TRANSPORT REVIEWS
https://doi.org/10.1080/01441647.2022.2119298

Routledge
Taylor & Francis Group

Stakeholders' experiences of what works in planning and implementing environmental interventions to promote active travel: a systematic review and qualitative synthesis

Emma R. Lawlor [a], Kate Ellis[a], Jean Adams [a], Russell Jago [b], Louise Foley [a], Stephanie Morris[c,d,e], Tessa Pollard [c,e], Carolyn Summerbell [d,e], Steven Cummins [f], Hannah Forde [a], Campbell Foubister[a], Christina Xiao [a] and Jenna Panter [a]

[a]Centre for Diet and Activity Research, MRC Epidemiology Unit, University of Cambridge, Cambridge, UK; [b]Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies, University of Bristol, Bristol, UK; [c]Department of Anthropology, Durham University, Durham, UK; [d]Department of Sport and Exercises Sciences, Durham University, Durham, UK; [e]Fuse, The Centre for Translational Research in Public Health, UK; [f]Department of Public Health, Environments and Society, London School of Hygiene and Tropical Medicine, London, UK

ABSTRACT

Infrastructure for active travel (AT) is receiving attention as a low-cost, sustainable transport option that promotes physical activity. However, the planning and implementation of new AT infrastructure often brings challenges. This review synthesises stakeholders' views and experiences of developing guidance for, designing, commissioning and implementing environmental interventions to promote AT. Eight databases were searched for studies containing qualitative data from stakeholders with direct experience. Results were synthesised thematically. The risk of bias was assessed using the CASP checklist for qualitative research, and evidence quality using the GRADE-CERQual tool. A total of 21,703 articles were identified from database searches, with 35 studies included. Eighteen studies focused on infrastructure promoting walking and cycling, fourteen on cycling and three on walking. Fifteen studies were judged to have no/very minor concerns, 12 had minor concerns, four had moderate concerns and four were of serious concern. A variety of stakeholders were influential, most commonly supportive elected leaders and individuals in public and voluntary sectors. Inter-disciplinary collaboration facilitated sharing of expertise and resources, and upskilling was beneficial. Effective communication methods varied between stakeholders and reason for communication. Persuasive strategies included aligning with stakeholders priorities and making the best use of evidence. Opportune moments to implement AT infrastructure were alongside non-AT

ARTICLE HISTORY
Received 19 November 2021
Accepted 28 July 2022

KEYWORDS
Walking; cycling; transport; interventions; systematic review; qualitative

CONTACT Emma R. Lawlor emma.lawlor@mrc-epid.cam.ac.uk Centre for Diet and Activity Research, MRC Epidemiology Unit, University of Cambridge, Institute of Metabolic Science, Cambridge Biomedical Campus, Cambridge CB2 1TN, UK

Supplemental data for this article can be accessed online at https://doi.org/10.1080/01441647.2022.2119298

projects and exogenous events. Compliance with AT policies could increase by embedding in higher level legislation. Political support was important and fostered through not de-prioritising cars and gaining external funding. The GRADE-CERQual found high confidence in our findings, apart from the sub-themes "Methods of communication" and "Political will" that had moderate confidence. Our findings can assist stakeholders in successfully navigating the process from conception to implementation of AT infrastructure and inform future policy and decision-making.

Introduction

Active travel (AT) is walking or cycling as an alternative to motorised transport for the purpose of making everyday journeys (Public Health England, 2016). It has the potential to address low levels of physical activity (Sahlqvist et al., 2012) and have beneficial health outcomes (Celis-Morales et al., 2017; Patterson et al., 2020). It is an accessible, low-cost, sustainable transport option (Ogilvie et al., 2008; Pucher & Buehler, 2008, 2017) that has societal benefits such as reduced air pollution, traffic congestion and healthcare costs (Woodcock et al., 2012). Evidence suggests that implementing environmental interventions that aim to promote AT can be important in encouraging AT behaviours (Scheepers et al., 2014; Stappers et al., 2018), such as introducing bicycle lanes and improving the walkability of an area. It has also recently been included in local and national health and transport policies (National Institute of Clinical Excellence (NICE), 2020; World Health Organisation, 2018).

Multiple stakeholders play an important role and have real-world experiences and practical knowledge in the process of designing, commissioning and implementing these changes, and developing guidance to promote and inform AT interventions (Reis et al., 2016). These stakeholders can come from a diverse range of backgrounds, for example, elected representatives, government employees, advocacy groups and public health and can contribute at different stages of the process. However, often many challenges are experienced by stakeholders in navigating these processes which can obstruct efforts (Reis et al., 2016; Watts et al., 2011). By aggregating the experiences of stakeholders from multiple contexts and disciplines, generalisable lessons may be learnt that could inform the actions of others. In particular, qualitative evidence synthesises have been highlighted as a key approach to understand the needs, values, perceptions and experiences of stakeholders, which is crucial in decision-making (Langlois et al., 2018). However, no previous review on this topic has been conducted. Therefore, the purpose of this review was to explore stakeholders' views and experiences of developing guidance for, designing, commissioning and implementing environmental interventions that aim to promote AT. This review has identified four overarching themes that could assist stakeholders in navigating the process: (1) successfully initiating and maintaining collaborations; (2) securing and maintaining resources; (3) recognising and acting on opportunities; and (4) navigating the policy and political environment.

Methods

This review searched eight databases for peer-reviewed articles containing qualitative data on stakeholders' views and experiences of planning and implementing

environmental interventions to promote AT. This review uses the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) criteria (Tong et al., 2012), supplemented by Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (Page et al., 2021) and the STARLITE mnemonic (Sampling strategy, Type of study, Approaches, Range of years, Limits, Inclusion and exclusions, Terms used, Electronic sources) (Booth, 2006). These provide guidance on how to report the identification of studies and are recommended to enhance the quality of reporting (Flemming et al., 2018).

Database searches

An initial scoping of databases was conducted to understand the amount of research and how this review could add to the evidence base (Harris et al., 2018) using wide eligibility criteria (available in the protocol). In brief, the original criteria had a broad definition of infrastructure to promote physical activity (e.g. open spaces, walking and cycling infrastructure for leisure), included non-peer reviewed articles, articles primarily using data from documents and those focusing on non-adults (list of articles provided at https://osf.io/wrg7b/). As qualitative synthesises are iterative and flexible by nature (Harris et al., 2018), we then refined our criteria to focus on changes to the physical environment that aim to promote AT, included only peer-reviewed journal articles to ensure high-quality research and excluded articles focusing mostly on the analysis of documents (e.g. policies and newspaper articles) as our main outcome of interest was first-hand experiences of stakeholders. We also excluded studies that focused on non-adult populations. The protocol was pre-registered on Open Science Framework before commencing database searching on 27 April 2020 (https://osf.io/wrg7b/) with an update on 2 November 2020 before the refined criteria was applied. The refined criteria are outlined in detail below with included studies selected based on these criteria.

Eligibility criteria

Study designs

Studies were included if they contained qualitative data analysed using qualitative methods (e.g. interviews, focus groups, surveys, ethnographic and mixed-methods). This could be part of a larger study of any design. We excluded studies reporting quantitative findings as they would not provide informative insights to address our aims. Studies had to be published in peer-reviewed journals.

Participants

This review used a broad definition of stakeholders due to the role of multisector and multidisciplinary stakeholders throughout the process (Reis et al., 2016). Eligible stakeholders were those with direct experience of developing guidance, planning or delivering changes to the physical environment that aimed to promote AT. Examples of eligible stakeholders included town planners, council staff, public health professionals, advocacy groups, elected politicians and civil servants (examples not exhaustive), working at local, national, transnational or global levels. Examples of individuals not eligible included those working on individual level behaviour change interventions (e.g. walking group

leaders), academics and users of AT infrastructure. Studies that included both eligible and ineligible stakeholders were included if the findings were presented separately.

Intervention

Interventions were defined as "any change in the physical (i.e. natural) environment or the urban or constructed (i.e. built) environment that subconsciously or consciously relates to a social group or population and their walking and cycling behaviour, regardless of whether or not they have the aim of improving health" (Panter et al., 2019, p. 3). Interventions could be of any scale. Studies could also focus on the experiences of stakeholders in developing guidelines/policies that have the potential to inform AT infrastructure. Studies focusing exclusively on individually-delivered behaviour change interventions, media/public awareness campaigns or groups using the infrastructure (e.g. cycling groups) were excluded as the aim of the review was to focus on those directly involved in the process of changing the physical environment to promote AT.

Context

No restrictions were placed on context or location.

Phenomenon of interest

Qualitatively analysed data were extracted relating to the experiences and views of stakeholders from the results and discussion sections of articles. This could be primary data (e.g. participant quotes) and/or authors analysis or interpretation of the data. We focused on: (i) experiences of successfully developing guidance for, planning and implementing changes to the physical environment that aims to promote AT; (ii) the processes involved and how decisions are made. No exclusion criterion was applied to the type of qualitative analysis.

Language

No language restriction filters were placed on database searches, and articles in any language identified through our searches were judged against our inclusion criteria.

