty gripping objects with your/[name] left hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. [Do/Does] you/[name] have difficulty gripping objects with your/[name] right hand?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. [Do/Does] you/[name] have difficulty carrying items, such as a basket?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Do you think you/[name] could benefit from a stick or cane with one point that would make it easier for you to walk? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
9a. Why don't you think you could benefit?	<i>✍</i> text if E13.3 II q9=0	_____					
CANE OR STICK NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
10. COULD THE PARTICIPANT BENEFIT FROM CANE OR STICK?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
10a. WHY?	<i>✍</i> text if E13.3 II q10=1	_____					
10b. WHY NOT?	<i>✍</i> text if E13.3 II q10=0	_____					
11. Do you think you/[name] could benefit from a device with wheels and handles that would make it easier for you to walk? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			

11a. Why don't you think you could benefit?	✍ text if E13.3    q11=0	_____		
ROLLATOR/WALKER NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>		
12. COULD THE PARTICIPANT BENEFIT FROM ROLLATOR/WALKER?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)	
12a. WHY?	✍ text if E13.3    q12=1	_____		
12b. WHY NOT?	✍ text if E13.3    q12=0	_____		
13. Do you think you/[name] could benefit from a device with legs and handles that would make it easier for you to walk? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)	
13a. Why don't you think you could benefit?	✍ text if E13.3    q13=0	_____		
WALKING FRAME NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>		
14. COULD THE PARTICIPANT BENEFIT FROM WALKING FRAME?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)	
14a. WHY?	✍ text if E13.3    q14=1	_____		
14b. WHY NOT?	✍ text if E13.3    q14=0	_____		
15. Do you think you/[name] could benefit from a device that would allow you to rest your elbow on sticks to make it easier to walk around?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)	
16. Do you think you/[name] could benefit from a device that would allow you to rest your upper arm on sticks to make it easier to walk around? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)	
16a. Why don't you think you could benefit?	✍ text if E13.3    q16=0	_____		
CRUTCHES NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>		
17. COULD THE PARTICIPANT BENEFIT FROM CRUTCHES?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)	
17a. WHY?	✍ text if E13.3	_____		



	II q17=1						
17b. WHY NOT?	✍ text if E13.3 II q17=0	_____					
<b>III. Prosthetics</b> <i>Only ask if lower limb is reported as missing in RAM.  If E9.A2=3,4,5,7 or E9.C=11  AND IF B4 q3 does not=B(4) or [B4 q3=B(4) AND E13.3 q2=1]</i>							
1. Because of your/[name]'s missing limb [do/does] you/[name] have difficulty moving around?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. [Do/Does] you/[name] have any pain in your missing limb?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
3. IS THE PARTICIPANT'S MISSING LIMB STUMP INTACT, WITHOUT CUTS OR ABRASIONS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
4. DOES THE PARTICIPANT HAVE ANY SWELLING IN HIS/HER STUMP?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
5. Do you think you/[name] could benefit from use of an artificial limb that could help with your mobility following training? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
5a. Why don't you think you could benefit?	✍ text if E13.3 III q5=0	_____					
PROSTHETIC NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF E13.1 q5=2,3,4 AND E13.2 Q1=1 OR E13.2 Q2=1,2 OR E13.2 Q3=1,2 OR E13.3 III Q1=2,3,4,5 OR E13.3 III Q2=0 E13.3 III Q5=1 AND E13.3 III Q3=1 OR E13.3 III Q4=0					
6. COULD THE PARTICIPANT BENEFIT FROM A PROSTHETIC?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
6a. WHY?	✍ text if E13.3 III q6=1	_____					
6b. WHY NOT?	✍ text if E13.3 III q6=0	_____					
<b>IV. Orthoses</b> <i>Only ask if RAM reports walking difficulty with gait.  If E8 q2= 1 or 2 or 3</i>							
1. [Do/Does] you/[name] have difficulty lifting your/[name] foot completely off the ground when walking?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Does your/[name]'s foot have pain in the arch or bottom of the foot?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you think you/[name] could benefit from a device that could make it easier for	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			

