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RESEARCH ARTICLE

Treatment of child wasting: results of a child health and nutrition research initiative (CHNRI) prioritisation exercise [version 1; peer review: 2 approved with reservations]

Chloe Angood [ID][1], Marko Kerac [ID][2], Robert Black[3], André Briend[4,5], Kerstin Hanson [ID][6], Stephen Jarrett[7], Mark Manary[8], Marie McGrath[9], Noël Zagre[10], Natasha Lelijveld[1], Amy Mayberry[1], CHNRI collaborators, Council of Research & Technical Advice on Acute Malnutrition (CORTASAM)

[1]No Wasted Lives, Action Against Hunger UK, London, SE10 0ER, UK
[2]Department of Population Health and maternal, adolescent, reproductive and child health centre, London School of Hygiene & Tropical Medicine, London, WC1E 7HT, UK
[3]Institute for International Programs, Bloomberg School of Public Health, Johns Hopkins Medicine, Baltimore, MD, 21205, USA
[4]Department of Nutrition, Exercise and Sports, Faculty of Science, University of Copenhagen, Rolighedsvej, Frederiksberg, DK-1958, Denmark
[5]Center for Child Health Research, Tampere University, Tampere, FIN-33014, Finland
[6]World Food Programme, Rome, 00148, Italy
[7]Gracious International Inc, Shanghai, 200131, China
[8]Department of Pediatrics, St Louis Children's Hospital, St. Louis, MO, 63110, USA
[9]Emergency Nutrition Network, Kidlington, Oxfordshire, OX5 2DN, UK
[10]UNICEF Gabon, Libreville, Gabon

Abstract

Background: Child wasting is highly prevalent, with around 49.5 million children under five years affected globally. More evidence is needed to inform the scale up of effective treatment of wasted children worldwide. The aim of this study was to identify and prioritise the main outstanding research questions relating to the treatment of wasting to inform future research agendas.

Methods: A research prioritisation exercise was undertaken using the Child Health and Nutrition Research Initiative method. Research gaps were identified from multiple sources, grouped in themes and condensed into a list of 53 research areas by a group of experts. An online survey was developed and circulated globally to individuals working in the global nutrition sector. Participants evaluated each research area according to four agreed criteria. Research areas were then ranked according to an overall research priority score.

Results: A total of 394 individuals from 63 countries participated in the survey. Research areas prioritised by the group focused on the effective detection and diagnosis of 'high risk' wasted children in the

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1. **Carl Lachat** [ID], Ghent University, Ghent, Belgium

2. **Noemi Lopez-Ejeda** [ID], Complutense University of Madrid, Madrid, Spain

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community; provision of a continuum of care; and early life course interventions. The group also prioritised evidence to inform guidance on the impatient management of wasted children with diarrhoea; prevention of post-treatment relapse and mortality; and the optimisation of ready-to-use therapeutic foods in treatment programmes.

Conclusions: Critical gaps in our understanding of the treatment of wasting must be filled to inform guidance, policy and programming to ensure that all wasted children receive the treatment services that they need. A coordinated research agenda across treatment and prevention is urgently needed to maximise the impact of funding investments towards the meeting of global targets to reduce child wasting.

Keywords
acute malnutrition, severe acute malnutrition, moderate acute malnutrition, undernutrition, nutrition, research priorities, treatment, wasting

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Corresponding author: Chloe Angood (chloe.angood@gmail.com)

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Introduction

Child wasting is highly prevalent, with approximately 49.5 million children under five years affected globally (Joint malnutrition estimates, 2019). Wasting is associated with a high risk of death, with severely wasted children 9 to 12 times more likely to die compared to their well-nourished counterparts[1]. Those who survive one or more episodes of wasting have increased risk of childhood infection and detrimental consequences to their healthy growth, development and cognition[2]. The long term consequences of this can be severe and include: reduced economic productivity; negative health outcomes into adulthood; for women, risk of giving birth to infants who are born wasted and/or stunted (low birth weight (LBW)) who then themselves have heightened risk of illness and death[3–5]. In this way, the consequences of childhood wasting can pass from one generation to the next.

The global prevalence of wasting has decreased very little over the past 20 years, particularly when compared to reductions of other manifestations of malnutrition, such as stunting[6,7]. Currently, only 37 out of 194 countries are on track to reach the World Health Assembly (WHA) 2025 target to reduce and maintain prevalence of wasting below 5% (Global Nutrition Report, 2018) which aims to contribute to the sustainable development goal (SDG) of ending preventable child deaths and ensuring health, progress and opportunities for all children by 2030.

