# The Impact of Changes in Active Travel Infrastructure on Disabled People: A Rapid Review

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**Abstract:** This review examines international evidence on how changes to active travel infrastructure affect disabled people. It explores the impact of infrastructure changes on accessibility and identifies the barriers and facilitators experienced by disabled people. The review included 11 primary research studies and 8 reviews published between 2015 and July 2025. Populations represented across the studies included: People with visual impairments; People with mobility impairments; Neurodivergent people; People with mobility, hearing, or vision impairments; People with mobility, hearing, vision impairments and neurodivergence; People using mobility assistive devices; and older adults with motor, visual, hearing impairments, or orientation difficulties.

Design changes to bus stop infrastructure, were consistently associated with reduced accessibility, subjective feelings of safety, and confidence among disabled people getting on and off buses. Uneven pavements and surface defects reduced perceived safety and confidence for people with visual and mobility impairments, with tactile paving aiding navigation for blind users but creating instability for mobility aid users. The review also describes the impact of kerb level changes, continuous footways, low traffic neighbourhoods, barrier removal, and the development of shared spaces. Raised trapezoidal designs were most effective in providing clear, detectable boundaries and supporting confidence among visually impaired users.

Some design features, such as kerb-free layouts, clear tactile paving, and well-marked crossings, acted as facilitators that improved accessibility, perceived safety, and confidence, while other features introduced barriers. Some barriers were consistent across all disability groups, whereas others were impairment-specific. Vehicles parked on pavements created barriers to navigation for neurodivergent people and blocked movement for guide dog users. Tactile paving aided navigation for people with visual impairments but was perceived to create a barrier to wheelchair stability, whereas kerb removal reduced barriers for wheelchair users but created orientation barriers for people with visual impairments.

Meeting conflicting accessibility needs of different groups of disabled people can be challenging when planning and implementing change in active travel infrastructure. Inconsistent infrastructure designs across different spaces and regions can create confusion among disabled people and lead to them feeling unsafe or potentially being directed to harm's way.

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Screen-reader-friendly versions of tables found within the report can be found here:
https://researchwalesevidencecentre.co.uk/active-travel

Health and Care Research Wales Evidence Centre

Canolfan Dystiolaeth Ymchwil Iechyd a Gofal Cymru

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# The Impact of Changes in Active Travel Infrastructure on Disabled People
## Rapid Review (Report number_RR0048. December 2025)
## Executive Summary

### What is a Rapid Review?
Our Rapid Reviews (RR) use a variation of the systematic review approach, abbreviating or omitting some components to generate the evidence to inform stakeholders promptly whilst maintaining attention to bias.

### Who is this Rapid Review for?
This Rapid Review was requested by Transport for Wales to support policy development and is intended for policymakers involved in the revision of the Active Travel (Wales) Act guidance. It may also be of value to third sector organisations working on transport, accessibility, and inclusion.

### Background / Aim of Rapid Review
This rapid review examines international evidence on how changes to active travel infrastructure affect disabled people. The review aims to inform future revisions of the 2021 guidance that followed the Active Travel (Wales) Act 2013, by exploring the impact of infrastructure changes on accessibility and identifying the barriers and facilitators experienced by disabled people.

### Results of the Rapid Review
*Recency of the evidence base*
- The review included evidence available up until July 2025. The included studies were published between 2015 and 2025.

*Extent of the evidence base*
- Primary research studies (n=11, from 12 publications) with relevant quantitative data (n=3), qualitative data (n=6) and both qualitative and quantitative data (n=2).
  - Studies were conducted in England (n=3), Scotland (n=1), Wales (n=1), and UK-wide (n=4), Portugal (n=1) and across 6 countries in Europe (n=1).
  - Most took place in urban city centres.
- Reviews (n=4): systematic (n=2), scoping (n=1) and narrative (n=1)
  - Covered studies from a range of countries, with most conducted in North America and Europe.
- Across the included reports, the following populations were represented
  - People with visual impairments (n=4).
  - People with mobility impairments (n=1).
  - Neurodivergent people (n=1).
  - People with mobility, hearing, or vision impairments (n=4).
  - People with mobility, hearing, vision impairments and neurodivergence (n=3).
  - People using mobility assistive devices (n=1).
  - Older adults with motor, visual, hearing impairments, or orientation difficulties (n=1).
- Infrastructure changes were examined in relation to their impact on accessibility (n=11) and/or identified the barriers and facilitators experienced by disabled people (n=11) in relation to:
  - Bus stop designs: Accessible/adapted bus stops (n=2), Floating Island bus stops (n=4), Kerbside track arrangements & shared platform border arrangements (n=1), Shared bus stop borders (n=2).
  - Pedestrian infrastructure: Pavements & surfaces including tactile paving (n=7); Kerbs & dropped kerbs (n=4); Crossings (n=4), Wayfinding (n=1); Continuous footways (n=2), Segregated cycle-footways (n=1).
  - Streetscape modifications: Shared spaces (n=2), Low Traffic Neighbourhoods (n=2).
  - Cycle infrastructure: Shared use path (n=1); General cycle infrastructure (n=1).

*Key findings – impact*
- Design changes to bus stop infrastructure, including Floating Island Bus Stops and Shared Bus Stop Borders were consistently associated with reduced accessibility, subjective feelings of safety, and confidence among disabled people getting on and off buses, particularly those with visual or mobility impairments.
- Uneven pavements and surface defects reduced perceived safety and confidence for people with visual and mobility impairments, with tactile paving aiding navigation for blind users but creating instability for mobility aid users, highlighting conflicting access requirements.

- Kerb and level changes introduced perceived safety risks and reduced confidence, particularly for mobility-aid users and people with visual impairments, because they felt at risk of tipping over due to uneven surfaces.
- Overall, continuous footways had mixed effects on accessibility, improving mobility for some users while reducing subjective feelings of safety and confidence for others.
- Wayfinding difficulties limited independent travel for neurodivergent people, leading to journey avoidance or increased reliance on taxis.
- For experiments of different delineators at segregated cycle-footways, continuous raised trapezoidal designs were most effective in providing clear, detectable boundaries and supporting confidence among visually impaired users.
- Low Traffic Neighbourhoods were experienced in mixed ways by disabled people, some reported reduced independence and increased stress, while others described greater confidence, feelings of safety and improved wellbeing in quieter streets.
- The development of shared spaces was often characterised by the removal of traditional street features such as kerbs, signals and tactile paving, intended to create open, integrated environments but often perceived to reduce safety and clarity for people with visual impairments who are walking, particularly cane users.
- Barrier removal on shared-use paths increased accessibility for people using mobility aids and non-standard cycles, enabling more frequent travel for commuting and everyday journeys.

*Key findings – Barriers and facilitators*

- Some design features, such as kerb-free layouts, clear tactile paving, and well-marked crossings, acted as facilitators that improved accessibility, perceived safety, and confidence, other features introduced barriers.
- These included unclear or inconsistent layouts, unsafe interactions between people walking and wheeling and people cycling, and inadequate tactile or visual cues.
- Some barriers were consistent across all disability groups, such as steep pavements, steps, and permanent obstacles, whereas others were impairment-specific.
- Vehicles parked on pavements created barriers to navigation for neurodivergent people and blocked movement for guide dog users.
- Tactile paving aided navigation for people with visual impairments but was perceived to create a barrier to wheelchair stability, whereas kerb removal reduced barriers for wheelchair users but created orientation barriers for people with visual impairments.
- Overall, barriers were reported far more frequently than facilitators.

## Policy and Practice Implications

- Meeting conflicting accessibility needs (or ‘access friction’) of different groups of disabled people can be challenging when planning and implementing change in active travel infrastructure.
- Disabled people often reported that cycling infrastructure was prioritised over their needs and described safety concerns and feelings of exclusion in relation to these infrastructures.
- Inconsistent infrastructure designs across different spaces and regions can create confusion among disabled people and lead to them feeling unsafe or potentially being directed to harm’s way.

## Research Implications and Evidence Gaps

- The quality of the included literature is highly varied with many reports lacking methodological detail.
- Sociodemographic data, such as gender, ethnicity, and socioeconomic status, were rarely reported in the included studies and future studies should examine whether these characteristics influence experiences.
- There was a lack of studies including participants with learning disabilities. Future studies evaluating new active travel infrastructure may need to ensure inclusion of a wide range of disabilities.

## Economic considerations

- Active travel infrastructure that accounts for the needs of people living with a disability can produce positive economic impacts by improving access to goods and services, sometimes referred to as the ‘Purple Pound’. Local retail expenditure can increase by up to 30 percent following improvements in active travel infrastructure.
- Transport providers may be losing out on as much as £58 million per month through lack of accessibility.
- At the UK level, 52% of disabled people have reduced their essential travel because of the cost-of-living crisis, further evidencing the need for appropriate active travel infrastructure to support them.