Information sources and search strategy

Electronic searches

We searched databases from a range of disciplines from inception on 27 April 2020: MEDLINE, Embase, CINAHL, Cochrane database (CENTRAL), PsycINFO, ASSIA, Web of Science and Transport Research International Documentation (TRID) database. The search strategy was developed with input from a medical librarian, including key word and subject headings relating to the concepts: (1) Physical environment/Active travel AND (2) Policymakers/Stakeholders AND (3) Qualitative research. Terms used for concept (1) were based on Smith et al.'s (2017) systematic review search strategy and terms used for concept (3) were those recommended by Cochrane for qualitative research (University of Texas, n.d.). Searches were based on the MEDLINE search strategy (Supplementary Table 1), with the modification for database-specific terms.

Study records

Results from the database searches were imported into Covidence software (Veritas Health Innovation, n.d.) and duplicates removed. An initial independent piloting of 400 articles was conducted to test the inclusion/exclusion criteria. Study titles and abstracts were screened, and full-text papers were obtained when titles and abstracts were relevant or eligibility was unclear. Articles meeting the refined inclusion criteria were included in the review. All stages were conducted independently by two researchers (ERL and KE/HF/CF/CX). Throughout, in cases of disagreement, eligibility was discussed and a third author consulted (JP) to reach consensus. Reviewers were not blinded to authors, institution or journal.

Other search methods

Studies eligible for inclusion identified from our database searches had their reference lists searched for potentially eligible studies and citation searches using Google Scholar. A bibliography of included studies identified through these searches was circulated to the review team and corresponding authors of included studies to ensure studies were not overlooked.

Data collection process

Data were extracted and a 25% sample verified using a data collection form in Microsoft Excel that was piloted on three articles to ensure an appropriate breadth and depth of detail was captured (copy of form at https://osf.io/wrg7b/).

Qualitative data were extracted verbatim from articles in NVivo software v12 (QSR International Pty Ltd., 2018), focusing on the results and discussion sections (Thomas & Harden, 2008). Quotes from participants, themes and sub-themes, explanations, hypotheses or new theory, observational excerpts and author interpretations of data were extracted (Noyes et al., 2018).

Risk of bias (quality) assessment

The quality of each study was assessed against the Critical Appraisal Skills Programmes (CASP) checklist for qualitative research (2018). This is a structured approach to the critical appraisal that helps users to make judgements rather than apply arbitrary scores. This was appropriate for the study design and enabled the studies to be judged on its trustworthiness, and its value and relevance in a particular context. An additional criterion was added to give an overall assessment of the risk of bias for the study ("Overall assessment of methodological limitations"), using the findings for the other CASP criteria. The classifications for this criterion were "no or very minor concerns", "minor concerns", "moderate concerns" and "serious concern". For studies that included both quantitative and qualitative methods, this was completed for qualitative components only. Studies were not excluded from the review based on assessment. The judgements for the criterion "Overall assessment of methodological limitations" was used in the Grades of Recommendation, Assessment, Development, and Evaluation–Confidence in the Evidence from Qualitative Reviews (GRADE-CERQual) tool (Lewin et al., 2015) to assess confidence in sub-themes.

Data synthesis

Data from the results and discussion sections were analysed using thematic synthesis (Thomas & Harden, 2008) in NVivo v12, using a "solution lens" to focus on strategies perceived by stakeholders in studies to solve problems and overcome challenges encountered in the planning and implementation process (Watts, 2017). This approach would provide findings that could inform the actions of other stakeholders. The synthesis took place in three stages, using an iterative approach: "line-by-line" coding of the text of primary studies; organisation of these codes into related areas to construct "descriptive" themes; and the generation of "analytical" themes (Thomas & Harden, 2008). The analysis was conducted primarily by one researcher (ERL), with findings iteratively discussed throughout the analysis process.

Results

After duplicate removal, 21,703 titles and abstracts identified from databases were screened, and 874 full-text articles were assessed. An additional 13 articles were identified through other sources, resulting in 35 studies meeting the refined inclusion criteria (Figure 1).

Study characteristics

Of the 35 included studied, 14 (40.0%) focused on changes to the environment to promote cycling, three (8.6%) on walking, and 18 studies (51.4%) on both walking and cycling. Most studies ($n = 26$; 74.3%) used a case study design focusing on general experiences of implementing changes throughout one or multiple cities/areas. The majority of studies were conducted in North America ($n = 14$; 40.0%) and Europe ($n = 14$; 40.0%), and

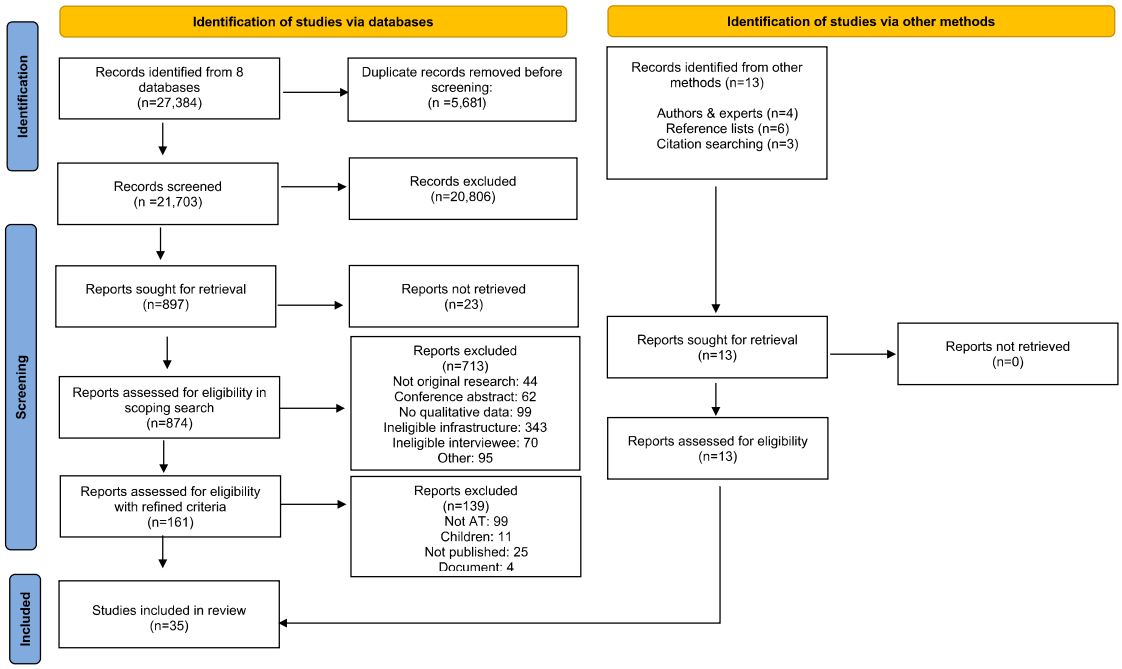

Figure 1. PRISMA diagram of studies.

focused on urban/sub-urban areas ($n = 31$; 88.6%). Most studies used individual interviews ($n = 34$; 97.1%), supplemented by other qualitative methods. One study was published in French (Saidla et al., 2017) but, the author kindly provided a translation (Table 1; Supplementary Table 2).

Risk of bias (Quality) assessment

Judged upon the CASP criteria, for the studies of overall risk of bias, 15 studies (42.9%) had no or very minor concerns, 12 (34.3%) had minor concerns, four (11.4%) had moderate concerns and four (11.4%) were of serious concern. See Supplementary Table 2 and https://osf.io/wrg7b/ for further detail on each category. The findings of the GRADE-CERQual are presented.

Synthesis of qualitative findings

Based upon our "solution lens" analysis, four overarching themes were identified: (1) successfully initiating and maintaining collaborations; (2) securing and maintaining resources; (3) recognising and acting on opportunities; and (4) navigating the policy and political environment. These themes were non-exclusive and interconnected. A summary of findings are presented in Table 2. Additional quotes, information on context and comparisons between walking and cycling infrastructure are available at: https://osf.io/wrg7b/.

Table 1. Summary of study characteristics.

	Number of studies *n* (%)
Active travel mode	
Walking and cycling	18 (51.4)
Cycling	14 (40.0)
Walking	3 (8.6)
Continent*	
North America	14 (40.0)
Europe	14 (40.0)
Australasia	5 (14.3)
Asia	2 (5.7)
Latin America and Caribbean	1 (2.9)
South America	1 (2.9)
Multi-country	5 (14.3)
Setting	
Sub-urban/urban	31 (88.6)
Rural/sub-urban/urban	3 (8.6)
Rural/sub-urban	1 (2.9)
Methods*	
Individual interviews	34 (97.1)
Focus groups	4 (11.4)
Workshop/event	3 (8.6)
Surveys with open ended questions	3 (8.6)
Participants*	
Public sector	35 (100.0)
Voluntary sector	21 (60.0)
Private sector	8 (22.9)
Research sector	5 (14.3)

*Studies are represented in more than one category.

Table 2. Table of review findings.