Efforts to prevent wasting must be urgently accelerated to reduce the global burden[8]. There is also an ethical and moral imperative to ensure universal access to life-saving treatment to wasted children who need it. Significant advances have been made in the treatment of severe wasting in children over six months of age over the last three decades, particularly through the development of ready-to-use therapeutic foods (RUTF). This has substantially changed the treatment of severe wasting and is an approach that is supported by substantial programmatic evidence[9]. Nevertheless, it is estimated that currently less than 20% of children with wasting receive the treatment that they need (No Wasted Lives, 2018). The management of wasted infants under six months of age has lagged even further behind this[10]. There has also been a lack of attention afforded to those on the moderate end of the wasting spectrum, underweight children (defined by low weight-for-age), and children with multiple anthropometric deficits who are all also at increased risk of death[11,12].

In response to the pressing need to rapidly scale up and improve wasting treatment, a research prioritisation exercise was carried out with the support of No Wasted Lives (www. nowastedlives.org), a multi-agency coalition that aims to combat acute malnutrition. The objective was to establish a clear set of research priorities that, in the context of limited time and resources, would guide financial investments in research with high potential to translate into meaningful programme and policy action towards the meeting of the SDGs.

Methods

The Child Health and Nutrition Research Initiative (CHNRI) method, described in detail elsewhere[13,14], was used as a framework for this research prioritisation exercise. In brief, this involves the identification and listing of many possible research options within a defined context, which are systematically and transparently scored by experts against agreed criteria. The result is a list of priorities that can be used to inform decisions about research investments by governments, international agencies and donors.

The context and scope of the exercise was first outlined by the Council of Research and Technical Advice on Acute Malnutrition (CORTASAM), a panel of technical experts and advisory group for No Wasted Lives. A decision was made to focus predominantly on the *treatment* of wasting in children under five years of age, including aspects of prevention only where explicitly linked to treatment. A timeline was set to identify research priorities that would be actionable by 2020 with the support of CORTASAM, No Wasted Lives and partners before the end of the current No Wasted Lives project cycle (2015–2020).

A non-systematic review was conducted to identify previously published priority research questions within the specified context. Several hundred priorities were identified across multiple sources, including the World Health Organization (WHO)'s 2013 guideline updates for the management of SAM[15], subsequent focused publications[16,17] and other related CHNRI exercises[18–21]. A consultation was held with members of the No Wasted Lives Coalition, CORTASAM, and other regional and country-level stakeholders to condense this list. The decision was made to focus on areas of research that could each encompass several research studies, rather than specific research questions, in order to include as wide a scope of research needs as possible within an actionable survey. This approach also allowed for high-level strategic prioritisation that could feed into research strategies and incentivise funding for portfolios of research, and flexibility for investors and researchers to respond to emerging evidence and changing needs. The result was a list of 53 research areas, categorised into 11 broader research themes and further into two sections: 'technical and operational' (n=30) and 'epidemiological' (n=23) (extended data file 3). Criteria against which the research areas would be judged (Table 1) were then selected from the long list of possible criteria described in CHNRI methodology.

The research questions framed for this exercise use the term 'acute malnutrition' to describe wasting, defined as weight-for-height z-score (WHO) <-2, and bilateral pitting oedema and/or mid-upper arm circumference (MUAC) <125 mm. To reflect direction of travel in accepted nomenclature, this paper uses the term 'wasting' in place of 'acute malnutrition'; for the purposes of this paper, when the term 'wasting' is used, this also implicitly refers to oedematous malnutrition.

Table 1. Agreed judging criteria. The table presents the agreed criteria by which each research area was judged by survey participants.

Impact	Would the research lead to interventions and solutions that provide the maximum potential impact (i.e. on global burden of acute malnutrition or mortality due to malnutrition) by 2020?
Effectiveness	Would the research lead to interventions and solutions that are effective (e.g. under routine programme conditions) and deliverable (taking the health system infrastructure, human resources, safety, etc)?
Answerability	Would you say that the research is possible to answer (e.g. is it feasible to implement within the given context and timeframe? Is it ethical?)?
Sustainability	Would the research lead to interventions and solutions that are sustainable (taking into account cost and financial affordability, cost-effectiveness, favourable political climate, etc)?

The research areas and criteria were used to create a survey in English and French using the online tool 'Survey Monkey' (www.surveymonkey.co.uk) (extended data file 2[22]). The order that research areas were presented to respondents was randomised to avoid question bias caused by respondent fatigue. An invitation to participate in the survey was circulated in English and French to CORTASAM members; global, regional and country staff within the No Wasted Lives Coalition; and other researchers, implementers, academics and donors through relevant listservs, social media and relevant websites (extended data file 1[22]). Non-probability (convenience) sampling was used with no minimum quota of participants and no specific eligibility criteria was applied; participants took part based on their interest in the study given that all viewpoints were counted as valid and useful. The survey was open between 3rd April and 5th May 2017.