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## Abbreviations

| Acronym | Full Description |
|---|---|
| CRPD | Convention on the Rights of Persons with Disabilities |
| FIBS | Floating island bus stop |
| ICF | International Classification of Functioning, Disability and Health |
| LTN | Low traffic neighbourhood |
| MobAD | Mobility Assistive Devices |
| OECD | Organisation for Economic Co-operation and Development |
| RNIB | Royal National Institute for the Blind |
| SBSB | Shared bus stop border |
| TRIPS | Transport Innovation for disabled People needs Satisfaction |

## Glossary and terminology

**Active travel**
Active travel means making ordinary everyday journeys to any destination in physically active ways such as walking, wheeling (using a wheelchair or mobility aid), cycling (Wheels for Wellbeing 2024).

**Continuous footways**
Continuous footways are installations where the level of the footway stays the same across the entrance of a minor side road, signalling pedestrian priority. Vehicles must cross a raised section, reinforcing the transition from a main traffic priority road into a residential area. (Guide Dogs & UCL 2024).

**Kerbs and dropped kerbs**
A kerb is the raised edge between the pavement and the road. The word is spelled differently in British (kerb) and American English (curb). In this document, the British spelling (kerb) is used consistently, except in direct quotations from original studies. In this document, the term dropped kerbs is also used to refer to lowered sections of the pavement by crossings. However, in the wider literature this infrastructure may be referred to as lowered kerbs, kerb ramps, or Kerb cuts (Georgescu et al. 2024).

**Crossings**
A designated safe area where people walking, wheeling and cycling can cross the road. In British English, this is referred to as a crossing and is synonymous with the American English term *crosswalk*. In this document, the British term crossing is used consistently, except in direct quotations from original studies.

**Disability**
This review adopts a broad, inclusive definition of disability informed by the International Classification of Functioning, Disability and Health (ICF) (WHO 2001) and the United Nations Convention on the Rights of Persons with Disabilities (CRPD) (United Nations 2006). The ICF frames disability as a dynamic interaction between a person's health condition and their personal and environmental context, incorporating impairments, activity limitations, and participation restrictions within a bio-psycho-social model. This approach acknowledges that individuals may experience difficulties related to their condition while also facing disabling barriers in society (WHO 2011). The CRPD further recognises disability as "an evolving concept" resulting from the interaction between persons with impairments and attitudinal and environmental barriers that hinder full and effective participation in society on an equal basis with others. This aligns with the Social Model of Disability adopted by Welsh Government and Transport for Wales, which emphasises that people are disabled not by their impairments but by the physical, organisational, and attitudinal barriers around them. Disability is therefore not an attribute of the person but seen as arising from the interaction between a person and their environment.

**Floating island bus stops**
Also known as a bus stop bypass or bus stop island, this design positions the bus stop waiting area on an island that is separated from the pavement by a cycle lane. Buses stop alongside the island to allow passengers to board and alight. People walking and wheeling can access the bus stop by crossing the cycle lane via a zebra crossing, often installed with tactile paving to support those with vision impairments. The layout is intended to balance accessibility with maintaining uninterrupted cycling flow (RNIB 2025, Guide Dogs & UCL 2024).

**Low traffic neighbourhoods**
Low Traffic Neighbourhoods are movement and place-based initiatives that use measures such as bollards, planters, and other barriers to restrict through-traffic on residential streets, creating environments that are better for walking, wheeling, cycling and play in residential areas. Their purpose is to promote walking, wheeling and cycling, create places for alternative uses of the highway (such as pocket parks and play features), and create more human friendly and less traffic dominated places (Transport for All 2021).

**Neurodivergence**
"Neurodivergence refers to "*any neurological condition that falls outside what most people would consider to be normal or neurotypical"* The conditions included under this umbrella vary across sources but commonly encompass autism, attention deficit hyperactivity disorder, Tourette's syndrome, developmental coordination disorder (also known as dyspraxia in the UK), obsessive compulsive disorder, dyslexia, and sensory processing disorder (Day 2024, p.8)

**Pavement**
The part of the road designated for people walking and wheeling, often raised above the carriageway. Though more properly referred to as 'footways' within highways law and technical literature in the UK, this is more generally referred to as the 'pavement' in everyday English. It is synonymous with the American English term *sidewalk*. In this document, the British term pavement is used consistently, except in direct quotations from original studies.

**Segregated cycle–footways**
A shared path for people walking and wheeling and people cycling divided by a visual or physical boundary called a delineator, such as a painted line or raised strip, which can either be continuous or with gaps every one or more metres (Guide Dogs & UCL 2024). Continuous raised trapezoidal delineators are narrow raised strips running the full length of the path, providing consistent tactile and visual cues between pedestrian and cycle areas. Gaps in delineators refer to breaks or interruptions in the tactile or visual boundary, such as where the separator stops at crossings, driveways, or entrances.

**Shared bus stop boarders**
In this design, the bus stop is located within the footway, similar to conventional bus stops, allowing people walking and wheeling to access it directly from the pavement. However, a cycle lane runs between the bus and the bus stop platform, at the same level as the footway. Unlike floating island bus stops, there is typically no raised zebra-style crossing to prioritise people walking and wheeling. To board or alight, passengers must cross the cycle lane. For passengers requiring a ramp, manoeuvring may involve positioning within the cycle lane itself (Guide Dogs & UCL 2024).

**Shared space**
The idea behind the shared space is to enable all users to share the space and reduce the dominance from motor vehicles. Within this space the onus is on the people driving and people cycling to give way to people walking and wheeling. Physically, shared spaces are devoid of attributes such as kerbs, road markings, signals and barriers (Brown & Norgate 2019).

**Shared use paths**
A shared-use path is a path that supports people walking, wheeling and cycling within the same space.

**Tactile paving**
Tactile paving is a *"profiled paving surface providing guidance or warning to vision impaired people,"* (Department for Transport 2021, p. 80) developed to assist individuals with visual disabilities by leading them to crossing points and providing warnings and guidance where the footway ends and the carriageway begins (Ormerod et al. 2015).

**Wayfinding**
Wayfinding is the process through which people determine and follow a route through a physical environment to a destination, using environmental cues such as signage, landmarks, auditory or tactile signals, maps, and digital aids (Fang et al. 2015).

# 1. BACKGROUND

## 1.1 Who is this review for?

This Rapid Review was conducted as part of the Health and Care Research Wales Evidence Centre Work Programme. The above question was suggested by Transport for Wales and will be used to help inform the forthcoming revision of the Active Travel (Wales) Act guidance (Welsh Government 2021).

## 1.2 Background and purpose of this review

Active travel refers to physically active modes of making ordinary everyday journeys to any destination, including schools or work (Active Travel Board 2024, Wheels for Wellbeing 2024). These physically active modes of travel include walking, wheeling (using a wheelchair or mobility aid), or cycling, often used alone or in combination with public transport. Active travel has recognised health benefits, such as improved general and mental health and weight-related outcomes (Ding et al. 2024). Additionally, active travel can have economic, environmental and social advantages (Ding et al. 2024). Economic advantages include healthcare cost savings, a reduction in unemployment benefits and sickness absences from work, and improved productivity (Ding et al. 2024). Reduced carbon emission and air pollution have been reported in relation to active travel, indicating its potential positive environmental impact. Regarding social advantages, research suggests active travel can improve social connection and cohesion and help children develop more sociable attitudes (Ding et al. 2024).

While active travel can have many benefits, in Wales low levels of people make journeys actively. Based on the National Survey for Wales about active travel in 2022-2023, only 17% of adults walked daily and 10% of adults cycled at least once a month (Welsh Government 2023). Of those completing the survey, people with limiting long-standing illnesses (including disabled people with visual and hearing impairment) were less likely to travel actively compared to people without. Approximately 12% reported walking daily, while around 6% reported cycling once a month (Welsh Government 2023).

Reasons for lower levels of active travel among disabled people include accessibility issues and barriers related to the infrastructure (Sustrans 2023). Common infrastructure related issues include poor quality pavement (bumps, potholes, cracked tiles among others), street clutter, lack of dropped kerbs, inadequate crossings, and insufficient tactile paving (Transport for All 2023). In 2013, the Welsh Government set out to increase levels of active travel and make walking and cycling the most natural mode of getting about, and the Welsh Parliament unanimously passed The Active Travel (Wales) Act 2013 (Welsh Parliament 2023). The Act aims to promote walking, wheeling, and cycling for everyday journeys by improving active travel infrastructure across Wales (National Assembly for Wales 2013). The accompanying 2021 guidance (Welsh Government 2021) sets out expectations for local authorities to deliver routes that are safe, comfortable, coherent, direct, and attractive, and explicitly states that infrastructure must be accessible for disabled people. It emphasises the removal of barriers and the need to design environments that support people with mobility, sensory, and cognitive impairments, as well as those at greater risk of exclusion from active travel.