you/[name] to lift your foot and/or walk on your/[name]'s foot without pain? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>					
3a. Why don't you think you could benefit?	✍ text if E13.3 IV q3=0	_____			
ORTHOTIC NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>			
4. COULD THE PARTICIPANT BENEFIT FROM AN ORTHOTIC?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
4a. WHY?	✍ text if E13.3 IV q4=1	_____			
4b. WHY NOT?	✍ text if E13.3 IV q4=0	_____			
<b>V. Therapeutic footwear diabetic, neuropathic, orthopaedic</b> <i>If E8 q2= 1 or 2 or 3</i>					
1. Are you/[name] able to feel touch or items on the bottom of your/[his/her] feet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
2. [Do/Does] you/[name] sometimes have numbness or tingling on the bottom of your/[his/her] feet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
3. ARE BOTH OF THE PARTICIPANT'S LEGS EVEN LENGTH?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
4. Do you think you/[name] could benefit from a device that could make it easier for you/[name] to protect your foot and/or walk on your/[name]'s foot evenly? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
4a. Why don't you think you could benefit?	✍ text if E13.3 V q4=0	_____			
THERAPEUTIC FOOTWEAR NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>			
5. COULD THE PARTICIPANT BENEFIT FROM THERAPEUTIC FOOTWEAR?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
5a. WHY?	✍ text if E13.3 V q5=1	_____			
5b. WHY NOT?	✍ text if E13.3 V q5=0	_____			
<b>VI. Toilet chair/commode</b>					
VI.a Commode <i>If E8 q2= 1 or 2 or 3</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/> No facility/bush/field (1) <input type="checkbox"/> Other (2)		Autofill from SES if asked; Uganda SES section does not ask about commode.	
1. Because of your/[name]'s mobility, do you/[name] have difficulty going to the toilet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
2. Do you/[name] have difficulty removing and replacing your clothing and cleaning yourself when you go to the toilet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Do you/[name] have difficulty getting to a toilet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Do you/[name] have difficulty getting on and off the toilet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Do you think you/[name] could benefit from a device that would make it easier for you/[name] to toilet by providing a raised seat with rails and a bucket? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
5a. Why don't you think you could benefit?	<input type="checkbox"/> text if E13.3 Via q5=0	_____					
COMMODE NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
6. COULD THE PARTICIPANT BENEFIT FROM A COMMODE?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
6a. WHY?	<input type="checkbox"/> text if E13.3 Via q6=1	_____					
6b. WHY NOT?	<input type="checkbox"/> text if E13.3 Via q6=0	_____					
<b>VI.b Shower/bath chair</b> <b>If E8 q2= 1 or 2 or 3</b>							
1. [Do/Does] you/[name] have difficulty getting in/out of the washing area?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do you/[name] have difficulty standing when you/[his/her] wash your body, even your legs and feet?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you/[name] have difficulty sitting down when you/[his/her] wash your body?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. When you/[name] are sitting down, [are/is] you/[name] able to move your/[his/her] arms without any support?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
5. Do you think you/[name] could benefit from a seat to sit on to make it easier for you/[name] to wash yourself/[him/herself]? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
5a. Why don't you think you could benefit?	<input type="checkbox"/> text if E13.3 Vlb q5=0	_____					
SHOWER/BATH CHAIR NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>					
6. COULD THE PARTICIPANT BENEFIT FROM A SHOWER/BATH CHAIR?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)		<input type="checkbox"/> no (0)			
6a. WHY?	<input type="checkbox"/> text if E13.3 Vlb q6=1	_____					