Basic information on the country and region and type of work was collected from each individual. Respondents were then asked to judge how each research area might meet each of the four judging criteria by indicating "Yes" (which was allocated one point); "No" (0 points); "Undecided" (0.5 points); or "Insufficiently informed" (missing input). While we aimed to provide clear and concise guidance and criteria, as with other CHNRI exercises, it was ultimately up to the respondent to interpret the question and respond based on how they envisioned it. Results of the survey were downloaded into Excel and a research priority score (RPS) computed for each criterion for every research area ranging from 0–100%. From this, an overall RPS was computed for each research area (mean of the RPS of all four criteria) globally and for three regions most represented in the data and relevant in terms of burden of wasting, grouped as follows: West and Central Africa; East Africa; and South Asia. The level of agreement or controversy between participants' answers for each research area was assessed by calculating the average expert agreement (AEA). The AEA is a proportion of scorers who gave the most common score (mode) for a question, divided by the total number of scorers who scored that question. This is computed as follows:

$$\text{AEA} = \frac{1}{4} \times \sum_{q=1}^{4} \frac{\text{N(scorers who provided most frequent response)}}{\text{N(scorers who provided any response)}} \times 100$$

where q is a question that experts are being asked to evaluate each research area against.

The AEA is unaffected by 'undecided' responses and variances in the number of scorers for each survey question. In AEA computation all four possible responses are treated as valid, including 'insufficiently informed' to reflect all responses in the level of overall agreement.

This CHNRI exercise did not involve any personal or otherwise sensitive data and deals with professional individuals solicited through established professional networks. Participants who completed the questionnaire were asked if they would like to be named as part of the group author list, and only those answering "yes" are listed in this paper. All findings were anonymised and individual answers to the questions are not presented.

As is standard for CHNRI exercises[13,21], this research does not require formal ethical committee review. The intent to make results of the survey publicly available and publish the analysis was clearly laid out in the participant instructions (extended data file 1[22]); voluntary participation in the survey was taken as consent. Participants were given the option to be listed as group authors of this paper ("CHNRI collaborators"); those who gave their consent are named in the acknowledgements section.

Results
Characteristics of participants
A total of 394 survey responses were received. A total of 81 responses were removed as they were either repeat submissions or no survey questions were answered. Of the final 313 respondents, 143 (46%) answered the full survey and the rest answered only some of the questions. Responses represented 63 different countries (53 of which were low-middle income). There was broad geographical representation in the responses; according to UNICEF regional classifications, 72 (23%) of respondents worked at a global level, (71) 22.7% East Africa, (58) 18.5% West Africa and (46) 14.7% South Asia (Figure 1). Respondents represented a total of 167 different organisations. In total, 149 (47.6%) respondents described themselves as working in operational/programmatic areas; 49 (15.7%) academic; 36 (11.5%) government; 6 (2.2%) policy and 72 (23%) 'other' (Figure 2).
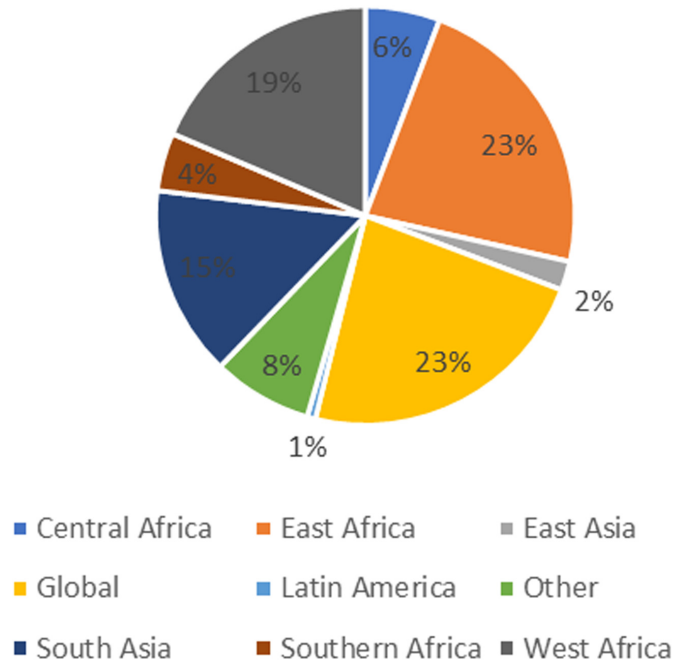
Figure 1. Regional representation of participants. The figure represents the proportion of survey participants by geographical region.
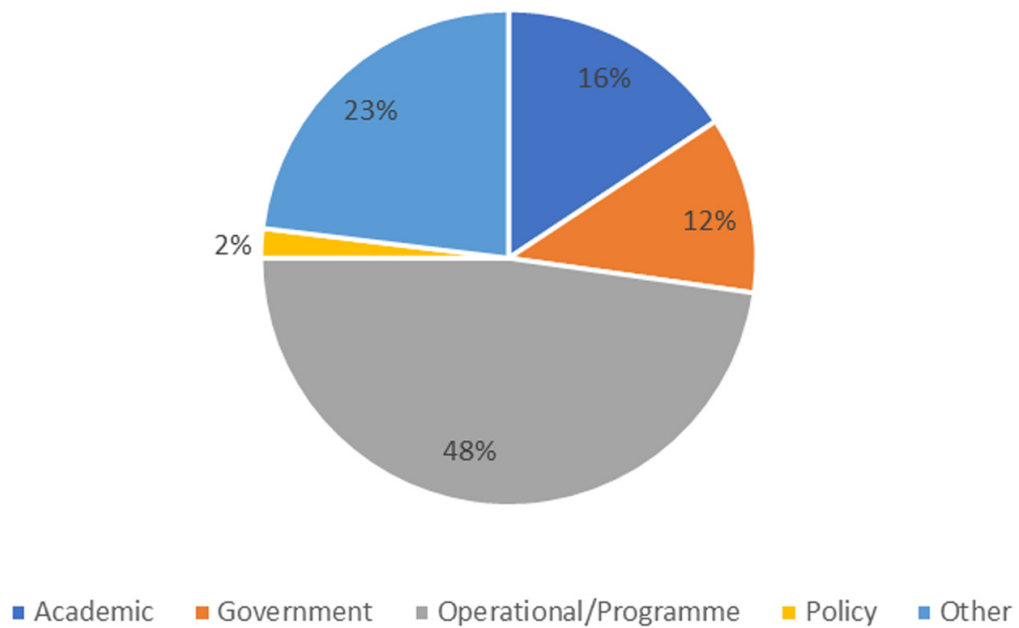
Figure 2. Type of work of respondents. The figure represents the proportion of survey participants by type of work that they are engaged in.