Theme	Sub-theme	Summary	Level of confidence*
1. Successfully initiating and maintaining collaborations	1.1 Identifying the right people and building networks	A variety of individuals were perceived influential in the process, most commonly politicians. Having a network of individuals from differing backgrounds was beneficial.	
	1.2.1 Methods of communication	Effective communication methods varied between stakeholders and the reason for communication. Strategies included using formal processes, political channels, media, in-person awareness-raising activities and co-design with communities.	
	1.2.2 Making persuasive arguments	Strategies to overcome limitations of evidence included using evidence from other contexts, routinely available data and piloting temporary infrastructure. Convincing rationale were perceived to be economic, health, environmental and demonstrating public support.	
2. Securing and maintaining resources		Collaboration with other stakeholders helped leverage funding and share resources. Funding could be reallocated. Funders looked positively on community involvement in applications. Upskilling was required to support staff and communities, such as training, and prioritising of activities may be necessary.	
3. Recognising and acting on opportunities		Opportunities to implement AT infrastructure were exogenous events and tying into non-active travel focused projects. This requires the right person and timing, and sufficient resources.	
4. Navigating the policy and political environment	4.1 Influence of policy and guidelines	Guidance could potentially hold developers to account however, they were generally given little attention or not enforced. There was the need for active travel to be embedded in legislation. Stakeholders should provide input into updates of standards/policies and documents cross-referenced.	
	4.2 Political will	Political support was important however, often they were risk adverse. Using persuasive arguments could foster support, ensuring cars are not de-prioritised, and gaining external funding.	

*Based on GRADE-CERQual assessments; Green = High, Yellow = Moderate.

Theme 1: successfully initiating and maintaining collaborations

Two sub-themes were identified: (1.1) Identify the right people and building networks and (1.2) Communicating to influence change.

Sub-theme 1.1: identifying the right people and building networks

Participants in numerous studies ($n = 17$) highlighted particular individuals or groups perceived to be influential in the process of planning and implementing AT infrastructure

(Adams et al., 2017; Aldred et al., 2019; Cole et al., 2010; Dodson et al., 2014; Grant et al., 2011; Jones & de Azevedo, 2013; Koglin, 2015b; Le Gouais et al., 2019, 2020; Lenker et al., 2016; McAndrews et al., 2018; Mrkajić & Anguelovski, 2016; Richards et al., 2010; Saidla, 2019; Wilson & Mitra, 2020; Zhao et al., 2018; Zwald et al., 2017). Most commonly reported were supportive elected leaders (Aldred et al., 2019; Cole et al., 2010; Grant et al., 2011; Koglin, 2015b; Mrkajić & Anguelovski, 2016; Saidla, 2019; Wilson & Mitra, 2020; Zhao et al., 2018; Zwald et al., 2017). Other individuals tended to be working in the public or voluntary sectors.

Participants elaborated on reasons and qualities of individuals perceived to be beneficial to the planning and implementation process. Five studies reported job-related factors, including the ability to act and mobilise resources, authority, work load capacity, having established networks and opportunity to collaborate, and relevance of their role to AT (Adams et al., 2017; Aldred et al., 2019; Grant et al., 2011; Le Gouais et al., 2019, 2020). Participants in seven studies highlighted understanding or taking time to familiarise themselves with local contextual issues and processes (Adams et al., 2017; Field et al., 2018; Grant et al., 2010, 2011; Le Gouais et al., 2019; Lubitow et al., 2016; McAndrews et al., 2018). Personal qualities were perceived as important with four studies highlighting stakeholders who could have difficult conversations with collaborators or those opposing the infrastructure (Aldred et al., 2019; Dodson et al., 2014; Grant et al., 2011; Le Gouais et al., 2019). For example, Aldred et al. (2019) noted the role of local figureheads who were " … willing to risk internal opposition or stakeholder/voter displeasure … " (p. 152) in relation to bicycle infrastructure in the UK. Participants in ten studies commented on stakeholders showing passion and commitment to the project (Adams et al., 2017; Aldred et al., 2019; Cole et al., 2010; Dodson et al., 2014; Lambe et al., 2017; Le Gouais et al., 2019; Mrkajić & Anguelovski, 2016; Richards et al., 2010; Zhao et al., 2018; Zwald et al., 2017). Studies noted that stakeholders having experiential knowledge of AT improved their knowledge of good infrastructure design (Aldred et al., 2019; Dodson et al., 2014; Jones & de Azevedo, 2013; Richards et al., 2010; Zhao et al., 2018). Participants also perceived in Australia and Brazil that " … being seen on your bike … " (Richards et al., 2010, p. 6) and " … setting an example and cycling themselves" (Jones & de Azevedo, 2013, p. 213) was an effective type of advocacy.

Participants highlighted the importance of having a network and partnerships with other stakeholders. Multiple studies ($n = 14$) emphasised valuing a mix of professional backgrounds and expertise in collaborations (Adams et al., 2017; Allender et al., 2009; Cole et al., 2010; Dodson et al., 2014; Field et al., 2018; Grant et al., 2011; Koglin, 2015a; Le Gouais et al., 2019; Lenker et al., 2016; Lubitow et al., 2016; McAndrews et al., 2018; Saidla, 2018; Saidla et al., 2017; Witten et al., 2018). For example, Dodson et al. (2014, p. 4) stated regarding a "complete streets" intervention in a US town that " … participants noted that the diversity of support may have been one of the greatest strengths of this movement". Furthermore, Adams et al. (2017) suggested identifying existing stakeholder groups (e.g. advocacy groups) that have already established networks.

Based on our GRADE-CERQual assessments, we have high confidence that this subtheme is a good representation of the phenomenon.

Sub-theme 1.2: communicating to influence change

Sub-theme (1.2) Communicating to influence change was divided into (1.2.1) Methods of communication and (1.2.2) Making persuasive arguments.

1.2.1: Methods of communication. Participants in numerous studies ($n = 15$) provided strategies they perceived effective to facilitate communication and collaboration with stakeholders across other professions or organisations (Adams et al., 2017; Dodson et al., 2014; Guell et al., 2017; Jones & de Azevedo, 2013; Koglin, 2015a; Lambe et al., 2017; Le Gouais et al., 2019; Lubitow et al., 2016; McAndrews et al., 2018; Richards et al., 2010; Wang, 2018; Whitney et al., 2020; Witten et al., 2018; Zhao et al., 2018; Zwald et al., 2017). Four studies suggested responding to official documents, providing feedback on plans for new AT infrastructure and identifying points of contact to be an intermediary between different organisations (Adams et al., 2017; Koglin, 2015a; Richards et al., 2010; Zwald et al., 2017). Public health stakeholders were highlighted in Le Gouais et al. (2019) and Richards et al. (2010) to be particularly good at cross-sectoral working and exchanging knowledge. Participants in seven studies suggested that stakeholders could communicate with both other stakeholders and the community through publicity activities or media outlets (e.g. advertisements or social media) to generate exposure to AT issues and infrastructure (Adams et al., 2017; Dodson et al., 2014; Field et al., 2018; Lambe et al., 2017; Mrkajić & Anguelovski, 2016; Richards et al., 2010; Zwald et al., 2017). National campaigns could be facilitated by collaboration between organisations working in promotions and health (Richards et al., 2010) and stakeholders could benefit from capacity building in engaging with media and countering opposition narratives (Field et al., 2018; Zwald, 2017).

Participants in multiple studies ($n = 13$) recommended that stakeholders (e.g. intervention coordinators, transport sector staff, city council and charities) engage with communities during the process and gain their input (i.e. local residents and businesses), for example, selecting locations, identifying barriers and generating potential solutions (Adams et al., 2017; Cole et al., 2010; Dodson et al., 2014; Field et al., 2018; Grant et al., 2011; Lambe et al., 2017; Le Gouais et al., 2020; Lenker et al., 2016; Lubitow et al., 2016; McAndrews et al., 2018; Richards et al., 2010; Vreugdenhil & Williams, 2013; Witten et al., 2018). Strategies reported effective included: involving communities early and throughout the process; providing regular updates and being transparent about decisions; not pre-empting inputs; delivering engaging and meaningful activities; and encouraging ownership of projects (Adams et al., 2017; Field et al., 2018; Lambe et al., 2017; Le Gouais et al., 2020; Lubitow et al., 2016; Vreugdenhil & Williams, 2013; Witten et al., 2018). Lambe et al. (2017) noted in two Irish towns that community input could overcome opposition as " … they felt like they were part of the process and the end result was when the work happened none of them could complain". Lubitow et al. (2016) also suggested some community members living in areas concerned about gentrification in inner cities may support bicycle lanes if there was engagement on how bicycle lanes connect to the communities own ideas about cycling, and projects are grassroots led and had transparent decision-making. Stakeholders (e.g. intervention coordinators, advocates and council staff) engaging with communities through conducting in-person publicity and awareness-raising activities was suggested by six studies (Adams

et al., 2017; Aldred et al., 2019; Dodson et al., 2014; Lenker et al., 2016; Richards et al., 2010; Sreedhara et al., 2017). Strategies perceived effective included: attending local area meetings, community events and amenities (e.g. libraries and churches), approaching local community groups, delivering workshops with communities, story-telling, road-shows in the street to engage a broad cross-section of people to enable myth-busting, and walk and bike ride events to illustrate the need for AT infrastructure (Adams et al., 2017; Aldred et al., 2019; Dodson et al., 2014; Sreedhara et al., 2017).