6b. WHY NOT?	✍ text if E13.3 VIb q6=0	_____				
<b>VII. Ramp</b> <i>If E8 q2= 1 or 2 or 3</i>						
1. [Do/Does] you/[name] have one step or multiple steps to enter your/[his/her] home?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)			
2. [Do/Does] you/[name] have a step or a few steps inside your/[his/her] home?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)			
3. Do you think you/[name] would benefit from a slanted platform that could go over the step/s to make it easier for you/[name] to move around? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)			
3a. Why don't you think you could benefit?	✍ text if E13.3 VII q3=0	_____				
RAMP NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>				
4. COULD THE PARTICIPANT BENEFIT FROM A RAMP?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)			
4a. WHY?	✍ text if E13.3 VII q4=1	_____				
4b. WHY NOT?	✍ text if E13.3 VII q4=0	_____				
<b>VIII. Grab bars</b> <i>If E8 q2= 1 or 2 or 3</i>						
1. [Do/Does] you/[name] have difficulty getting on/off the toilet?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. [Do/Does] you/[name] have difficulty getting in/out of the washing area?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you think you/[name] would benefit from a bar to hold onto near [the toilet to that might make it easier for you/[name] to get on/off] and/or [the washing area that might make it easier for you/[name] to get in/out]? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)			
3a. Why don't you think you could benefit?	✍ text if E13.3 VIII q3=0	_____				
GRAB BARS NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>				
4. COULD THE PARTICIPANT BENEFIT FROM GRAB BARS?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)			
4a. WHY?	✍ text if E13.3 VIII q4=1	_____				

4b. WHY NOT?	✍ text if E13.3 VIII q4=0	_____			
IX. Smart PDAs & Tablets with accessible software/applications <i>If E8 q2= 1 or 2 or 3</i>					
1. [Do/Does] you/[name] or a family member have a mobile phone with smart technology?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> No (0) <input type="checkbox"/> Yes - respondent (1) <input type="checkbox"/> Yes - another family member (2)			If 0, go to q4 in this section
2. Because of your/[name]'s moving difficulties, do you/[name] use a mobile phone or tablet to help improve your/[his or her] mobility?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)		
3. Can you show me how you/[name] make a call on your/[name]'s mobile phone? INTERVIEWER: Show mobile phone and ask participant to demonstrate making a call	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes, able to complete call without use of accessibility features (1)	<input type="checkbox"/> Yes, able to complete call using accessibility features (2)	<input type="checkbox"/> Not able to complete call (0)	
4. Do you think you/[name] could benefit from mobile applications that would make moving around easier, such as exercise programmes or daily living skills training? <b>SHOW PICTURE; READ ITEM DESCRIPTION</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)		
4a. Why don't you think you could benefit?	✍ text if E13.3 IX q4=0	_____			
MOBILE PHONE APPLICATIONS NEED?	<input checked="" type="checkbox"/> Autofill	<input type="checkbox"/> yes (1) IF <b>THIS WILL BE ADDED IN NEXT VERSION</b>			
5. COULD THE PARTICIPANT BENEFIT FROM APPS ON A MOBILE PHONE?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> yes (1)	<input type="checkbox"/> no (0)		
5a. WHY?	✍ text if E13.3 IX q5=1	_____			
5b. WHY NOT?	✍ text if E13.3 IX q5=0	_____			

<b>E14. Mobility service and AP need</b>		
<b>E14.1 Mobility service need</b>		
<b>FOR CLINICAN REVIEW ONLY</b>		
DIAGNOSES	<input checked="" type="checkbox"/> Autofill from E10	Diagnosis 1 _____ Diagnosis 2 _____ Diagnosis 3 _____
SERVICES PREVIOUSLY RECEIVED	<input checked="" type="checkbox"/> Autofill from E11.1 q1a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Physiotherapy (3) <input type="checkbox"/> Occupational therapy (4) <input type="checkbox"/> P & O services (5) <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No treatment (9)