Active travel infrastructure across Wales and the wider UK has undergone significant change in recent years. These developments include, but are not limited to, continuous footways (Weetman et al. 2023), urban shared spaces (Brown & Norgate 2019), shared use paths (Sustrans 2024), floating island bus stops (Weetman et al. 2024), low traffic neighbourhoods (Transport for All 2021), or new tactile paving (Georgescu et al. 2024). While these initiatives aim to improve safety and conditions for people walking and wheeling and people cycling (Weetman et al. 2023, Weetman et al. 2024), they may also create **barriers** for disabled people (Guide Dogs & UCL 2024, RNIB 2025, RNIB Cymru 2025, Weetman et al. 2023, Weetman et al. 2024). Furthermore, "access friction" can arise where design changes that meet the needs of one group of disabled people are incompatible with the needs of others (Larrington-Spencer 2024). Therefore, it is important to understand the impact infrastructure changes have on disabled people and explore their experiences.

This rapid review therefore aimed to examine the international evidence on the impact of changes in active travel infrastructure on disabled people and help inform the forthcoming update of The Active Travel (Wales) Act 2013. The overall aim of the review was addressed by answering the two research questions below.

- What is the impact of changes in active travel infrastructure on accessibility for disabled people?
- What are the barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure?

# 2. RESULTS

This section details the extent of the evidence base and findings of the included research that reported on the impact of changes in active travel infrastructure on disabled people, and barriers and facilitators experienced in response. The detailed methods used for this rapid review are described in Section 6. This includes the eligibility criteria (Section 6.1) used to select the evidence.

This mixed methods rapid review included both qualitative and quantitative evidence from primary research (collecting new data) and evidence reviews (summarising data from existing research). A description of the characteristics of the available evidence, including study designs, country of origin and setting, population (disability, age, gender, ethnicity, sociodemographic status), details of the active travel infrastructure changes investigated (planned or already been implemented), and methodological quality is provided in Section 2.1, under Overview of the evidence base. Narrative summaries of the findings of the included research addressing each review question are presented in Sections 2.2 and 2.3, respectively. Bottom line summaries are also provided synthesising all evidence by the type of infrastructure investigated.

## 2.1 Overview of the Evidence Base

The results of the searches and study selection process are presented in Section 7.1.

Following on from the searches 16 reports (comprising 11 primary research studies reported across 12 publications[1], and four reviews) were included in this rapid review. The reviews included two systematic reviews, one scoping review and one narrative review: three addressed the first review question and examined the impact of active travel infrastructure changes on accessibility for disabled people, while four addressed the second review question, focusing on barriers and facilitators experienced in response to such changes.

A summary of the characterises of the available evidence including study designs, country of origin and settings, population (including participant ages), and types of infrastructure change is presented in Table 1 (participants' age for primary research) and Table 2 (description of the characteristics of included research). A more detailed overview of the included primary research studies and reviews are provided in Section 7.2. The detailed study characteristics are provided in Table 4 and Table 5.

*Study designs*

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[1] Alciauskaite et al. 2020; Hatzakis et al. 2024 both report on the TRIPS study

Across the included primary research studies, six studies (reported across seven publications) were qualitative descriptive (Alciauskaite et al. 2020, Hatzakis et al. 2024, Brown & Norgate 2019, Ormerod et al. 2015, Transport for All 2021, Weetman et al. 2023, Weetman et al. 2024) and of these, two were mixed methods studies where only the qualitative descriptive component was relevant to this rapid review (Weetman et al. 2023, Weetman et al. 2024). Three studies were quantitative descriptive (RNIB 2025, RNIB Cymru 2025, Rosa et al. 2025), and of these, one was a mixed methods study where only the quantitative component was relevant to this rapid review (Rosa et al. 2025). Two studies used a mixed methods design incorporating both qualitative and quantitative data (Guide Dogs & UCL 2024, Sustrans 2024). There were two systematic reviews (Georgescu et al. 2024, Kapsalis et al. 2024), one scoping review (Seetharaman et al. 2024) and one narrative review (Day. 2024).

*Country of origin and setting*
Across the included primary research studies, nine were conducted in the UK. Three took place in England (Brown & Norgate 2019, Sustrans 2024, Transport for All 2021), one in Scotland (Ormerod et al. 2015), one in Wales (RNIB Cymru 2025), and four were UK-wide (Guide Dogs & UCL 2024, RNIB 2025a, Weetman et al. 2023, Weetman et al. 2024). Most were situated in urban city centres, with one in a small town centre (Brown & Norgate 2019) and another spanning rural and semi-rural areas (RNIB Cymru 2025). One further study was conducted in Portugal at Faro Airport (Rosa et al. 2025), while the EU-funded TRIPS project was reported across two publications (Alciauskaite et al. 2020, Hatzakis et al. 2024).

The four included reviews covered studies from a range of countries, with most conducted in North America and Europe. The narrative review focused mainly on studies from the UK, with additional sources from Ireland and the USA (Day 2004). Georgescu et al. (2024) included seven studies from North America and 11 studies conducted in a single country across Europe, Asia, Latin America, and Australasia; geographic data was not reported for two studies. Kapsalis et al. (2024), included studies from North America (n=23), Europe (n=12), the UK (n=3), Australasia (n=1), Asia (n=5), the Middle East (n=1), and Africa (n=4). The scoping review comprised studies from North America (n=16), Europe (n=16) and Australasia (n=6) (Seetharaman et al. 2024).

*Population*
The number of individuals across the primary research studies ranged from two (Sustrans 2024) to 90 (Guide Dogs & UCL 2024) in the qualitative studies (or the qualitative components of the mixed methods studies), from 146 (RNIB Cymru 2025) to 1197 (RNIB 2025) in the quantitative studies (or the quantitative components of the mixed methods studies).

Participant groups were as follows:
Primary Studies:
- People with visual impairments (3 studies: Brown & Norgate 2019, RNIB 2025, RNIB Cymru 2025).
- People with mobility impairments (1 study: Sustrans 2024).
- People with mobility, hearing, or visual impairments were represented across several studies, with some including all three groups and others focusing on different combinations (3 studies: Ormerod et al. 2015, Weetman et al. 2023, Weetman et al. 2024)
- Mixed sensory impairment groups and neurodivergent people[2] (3 studies reported across 4 publications: Alciauskaite et al. 2020, Hatzakis et al. 2024, Guide Dogs & UCL 2024, Transport for All 2021).

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[2] One study (Alciauskaite et al. 2020) reported the type of divergence. The authors describe the one participant as having ADD, autism, non-normative ability, PTSD and depression.

- Older adult tourists with motor, visual, hearing impairments or orientation problems (1 study: Rosa et al. 2025).

Reviews:
- People with visual impairments (1 study: Seetharaman et al. 2024).
- People with mobility and visual impairments (1 study: Georgescu et al. 2024[3]).
- Neurodivergent people (1 study: Day 2024)[4].
- Mobility assistive device users (Kapsalis et al. 2024)[5].

Age was reported across eight of the primary studies and two of the reviews and details are provided in Table 1 below.

**Table 1: Age of the participants included in the primary research studies**

| Study | Age Range (years) | Mean age (years) (where reported) |
|---|---|---|
| Alciauskaite et al 2020<br>Hatzakis et al 2024 | 21-70 | 44.4 |
| Brown & Northgate 2019 | 21-54 | 54 |
| Georgescu et al. 2024 | [a]18+ | |
| Guide Dogs & UCL 2024<br>(Site visits & experiment) | 25-65+ | |
| Ormerod et al. 2015 | [b]65+ | |
| RNIB Cymru 2025 | 18-65+ | |
| Rosa et al. 2025[a] | 60+ | |
| Seetharaman et al. 2024 | 18+ | |
| Transport for All 2021 | 8-89 | |
| Weetman et al. 2024 | 16-66+ | |

Notes
[a] no details available or four of the included studies
[b] judgement of age made by researchers

Further demographic detail was rarely reported across the included primary studies. Gender was reported in three studies (across four publications: Alciauskaite et al. 2020, Hatzakis et al. 2024, Brown & Norgate 2019, Guide Dogs & UCL 2024), with the proportion of female participants ranging from 40% (Brown & Norgate 2019) to 60% (Guide Dogs & UCL 2024, experiment). Ethnicity was reported in one study (Weetman et al. 2024), where 60% of participants were recorded as White, 16% Black, Asian or Caribbean, 12% Asian, 8% mixed, and 2% other. Socio-economic status was reported in two studies (across three publications: Alciauskaite et al. 2020, Hatzakis et al. 2024, Rosa et al. 2025). Rosa et al. (2025) reported working status, with 70% of participants retired, while Alciauskaite et al. (2020) reported education, with 23% of participants holding a higher education degree. Across the four reviews, demographic details were absent in the narrative review, and lacking in the remaining reviews, which often highlighted that demographic data was inconsistently reported in the included studies.