Priority research areas

Global analysis. The distribution of RPS was relatively narrow. The average score was 83 (on a scale of 0 to 100) and 95% of scores fell between 73 and 94. The top ten priority research areas according to the overall RPS are presented in Table 2 (the full list is available in Supplementary Material 2). The AEA in this top ten was high (80.3 to 91.6), indicating a high-level of agreement between experts on the top priorities.

The top ten priorities have a strong focus on programming - seven out of the top ten are technical and operational in nature and only three are epidemiological. The top ranked research area (and with the highest AEA) relates to the effective detection of acute malnutrition in community settings, also echoed in the area ranked eighth in the list around the need for more evidence to inform tools used for community-based detection. The second priority relates to the inpatient management of children with severe wasting with diarrhoea and the need for evidence to inform effective treatment protocols for these children. The third priority identified is to identify strategies and protocols to support scale-up of treatment of acute malnutrition in infants under six months of age. The next two research areas (ranked fourth and fifth) are epidemiological questions on the same theme of understanding the natural course of malnutrition, specifically relating to the process of relapse after treatment and the relationship between maternal and child nutrition. The question ranked sixth is around entry and discharge criteria of treatment programmes to ensure optimum outcomes, which is also relevant to the issue of relapse. The area ranked seventh relates to effective approaches to support infant and young child feeding (IYCF) practices and the need for evidence of the impact of these approaches on CMAM programming and vice versa. The area ranked ninth speaks to the need for more evidence around the safety and cost-effectiveness of locally produced RUTF to support scale up of therapeutic treatment. This relates to the area ranked twelfth around the need for evidence of optimum doses of RUTF. Question ten is the final of the three epidemiological research areas included in the top ten list and relates to the need for evidence to inform strategies to reduce risk of post treatment mortality.

Other high ranked questions that did not make the top ten were around vitamin A supplementation for uncomplicated cases of acute malnutrition (eleventh) and the integration of wasting treatment services into routine health systems (thirteenth). Research areas relating to long-term outcomes, burden estimation and risk factors (all epidemiological in nature) appear much lower in the prioritised list. The lowest priority research areas (ranked 51, 52 and 53) all relate to body composition (either as a predictor or outcome of acute malnutrition), were highly controversial (low AEA levels) and ranked particularly low in terms of their likelihood to result in sustainable interventions.

Regional analyses. Sub-analyses by region (East Africa, West and Central Africa and South Asia) reveal some differences in priorities between regions, although these results must be interpreted with caution given that the survey was not designed to be regionally representative. In the East Africa responses

(n=71), questions related to detection were ranked lower than in global and other regional results. Those related to early intervention (in the under six month age group, IYCF and maternal nutrition) and achieving a continuum of care (understanding the process of deterioration from moderate to severe wasting and management of patients between inpatient and outpatient services) were ranked higher. Novel research areas that appeared in the East Africa top ten were on the cognitive effects of acute malnutrition and vitamin A supplementation for uncomplicated cases of acute malnutrition. West and Central African responses (n=76) largely reflected the global results, except for the addition of evidence around the strengthening of surge capacity for wasting treatment. South Asia responses (n=53) demonstrated the need for evidence around maternal nutrition, wasting in infants under six months and detection, diagnosis and estimation of the burden which all scored higher in this region than elsewhere. Three priorities were included in the top ten in South Asia alone that related to community perceptions of treatment, generation of demand for treatment and improving health-seeking behaviours.