		<input type="checkbox"/> Other (99)	
<b>SERVICES CURRENTLY RECEIVING</b>	<input checked="" type="checkbox"/> Autofill from E11.1 q3a	<input type="checkbox"/> Medication (1) <input type="checkbox"/> Surgery (2) <input type="checkbox"/> Physiotherapy (3) <input type="checkbox"/> Occupational therapy (4) <input type="checkbox"/> P & O services (5) <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No treatment (9) <input type="checkbox"/> Other (99)	
<b>1. PLEASE SPECIFY ANY ADDITIONAL INFORMATION YOU NEED TO KNOW TO DETERMINE MOBILITY SERVICE NEEDS:</b>			
	_____		
	_____		
<b>2. THE FOLLOWING SERVICE/S ARE RECOMMENDED FOR THE PARTICIPANT:</b>	Autofill when possible, see criteria set	<input type="checkbox"/> Surgical (1) IF E12 q2=1 <input type="checkbox"/> Medical (i.e. medicine) (2) IF E12 q3=1 <input type="checkbox"/> Physiotherapy (3) IF E12 q4=1; <input type="checkbox"/> Occupational therapy (4) IF E12 q4=1; <input type="checkbox"/> P & O services (5) IF E13.3 III q6=1; IV q4=1, V q6=1 <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) IF E13.3 VII q4=1 or VIII q3=1 <input type="checkbox"/> No service follow up (9) IF E12 q2=0 and q3=1 and q4=0	
<b>3. DO YOU AGREE WITH THE SERVICE/S RECOMMENDED?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1)	<input type="checkbox"/> No (0)
<b>4. DO YOU RECOMMEND DIFFERENT/ADDITIONAL SERVICE/S FOLLOW UP FOR THE PARTICIPANT?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) go to q4a	<input type="checkbox"/> No (0) Go to text
<b>4a. IF YES: PLEASE SPECIFY ALL SERVICES FOR REFERRAL (CAN CHOOSE MORE THAN ONE)</b>  <b>NOTE: IF NOT RECEIVED/CURRENTLY RECEIVING, WHAT SERVICES COULD THE PARTICIPANT BENEFIT FROM THIS?</b>	<input checked="" type="checkbox"/> Select as many as apply ONLY IF E14.1 q4=1	<input type="checkbox"/> Surgical (1) <input type="checkbox"/> Medical (2) <input type="checkbox"/> Physiotherapy (3) <input type="checkbox"/> Occupational therapy (4) <input type="checkbox"/> P & O services (5) <input type="checkbox"/> Information exercises without ongoing rehabilitation (6) <input type="checkbox"/> Other rehabilitation (psychosocial support, speech therapy) (7) <input type="checkbox"/> Environmental modification (8) <input type="checkbox"/> No service follow up (9) <input type="checkbox"/> Other (10) (if E14.1 q4a=10 then go to E14.1 q4b)	
<b>4b. SPECIFY OTHER</b>	<input type="text"/> text if E14.1 Q4a = (10)	_____	

**INTERVIEWER READ:**

IF NO FOLLOW UP: We do not recommend any follow up services for your mobility.


IF SURGICAL OR MEDICAL SERVICE REFERRAL: We are recommending that you have [insert services] for follow up service/s for your mobility.

IF PHYSIOTHERAPY, OCCUPATIONAL THERAPY, P&O SERVICE AND/OR OTHER REHABILITATION (PSYCHOSOCIAL SUPPORT, SPEECH THERAPY): We are recommending that you have [insert services] for follow up service/s for your mobility.

IF INFORMATION EXERCISES WITHOUT ONGOING REHABILITATION OR ENVIRONMENTAL MODIFICATION: We are recommending that you have [insert services] for follow up service/s for your mobility for [exercises/environmental modifications].

**INTERVIEWER NOTE: THIS IS A RECOMMENDATION, BUT TEXT TO BE READ ALOUD WILL BE MODIFIED ACCORDING TO WHAT IS AVAILABLE.**

**E14.2 Barriers to services**

 **RELEVANT IF E14.1 q3=1 and q4=0 and q2= 1 to 8 OR E14.1 q4a= 1 to 8 or 10 specific service**  
**This section to be repeated for each service reported in E14.1 q2 or E14.1 q4a**