*Infrastructure changes*
This rapid review examined a range of modifications to the built environment intended to support active travel. Evidence included 10 studies and four reviews that focused on existing infrastructure where changes had already been implemented; one study of planned changes; and one study exploring both existing infrastructure and experimental (purpose

[3] Also included individuals with situational mobility restriction (i.e. strollers)
[4] No details of the type of divergence reported
[5] Also included individuals with situational mobility restriction (i.e. strollers)

built for research purposes) layouts. Several studies addressed more than one type of modification.

*Existing infrastructure*:

- Bus stop design (5 studies, reported across 6 publications)
  - Adapted bus stops (Alciauskaite et al. 2020; Hatzakis et al. 2024).
  - Floating island bus stops (FIBS) (Guide Dogs & UCL. 2024; RNIB 2025; RNIB Cymru 2025; Weetman et al. 2024).
  - Kerbside track arrangements and shared platform boarder arrangements (Weetman et al. 2024).
  - Shared bus stop boarders (SBSB) (Guide Dogs & UCL 2024; RNIB Cymru 2025).

- Pedestrian infrastructure (4 studies, reported across 5 publications and 4 reviews)
  - Pavements and surfaces (including tactile paving) (Alciauskaite et al. 2020; Day 2004, Georgescu et al. 2024; Guide Dogs & UCL 2024; Hatzakis et al. 2024; Kapsalis et al. 2024; Ormerod et al. 2015; Seetharaman et al. 2024).
  - Kerbs and dropped kerbs (Georgescu et al. 2024; Kapsalis et al. 2024; Ormerod et al. 2015; Seetharaman et al. 2024).
  - Crossings (Alciauskaite et al. 2020; Day 2024; Georgescu et al. 2024; Hatzakis et al. 2024; Ormerod et al. 2015; Seetharaman et al. 2024)
  - Continuous footways (Guide Dogs & UCL 2024; Weetman et al. 2023).
  - Segregated cycle-footways (Guide Dogs & UCL 2024)

- Streetscape modifications (2 studies and 2 reviews)
  - Shared space (Brown & Norgate 2019; Seetharaman et al. 2024).
  - Low Traffic Neighbourhoods (Day 2024; Transport for All 2021).

- Cycle infrastructure (1 study and 1 review)
  - Shared use path - Barrier removal and redesign (Sustrans 2024).
  - General cycle infrastructure (Day 2024).

Planned changes

- Bus stop design (1 study)
  - Accessible bus stop at Faro Airport (Rosa et al. 2025).

- Pedestrian infrastructure (1 study)
  - Pavements and surfaces (including tactile paving) (Rosa et al. 2025).

Experimental layouts (Purpose-built test sites)

- Bus stop design (1 study)
  - Floating island bus stops (FIBs) (Guide Dogs & UCL 2024)
  - Shared bus stop boarders (SBSB) (Guide Dogs & UCL 2024)

- Pedestrian infrastructure (1 study)
  - Continuous footways (Guide Dogs & UCL 2024)

**Table 2: Summary of included research including details of settings, participants, study design and type of infrastructure change**

| **Author, Year**<br>**Setting and Country** | **Participants**<br>**Study design** | **Type of Infrastructure change** |
|---|---|---|
| Alciauskaite et al. 2020<br>Hatzakis et al. 2024<br>Brussels (urban city centre); Belgium<br>Sofia (urban city centre); Bulgaria<br>Zagreb (urban city centre); Croatia<br>Lisbon (urban city centre); Portugal<br>Cagliari (small town centre); Sardinia<br>Stockholm (urban city centre); Sweden<br>Europe | Adults with mobility, visual, hearing and neurodivergent impairments who are walking or wheeling (n=41)<br>Qualitative descriptive | Type: Adapted bus stops, Pavements and surfaces (including tactile paving), crossings<br>Participants considered existing infrastructure already in place as part of the TRIPS project across 6 Europe cities |
| Brown & Norgate 2019<br>Poynton (small town centre)<br>England | Adults with blindness or visual impairments who are walking or wheeling (n=5).<br>Qualitative descriptive | Type: Urban shared space<br>• Footway: No designated pavement<br>• Crossing: Tactile paving delineating the informal crossing area<br>• Surfacing: Paved bricks along the route<br>• Demarcation: Boundary between pedestrian path and vehicle space<br>Participants considered existing infrastructure already in place as part of the (Poynton Regenerated Project 2012-2103) |
| Day 2024<br>UK<br>Ireland<br>USA | Neurodivergent people<br>Number of included studies: NR<br>Narrative Review | Type: Pavements and surfaces, crossings, Low Traffic Neighbourhoods, cycling infrastructure<br>Participants considered existing infrastructure already in place |
| Georgescu et al. 2024<br>North America<br>Belgium, Italy, Croatia, Ireland<br>Ecuador, Chile, China, Malaysia, Taiwan, South Korea, New Zealand | People with mobility[a] and visual impairments who are walking or wheeling<br>Number of included studies (n=20)<br>Systematic review | Type: Kerbs and dropped kerbs, pavements and surfaces (including tactile paving)<br>Participants considered existing infrastructure already in place at the study sites |

| | | |
|---|---|---|
| Guide Dogs & UCL 2024<br>Cardiff (urban city centre)<br>Glasgow (urban city centre)<br>Birmingham (urban city centre)<br>Belfast (urban city centre)<br>London (urban city centre)<br>UK | Adults with blindness or visual impairments, as well as other groups of disabled adults including those with hearing loss, neurodivergence, and mobility impairments[a] who are walking or wheeling (n=90)<br>Mixed methods | Type: Floating Island Bus Stops, Shared Bus Stop Boarders, Continuous footways and surrounding pedestrian network (pavements and surfaces including tactile paving).<br>Participants considered existing infrastructure already in place through focus groups and site visits<br>Type: Floating Island Bus Stops, Shared Bus Stop Boarders, Segregated cycle–footways, Continuous footways<br>• Inclusion of segregated cycle–footways with different delineators (experiments)<br>• Continuous footways tested with and without tactile paving (experiments)<br>Experimental layouts, purpose built for research purposes were constructed and they assessed detection rates, safe distance to cross and heart rate |
| Kapsalis et al. 2024<br>UK<br>Europe<br>North America<br>Australasia<br>Asia<br>Middle East<br>Africa | People with mobile assistive devices[a] who are walking or wheeling<br>Number of included studies (n=48)<br>Systematic review | Type: Kerbs and dropped kerbs, pavements and surfaces (including tactile paving)<br>Participants considered existing infrastructure already in place at the study sites |
| Ormerod et al. 2015<br>Edinburgh (urban city centre)<br>Scotland | People with mobility impairments who are walking or wheeling (n=8)<br>People with moderate/severe vision impairments who are walking (n=30)<br>Qualitative descriptive | Type: Kerbs and dropped kerbs, pavements and surfaces (including tactile paving, crossings (pelican, signalised junction, uncontrolled crossings)<br>Participants considered existing infrastructure already in place at 8 selected road crossing sites |
| RNIB 2025<br>UK (all nations) | Blind and partially sighted adult bus users (n=1197)<br>Quantitative descriptive | Type: Floating Island Bus Stops<br>Participants considered existing infrastructure already in place |

| | | |
|---|---|---|
| RNIB Cymru 2025<br>Wales | Blind and partially sighted adult bus users (n=146)<br>Quantitative descriptive | Type: Floating Island Bus Stops, Shared Bus Stop Boarders<br>Participants considered existing infrastructure already in place |
| Rosa et al. 2025<br>Faro (Faro International Airport<br><br>Portugal | Older adult tourists (aged 60+) from various European countries (n=851) of which 25.3 % reported mobility impairments<br>Quantitative descriptive[b] | Type: Bus stop and surrounding pedestrian network (pavements and surfaces including tactile paving)<br>The data is to be used to assist with the design process of an age friendly accessible bus stop at Faro airport as part of the Accessibility for All in Tourism (ACCESS4ALL) project[c] |
| Seetharaman et al. 2024<br>North America<br>Europe<br>Australia<br>New Zealand | People with visual impairments who are walking<br>Number of included studies (n=43)<br>Scoping review | Type: Pavements and surfaces (including tactile paving), kerbs and dropped kerbs, crossings, shared spaces<br>Participants considered existing infrastructure already in place at the study sites |
| Sustrans 2024<br>York (Foss Islands Path)<br>England | Path users (counts of path users over a two-month period, daily numbers not reported)<br>Path users (interviews) (n=13) of which there were two users with disabilities<br>Mixed methods | Type: -Shared use path<br>Removing 30 restrictive barriers and replacing them with alternative facilities designed to maintain access for all users at Foss Islands Path in 2016<br>Participants retrospectively considered these changes and the impact that has had on them in 2023. |
| Transport for All 2021<br>London (urban city centre)<br>Newcastle (urban city centre)<br>Manchester (urban city centre)<br>Yorkshire (mixed urban and semi-urban settings<br>Woking (small town centre)<br>Oxford (urban city centre)<br>England | Participants identified as disabled or spanning a wide range of disability types (n=84)<br>Qualitative descriptive | Type: Low traffic neighbourhood<br>Participants who lived either inside, or close to, a LTN OR whose daily activities would be directly affected by the LTNs[d]<br>Participants considered existing infrastructure already in place at the study sites |

| | | |
|---|---|---|
| Weetman et al. 2023<br>Cardiff (urban city centre)<br>Leeds (urban city centre)<br>Edinburgh (urban city centre)<br>London (urban city centre)<br>Glasgow (urban city centre)<br>UK | People with mobility and vision impairments who are walking or wheeling (n=20)<br>Qualitative descriptive[e] | Type: Continuous footways<br>Participants considered existing infrastructure already in place at the study sites |
| Weetman et al. 2024<br>Cardiff (urban city centre)<br>Leeds (urban city centre)<br>Edinburgh (urban city centre)<br>London (urban city centre)<br>Glasgow (urban city centre)<br>UK | People with mobility, visual and hearing impairments who are walking or wheeling (n=25)<br>Qualitative descriptive[e] | Type: Bus stop bypasses, Kerbside track arrangements, Shared platform boarder arrangements and hybrid variations of these approaches<br>Participants considered existing infrastructure already in place at the study sites |