Discussion

This exercise brought together a wide group of participants to prioritise areas of technical, operational and epidemiological research most likely to contribute to the delivery of effective treatment of wasting at scale. Findings reflect that, despite considerable progress in the treatment of child wasting, our knowledge of what to do and how to do it to effect greater change is incomplete. Top priority research areas identified by this group of experts relate to the effective detection and diagnosis of 'high risk' wasted children in the community; inpatient management of wasted children with diarrhoea; the scaling up of effective management of infants under six months of age; prevention of post-treatment relapse and mortality; support for maternal nutrition and IYCF as means of improving the nutrition status of wasted infants; and the optimisation of RUTF for wasting treatment. Differences in priorities between regions demonstrate the need for research to inform context-specific approaches.

An important theme brought out in the results is the need to understand the characteristics of 'high risk' children in the community in different contexts to aid early detection and treatment. Results also support the recent rise in research studies to test simplified and/or combined protocols for wasting treatment to help streamline services, improve access to treatment for high risk moderate cases, and support continuity of care to discharge[23–25]. The prioritisation of areas related to relapse and post-treatment mortality demonstrates recognition among this group of experts that anthropometric recovery is important to achieve and contributes to recovery but is not in itself a cure. This is consistent with a recent review of the literature on relapse that indicated poor post-discharge outcomes after initial recovery (mortality and morbidity) and the need for appropriate, scalable solutions to tackle this problem[26].

Results of the present exercise accord with those of other recent CHNRI exercises that place a high priority on research to

Table 2. Top 10 research areas according to overall research priority score (RPS). The table lists the top 10 research areas prioritised by survey participants and includes priority scores according to each of the agreed judging criteria and overall scores: O = operational and technical; E = epidemiological; I = impact; E = effectiveness; A = answerability; S = sustainability; RPS = research priority score; AEA = average expert agreement.

Priority	Research area name	Research theme (section)	I	E	A	S	RPS	AEA	# Responses
1	What are the most effective tools to diagnose acute malnutrition by community members, including community health workers and caretakers?	*Detection (O)*	91.4	95.3	96.0	91.8	**93.6**	**91.6**	151
2	What are effective therapeutic feeding approaches for the management of severe acute malnutrition in children who are 6-59 months of age with diarrhoea?	*Inpatient effectiveness (O)*	92.0	93.3	95.4	90.1	**92.7**	**88.6**	143
3	What are effective and safe strategies and protocols to support the scale-up of treatment of acute malnutrition in infants <6 months of age?	*Coverage (O)*	92.1	93.1	90.9	87.8	**91.0**	**85.3**	141
4	What are the causal factors of relapse after treatment of acute malnutrition and how can they be minimized?	*Natural course (E)*	92.2	89.3	94.0	83.3	**89.7**	**83.1**	148
5	What is the relationship between the nutrition and health of mothers and acute malnutrition in their children and how can interventions within and beyond the 1,000 day window reduce the risk of acute malnutrition?	*Natural course (E)*	92.0	90.3	89.4	86.2	**89.5**	**84.1**	149
6	What are the optimum entry and discharge criteria for treatment of acute malnutrition to ensure optimum outcomes?	*Outpatient effectiveness (O)*	89.3	92.0	90.0	84.4	**88.9**	**83.9**	143
7	What is the impact infant and young child feeding practices (IYCF) in addition to the standard treatment of acute malnutrition and how do treatment programs impact individual and community IYCF practices?	*Outpatient effectiveness (O)*	91.9	88.8	89.8	85.1	**88.9**	**83.7**	150
8	How effective are tools for community-based detection and improving treatment-seeking behaviour across different geographies and contexts?	*Detection (O)*	89.6	89.7	90.1	85.4	**88.7**	**83.1**	149
9	Are there safe alternative formulations of RUTF for the treatment of uncomplicated severe acute malnutrition in children that use locally available ingredients and improve the cost-effectiveness of treatment?	*Therapeutic foods (O)*	87.1	88.0	92.0	85.5	**88.1**	**82.8**	171
10	What are effective interventions and operational models to reduce mortality risk after treatment?	*Mortality (E)*	90.4	89.6	89.2	82.4	**87.9**	**80.3**	150

inform the prevention and management of wasting in infants under six months of age[8,18,19]. It is now recognised that there are high burdens of wasting in this age group[10], that these infants have higher risk of death compared to wasted older children[27], and that interventions are urgently needed to avoid their further deterioration to maximise survival and reduce later burden of immediate and longer term care[18,19]. A previous CHNRI exercise on the management of 'at risk' mothers and infants under six months highlights in more detail priority research questions in this area that need to be addressed[19]. The priority placed on research around wasted infants under six months in this exercise, as well as research around the impact of maternal nutrition and IYCF practices on child wasting, highlights the felt need to tackle malnutrition with an early life course approach. This kind of approach aims to address nutritional needs at key stages within first 1,000 days window to prevent LBW and the deterioration of wasted infants as a means of preventing wasting into childhood and associated long term deleterious effects[28].