We would like to understand why you haven't received this service.		No	Yes	Don't know	Refused
1. Why [haven't/hasn't] you/[name] received the service you/he/she need/s? You may answer 'yes' to as many questions as you like. READ ALOUD ALL ANSWER OPTIONS.		(0)	(1)	(88)	(99)
1.1 You/[name] were not aware of the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 You/[name] were aware of the [service] but didn't know you needed it.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3 The service is not available locally.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4 The service was too far away.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 You/[name] cannot afford the cost of the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6 Service providers have negative attitudes.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7 Suitable transportation is not available/accessible to get to the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.8 Transportation is too expensive to get to the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.9 You/[name] need/s assistance to access the service, but no one was available to accompany.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.10 People would treat you/[name] differently if you/he/she sought the service.	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.11 Are there any other reasons why you/[name] [have/has] not sought the service?	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.12 Specify if other	<input checked="" type="checkbox"/> if E14.2 q.1.11= (1)	_____			

**E14.3 Mobility assistive product need**

<b>PARTICIPANT REPORTED ALREADY USING THESE ASSISITIVE PRODUCTS</b>	<input checked="" type="checkbox"/> Autofill from B4 q3	<p><b>C. MOBILITY</b></p> <p><input type="checkbox"/> Canes, Sticks, tripod and quadripod (1)</p> <p><input type="checkbox"/> Crutches (2)</p> <p><input type="checkbox"/> Orthoses (3)</p> <p><input type="checkbox"/> Prostheses (4)</p> <p><input type="checkbox"/> Therapeutic/protective footwear (5)</p> <p><input type="checkbox"/> Walking frame or rollators (6)</p> <p><input type="checkbox"/> Wheelchairs (7)</p> <p><b>F. SELF-CARE AND ENVIRONMENT</b></p> <p><input type="checkbox"/> Toilet chair/commode (1)</p> <p><input type="checkbox"/> Shower/bath chair (2)</p>
---	---	---

		<input type="checkbox"/> Incontinence products, absorbent (3) <input type="checkbox"/> Ramps (4) <input type="checkbox"/> Grab bars (5)  <b>G.ALL</b> <input type="checkbox"/> Smart phones/tablets/PDA (1) <input type="checkbox"/> Other assistive product (Specify) (99)
<b>1. THE FOLLOWING ASSISTIVE PRODUCTS ARE RECOMMENDED FOR THE PARTICIPANT:</b>	Autofill when possible	<b>MOBILITY</b> <input type="checkbox"/> Canes, Sticks, tripod and quadripod (1) IF E13.3 II q10=1 <input type="checkbox"/> Crutches (2) IF E13.3 II q17=1 <input type="checkbox"/> Orthoses (3) IF E13.3 IV q4=1 <input type="checkbox"/> Prostheses (4) IF E13.3 III q6=1 <input type="checkbox"/> Therapeutic/protective footwear (5) IF E13.3 V q5=1 <input type="checkbox"/> Walking frame or rollators (6) IF E13.3 II q12=1 and/or q14=1 <input type="checkbox"/> Wheelchairs (7) IF E13.3 I q7=1  <b>SELF-CARE AND ENVIRONMENT</b> <input type="checkbox"/> Toilet chair/commode (8) IF E13.3 VI.a q6=1 <input type="checkbox"/> Shower/bath chair (9) IF E13.3 VI.b q6=1 <input type="checkbox"/> Ramps (10) IF E13.3 VII q4=1 <input type="checkbox"/> Grab bars (11) IF E13.3 VIII q4=1  <b>ALL</b> <input type="checkbox"/> Smart phones/tablets/PDA (12) IF E13.3 IX q5=1  <input type="checkbox"/> No AP (13)
<b>2. DO YOU RECOMMEND (ADDITIONAL/DIFFERENT) ASSISTIVE PRODUCT/S FOR THE PARTICIPANT?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/> Yes (1) go to q3a <input type="checkbox"/> No (0) Skip to text
<b>3a. IF YES: PLEASE SPECIFY ALL ASSISTIVE PRODUCTS YOU ARE RECOMMENDING (CAN CHOOSE MORE THAN ONE)</b>	<input checked="" type="checkbox"/> Select as many as apply	
	MOBILITY	<input type="checkbox"/> Canes, Sticks, tripod and quadripod (1) <input type="checkbox"/> Crutches (2) <input type="checkbox"/> Orthoses (3) <input type="checkbox"/> Prostheses (4) <input type="checkbox"/> Therapeutic/protective footwear (5) <input type="checkbox"/> Walking frame or rollators (6) <input type="checkbox"/> Wheelchairs (7)
	SELF-CARE	<input type="checkbox"/> Toilet chair/commode (8) <input type="checkbox"/> Shower/bath chair (9) <input type="checkbox"/> Incontinence products, absorbent (10) <input type="checkbox"/> Ramps (11) <input type="checkbox"/> Grab bars (12)
	ALL	<input type="checkbox"/> Smart phones/tablets/PDA (13)