**Notes**
[a] Also included individuals with situational mobility restriction (i.e. strollers)
[b] The study employed a mixed methods design, but only data from the quantitative descriptive component were included in this rapid review
[c] Upon further examination, it appears that the proposed bus stop design was not implemented
[d] Participants from 19/21 London boroughs that have implemented LTNs and 5 locations outside on London
[e] The study employed a mixed methods design, but only data from the qualitative descriptive component were included in this rapid review

**Key**
LTN: low traffic neighbourhood, NR: not reported

***Methodological quality***

The quality of the included primary research studies was determined by using two tools. The 10-item JBI Critical Appraisal Checklist for Qualitative Research (Lockwood et al. 2015) was used for the four qualitative studies (reported across five publications). The 13-item Quality Assessment for Diverse Studies (QuADS) tool (Harrison et al. 2021) was applied to the quantitative studies and the mixed methods studies, including those where only the qualitative or quantitative components were relevant to the review. The 11-item JBI Critical Appraisal Checklist for Systematic reviews and Research syntheses (Aromataris et al. 2015) was used to assess the quality of included systematic and scoping reviews. These tools can help with identifying issues with study designs and potential biases that may influence validity and reliability of the findings. The tools cover a wide range of issues, including the appropriateness of the philosophical and theoretical underpinning of the research, recruitment of participants, suitability of how the data was collected and analysed, and whether the conclusions made align with the findings reported. A detailed description of the quality assessment process and the tools used is presented in Section 6.4 .

The qualitative studies had shortcomings, with detailed assessment results presented in Table 6, in Section **Error! Reference source not found.**. A common issue was that studies did not explain the approach or philosophy that guided their research, and they also gave little or no information about the researchers themselves. These details matter because the way a study is designed and the role of the researcher can influence the interpretation of findings. Across the studies there were generally limitations in quality due to insufficient information on whether data collection, analysis and interpretation of the findings were aligned, whether the participants' voices were adequately represented, and whether the study had received ethical approval from an appropriate organisation.

The detailed quality assessment results for the five mixed methods studies (including those where only the qualitative (n=2) or quantitative (n=1) components were relevant to the review) and the two quantitative descriptive studies, are presented in Table 7, in Section **Error! Reference source not found.**. None of the seven studies met all the criteria outlined b y QuADS, and studies often lacked explicit justification for methods used. None of the studies met all of the QuADS criteria, with common shortcomings including a lack of explicit justification for the methods used. Only one study reported the theoretical underpinning of their research, which may influence the method of analysis and interpretation of the findings. The aims and purpose of the studies were only stated explicitly in four studies. Most studies (n=5) provided at least a basic justification as to why the methods chosen were right for the aims and purposes of their research. The settings of the research, including the locations and types of infrastructure investigated, were generally described in sufficient detail, as were the disabilities of the targeted participants. However, very limited information was provided across all studies on how participants were recruited and what efforts were made to ensure they were a good representation of the target. Details on methods and tools used to collect data from participants were lacking in most studies, apart from two which provided limited or generic information. As a result, survey questions and interview guides were often not presented or shown to have been tested previously, making it unclear whether these tools were appropriate for capturing participants' experiences. Similarly, very limited information was provided on the procedure of collecting data, for example how interviews were conducted and who led them. All studies provided very limited or no information on how they analysed the data collected and why they choose their analytic approach. Four of the seven studies reported whether and how they involved stakeholders in the development and conduct of their research. Most studies (n=4) mentioned at least some limitations of their chosen research approach particularly relating to recruitment and representativeness. However, two studies did not include an explicit limitations section. These gaps in reporting reduce transparency and may influence how the results are interpreted by readers.

The detailed quality assessments of the two systematic reviews and the scoping review are presented in Table 8, in Section **Error! Reference source not found.**. Each review had a clear focus and explained who and what was included. However, the way the authors searched for studies was not always thorough, for example, they did not always use the full range of search terms, adapt searches for different databases, or look beyond published articles. This means some relevant studies may have been missed. Only one review carried out a formal quality check of the studies, another did not, and for the scoping review this was not required. All three reviews gave recommendations for policy and practice that matched their findings and suggested areas for future research, though some explained this in more detail than others. Overall, the reviews provide useful insights but are limited by weaker search methods and lack of clear information on how the checking processes were carried out.

## 2.2 Impact of changes in active travel infrastructure

This section presents narrative summaries of the included studies (n=7) and reviews (n=3) that examined how changes in active travel infrastructure affected accessibility for disabled people. Details of the findings extracted from each included study and reviews are provided in Table 9 and Table 10, respectively.

Brown & Norgate (2019) examined experiences of a **shared space scheme** in Poynton, North West England, developed in 2013. Using qualitative case studies with five participants and verbal protocol analysis, the study captured real-time perceptions of the environment. The space had no designated pavement but included tactile paving around an informal crossing area, a brick-paved surface, and a boundary separating pedestrian and vehicle areas. Cane users reported difficulty orientating safely due to the absence of a kerb or tactile contact point, with canes often extending into the carriageway and increasing risk, particularly from electric vehicles which were harder to detect. The lack of a kerb or trailing edge contributed to disorientation and fear of inadvertently wandering into traffic. Participants described shared spaces as unsuitable for independent travel and expressed confusion, disorientation and perceptions of reduced safety. Additionally, street furniture obstructed walking paths and pushed people walking and wheeling closer to traffic, increasing safety concerns.

Disabled people's experiences of the impact of different **bus stop layouts and crossing designs** were explored through focus groups, site visits, and controlled experiments in research conducted by Guide Dogs & UCL (2024). Five focus groups were held across Birmingham, Cardiff, London, Glasgow, and Belfast with participants who were blind or visually impaired, had hearing loss, were neurodivergent, or had mobility impairments. Site visits in London involved accompanied trips to **one FIBS, one SBSB and one continuous footway**, while the experiments reconstructed these layouts along with **segregated cycle–footways** with different delineators and continuous footways with and without tactile paving. Across all activities, these designs were generally experienced as reducing accessibility. Use of FIBS and SBSB reduced subjective feelings of safety and confidence, with vulnerability, confusion, anxiety and fear sometimes leading to avoidance of bus services altogether. Shared Bus Stop Boarders were considered to have a greater negative impact than FIBS, with the mixing of people walking and wheeling and people cycling, creating particular stress and being described as unsafe. Participants expressed a shared view that both designs could not be made safe and should be removed.

The Royal National Institute for the Blind (RNIB) survey of 1,197 blind and partially sighted people reported substantial impacts on accessibility linked to **bus stop designs** such as **FIBS** (RNIB, 2025). Among those who had encountered these stops (30%), 87% found it harder to reach the bus stop, 59% stopped using certain bus stops, 55% changed routes, 49% made fewer journeys, and 14% no longer went out. Open-text responses further suggested that some avoided areas with FIBS and no longer met friends in these locations. Crossing cycle paths to reach buses was described as unsafe, with reports of collisions and lack of protection from people cycling and people on e-scooters. Designs were considered inconsistent, with crossings not always present or clearly defined, and overall were viewed as dangerous and unsuitable for blind and vision-impaired people. A further survey by RNIB

Cymru (2025) found that FIBS and SBSB significantly reduced independent travel among blind and partially sighted people. One open-text response described additional safety concerns at SBSB, where cycle lanes run through bus stops and people walking and wheeling may disembark directly into the path of people cycling moving through waiting crowds. The respondent reported being unable to tell whether they were walking into people cycling and stated that such designs “should not be allowed.”