Another research area identified as a key gap by this group of experts is the treatment of severely wasted children with diarrhoea in inpatient settings. This reflects continuing uncertainty around the evidence base underlying the current WHO treatment guidelines in this area. A recent review of related studies concluded that the use of ReSoMal for the oral rehydration of severely wasted children with diarrhoea as opposed to ORS may be potentially harmful[29]. Another review on intravenous rehydration of children with severe wasting and diarrhoea found no support of the current recommendation to only use IV rehydration in case of shock and found that withholding IV fluids in case of heart failure in these children may be more harmful[29]. More operational research on the management of rehydration in severely wasted children in different settings is needed to inform an update of WHO guidelines.

A final theme in the global results is the need for research to enable the optimisation of RUTF for the management of wasting. Experts prioritised the need for further investigation into the safety and effectiveness of formulations that rely on local ingredients to improve the cost-effectiveness of treatment programmes to support greater coverage. Although there has been an increase in trials of alternative RUTF formulations since this exercise was carried out[30], important questions remain, including around the wider economic implications of using local products and producing locally, and on the efficacy of alternative formulations in settings outside of sub-Saharan Africa. Experts in this study also prioritised the need for research to investigate the safety, effectiveness and cost-effectiveness of reduced dosages of RUTF in treatment programmes. Recent trials have been undertaken to this end, some of the results of which have now been published[24,31,32]. Questions remain, however, on the longer-term impact of reduced dosage and risk of relapse, answers for which are urgently needed to inform national and global guidance.

Regional analyses demonstrate that experts in South Asia place more importance than those from other regions on research

into the generation of demand for wasting treatment, community perceptions of acute malnutrition and improving health-seeking behaviours. This may reflect the slower progress that has been made in South Asia compared to Africa to date in the scale up of wasting treatment services, as well as the need for evidence to inform scalable treatment options tailored specifically to the South Asia context (UNICEF, 2018). This is particularly important given that half the global burden of wasting is from South Asia (Joint malnutrition estimates, 2019). Regional analyses also reveal the importance of evidence to inform the development of models of integration of treatment services into routine health systems: experts from South Asia and East Africa prioritised research on the leveraging of existing opportunities within routine health systems to facilitate scale up and experts from West and Central African prioritised research on operational models to strengthen surge capacity of the health system to treat wasting. This suggests the need for models of integration that can be tailor-made to specific health systems and capacities and that reflect context-specific patterns of wasting.

Following this exercise, preliminary findings were immediately applied to the development of a research agenda to guide the efforts of CORTASAM, the No Wasted Lives Coalition, and partners (No Wasted Lives, 2018). A portfolio of operational research has since been funded and developed to build evidence around ways to improve the quality, coverage and cost-effectiveness of wasting treatment programmes. Multi-country studies are now in various stages of completion on simplified approaches for the treatment of wasting; community-based models for detection, diagnosis and treatment in the community and understanding treatment success and non-respondence. Although progress has been made, a recent landscape review of progress against the research agenda found many of the gaps identified in this original prioritisation exercise remain outstanding and require further investment (No Wasted Lives, 2020). Now that the United Nations Global Action Plan on Wasting has been released (UN GAP on child wasting) there is now more than ever a need to step up the generation of evidence to inform the development of guidance to successfully operationalise this plan. The World Health Organization (WHO) has a crucial role to play in coordinating a research agenda to fill critical evidence gaps across treatment and prevention identified by this and other recent CHNRI exercises[8,18,19]. A coordinated approach will maximise returns on research investments and ensure that findings contribute to programme and policy action towards reductions in child wasting.

Strengths and limitations of the study

This study used a validated method designed to maximise the predictive value of a group of experts[33]. Research ideas were systematically listed and independently and transparently scored by a large group of experts, most of whom have first-hand experience working on acute malnutrition treatment programmes. Participants in the survey were spread across several geographic regions, with good representation from areas of the world with high burdens of wasting (East Africa, West and Central Africa and South Asia). The CHNRI method allowed for the

measurement of collective priorities, agreement and controversy of this large, diverse group. The rating of research areas rather than specific questions enables results of this study to feed into research strategies and inform high level decisions about investments into portfolios of research. Results are therefore less sensitive to emerging evidence and changing needs and so remain relevant for a longer time period.