Studies also provided strategies on how community members themselves could communicate with stakeholders regarding AT infrastructure. In North America, Grant et al. (2011) and Lenker et al. (2016) reported community members successfully filtering issues and concerns upwards through formal systems and structures. They recommended utilising political channels, forging strong relationships and ongoing communication with municipal representatives, such as writing letters to local government and appearing at budget deputations and/or public advisory committees. A participant in Le Gouais et al. (2020) suggested that residents of a Jamaican town could informally lobby politicians living within their community.

For communications in general, several participants in studies based in the US and UK highlighted the need for stakeholders to use terminology that could be understood by all involved in communications (Dodson et al., 2014; Grant et al., 2011; Guell et al., 2017; Lenker et al., 2016). For example, Lenker et al. (2016) communicated with small children and non-English speakers using pictures or a glossary of terms at meetings. Richards et al. (2010) highlighted the need for respectful communication, with excessive complaints or aggression being counterproductive and weakening relationships.

Based on our GRADE-CERQual assessments, we have moderate confidence that this sub-theme is a good representation of the phenomenon. We downgraded this sub-theme due to poor reporting of the methods of some included studies.

1.2.2: Making persuasive arguments. Participants in studies provided arguments that could be used by stakeholders in communications to persuade decision-makers and communities of the need for new or improved AT infrastructure. Participants in ten studies suggested that an economic rationale could be convincing, including attracting young, educated people, encouraging tourism, supporting local businesses and connecting people to jobs (Cole et al., 2010; Dodson et al., 2014; Grant et al., 2011; Le Gouais et al., 2020; Lubitow et al., 2016; McAndrews et al., 2018; Saidla, 2018; Vith & Moessner, 2017; Whitney et al., 2020; Zwald et al., 2017). Grant et al. (2011) suggested illustrating walking infrastructure as beneficial to large numbers of people. Le Gouais et al. (2020) noted that many participants felt that framing AT infrastructure and non-communicable diseases as economic issues could raise their profile, improve political support and demonstrate return on investment. The influence of house prices on urban developers was noted to be convincing in some cases (Cole et al., 2010; Le Gouais et al., 2020), for example, presenting evidence of price rises could encourage open spaces in high-end residential developments (Le Gouais et al., 2020). However, participants indicated that there may be unequal demand for AT infrastructure by socio-economic group, for example, residents of poorer communities having more pressing issues such as employment (Le Gouais et al., 2020; Lubitow et al., 2016; Zwald et al., 2017). There were also concerns about gentrification and existing residents being outpriced from the housing

market (Lubitow et al., 2016; Vith & Moessner, 2017; Whitney et al., 2020). A few participants in Lubitow et al. (2016) suggested that in an area concerned about gentrification that some community members may be receptive if the economic development capacities for the existing community were appealed to, with strategies including introducing bicycle programmes and businesses, using language related to economic opportunity and connecting bicycles to larger issues in the community.

Participants in eight studies reported stakeholders making clear links between health and AT infrastructure in communications could be persuasive to decision-makers (e.g. town and transport planners, elected officials and council staff) (Allender et al., 2009; Dodson et al., 2014; Guell et al., 2017; Richards et al., 2010; Saidla, 2019; Sreedhara et al., 2017; Witten et al., 2018; Zwald et al., 2017). Participants perceived it could increase attention on AT, add credibility, and broaden the appeal of transport discussions to collaborators and funders (Allender et al., 2009; Sreedhara et al., 2017). Allender et al. (2009) also suggested that referring to health guidance could help funding negotiations. However, participants in Saidla (2018) in Finland reported economic benefits as more frequently important than health benefits, and Zwald et al. (2017, p. 296) in the US stated that "the health argument doesn't necessarily resonate with all people". In England, it was suggested that economic-health grounds could be used, such as cost–benefit evidence for a healthier population resulting in lower healthcare costs (Guell et al., 2017). However, participants had also noted that stakeholders (e.g. councillors) may feel that saving national-level health service money is not their responsibility, especially if it does not directly affect their local government budgets (Le Gouais et al., 2019).

Three studies suggested using the potential environmental benefits in communications with stakeholders (e.g. politicians, city planners and transport departments) (e.g. air pollution) (Le Gouais et al., 2019; Saidla, 2018; Zwald et al., 2017). However, a participant in Zwald et al. (2017) reported avoiding this argument as people are not concerned with this issue and sustainability was misunderstood.

Participants reported that stakeholders communicating and disseminating public support for AT infrastructure could be influential (Field et al., 2018; Le Gouais et al., 2019), making it harder for those opposing to claim that infrastructure is not wanted locally (Field et al., 2018). Participants in four studies suggested that it could be important to demonstrate the need for AT infrastructure through demonstrating local problems, the current dangers or safety issues experienced by local residents (e.g. poor quality sidewalks, traffic and injuries) (Dodson et al., 2014; Field et al., 2018; Guell et al., 2017; Le Gouais et al., 2019).

However, studies highlighted difficulties in stakeholders providing demonstrable evidence to support these arguments in communications, for example, health, economic and safety outcomes (Aldred et al., 2019; Allender et al., 2009; Field et al., 2018; Guell et al., 2017; Lambe et al., 2017; Le Gouais et al., 2019; Saidla et al., 2017). A large number of studies recommended using successful examples in communications to make persuasive arguments, including case studies, advice from visiting experts and testimonies of users (Aldred et al., 2019; Cole et al., 2010; Dodson et al., 2014; Field et al., 2018; Koglin, 2015b; Lambe et al., 2017; Le Gouais et al., 2019, 2020; Lenker et al., 2016; McAndrews et al., 2018; Wang, 2020; Whitney et al., 2020; Zhao et al., 2018). However, it was noted by participants across Europe and China that it was preferable if examples were comparable and local (Lambe et al., 2017; Le Gouais et al., 2019; Lenker et al.,

2016; Wang, 2020), although Le Gouais et al. (2020) suggested that a clearer understanding of where examples should be drawn from is necessary. Participants in Aldred et al. (2019) and Lambe et al. (2017) in the UK and Ireland reported piloting or implementing temporary AT infrastructure in the area to build local evidence for permanent infrastructure and generate community support, although this was still dependent on organisational and political will (Aldred et al., 2019). Studies recommended accessing local routinely collected information, local demographic data, environmental data (e.g. air pollution) and vehicle data, especially if it showed that previous AT infrastructure had no negative impacts (e.g. bus times, congestion and car parking) (Dodson et al., 2014; Field et al., 2018; Guell et al., 2017; Le Gouais et al., 2019, 2020; Zwald et al., 2017).

However, studies suggested that there is the need to consider that differing types of evidence may be used in decision-making dependent on the stakeholder, particularly those based in the UK and USA. Three studies contrasted stakeholders preferring differing types of evidence in decision-making, for example, some found randomised controlled trial evidence particularly persuasive (e.g. public health trainees), whereas others gave more weight to precedence from elsewhere (e.g. transport professionals) (Guell et al., 2017; Le Gouais et al., 2019, 2020). Le Gouais et al. (2019) suggested that tangible outcomes were perceived to be prioritised by decision-makers (e.g. pollution and congestion) although, Dodson et al. (2014) and Guell et al. (2017) highlighted that personal narratives could complement these outcomes by making it relatable and meaningful to listeners. In a few studies, evidence produced by academics was perceived to have authority and impact (Guell et al., 2017; Le Gouais et al., 2019, 2020), and may provide better support for AT infrastructure than evidence produced by advocacy groups, especially for contentious schemes (e.g. car parking charges) (Guell et al., 2017). Le Gouais et al. (2019) highlighted that stakeholders could work with academics to produce evidence for infrastructure. Furthermore, Guell et al. (2017) suggested research should be translated into actionable messages relevant to issues in policy and practice, and that academic researchers may need to become more confident in communicating the "best available" evidence to decision-makers rather than waiting for better quality evidence which could delay action and impede new infrastructure.

Based on our GRADE-CERQual assessments, we have high confidence that this subtheme is a good representation of the phenomenon.

Theme 2: securing and maintaining resources

Leveraging funding or resources could be achieved through collaboration with other stakeholder groups. Participants in multiple studies ($n = 7$) reported that collaboration with other stakeholders (e.g. intervention coordinators, local authorities, local health departments and transport departments) could provide opportunities to pool resources with these other groups or individuals (Cole et al., 2010; Grant et al., 2011) and may help gain funding to build the AT infrastructure (Adams et al., 2017; Cole et al., 2010; Grant et al., 2010, 2011; Harris et al., 2014; Sreedhara et al., 2017; Witten et al., 2018). Adams et al. (2017) and Sreedhara et al. (2017) singled out involving communities in funding applications and reports to funders, with a US participant in Sreedhara et al. (2017, p. 4) suggesting that demonstrating community support can be beneficial "as it 'lends credence', and funders look positively on applications that include local commitment, local matching grants, or in-kind investment".