Sustrans (2024) evaluated the Foss Islands Path in York, a **shared-use path,** seven years after 30 restrictive barriers were removed to improve accessibility, using a mixed methods design. Video monitoring over two months recorded an average of 45 daily trips by users with pushchairs, wheelchairs and cargo bikes that may previously have been excluded. Interviews with two adapted cycle users, one using an E trike and the other a recumbent tricycle, reported greater access which enabled more frequent travel for work, healthcare and personal purposes.

Transport for All (2021) conducted a qualitative study with 78 participants from 19 of the 21 London boroughs that had implemented **Low Traffic Neighbourhoods (LTNs),** along with five other UK locations. Participants represented a wide range of impairments and included carers, many of whom used mobility aids. The study aimed to understand the impact of LTNs on disabled residents. The reported impacts of LTNs for disabled people were mixed and at times contradictory. On the negative side, 33% of participants felt traffic danger had increased, 19% reported reduced independence, and 17% said the changes negatively affected their mental health. Participants described unsafe driving, dangerous cycling, and greater feelings of vulnerability. In contrast, some participants reported positive experiences: 18% felt traffic danger had decreased, 17% noted reduced noise (particularly valued by neurodivergent and visually impaired participants), 14% found their journeys easier or more pleasant, and small numbers described benefits to physical (n=4) and mental health (n=5). A minority (6%) also reported increased independence, particularly those using adapted cycles or wheelchairs who felt safer on quieter roads.

The Living Streets project, *Inclusive Design at Bus Stops and Continuous Footways*, funded by the Scottish Road Research Board, Transport Scotland, and the Department for Transport, was reported in two phases: **continuous footways** (Weetman et al. 2023) and **bus stops** (Weetman et al. 2024). Together, these studies examined whether continuous footways and bus stop bypasses risk excluding people from streets and bus services, and what design changes could make them more inclusive. This was a two-year mixed-methods project in the UK that combined a literature review, Geographic Information System mapping, interviews with professional informants, site visits, focus groups, and behavioural analysis at ten continuous footways in cities including London, Glasgow, Cardiff, Leeds, and Edinburgh. The development of **continuous footways and related infrastructure** had a varied impact. Some wheelchair users reported perceptions of improved safety and confidence due to kerb removal, while others, along with people with visual impairments, highlighted problems with tactile paving designs and street layouts. For other related infrastructure, wheelchair and mobility scooter users described tipping hazards caused by the combination of blister-style paving and angled slopes in dropped kerbs, with some avoiding these altogether and choosing to steer wheelchairs over mid-height kerbs instead.

People with visual impairments reported that blister-style paving did not always indicate the correct crossing direction, sometimes leading them into the main carriageway. Large, complex, or inconsistently laid tactile paving further reduced confidence and caused confusion. Impacts also included the perception that infrastructure designs prioritised people cycling over people walking and wheeling, for example, crossings obstructed by vehicles that forced guide dog users to use unsafe crossing techniques, blind people describing new infrastructure as turning previously secure routes into a “guessing game,” and difficulties avoiding oncoming people cycling when moving slowly. Some disabled people reported using buses for very short journeys due to local accessibility issues, and people with both visual impairments and wheelchair users reported struggling to see the edge of footways, leading them to stay close to the building line to remain safe.

Implementation of **bus stop bypasses and related infrastructure** often led to frustration among disabled people due to avoidable difficulties caused by these changes (Weetman et al. 2024). These included ambiguity in tactile paving use, which created uncertainty and navigation difficulties for people with visual impairments, and the perception that people cycling were prioritised over people walking and wheeling. Street changes were described as undermining trust in decision-makers, with floating bus stops criticised for creating "cycle-only areas" that reduced inclusivity and lowered confidence in navigation. Cycle tracks at bus stops were also viewed as unsafe, with uncertainty around approaching people cycling reducing people's confidence. While zebra crossings were often added to bus stop bypasses, they were not always perceived as safe. Markings were considered less obvious than on wider carriageways, and there was uncertainty around who had the right of way. Cycle tracks were not always perceived to be as dangerous as roads, but when crossing a road there was a tendency to seek out a zebra or light-controlled crossing. At small bus stop islands, accessibility was affected for wheelchair users as drivers struggled to position buses correctly, leading to poor kerb alignment and ramps that could not be deployed smoothly. Slopes at bus stop bypasses were also reported to cause issues, such as pulling wheelchairs sideways or making boarding and alighting a bus challenging. Negotiating crowds at these bus stops were also found physically difficult for wheelchair users and other disabled people, including long-cane and guide dog users, and often led to feelings of social pressure and fear of irritating others. Wheelchair users also expressed frustration when people walking and wheeling did not remain in designated spaces, leading to unexpected conflicts on cycle tracks. While the negative impact of infrastructure changes dominated conversations about bus stop bypasses, some positive effects were also noted. Kerb free arrangements at certain bus stop bypasses were seen to increase independence and confidence.

Day (2024) conducted a narrative review for Sustrans on how neurodivergent conditions influence active travel. Drawing mainly on UK sources, with some from Ireland and the USA, the review examined how neurodivergent people make travel choices, experience active journeys from mode choice to travel environment. The review found that some neurodivergent people **avoid making journeys altogether or turn back when wayfinding becomes too difficult**, while others rely on **taxis to overcome these challenges, incurring** additional costs that would not be necessary if travel infrastructure were more accessible.

A scoping review, conducted by Seetharaman et al. (2024), examined what aspects of the built environment affect the community mobility of adults with visual impairments and how these features influence travel. The review drew on 43 studies published between 2000 and 2022 across North America, Europe, Australia, and New Zealand. Findings indicated that poor pavement conditions such as cracks, bumps, unevenness, potholes, and slipperiness impaired depth perception for people with visual impairments and **increased the risk of trips, falls, and injury**. Suboptimal level changes, including small or uneven kerbs, minimal separation between kerb ramps, and unmarked stairs, **further increased risk.** People with visual impairments are more likely to **avoid walking in areas** with uneven surfaces such as kerbs, ramps, stairs or displaced slabs if they perceive these as **unsafe.** Additionally, in s**hared space designs,** the absence of kerbs and clear demarcations created **unsafe conditions** for people with visual impairments who are walking, by blurring boundaries, making it difficult for them to distinguish pedestrian zones from roads.

Kapsalis et al. (2024) conducted a systematic review of 48 studies published between 2005 and 2021 to identify the most obstructive physical barriers for mobility assistive device (MobAD) users in urban spaces and examined their impact on quality of life. The review population included users of wheelchairs, scooters, canes, crutches, walkers, and strollers, with studies spanning North America, Europe, Asia, Africa, and Australia. **Problematic**

**pathways**, including narrow, rough, uneven, or sloped pavements and improperly designed dropped kerbs, frequently led to **trips and falls**. **Tactile paving** also created challenges, as guides running perpendicular to the direction of travel caused fatigue and **instability for MobAD users**. This revealed contrasting impacts of accessibility features, with tactile paving supporting navigation for visually impaired individuals but reducing ease of movement for those using mobility aids. The review highlighted several safety concerns and secondary effects. Problematic pathways were described as contributing to injurious accidents, fatigue, physical pain, cardio-respiratory strain, reduced self-esteem, navigation challenges, perceived safety risks, social withdrawal and loss of contact with nature. Cracked or rough surfaces were reported to be associated with harmful whole-body vibrations, while cross-sloped pathways exceeding 8% were reported to be linked to increased physiological strain. Additionally, infrastructure elements such as poorly **designed or absent dropped kerbs** posed **a risk of tipping and** consequently increasing the risk of being struck by traffic. The review found that **safety fears undermined independent navigation,** with insecure and inaccessible pathway conditions often leading to psychosocial dysfunction, with some MobAD users isolating themselves from urban life and society, imposing psychological harm on already vulnerable individuals.

### 2.2.1 Bottom line results for impact of different bus stop designs

The impact of **different bus stop designs on accessibility for disabled people** was explored in four UK-based studies. This included **FIBS** (Guide Dogs & UCL 2024, RNIB 2025, RNIB Cymru 2025, Weetman et al. 2024), **SBSB** (Guide Dogs & UCL 2024, RNIB Cymru 2025), and **Shared Platform Boarder arrangements (bus stop bypasses) with kerbside track configurations** (Weetman et al. 2024). Study designs included mixed methods (Guide Dogs & UCL 2024), quantitative descriptive (RNIB 2025, RNIB Cymru 2025), and qualitative descriptive approaches (Weetman et al. 2024).

*Reduced accessibility and confidence in using bus services (three studies).*

- Disabled people reported difficulty reaching bus stops and boarding safely due to the need to cross cycle lanes, unclear layouts, and restricted space on bus stop islands. Bus stop designs were described as inconsistent, with crossings not always present or clearly marked, and lacking measures to ensure people cycling or people on e-scooters stopped safely. This impacted the confidence of disabled people, in some cases leading to the avoidance of bus services altogether (Guide Dogs & UCL 2024, RNIB 2025, Weetman et al. 2024).