The primary limitation of this study is that the source of the data is the opinions of individuals working in the field of childhood malnutrition. These opinions are often formed by the experiences of these individuals, and ideas outside of the imagination of those surveyed are not represented. The quality of the resulting recommendations is therefore only as good as the creativity and insight of the individuals surveyed. Respondents working in programming were much more heavily represented among respondents than those working in academia, policy or government; this may be reflected in the bias of results towards operational research rather than epidemiological. The broader political economy of scale-up, and what factors may influence uptake and application of evidence generated across these research priorities, is also not fully reflected. Although we have included a large number of participants (larger than most published CHNRI surveys), this is not representative of the nutrition community as a whole and therefore we cannot assume generalisability of results.

As this was an online survey with invitations via email, websites and social media, only respondents using these media could be included. This may have limited inclusion of potential respondents working at sub-national levels. Some respondents did not complete the survey; however, question bias was mitigated by the randomisation of the order that questions appeared to each respondent and by discounting non-responses from the computation of the RPS. Regional sub-analyses may be affected by sampling bias and vulnerable to confounding factors, given that regional sampling calculations were not designed into the survey. Furthermore, the proportion of respondents from each region do not accurately represent the regional spread of the burden of wasting. For example, while the current burden of wasting is highest in South Asia, this region was represented least in the results of all three regions included in the sub-analyses. The regional analyses are therefore purely descriptive and must be interpreted with caution.

Another limitation of the study is possible bias in the selection of research areas. As this is a large topic area spanning many geographical contexts, the list could not be exhaustive and some important research areas had to be removed to make the survey an actionable size. For example, research areas cover operational, technical and epidemiological questions, but not those relating to the wider political economy, which is an important contextual dimension that can hinder or facilitate scale up in any given context. The envisaged results of prioritised research are therefore unlikely alone to inform the scale up of effective wasting treatment programmes and need to be considered within the broader contexts that they are applied.

Lastly, given the time that has passed since this exercise was carried out and the rapidly evolving nature of research in this area, terminologies to describe this form of malnutrition have changed, and new evidence has emerged. This must be taken into consideration when decisions are made about which research areas to invest in and the way in which research questions are framed. However, the results remain important and directly relevant to many organisations to inform discussions on funding investments.

Conclusion
Child wasting is a global problem that requires urgent public health attention. The results of this research prioritisation exercise demonstrate the most critical gaps in our understanding that must be addressed to inform guidance, policy and programming to enable the meeting of global wasting targets. More evidence is urgently needed to inform the effective detection and diagnosis of 'high risk' wasted children in the community and to inform a continuum of care for their effective management, as well as to inform early life course interventions, particularly those targeted to mothers and infants under six months of age to prevent deterioration into child wasting. Evidence is also needed to inform guidance on the impatient management of wasted children with diarrhoea, prevention of post-treatment relapse and mortality and to enable the optimisation of RUTF in treatment programmes. Variance in the priorities identified by experts from different regions demonstrate the need for research to inform context-specific approaches that can be applied to specific health systems and patterns of wasting. The results of this exercise have since been used to inform a global research agenda on the treatment of wasting. However, many critical gaps in knowledge remain. A coordinated research agenda across treatment and prevention is urgently needed to maximise the impact of funding investments towards the meeting of global targets to reduce child wasting.

Data availability
Underlying data
LSHTM Data Compass: Treatment of child wasting: Child Health Research Initiative (CHNRI) prioritisation exercise dataset, https://doi.org/10.17037/DATA.00001882[22].

This project contains the following underlying data:

- Underlying data file 1: dataset (NWL-CHNRI-dataset) (restricted access)

- Underlying data file 2: dataset description (NWL-CHNRI-dataset-codebook) (unrestricted access)

Due to the fact that open posting of data on a repository was not included in the study information sheet at the time the survey was done, data access will be granted once users have consented to the data sharing agreement and provided written plans and justification for what is proposed with the data. Data access may be obtained by submitting a request to the No Wated Lives, Action Against Hunger authors via the LSHTM Data Compass repository. Requests will be reviewed by Action

Against Hunger/ No Wasted Lives (they lead agency for this study) and key collaborators as named on the repository.

Extended data

LSHTM Data Compass: Treatment of child wasting: Child Health Research Initiative (CHNRI) prioritisation exercise dataset, https://doi.org/10.17037/DATA.00001882[22].

This project contains the following extended data:

- Extended data file 1: Participant introduction sheet (CHNRI-Introduction-2017)
- Extended data file 2: Blank copy of survey (Surveymonkey-CHNRI-final- English)
- Extended data file 3: Full list of research questions (CHNRI-wasting-treatment-research-questions)

Reporting guidelines

The well recognised Child Health and Nutrition Research Initiative (CHNRI) method was followed in this exercise.