		<input type="checkbox"/> Other (14) (if 14.3 q3a=14 then go to E14.3 q3b) <input type="checkbox"/> No AP (15)
<b>4b. SPECIFY OTHER</b>	⌘ text if 14.3 Q3a=14	_____

**INTERVIEWER READ:**

IF NO ASSISTIVE PRODUCTS: We do not recommend any assistive products for your mobility.

IF ASSISTIVE PRODUCTS: We are recommending that you might benefit from *[insert assistive products]* your mobility.

**INTERVIEWER NOTE: THIS IS A RECOMMENDATION, BUT TEXT TO BE READ ALOUD WILL BE MODIFIED ACCORDING TO WHAT IS AVAILABLE.**

**E14.4 Barriers to assistive products**



**RELEVANT IF E14.3 q2=0 and q1=1 to 12 OR E14.3 q3a= 1 to 14 specific products**

**This section to be repeated for each assistive product reported in E14.3 q1 or E14.3 q3a**

<b>Preamble: We would like to understand why you don't have the product/s.</b>					
<b>1. Why [don't/doesn't] you/[name] have the assistive products you/he/she need/s?</b> You may answer 'yes' to as many questions as you like. <b>READ ALOUD ALL ANSWER OPTIONS.</b>		No	Yes	Don't know	Refused
		(0)	(1)	(88)	(99)
<b>1.1 You/[name] were not aware of the [assistive product]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.2 You/[name] were aware of the [assistive product] but didn't know you needed it.</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.3 Assistive product is not available locally</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.4 You/[name] cannot afford the cost</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.5 Available assistive products are not suitable for your/is/her home or surroundings</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.6 No one is available to show you/[name] how to use the [assistive product]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.7 Suitable transportation is not available to get the [assistive product]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.8 You/[name] need/s assistance to use it, but assistance is not available</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.9 You/[name] [don't/doesn't] like the appearance of the [assistive product]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.10 People would treat you/[name] differently if you/he/she had the [assistive product]</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.11 Are there any other reasons why you/[name] [do/does] not have the [assistance products] you need?</b>	<input checked="" type="checkbox"/> Select one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>1.12 Specify if other</b>	⌘ if E14.4 q.1.11= (1)	_____			

**INTERVIEW NOTES:** ⌘ text

**END of mobility module questionnaire**

## Appendix 7: Summary table of implications for the overall AP assessment methodology

Table A7-1: Summary of implications for the overall AP assessment methodology

IMPLICATIONS FOR SURVEY DEVELOPMENT	PHD CHAPTER	ALREADY INCLUDED FNAT SURVEY TOOL	WILL BE INCLUDED IN SURVEY TOOL	FUTURE RESEARCH RECOMMENDATIONS
<b>OVERALL ASSESSMENT APPROACHES</b>				
➤ Develop hybrid assessment modules incorporating clinical impairment, functional and self-report assessments.	4.4;5.4; 7.2	✓	✓	
➤ Explore the feasibility and practicality of hybrid assessment tool.	5.4; 7.2		✓	
➤ Explore other screening and clinical assessment tools incorporating more environmental factors.	8.2		✓	
➤ Explore the development of AP need decision trees following an algorithm.	5.4		✓	✓
➤ Test methods of how best integrate the hybrid assessment methods to estimate population-level AP need.	4.4			✓
➤ Agree definitions of assessment approaches and methods.	4.4			✓
➤ Consider relabelling the studies included in the AP systematic review to extract additional population-based functional assessment survey tools.	4.4			✓
<b>SURVEY MODULES</b>				
<b>Functional assessment</b>				
➤ Include hybrid functional assessment methods focusing upon wider health, personal, psychosocial and environmental factors in an AP need survey.	4.4	✓	✓	
➤ Select functional assessment sets that can provide specific measurements of AP need.	4.4		✓	
➤ Identify additional functional assessment tools.	4.4		✓	✓
➤ Conduct a functional assessment review including broader interventions.	4.4			✓
➤ Develop improved methodology to increase data collection efforts to assess rehabilitation/AP need in different settings.	6.2			✓
<b>Clinical VI AP assessment</b>				
➤ Measure both mild/worse and moderate/worse distance VI thresholds for distance glasses need.	5.3	✓		