*Vulnerability, confusion, anxiety, and fear, particularly when alighting the bus led to avoidance of bus services or nearby areas (three studies).*

- Stepping directly into a cycle lane caused distress and uncertainty, especially for blind and vision-impaired people, leading some to avoid using buses or visiting locations with these affected designs (Guide Dogs & UCL 2024, RNIB 2025, RNIB Cymru 2025).

*Designs such as FIBS and SBSB negatively affected accessibility, especially for people with vision or mobility impairments who are walking or wheeling (two studies).*

- Design features such as narrow bus stop islands, lack of tactile or visual boundaries, and inconsistent layouts made navigation difficult and reduced ease of movement (Guide Dogs & UCL 2024, Weetman et al. 2024).

*Shared Bus Stop Boarders considered more problematic than FIBS due to unsafe mixing of people cycling and people walking and wheeling (two studies).*

- The direct interface between people cycling and people walking and wheeling raised safety concerns, particularly where two-way cycle tracks and poor separation were present (Guide Dogs & UCL 2024, RNIB Cymru 2025).

*Designs like FIBS or SBSB were widely regarded as unsafe and unsuitable for blind and vision-impaired people (four studies)*

- Floating Island Bus Stops and SBSB layouts were described as confusing, hazardous, and incompatible with independent travel (Guide Dogs & UCL 2024, RNIB 2025, RNIB Cymru 2025). Reports of collisions when crossing cycle paths, inconsistent or unprotected crossings, and incidents such as being knocked down or struggling to navigate safely with a guide dog reinforced perceptions of danger (RNIB 2025).

*Changes in travel behaviour and social participation linked to bus stop accessibility (two studies)*

- Difficulties accessing bus stops and navigating crossings led to substantial changes in travel behaviour. Many found it harder to reach bus stops, stopped using certain stops, changed routes, made fewer journeys, or stopped going out altogether (RNIB 2025). Some also avoided meeting friends around these locations (RNIB Cymru 2025).

*FIBS and SBSB were deemed unsafe and required substantial redesign or removal (three studies)*

- There was strong agreement that FIBS and SBSB were fundamentally unsafe and should not continue in their existing form (Guide Dogs & UCL 2024, RNIB 2025, RNIB Cymru 2025).

*Accessibility and navigational challenges at shared platform boarder arrangements (one study)*

- Visually impaired people experienced uncertainty and difficulty navigating shared platform border arrangements due to ambiguous tactile paving, unclear cycle lane crossings, and the absence of kerbs distinguishing cycle tracks from pavements. Zebra crossings were also perceived as unsafe, with confusion around right of way and a preference for zebra or light-controlled crossings (Weetman et al. 2024).

*Physical and social barriers (one study)*

- Small bus stop islands created physical strain and social stress when navigating crowded areas. Poor bus alignment with kerbs also hindered smooth ramp deployment, affecting wheelchair access (Weetman et al. 2024).

*Accessibility benefits of kerb-free designs at bus stop bypasses (one study)*

- Kerb-free layouts at bus stop bypasses were viewed positively for improving independence and confidence in movement (Weetman et al. 2024).

### 2.2.2 Bottom line results for impact of changes to pedestrian infrastructure

The impact of **pedestrian infrastructure on accessibility for disabled people** was explored across six included sources, comprising three UK-based studies, two international reviews, and one predominantly UK-focused review. Two sources focused on **pavements and surfaces**, including tactile paving (Kapsalis et al. 2024; Seetharaman et al. 2024); two on **kerbs and dropped kerbs** (Kapsalis et al. 2024; Seetharaman et al. 2024); one on wayfinding (Day 2004); two on **continuous footways** (Guide Dogs and UCL 2024; Weetman et al. 2023); and one on **segregated cycle–footways** with different delineators (Guide Dogs and UCL 2024). Study designs included qualitative (Weetman et al. 2023; Weetman et al. 2024), mixed methods (Guide Dogs and UCL 2024), scoping review (Seetharaman et al. 2024); systematic review (Kapsalis et al. 2024) and narrative review approaches (Day 2004).

*Impacts of pavement and surface design on navigation and perceived safety* (two reviews)

- Poor surface conditions, such as cracks, bumps, unevenness, potholes, undulation and slipperiness impaired depth perception and orientation for people with visual impairments, increasing the risk of trips, falls and injury. For mobility aid users, narrow or rough pathways, sloped surfaces and poorly designed dropped kerbs frequently were perceived to pose risks of tipping over and instability.

- Tactile paving supported navigation for visually impaired users by providing directional cues but caused fatigue and instability for mobility aid users due to their uneven surfaces, revealing a tension of accessibility needs (Kapsalis et al. 2024; Seetharaman et al. 2024).

*Impact of pavements and surface design on wellbeing and independence* (one review)

- Inaccessible and insecure pathways undermined independent navigation and contributed to psychosocial distress among mobility aid users, leading to fatigue, physical pain, reduced self-esteem, social withdrawal, and loss of contact with nature (Kapsalis et al. 2024).

*Kerb and level changes that created perceived safety risks* (one review)

- Poorly designed, missing or improperly aligned dropped kerbs and kerb ramps were perceived to create a risk of tipping over, to increase the risk of trips and falls, and also generated concerns about being struck by traffic. Sloped surfaces further contributed to physical strain and injury risks, particularly for mobility aid users (Kapsalis et al. 2024)

*Kerb and level changes that reduced confidence* (two reviews)

- For people with visual impairments, uneven or poorly marked level changes, such as sloped kerbs, ramps, stairs or displaced slabs, were difficult to detect and often perceived as unsafe. These features undermined confidence in navigation and led some people with mobility or vision impairments who are walking or wheeling to avoid certain areas altogether (Kapsalis et al. 2024, Seetharaman et al. 2024).

*Accessibility and safety concerns relating to continuous footways and related infrastructure* (one study)

- Kerb removal in continuous pathways improved safety and confidence for some wheelchair users by enabling smoother movement across surfaces. However, other related infrastructure concerns were reported such as tipping hazards caused by angled slopes and blister-style tactile paving (Weetman et al. 2023).

*Reduced confidence and navigational challenges impacted by continuous footways* (two studies)

- Unclear or inconsistent tactile paving layouts undermined confidence and sometimes led people with visual impairments towards the carriageway. The absence of tactile paving made crossing points difficult to locate, while infrastructure was perceived to prioritise people cycling over people walking and wheeling. Individuals with multiple impairments struggled to detect pavement edges, often staying close to building lines to maintain safety and stability (Weetman et al. 2023; Guide Dogs & UCL 2024).

*Wayfinding difficulties and reduced independent travel among neurodivergent people (one review)*

- Wayfinding difficulties limited independent travel for neurodivergent people, leading to journey avoidance or increased reliance on taxis (Day 2024).

*Varying effects of different types of delineators at segregated cycle-footways (one study)*

- Continuous raised trapezoidal delineators were rated as the most effective, while painted line and kerb delineators performed worst, with gaps in the delineator further reducing detectability and confidence (Guide Dogs & UCL 2024).

### 2.2.3 Bottom line result for impact of streetscape modifications

The impact of **streetscape modifications on accessibility for disabled people** was explored in one scoping review conducted across North America, Europe, Australia, and

New Zealand (Seetharaman et al. 2024) and one qualitative descriptive study from the UK (Brown & Northgate 2019), while the impact of LTNs was examined in one qualitative study within the UK (Transport for All 2021).

*Contradictory impacts of Low Traffic Neighbourhoods (one study)*

- Disabled people's experiences of LTNs was mixed. Some reported reduced independence, increased stress and negative emotions, while others described greater confidence, improved mobility and enhanced wellbeing. Perceptions of safety also varied, with concerns about unsafe driving and cycling contrasted by feelings of security linked to quieter streets with reduced traffic (Transport for All.2021).

*Positive accessibility outcomes and perceived benefits of Low Traffic Neighbourhoods (one study)*

- Wheelchair users, people who cycle with adapted bikes, and neurodivergent or visually impaired people reported benefits from calmer streets and reduced noise, which contributed to a more accessible and less overwhelming environment (Transport for All 2021).

Absence of tactile and kinaesthetic cues and resulting disorientation in shared spaces (one review and one study)

- In shared space designs, the absence of tactile and kinaesthetic cues, such as kerbs and clear demarcations, made it difficult for People with visual impairments who are walking, especially those with canes to distinguish between pedestrian zones and roads, leading to unsafe and disorientating situations (Seetharaman et al. 2024; Brown & Norgate, 2019). Obstructive street furniture further increased disorientation and safety concerns by pushing cane users towards traffic and reducing independence.

### 2.2.4 Bottom line results for impact of changes to cycle track infrastructure

The impact of changes in cycle track infrastructure on accessibility for disabled people was explored in one UK-based study (Sustrans 2024). This mixed methods study examined a shared-use path and its effects on access and use among disabled people.