Studies provided suggestions on how stakeholders could navigate the funding system. Adams et al. (2017) reported gaining funding from other organisations when walking infrastructure fell outside of a local authority's remit or jurisdiction in deprived English towns. Participants reported applying to multiple funding sources to raise the total cost necessary for AT infrastructure (Adams et al., 2017; Aldred et al., 2019; Cole et al., 2010; Lenker et al., 2016). However, Aldred et al. (2019) noted this approach may increase administrative burden and result in disjointed cycling schemes. A few participants spoke positively about their experiences of changes to US funding distribution systems; Lenker et al. (2016) reported successfully reallocating funding that had not been protected for a particular purpose to AT, and Zwald et al. (2017) commented that distributing funds on a local level could enable local authorities to enhance their capacity to address AT. A participant in Aldred et al. (2019) also suggested a new funding system is required to build AT infrastructure, as large upfront capital is required.

Multiple studies ($n = 12$) recognised the importance of supporting and upskilling staff and communities about AT, such as through conferences and training materials (Adams et al., 2017; Aldred et al., 2019; Cole et al., 2010; Dodson et al., 2014; Field et al., 2018; Le Gouais et al., 2019; Lenker et al., 2016; Lubitow et al., 2016; Richards et al., 2010; Wang, 2018; Witten et al., 2018; Zhao et al., 2018). Field et al. (2018) and Richards et al. (2010) reported it was worthwhile to build resilience within organisations, local authorities and advocates in anticipation of opposition to AT. Aldred et al. (2019) and Le Gouais et al. (2020) also suggested that AT infrastructure and health should be included in the training of future engineers, planners and urban developers to challenge existing thinking in transport planning. Furthermore, to facilitate longer-term commitment to AT from the community, participants in Adams et al. (2017) and Lubitow et al. (2016) in deprived urban areas suggested strategies including providing printed resources on maintaining the AT infrastructure, workshops (e.g. how to repair bikes) and bike apprentice training programmes.

Participants discussed the distribution of stakeholder roles and maximising work capacity. Some studies ($n = 5$) reported hiring transport consultants with expertise in AT external to the core stakeholder group, although views were mixed (Aldred et al., 2019; Field et al., 2018; Jones & de Azevedo, 2013; Lenker et al., 2016; Witten et al., 2018); they could lack local contextual knowledge and be expensive but could alleviate workload, accelerate timelines, offer technical expertise and provide an external perspective on visions and plans. Grant et al. (2010) suggested that community groups with larger memberships could enable work to be shared among a greater number of people. Three studies highlighted that stakeholders (e.g. local governments) could facilitate strategic coordination of advocacy groups with different roles and/or aims, providing a more powerful voice when combined (McAndrews et al., 2018; Mrkajić & Anguelovski, 2016; Saidla, 2019). Grant et al. (2011, p. 91) also reported that multiple individuals working in unison on walking infrastructure appeared to have more legitimacy with Canadian municipal councillors and provided "power in numbers". It was noted by Adams et al. (2017) and Harris et al. (2014) that there may be the need to prioritise activities in times of limited funding, dependent on the cost or time involved and the benefits of being involved in activities not generating income. Arguments presented in "Theme 1.2" could also be beneficial to securing some of these resources.

Based on our GRADE-CERQual assessments, we have high confidence that this subtheme is a good representation of the phenomenon.

Theme 3: recognising and acting on opportunities

Studies highlighted that stakeholders could take advantage of strategic opportunism to facilitate the planning and implementation of new AT infrastructure. Ten studies reported successfully implementing AT infrastructure within, or tying into the aims of, larger non-AT focused projects, such as the regeneration of areas and public works projects (e.g. storm water projects and roads) (Adams et al., 2017; Dodson et al., 2014; Grant et al., 2011; Guell et al., 2017; Lambe et al., 2017; Lenker et al., 2016; Mrkajić & Anguelovski, 2016; Vreugdenhil & Williams, 2013; Wang, 2018; Wilson & Mitra, 2020). It was noted by Wilson and Mitra (2020) in a Canadian city that this could be less contentious and required minimal funding than stand-alone cycling initiatives. Participants also gave examples of exogenous events that enabled action, for example, an oil crisis, initiation of cycling clubs and clean air campaigns (Dodson et al., 2014; Grant et al., 2011; Le Gouais et al., 2020; Saidla, 2018; Zwald et al., 2017). A few studies noted that cyclist and pedestrian accidents raised safety awareness in the public consciousness (Dodson et al., 2014; Le Gouais et al., 2020; Zwald et al., 2017) although a participant in Le Gouais et al. (2020) also reported that this may not be sustained longer-term. Participants in Grant et al. (2011) and Mrkajić and Anguelovski (2016) perceived that some projects require the "right person at the right moment" to initiate and re-energise plans. Grant et al. (2011) also noted that if necessary, individuals might need to have the resources and ability to persist long-term to wait for these windows of opportunity to implement the walking infrastructure. Opportunities to gain resources through the strategies outlined in "Theme 2" should also be identified and acted upon.

Based on our GRADE-CERQual assessments, we have high confidence that this sub-theme is a good representation of the phenomenon.

Theme 4: navigating the policy and political environment

Sub-themes identified were: (4.1) Influence of policy and guidelines, and (4.2) Political will.

Sub-theme 4.1: influence of policy and guidelines

Participants in multiple studies and contexts ($n = 16$) highlighted how multi-level policy and guidance could influence the development and implementation of AT infrastructure (Aldred et al., 2019; Allender et al., 2009; Cole et al., 2010; Dodson et al., 2014; Grant et al., 2011; Jones & de Azevedo, 2013; Le Gouais et al., 2019, 2020; Lenker et al., 2016; McAndrews et al., 2018; Mrkajić & Anguelovski, 2016; Saidla et al., 2017; Wang, 2018, 2020; Whitney et al., 2020; Zwald et al., 2017). Some participants suggested these could be used by local authorities to hold developers to account, such as through setting out minimum standards or requiring impact statements in new developments (Cole et al., 2010; Dodson et al., 2014; Jones & de Azevedo, 2013; Le Gouais et al., 2019). Conversely, a number of studies ($n = 6$) reported that policy and guidance were generally given little attention by stakeholders (e.g. developers, transport planners and engineers) or not enforced, still prioritised cars, lacked detail and/or were difficult to understand (Aldred et al., 2019; Allender et al., 2009; Cole et al., 2010; Jones & de Azevedo, 2013; Le Gouais et al., 2019, 2020). To overcome these problems, studies ($n = 6$) suggested that AT needs to be embedded in central government policies or originate from a higher level of authority (Aldred et al., 2019; Allender et al., 2009; Cole et al., 2010; Dodson et al.,

2014; Wang, 2020; Zwald et al., 2017). Allender et al. (2009, p. 108) also reported that including AT in health guidance may "provide from the health sector an endorsement for their work". Furthermore, Grant et al. (2011) and Lenker et al. (2016) reported that disability legislation presented an opportunity for improving pedestrian environments for people with disabilities in North America, and Mrkajić and Anguelovski (2016) indicated that the European Union sustainability plans could benefit cycling initiatives for member states.

A few studies discussed the need to update or develop new transport, environment or health-related standards or policies. Participants in Zwald et al. (2017) noted that updates could be an opportunity for stakeholders to integrate broader health and environment outcomes and engage diverse stakeholders, such as public health professionals, therefore attention should be paid to the timing. A participant in Allender et al. (2009) recommended that documents should be cross-referenced to help reach different sectors.

Studies highlighted that stakeholders should consider the role of context; Mrkajić and Anguelovski (2016) in a Serbian city reported that decentralisation of decisions on cycling policies and programmes helped incorporate local context, and some interviewees in Le Gouais et al. (2020) felt that Jamaica should develop its own standards, supported by international guidance, instead of adopting international standards. However, studies generally reported little in-depth detail on experiences of creating effective guidelines or policies.

Based on our GRADE-CERQual assessments, we have high confidence that this subtheme is a good representation of the phenomenon.

Sub-theme 4.2: political will

Numerous studies ($n = 13$) reported the importance of gaining and navigating political support for AT infrastructure projects (Aldred et al., 2019; Cole et al., 2010; Grant et al., 2010, 2011; Jones & de Azevedo, 2013; Koglin, 2015b; Le Gouais et al., 2020; Mrkajić & Anguelovski, 2016; Saidla, 2018; Wang, 2018; Wilson & Mitra, 2020; Zhao et al., 2018; Zwald et al., 2017). Participants highlighted that politicians in England were often concerned about the public acceptability of AT measures (e.g. response of residents) and tended to be risk adverse (Aldred et al., 2019; Guell et al., 2017). Strategies to gain the support of politicians and political representatives included using the arguments presented in "Theme 1.2.2". In addition to these, a participant in Koglin (2015b) reported that positive representation of cycling in media could guide politicians and planners towards better planning for cycling. Wilson and Mitra (2020) and Zhao et al. (2018) reported cycling infrastructure could be implemented with less political contestation if vehicle priority was maintained, there was no loss of lanes or parking spaces and if it improved the roads for vehicles (e.g. tarmacking). A participant in Wilson and Mitra (2020) also suggested that they were less likely to propose cycle lanes in areas where they perceived they would not receive support, resulting in pre-emptively re-routing cycling infrastructure away from these areas. However, it was acknowledged that this might result in sub-standard routes and a dis-connected network.