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Open Peer Review

Current Peer Review Status: ❓ ❓

Version 1

Reviewer Report 14 December 2021

❓

Noemi Lopez-Ejeda (iD)

Unit of Physical Anthropology Department of Biodiversity, Ecology and Evolution, Faculty of Biology, Complutense University of Madrid, Madrid, Spain

I believe that the paper is of great interest to implementers, policy-makers, and academics involved in the finding of better ways to manage acute malnutrition. Many of my comments or concerns have already been brought out by the other reviewer of the paper, and I will add only a few lighter aspects that have not been mentioned.

I consider that the objective of the article is well justified and relevant. The methodology is adequate and well described. The results are described in sufficient detail although there is some redundancy between the info in Figure 2 and the text. I recommend the authors redo this sentence so that it is a more general summary of the information (e.g., Most of the respondents belonged to XXX and with a low percentage of XXX).

In the methodology section, 2nd paragraph, the authors write 'A decision was made to focus predominantly on the *treatment* of wasting in children under five years of age, including aspects of prevention only where explicitly linked to treatment'. Could the authors clarify what is meant by "aspects of prevention only where explicitly linked to treatment" (perhaps by explicitly adding some examples of such prevention activities that were included as options in the survey).

The authors use different labels as "extended data file" or "supplementary material". It would be convenient to unify the naming of all those supplementary files and also reorder them according to the order of appearance in the main text (the first one mentioned is extended data file 3, this should be 1).

In general, the discussion is pertinent, with adequate and recent bibliography. However, given that the data collection was in 2017 and the paradigm shift after the COVID-19 crisis, I think it would be helpful if the authors to reflect further on the applicability of these results to the current context (where the pandemic has accelerated the implementation of simplified protocols and there are documents from international agencies that already review the implementation of these

activities that have been identified as priorities).

Otherwise, I believe that the paper is of great interest to the journal's readers and after those clarifications (and that from the other reviewer) the article will meet the required scientific and writing quality to be approved.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Nutritional epidemiology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 13 April 2021

https://doi.org/10.5256/f1000research.49618.r82098

? **Carl Lachat** iD

Department of Food Technology, Safety and Health, Faculty of Bioscience Engineering, Ghent University, Ghent, Belgium

The manuscript provides the findings on research priorities for the treatment of child wasting. Although the manuscript is well written and informative, there are in my opinion, some additional

elements that require consideration.

The focus of the exercise is quite narrow, restricted to the treatment options. Although it is acknowledged, it is important to provide perspective and highlight this bias early on. It would be informative for the reader to know how this exercise fits into a larger research agenda of optimal child nutrition, including options of prevention.

The largest area of concern for this manuscript is how the selection research options and criteria used to score them were determined. Although large efforts were made to ensure a wide representation to stakeholders in the appraisal of the research priorities against the criteria, it is not clear to the reader how the pre-selection of the research options and criteria was determined. How was a consensus at this initiatively stage achieved, how were dissenting views considered and how were participants selected for this purpose (with consideration of potential conflict of interest).

For instance, why was a decision made "to focus on areas of research that could each encompass several research studies, rather than specific research questions, in order to include as wide a scope of research needs as possible within an actionable survey." Why was it decided to narrow down the list of options using this criterion before sending it out to the wider group? Why for instance not use this as a criterion for the wider group to score the research options? Some of these decisions obviously may have biased overall findings (e.g. a higher preference for operational aspects compared to for instance research on body composition).

In addition, the decision on the approach used (e.g. weighting of the criteria to compute the overall score) entails a decision on values and what is considered important for research. Did the smaller group that made the pre-selection consider such values e.g. by accommodating stakeholders (e.g. funders, decision-makers)? Researchers might not be well placed to decide on these values.

Finally, a limitation of the approach used is the quantitative approach to scoring and listing of priorities. The difference between the options is essentially due to small differences in (sub)scores. Items are ranked based on numerical scores, which essentially reflect a qualitative appraisal. Using this approach, each criterion is given an equal weight to arrive at the final score. How was this decided? and was this clear to the participants who scored the options? How different criteria are weighed and combined is essentially a value-driven decision that might not have been captured well by the consultation process. Although stakeholders (e.g. funding agencies) that need to act on the research priorities provided may have a different value framework to decide on what to select as a priority for action.

To illustrate: can a research option (number 4) with an overall score of 89.7 be really considered a higher priority compared to an option (number 5) that was scored 89.5 even if that option had a higher score for sustainability and effectiveness? The absolute ranking might be misleading to the reader in this sense. A more qualitative presentation of the overall leading list of research priorities (without exact ranking) might have been more appropriate.

The practical aspects of the CHNRI approach are clear but a critical discussion on the limits of this approach and the potential bias for the overall findings would be informative to the reader.

Lastly, the paper aims to inform funding on research. Before funding new research, however, it would be necessary to review the literature on the topic. Several of the proposed research questions have been addressed in studies. It might be that participants considered the research options as priorities but, before recommending funding, a careful account of existing evidence and knowledge gaps is necessary. It would be good to clarify that funding might also be necessary to take stock of existing evidence on the topic.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: nutrition

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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