➤ Measure uncorrected and corrected VA to report met need, unmet need, undermet need and total need for distance glasses indicators, which is well aligned with the vision sector indicator for effective coverage.	5.3	✓		
➤ Follow the VA assessment approach used within RAAB methodology for ages >4 years in the vision assessment module.	5.3	✓		
➤ Include near VI and the need for near vision glasses.	5.3	✓		
➤ Use both Peek acuity and near vision assessments in the vision assessment module.	5.3	✓		
➤ Ensure the clinician cadre administering the AP need vision module is well-aligned with RAAB methodology recommendations.	5.3	✓	✓	
➤ Review VI and additional AP assessment for ages ≤4 years old.	5.3	✓	✓	✓
➤ Explore VI and AP need measurement approaches for additional AP.			✓	✓
<b>Clinical HI AP assessment</b>				
➤ Measure both mild/worse and moderate/worse HI thresholds and AP need, and consider estimates for both unilateral and bilateral AP need.	5.3	✓		
➤ Follow the HI assessment approach used within RAHL methodology for ages >4 years in the hearing assessment module using hearTest for PTA.	5.3	✓		
➤ Ensure the clinician cadre administering the AP need hearing module is well-aligned with RAHL methodology recommendations.		✓	✓	
➤ Review AP need measurement approaches for ages ≤4 years old.	5.3	✓	✓	✓
➤ Explore HI and AP need measurement approaches for additional AP.	5.3		✓	✓
<b>Rapid Assessment of MSI</b>				
➤ See specific RAM section for implications.	6.2	✓	✓	✓
<b>AP Indicators</b>				
➤ Ensure AP met need, undermet need and unmet need are measured when feasible and possible, i.e. for vision, distance glasses met need and undermet need <i>both</i> uncorrected and corrected VA need to be assessed.	5.3	✓		
➤ Use AP item descriptions and pictorial image cards in self-reported AP use sections to facilitate participants' understanding of self-reported AP questions.	5.3; 7.2	✓		
➤ Separate unmet and undermet need self-reported AP indicators.	7.2	✓		
➤ Ensure the measurement of AP awareness at the beginning of self-reported AP section in an AP need survey.	7.2	✓		
➤ Include option to provide up to three additional locally sourced and made AP with possible photos in AP need survey.	7.2	✓		
➤ Collect AP data on access barriers, payment details, satisfaction and environment in an AP need survey.	7.2	✓		