Participants in McAndrews et al. (2018) and Wilson and Mitra (2020) reported that external funding for cycling infrastructure (e.g. not from their own budget) in North America could overcome political barriers, as it meant that AT infrastructure was of minimal cost to local governments and hence required less political input. Wilson and

Mitra (2020, p. 5) suggested that grants from upper-levels of government could secure council support "as the politicians did not want to be seen as refusing 'free' funds intended for making improvements to the community". This indicates that in at least some cases, support can be leveraged as long as funding was not taken away from other causes. Adding infrastructure during other public works also led to less political opposition, as outlined in "Theme 3".

Nine studies noted the influence of election cycles and political turnover on AT priorities (Aldred et al., 2019; Field et al., 2018; Grant et al., 2011; Jones and de Azevedo, 2013; Koglin, 2015b; Mrkajić & Anguelovski, 2016; Saidla, 2019; Wilson & Mitra, 2020; Zwald et al., 2017). A sustained commitment to AT infrastructure was important; Jones and de Azevedo (2013, p. 214) highlighted that for cycling infrastructure in Brazil, there was " … the need for a long-term vision that would extend beyond the term of the ruling political party of the time". A participant in Koglin (2015b) suggests that this could be achievable, providing an example of a previously elected politician in a Scandinavian city initiating a change in priorities and AT was now in all policy decisions across all parties.

Based on our GRADE-CERQual assessments, we have moderate confidence that this sub-theme is a good representation of the phenomenon. We downgraded this sub-theme due to poor reporting of the methods of included studies.

Confidence in findings assessment (GRADE-CERQual)

The GRADE-CERQual assessment highlighted that although there were multiple studies supporting the findings, the richness of data within the individual studies was sometimes thin. However, this was not enough of a concern to downgrade any findings overall (see Supplementary Table 3).

Discussion

This systematic review and qualitative synthesis explored stakeholders' views and experiences of planning and implementing changes to the physical environment to promote AT. Importantly, it has identified strategies that stakeholders could use to navigate the process. Findings suggest that key stakeholders are influential, with an inter-disciplinary network valued. Effective communication methods varied between stakeholders and the reason for communication. Arguments perceived to be convincing to decision-makers were economic (most persuasive), health, environmental and public support. Collaboration with other stakeholders reportedly helped to leverage funding and share resources, and upskilling was important to support staff and communities. Favourable opportunities to implement AT infrastructure was perceived to be alongside non-AT focused projects and exogenous events. Stakeholders felt compliance with AT guidance and policies could be increased by embedding them in higher level legislation. Political support was perceived as essential, with strategies to foster support including not de-prioritising cars and gaining funding from external sources.

Our findings summarise previous evidence highlighting the need to build relationships and synergies with a diverse range of stakeholders with mutual interests to bring about change (Reis et al., 2016; Salvo et al., 2018). Stakeholders from a broad spectrum of

disciplines should be supported to take part in the decision-making process, such as through training, fostering a collaborative work culture and networking events. Our findings confirm the importance of local community members having early input into the planning process to ensure it is contextually relevant and could potentially increase usage of the infrastructure.

The framing of evidence can help persuade stakeholders for the need for AT infrastructure (Aldred, 2019). A range of differing experiences and strategies were offered by participants in our review, potentially due to the wide range of disciplines and contexts. Our findings emphasise the importance of knowing the audience, tailoring communication strategies and aligning with their priorities, although this may cause difficulties when working with multiple stakeholders. Potential solutions could include focusing on a common goal, highlighting multiple different benefits simultaneously or prioritising economic arguments.

Methodological limitations of evidence have previously been found to influence decision-making (Benton et al., 2016; Reis et al., 2016). Our findings provide evidence complimenting Ogilvie and colleagues (2020) recommendation for a more flexible and reflexive approach, using research robust enough to guide action but accepting that limitations in the evidence exist, rather than delaying action. Our results suggest that looking for alternative sources of data to build the evidence base may be helpful and using evidence from other contexts was commonly mentioned, particularly local examples. However, it is unlikely that evidence from exactly comparable localities ever exists, meaning inferences about the generalisability of findings across contexts need to be made (Watts et al., 2011). One method of bridging this uncertain contextual gap may be to trial temporary AT infrastructure to establish generalisability to the new context.

Our findings on recognising and acting on opportunities is consistent with policy process literature (Kingdon, 1984). However, it should be acknowledged that stakeholders need to be realistic when the timing is not right, for example, during budget cuts. Despite this, ongoing preparatory work for AT infrastructure (e.g. identifying potential locations, building support of people) may still be valuable to be ready for when the opportunity arises (Cullerton et al., 2016).

Gaining political support for AT infrastructure was perceived important, with public acceptability highlighted as a main concern. When enacting the strategies identified in our review, it should be taken into account that multiple factors may influence political support including the personal views of key decision-makers, familiarity with information, legislation and guidance restraints and/or strategic goals of the government (Lorenc et al., 2014).

This review highlighted important gaps in evidence. Only one study focused on new developments, therefore further investigation would be beneficial to inform the design of health-promoting new communities. There was little consideration of rural and coastal areas in studies despite having their own unique challenges (e.g. narrow, winding roads) (Salvo et al., 2018). More comparisons between contexts would be beneficial to improve the understanding of contextual factors and the transferability of AT infrastructure (Craig et al., 2018; Watts et al., 2011). Few studies focused on a specific intervention or a single mode of AT (e.g. walking) meaning that experiences specific to each type of intervention and AT mode could not be identified. Future research should consider the needs of under-represented groups (e.g. older people and those with disabilities) when designing AT infrastructure, previously identified as a gap in research (McAndrews et al., 2018). No included studies focused in detail on writing AT policies

despite understanding how best to write national and local level policy to ensure it is most useful to stakeholders is of sustained importance.

Strengths and limitations

Our inclusion criteria included a wide range of infrastructure and stakeholders, and we did not impose any context or language restrictions, to gain a breadth of views and experiences. We used multiple databases and methods to identify articles, resulting in a large number of studies identified and screened, although other databases may also have been appropriate due to the number found through hand searching. We used rigorous screening methods, although it was sometimes difficult to judge if a study focused on AT or another PA domain, or if the majority of results reported were based on qualitative first-hand experiences. We tried to overcome this through independently double-screening articles and discussions to resolve discrepancies. The majority of studies were conducted in a limited number of developed countries, resulting in knowledge gaps across regions. These results are based on the personal opinions of the stakeholders, and there is no way to verify how successful these strategies have been in practice. In addition, our interpretation of the findings may have been influenced by all involved researchers being broadly from a public health background, and researchers from other disciplines may have drawn a different view. It should also be noted that the included studies had some limitations but these were primarily related to insufficient information reported by studies rather than evidence of problems.

Conclusion

This review was the first to synthesise the views and experiences of stakeholders developing guidance for, designing, commissioning and implementing environmental interventions to promote AT. Our review filled this gap, with findings providing strategies to assist stakeholders in navigating the process: successfully initiating and maintaining collaborations, securing and maintaining resources, recognising and acting on opportunities and navigating the policy and political environment. These findings can assist future stakeholders in successfully designing and implementing AT infrastructure however, they also highlight the complexity of the process and that multiple strategies may need to be implemented simultaneously.

Acknowledgements

The authors would like to thank Eleanor Barker for her assistance in developing the database search strategy and all corresponding authors of included papers that assisted with identifying additional articles. The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care. The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR or the UK Department of Health and Social Care.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the National Institute for Health and Care Research (NIHR) School for Public Health Research is a partnership between the Universities of Sheffield; Bristol; Cambridge; Imperial; and University College London; the London School for Hygiene and Tropical Medicine (LSHTM); LiLaC – a collaboration between the Universities of Liverpool and Lancaster; and Fuse – The Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities. This study is funded by the National Institute for Health Research (NIHR) School for Public Health Research (Grant Reference Number: SPHR-PROG-WSBT-CS2). JP is supported by the Medical Research Council (MRC; Unit Programme number MC_UU_12015/6 & MC_UU_00006/7). LF was funded by the National Institute for Health Research (NIHR) (16/137/64) using UK aid from the UK Government to support global health research.

ORCID

Russell Jago http://orcid.org/0000-0002-3394-0176
Emma R. Lawlor http://orcid.org/0000-0002-0742-0476
Jean Adams http://orcid.org/0000-0002-5733-7830
Louise Foley http://orcid.org/0000-0003-3028-7340
Tessa Pollard http://orcid.org/0000-0002-0544-0158
Carolyn Summerbell http://orcid.org/0000-0003-1910-9383
Steven Cummins http://orcid.org/0000-0002-3957-4357
Hannah Forde http://orcid.org/0000-0001-7447-7264
Christina Xiao http://orcid.org/0000-0002-1183-0259
Jenna Panter http://orcid.org/0000-0001-8870-718X

References

Adams, E. J., Cavill, N., & Sherar, L. B. (2017). Evaluation of the implementation of an intervention to improve the street environment and promote walking for transport in deprived neighbourhoods. *BMC Public Health*, *17*(1), 655. https://doi.org/10.1186/s12889-017-4637-5

Aldred, R. (2019). Built environment interventions to increase active travel: A critical review and discussion. *Current Environmental Health Reports*, *6*(4), 309–315. https://doi.org/10.1007/s40572-019-00254-4

Aldred, R., Watson, T., Lovelace, R., & Woodcock, J. (2019). Barriers to investing in cycling: Stakeholder views from England. *Transportation Research. Part A, Policy and Practice*, *128*, 149–159. https://doi.org/10.1016/j.tra.2017.11.003

Allender, S., Cavill, N., & Parker, M. (2009). Tell us something we don't already know or do! The response of planning and transport professionals to public health guidance on the built environment and physical activity. *Journal of Public Health Policy*, *30*(1), 102–116. https://doi.org/10.1057/jphp.2008.43

Benton, J. S., Anderson, J., Hunter, R. F., & French, D. P. (2016). The effect of changing the built environment on physical activity: A quantitative review of the risk of bias in natural experiments. *The International Journal of Behavioral Nutrition and Physical Activity*, *13*(1), 107. https://doi.org/10.1186/s12966-016-0433-3

Booth, A. (2006). Brimful of STARLITE: Toward standards for reporting literature searches. *Journal of the Medical Library Association*, *94*(4), 421–430.

Celis-Morales, C. A., Lyall, D. M., Welsh, P., Anderson, J., Steell, L., Guo, Y., & Gill, J. M. R. (2017). Association between active commuting and incident cardiovascular disease, cancer, and mortality: Prospective cohort study. *BMJ*, *357*, j1456. https://doi.org/10.1136/bmj.j1456

Cole, R., Burke, M., Leslie, E., Donald, M., & Owen, N. (2010). Perceptions of representatives of public, private, and community sector institutions of the barriers and enablers for physically active transport. *Transport Policy*, *17*(6), 496–504. https://doi.org/10.1016/j.tranpol.2010.05.003

Craig, P., Ruggiero, E. D., Frohlich, K. L., Mykhalovskiy, E., White, M., Campbell, R., … Wight, D. (2018). *Taking account of context in population health intervention research: Guidance for producers, users and funders of research*. NIHR Journals Library.

Critical Appraisal Skills Programme. (2018). CASP Qualitative Checklist. CASP Online. https://casp-uk.net/%0Ahttp://www.casp-uk.net/casp-tools-checklists

Cullerton, K., Donnet, T., Lee, A., & Gallegos, D. (2016). Playing the policy game: A review of the barriers to and enablers of nutrition policy change. *Public Health Nutrition*, *19*(14), 2643–2653. https://doi.org/10.1017/S1368980016000677

Dodson, E. A., Langston, M., Cardick, L. C., Johnson, N., Clayton, P., & Brownson, R. C. (2014). Everyone should be able to choose how they get around: how Topeka, Kansas, passed a complete streets resolution. *Preventing Chronic Disease*, *11*, E25. https://doi.org/10.5888/pcd11.130292

Field, A., Wild, K., Woodward, A., Macmillan, A., & Mackie, H. (2018). Encountering bikelash: Experiences and lessons from New Zealand communities. *Journal of Transport & Health*, *11*, 130–140. https://doi.org/10.1016/j.jth.2018.10.003

Grant, T., Andrew, C., Edwards, N., Sveistrup, H., & Egan, M. (2011). Creating walkable places: Neighbourhood and municipal level perspectives on the socio-political process in Ottawa, Canada. *Journal of Urbanism*, *4*(1), 81–104. https://doi.org/10.1080/17549175.2011.563958

Grant, T. L., Edwards, N., Sveistrup, H., Andrew, C., & Egan, M. (2010). Inequitable walking conditions among older people: Examining the interrelationship of neighbourhood socio-economic status and urban form using a comparative case study. *BMC Public Health*, *10*(1), 677. https://doi.org/10.1186/1471-2458-10-677

Guell, C., Mackett, R., & Ogilvie, D. (2017). Negotiating multisectoral evidence: A qualitative study of knowledge exchange at the intersection of transport and public health. *BMC Public Health*, *17*(1), 17. https://doi.org/10.1186/s12889-016-3940-x

Harris, J. K., Roche, J., Estlund, A. K., Mense, C., & Baker, E. A. (2014). Partnering to create a more livable city: The livable St louis network. *Journal of Public Health Management & Practice*, *20*(4), 384–391. https://doi.org/10.1097/PHH.0b013e31829bfc3a

Harris, J. L., Booth, A., Cargo, M., Hannes, K., Harden, A., Flemming, K., & Noyes, J. (2018). Cochrane qualitative and implementation methods group guidance series—paper 2: Methods for question formulation, searching, and protocol development for qualitative evidence synthesis. *Journal of Clinical Epidemiology*, *97*, 39–48. https://doi.org/10.1016/j.jclinepi.2017.10.023

Jones, T., & de Azevedo, L. N. (2013). Economic, social and cultural transformation and the role of the bicycle in Brazil. *Journal of Transport Geography*, *30*, 208–219. https://doi.org/10.1016/j.jtrangeo.2013.02.005

Kingdon, J. W. (1984). *Agendas, alernatives and public policies*. Little, Brown and Company.

Koglin, T. (2015a). Organisation does matter – planning for cycling in Stockholm and Copenhagen. *Transport Policy*, *39*, 55–62. https://doi.org/10.1016/j.tranpol.2015.02.003

Koglin, T. (2015b). Vélomobility and the politics of transport planning. *GeoJournal*, *80*(4), 569–586. https://doi.org/10.1007/s10708-014-9565-7

Lambe, B., Murphy, N., & Bauman, A. (2017). Smarter travel, car restriction and reticence: Understanding the process in Ireland's active travel towns. *Case Studies on Transport Policy*, *5*(2), 208–214. https://doi.org/10.1016/j.cstp.2017.02.003

Langlois, E. V., Tunçalp, Ö, Norris, S. L., & Ghaffar, A. (2018). Qualitative evidence to improve guidelines and health decision-making. *Bulletin of the World Health Organisation*, *96*(2), 79. https://doi.org/10.2471/BLT.17.206540

Le Gouais, A., Foley, L., Ogilvie, D., & Guell, C. (2019). Decision-making for active living infrastructure in new communities: A qualitative study in England. *Journal of Public Health*, *42*(3), 1–10. https://doi.org/10.1093/pubmed/fdz105.

Le Gouais, A., Govia, I., & Guell, C. (2020). Challenges for creating active living infrastructure in a middle-income country: A qualitative case study in Jamaica. *Cities & Health*, 1–12. https://doi.org/10.1080/23748834.2020.1767950

Lenker, J. A., Maisel, J. L., & Ranahan, M. E. (2016). Assessing the implementation of complete streets projects. *Journal of Architectural and Planning Research*, *33*(3), 199–212. https://www.jstor.org/stable/44987200

Lewin, S., Glenton, C., Munthe-Kaas, H., Carlsen, B., Colvin, C. J., Gülmezoglu, M., & Rashidian, A. (2015). Using qualitative evidence in decision making for health and social interventions: An approach to assess confidence in findings from qualitative evidence syntheses (GRADE-CERQual). *PLoS Medicine*, *12*(10), 1–18. https://doi.org/10.1371/journal.pmed.1001895

Lorenc, T., Tyner, E. F., Petticrew, M., Duffy, S., Martineau, F. P., Phillips, G., & Lock, K. (2014). Cultures of evidence across policy sectors: Systematic review of qualitative evidence. *European Journal of Public Health*, *24*(6), 1041–1047. https://doi.org/10.1093/eurpub/cku038

Lubitow, A., Zinschlag, B., & Rochester, N. (2016). Plans for pavement or for people? The politics of bike lanes on the 'Paseo Boricua' in Chicago, Illinois. *Urban Studies (edinburgh, Scotland)*, *53*(12), 2637–2653. https://doi.org/10.1177/0042098015592823

McAndrews, C., Tabatabaie, S., & Litt, J. S. (2018). Motivations and strategies for bicycle planning in rural, suburban, and low-density communities: The need for new best practices. *Journal of the American Planning Association*, *84*(2), 99–111. https://doi.org/10.1080/01944363.2018.1438849

Mrkajić, V., & Anguelovski, I. (2016). Planning for sustainable mobility in transition cities: Cycling losses and hopes of revival in Novi Sad, Serbia. *Cities*, *52*, 66–78. https://doi.org/10.1016/j.cities.2015.11.029

National Institute of Clinical Excellence (NICE). (2020). Physical activity and the environment. NICE Guideline (March 2018). https://doi.org/10.1136/archdischild-2020-319350

Noyes, J., Booth, A., Flemming, K., Garside, R., Harden, A., Lewin, S., & Thomas, J. (2018). Cochrane qualitative and implementation methods group guidance series—paper 3: Methods for assessing methodological limitations, data extraction and synthesis, and confidence in synthesized qualitative findings. *Journal of Clinical Epidemiology*, *97*, 49–58. https://doi.org/10.1016/j.jclinepi.2017.06.020

Ogilvie, D., Bauman, A., Foley, L., Guell, C., Humphreys, D., & Panter, J. (2020). Making sense of the evidence in population health intervention research: Building a dry stone wall. *BMJ Global Health*, *5*(12), 1–9. https://doi.org/10.1136/bmjgh-2020-004017

Ogilvie, D., Mitchell, R., Mutrie, N., Petticrew, M., & Platt, S. (2008). Personal and environmental correlates of active travel and physical activity in a deprived urban population. *International Journal of Behavioral Nutrition and Physical Activity*, *5*(1), 1–12. https://doi.org/10.1186/1479-5868-5-43

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *The BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Panter, J., Guell, C., Humphreys, D., & Ogilvie, D. (2019). Can changing the physical environment promote walking and cycling? A systematic review of what works and how. *Health and Place*, *58*(102161), 102161. https://doi.org/10.1016/j.healthplace.2019.102161.