➤ Assess AP need in all age groups, including younger age groups.	5.3	✓	✓	✓
➤ Improve the reliability of data collected on AP use by ensuring more consistency with the administration of this self-reported question and, for glasses asking specifically about use of distance glasses and near glasses separately.	5.3; 9.5	✓	✓	
➤ In a broader need survey, recommendation to collect data on vision and hearing related service need, alongside AP need data.	5.3	✓	✓	
➤ Explore the most feasible method for use of AP images (i.e. printed versus electronic).	7.2		✓	
<b>Data disaggregation</b>				
➤ Disaggregate vision and hearing AP indicators by age, sex, location and SES ensuring data is collected to enable disaggregation of AP need by these variables.	5.3	✓		
<b>Washington Group questions</b>				
➤ Include a specific near vision screening question in an AP need survey, such as the WG ES question, if near VI is clinically assessed.	8.2	✓		
➤ Recommend modifications to the WG ES questions to gather self-reported use/undermet/unmet need, while also ensuring that the data collected can be analysed to align with standardised WG reporting.	7.2	✓	✓	
<b>OTHER SURVEY METHODOLOGY</b>				
<b>First-stage screening</b>				
➤ Explore the accuracy of using the WG question cut-off of “some or worse” difficulty as a first stage screen for assessing AP need.	5.3	✓		
➤ Develop a multi-domain modular AP need survey tool to include options to i) include or not include the first stage WG screen in the survey and ii) select which functional domains to include.	8.2	✓		
➤ Compare the use of the WG first stage screening of “some or worse difficulty” in a minimum of one functional domain, as well as the feasibility, affordability and acceptability of this approach, to this study’s findings.	8.2		✓	
➤ Review other screening and clinical assessment tools incorporating more environmental factors for second stage screening, in addition to clinical impairment assessment.	8.2		✓	✓
➤ Design studies to investigate ‘service demand’ and explore if the use of a set of self-reported screening questions, such as the WG questions, in a two-stage screening survey can identify this demand in a given population.	8.2			✓
➤ Investigate if a combination of WG screening questions related to MSI might have improved sensitivity and specificity to identify people with MSI and service needs.	8.2			✓
➤ Explore how a first stage screening could best capture people who are using AP to gather specific AP indicators.	8.2			✓

<b>Additional methodology</b>			
➤ Ensure in-depth qualitative studies are undertaken alongside AP need survey.	7.2		✓
➤ Recommend that relevant AP use prevalence estimates are used in sample size calculations to ensure adequate power in an AP need survey until more data is generated.	7.2		✓
<b>SURVEY PROCESSES</b>			
<b>Data collection and management</b>			
➤ Ensure codebooks are created for AP need survey for consistency.	8.2		✓
➤ Programme electronic versions of web-based data dashboards and app-based when developing an AP need survey mobile application.	7.2; 9.5		✓
➤ Provide clear communication to participants indicating if the AP should be worn at the time of the assessment and if free AP will or will not be provided following a survey.	9.5		✓
➤ Qualitative research with both the participants and the data collectors could be planned alongside conducting the AP need survey.	9.5		✓
			✓
<b>Planning</b>			
➤ Budget for employing clinical staff for the whole duration of the survey ensuring at least one refresher training and rest days are scheduled.	9.1		✓
➤ Use equipment checklists and ensure budgets are adequate for appropriate size transport throughout the whole survey.	9.1		✓
➤ Ensure AP/service referral mappings are conducted prior to the survey, and that referral information is included in data collector training and in a pamphlet for participants.	9.1		✓
➤ Conduct the AP need survey according to the needs and resources of the population.	9.1		✓
➤ If data collection occurs during a pandemic, such as the COVID-19 pandemic, adapt methods to ensure safety and plan for necessary precautions, such as PPE and testing.	9.1		✓
<b>Training and IOV</b>			
➤ Ensure there is adequate training space available for parallel sessions in a multi-domain survey and that there are appointed trainers/supervisors per cadre.	9.2		✓
➤ Ensure time is allocated for data collectors to gain thorough AP understanding and knowledge.	9.2		✓
➤ Plan in advance for IOV assessment to ensure adequate time and sources of patients.	9.2		✓
<b>Logistics</b>			
➤ Consider pros and cons of central location versus household visits for AP need survey administration.	9.3	✓	✓
➤ In a multi-domain AP need survey, pilot test for feasibility, ensure each clinician is aware of and understands the importance of collection in the other domains, and consider rotating the order of testing.	9.3		✓

➤ Work in partnership with local partner organisations and researchers who can provide logistical support and local context coordination at each survey stage.	9.3	✓
<b>Supervision and support</b>		
➤ Ensure ongoing supervision and support throughout the multi-domain AP need survey through clinical team leaders for each cadre.	9.4	✓
➤ Set up communication groups for each worker cadre, alongside scheduled catch ups with the team leaders and trainers, to facilitate ongoing support throughout.	9.4	✓