Patterson, R., Panter, J., Vamos, E., Cummins, S., Millett, C., & Laverty, A. (2020). Associations between commute mode, cardiovascular disease, cancer and all-cause mortality in England and Wales: A cohort study using linked census data over 25 years. *The Lancet Planetary Health*, *4*(5), e186–e194. https://doi.org/10.1016/S2542-5196(20)30079-6.

Public Health England. (2016). Health matters: getting every adult active every day. https://www.gov.uk/government/publications/health-matters-getting-every-adult-active-every-day/health-matters-getting-every-adult-active-every-day

Pucher, J., & Buehler, R. (2008). Making cycling irresistible: Lessons from the Netherlands, Denmark and Germany. *Transport Reviews*, *28*(4), 495–528. https://doi.org/10.1080/01441640701806612

Pucher, J., & Buehler, R. (2017). Cycling towards a more sustainable transport future. *Transport Reviews*, *37*(6), 689–694. https://doi.org/10.1080/01441647.2017.1340234

QSR International Pty Ltd. (2018). NVivo (Version 12 Pro).

Reis, R. S., Salvo, D., Ogilvie, D., Lambert, E. V., Goenka, S., & Brownson, R. C. (2016). Scaling up physical activity interventions worldwide: Stepping up to larger and smarter approaches to get people moving. *The Lancet*, *388*(10051), 1337–1348. https://doi.org/10.1016/S0140-6736(16)30728-0

Richards, R., Murdoch, L., Reeder, A. I., & Rosenby, M. (2010). Advocacy for active transport: Advocate and city council perspectives. *The International Journal of Behavioral Nutrition and Physical Activity*, *7*(1), 5. https://doi.org/10.1186/1479-5868-7-5

Sahlqvist, S., Song, Y., & Ogilvie, D. (2012). Is active travel associated with greater physical activity? The contribution of commuting and non-commuting active travel to total physical activity in adults. *Preventive Medicine*, *55*(3), 206–211. https://doi.org/10.1016/j.ypmed.2012.06.028

Saidla, K. (2018). Health promotion by stealth: Active transportation success in Helsinki, Finland. *Health Promotion International*, *33*(4), 600–609. https://doi.org/10.1093/heapro/daw110

Saidla, K. (2019). Active transportation promotion: Easier in a European city, but Why? *Health Behavior and Policy Review*, *6*(1), 18–35. https://doi.org/10.14485/hbpr.6.1.2

Saidla, K., Préfontaine, A., Clavier, C., & Crespin, R. (2017). Le transport actif à Ottawa (Canada) face à des obstacles politiques tenaces. *Lien Social et Politiques*, (78), 171–192. https://doi.org/10.7202/1039344ar

Salvo, G., Lashewicz, B. M., Doyle-Baker, P. K., & McCormack, G. R. (2018). Neighbourhood built environment influences on physical activity among adults: A systematized review of qualitative evidence. *International Journal of Environmental Research and Public Health*, *15*(5), 5. https://doi.org/10.3390/ijerph15050897

Scheepers, C. E., Wendel-Vos, G. C. W., Broeder, d., M, J., van Kempen, E. E. M. M., van Wesemael, P. J. V., & Schuit, A. J. (2014). Shifting from car to active transport: A systematic review of the effectiveness of interventions. *Transportation Research Part A: Policy and Practice*, *70*, 264–280. https://doi.org/10.1016/j.tra.2014.10.015

Smith, M., Hosking, J., Woodward, A., Witten, K., MacMillan, A., Field, A., & Mackie, H. (2017). Systematic literature review of built environment effects on physical activity and active transport – an update and new findings on health equity. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 1–27. https://doi.org/10.1186/s12966-017-0613-9

Solá, A. G., Vilhelmson, B., & Larsson, A. (2018). Understanding sustainable accessibility in urban planning: Themes of consensus, themes of tension. *Journal of Transport Geography*, *70*, 1–10. https://doi.org/10.1016/j.jtrangeo.2018.05.010

Sreedhara, M., Goins, K. V., Aytur, S. A., Lyn, R., Maddock, J. E., Riessman, R., & Lemon, S. C. (2017). Qualitative exploration of cross-sector perspectives on the contributions of local health departments in land-use and transportation policy. *Preventing Chronic Disease*, *14*, E118. https://doi.org/10.5888/pcd14.170226

Stappers, N. E. H., Van Kann, D. H. H., Ettema, D., De Vries, N. K., & Kremers, S. P. J. (2018). The effect of infrastructural changes in the built environment on physical activity, active transportation and sedentary behavior – A systematic review. *Health and Place*, *53*, 135–149. https://doi.org/10.1016/j.healthplace.2018.08.002

Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, *8*(1), 1–10. https://doi.org/10.1186/1471-2288-8-45

Tong, A., Flemming, K., McInnes, E., Oliver, S., & Craig, J. (2012). Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ. *BMC Medical Research Methodology*, *12*(181), https://doi.org/10.1186/1471-2288-12-181

University of Texas, School of Public Health. (n.d.). Search filters for various databases: Ovid Medline. http://libguides.sph.uth.tmc.edu/search_filters/ovid_medline_filters

Veritas Health Innovation. (n.d.). Covidence systematic review software. Melbourne, Australia. www.covidence.org

Vith, T. A., & Moessner, S. (2017). Contesting sustainable transportation: Bicycle mobility in Boston and beyond. *Die Erde; Zeitschrift Der Gesellschaft Fur Erdkunde Zu Berlin*, *148*(4), 229–237. https://doi.org/10.12854/erde-148-51

Vreugdenhil, R., & Williams, S. (2013). White line fever: A sociotechnical perspective on the contested implementation of an urban bike lane network. *Area*, *45*(3), 283–291. https://doi.org/10.1111/area.12029

Wang, L. (2018). Barriers to implementing pro-cycling policies: A case study of Hamburg. *Sustainability*, *10*(11), 4196. https://doi.org/10.3390/su10114196

Wang, L. (2020). Planning for cycling in a growing megacity: Exploring planners' perceptions and shared values. *Cities*, *106*, 102857. https://doi.org/10.1016/j.cities.2020.102857

Watts, D. (2017). Should social science be more solution-oriented? *Nature Human Behaviour*, *1*(1), 0015. https://doi.org/10.1038/s41562-016-0015

Watts, P., Phillips, G., Petticrew, M., Harden, A., & Renton, A. (2011). The influence of environmental factors on the generalisability of public health research evidence: Physical activity as a worked example. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 1–12. https://doi.org/10.1186/1479-5868-8-128

Whitney, R. A., Hess, P. M., & Sarmiento-Casas, C. (2020). Livable streets and global competitiveness: A survey of Mexico city. *Journal of Planning Education and Research*, https://doi.org/10.1177/0739456X20904428

Wilson, A., & Mitra, R. (2020). Implementing cycling infrastructure in a politicized space: Lessons from Toronto, Canada. *Journal of Transport Geography*, *86*, 102760. https://doi.org/10.1016/j.jtrangeo.2020.102760

Witten, K., Carroll, P., Calder-Dawe, O., Smith, M., Field, A., & Hosking, J. (2018). Te Ara Mua –future streets: Knowledge exchange and the highs and lows of researcher-practitioner collaboration to design active travel infrastructure. *Journal of Transport and Health*, *9*, 34–44. https://doi.org/10.1016/j.jth.2018.03.001

Woodcock, J., Griffiths, U., Roberts, I. W., Haines, A., Jarrett, J., & Haines, A. (2012). Effect of increasing active travel in urban England and Wales on costs to the national health service effect of increasing active travel in urban England and Wales on costs to the national health service. *The Lancet*, *379*(9832), 2198–2205. https://doi.org/10.1016/S0140-6736(12)60766-1

World Health Organisation. (2018). *Global action plan on physical activity 2018–2030: More active people for a healthier world*.

Zhao, C., Carstensen, T. A., Nielsen, T. A. S., & Olafsson, A. S. (2018). Bicycle-friendly infrastructure planning in Beijing and Copenhagen between adapting design solutions and learning local planning cultures. *Journal of Transport Geography*, *68*, 149–159. https://doi.org/10.1016/j.jtrangeo.2018.03.003

Zwald, M. L., Eyler, A. A., Valentine Goins, K., Brownson, R. C., Schmid, T. L., & Lemon, S. C. (2017). Understanding municipal officials' involvement in transportation policies supportive of walking and bicycling. *Journal of Public Health Management & Practice*, *23*(4), 348–355. https://doi.org/10.1097/PHH.0000000000000152