*Improved access after barrier removal enabling more frequent travel (one study)*

- Barrier removal on shared-use paths increased accessibility for users with mobility aids and non-standard cycles, allowing more frequent travel for commuting and everyday journeys (Sustrans 2024).

## 2.3 Barriers and facilitators experienced in response to changes in active travel infrastructure

This section provides narrative summaries of the included studies (n=7) and reviews (n=4) reporting barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure. Details of the findings extracted from each included study and reviews are provided in Table 9 and Table 10, respectively

In addition to the impacts outlined in section 2.2, Brown & Norgate (2019) examined experiences of a **shared space scheme.** Flat surfaces made it difficult for participants to detect boundaries. The most common difficulties related to identifying informal crossing (14 mentions) and distinguishing between the road area and the pedestrian route (12 mentions). Every participant noted challenges in recognising where the walking space-ended and vehicle space began. When describing the informal crossing, participants emphasised the importance of having clear signals or tactile markers to indicate a safe place to cross. Objects such as bins, signs, tables and planters were often described **as obstacles** that forced participants towards traffic. However, one participant found large fixtures like lampposts useful as orientation points.

The Guide Dogs & UCL (2024) mixed methods study also gathered disabled people's experiences of different **bus stop layouts and crossing designs** in addition to the impacts outlined in section 2.2**.** Participants identified a range of barriers across the focus groups and site visits. At **FIBS,** difficulties included narrow islands, locating crossings, inconsistent design of tactile paving, speed of people who cycle, environmental noise, confusing layouts, and lack of clear signage or bus stop facilities. **Shared Bus Stop Boarders** were described as even more problematic, with concerns about alighting directly into cycle lanes, guide dog users' safety, problems for carers assisting wheelchair users, poor delineation, and dangers from two-way cycle lanes. **Continuous footways** presented difficulties due to lack of tactile paving, undetectable transitions, and limited visual cues, while surface contrast and markings were seen as potentially helpful. **Segregated cycle–footways** posed challenges where guide dogs did not recognise boundaries, tactile cues were insufficient without repetition, and blind or visually disabled participants struggled to distinguish between pedestrian and cycle space. **Facilitators were limited** but some features were identified as helpful for people with visual impairments (Guide Dogs & UCL 2024). **Tactile paving** improved orientation and supported the detection of crossing points, particularly at continuous footways. Differences in **surface materials**, such as asphalt compared with concrete, provided useful contrast. Visual markings, repeat cues and colour contrast along **cycle–footways** offered some assistance in maintaining orientation. **Bus stop** announcements were seen as helpful when alighting into cycle lanes, while consistent placement of shelters, flags and tactile paving was considered important for building confidence. A few participants also observed that **FIBS** worked more effectively in other countries where there was sufficient space to accommodate both people cycling and people walking and wheeling. The experimental findings reinforced participant concerns (Guide Dogs & UCL 2024), with many, particularly people who are blind or with visual impairments who are walking failing to detect people cycling until it was too late. Differences in the speeds of people who cycle heightened feelings of being unsafe, and physiological data confirmed the elevated stress levels. **Shared Bus Stop Borders** were perceived as more stressful and unsafe than FIBS. Among the **delineators** tested, continuous raised trapezoidal delineators were most effective, while painted lines, kerbs and delineators with gaps performed poorly as they reduced detectability and confidence. For **continuous footways,** those with tactile paving improved detection for people with visual impairments but concerns remained about unclear priority and unpredictable vehicle behaviour.

Ormerod et al. (2015) conducted qualitative interviews across eight road **crossing sites** in Edinburgh, UK, each featuring blister tactile paving compliant with regulations, to explore how older people, particularly those with mobility and vision impairments, perceive and navigate tactile paving. The types of road crossing at the sites included pelican crossings, signalised junctions, and uncontrolled crossings. The participants included eight older adults with mobility impairments and 30 with moderate to severe visual impairments. For those with mobility impairments, tactile paving created significant challenges. Wheelchair users described discomfort from feeling every bump of the blisters, while self-propelling users were somewhat more tolerant but still identified difficulties. The lack of **dropped kerbs** was also a notable barrier. Participants with visual impairments described six recurring issues. Variation in the types of **tactile paving** caused confusion about appropriate behaviours at crossings. Colour coding (red for controlled crossings, buff for uncontrolled) was often misunderstood, while tonal contrast between tactile paving and surrounding surfaces was inadequate, particularly in poor lighting or strong sunlight. Non-cane users found it difficult to detect blister paving, limiting its usefulness for wayfinding. Many therefore relied more heavily on other cues such as environmental sounds, beeps from crossings, or guidance from canes, guide dogs, and companions. Finally, participants suggested that local authorities should invest more in improving the overall quality of footways to prevent slips, trips, and falls from uneven surfaces, rather than focusing solely on tactile paving.

A descriptive **survey** was conducted at Faro International Airport with older adult tourists, including those with motor or visual impairments, arriving from various European countries to explore their perspectives on **accessibility features at bus stops** (Rosa et al. 2025). Participants' responses were based on their own knowledge and experiences of bus stops in their countries of origin rather than use of the Faro airport bus stop itself. The survey formed part of a wider design process for an age-friendly accessible bus stop at Faro airport, which also drew on co-design workshops, and expert consultations; however, it was unclear whether the bus stop was implemented. The survey highlighted a range of accessibility features at bus stops that function as either barriers when absent or facilitators when provided. Among respondents with mobility impairments, the most important facilitators identified included seating areas within shelters (72.4%), non-slip waiting platforms (65.0%), level boarding platforms (63.6%), well-lit shelters (62.6%), ramps with suitable inclines (59.3%), elevated bus stops (50.9%), sufficient space for wheelchair manoeuvrability on waiting platforms (50.0%), tactile warning strips on waiting platforms (50.0%), tactile pavement in the boarding area (48.6%), and boarding area pavement with a contrasting colour (47.2%).

The qualitative descriptive component of the EU-funded TRIPS (Transport Innovation for disabled People needs Satisfaction) project explored disabled people's needs, barriers, and preferences related to mobility (Alciauskaite et al. 2020) and their experiences of moving around cities on foot or wheels (Hatzakis et al. 2024). Data were collected through online or telephone interviews (June–September 2020) with 41 participants with physical, visual, and hearing impairments across six European cities (Brussels, Sofia, Zagreb, Lisbon, Cagliari, and Stockholm). Results showed that **adapted bus stops** had often been constructed higher than pavements, preventing level access. Wheelchair users in Cagliari reported needing to cross the street and remain in the roadway to board buses. Similar issues were also noticed in Brussels, where a wheelchair user described inconsistencies in bus stop heights and discrepancies in pavement design, noting differences even between **pavements** directly opposite one another. A separate participant with visual impairment in Brussels reported that incorrect **tactile paving slabs** had been installed during reconstruction, making pedestrian crossings undetectable with a white cane.

Transport for All (2021) in their qualitative study reported a number of barriers in addition to the impacts outlined in section 2.2. Participants identified a wide range of barriers to walking, wheeling, and navigating **LTNs.** These included pavements cluttered by obstacles (e.g. bins, A-boards, bikes, e-scooters), uneven or steep surfaces, lack of dropped kerbs, and insufficient places to rest such as alcoves or benches. Hazards such as integrated cycle lanes, unmarked changes in pavement height, and poorly contrasted tactile paving posed risks to those with mobility or visual impairments. Confusing street layouts, poor signage, and excess street furniture were reported as distressing and overwhelming, especially for neurodivergent people. Road crossings often lacked appropriate tactile paving, kerbs, and obstruction-free layouts, contributing further barriers. Communication and consultation emerged as a significant concern. A large majority (72%) of participants reported issues with how changes had been communicated, including the lack of information provided, poor quality or inaccessible formats, and not receiving any prior warning before an LTN was installed.

Following the discussion on the impact of **continuous footways** presented in section 2.2, Weetman et al. (2023) also identified a number of barriers and one facilitator related to infrastructure and active travel. Tactile paving at continuous footways was often reported as a barrier. While tactile paving was installed to provide a warning for kerb-free transition in continuous footways, it was also found to suggest unsafe crossing directions to people with visual impairments in certain layouts, particularly when blister-style tactile paving was used. Alternative layouts of tactile paving used in continuous footways that differed from standard approaches was also seen confusing, especially when it was laid in large areas or in places with multiple adjoining sections. Additionally, people with balance issues and pain reported difficulties crossing tactile paving, especially at dropped kerbs. The removal of kerbs also introduced barriers. Vehicles parked in areas intended for footways obstructed guide dog users and blocked safe movement between carriageway and footway. Dropped kerbs created orientation difficulties for people with visual impairments when slopes were not aligned with the intended path of travel. For those with partial sight, continuous footways and other kerb-free junctions were inaccessible due to the absence of colour contrast, particularly in complex environments or poor light. However, the removal of kerbs was reported as a facilitator for wheelchair users, who described feeling safer and more confident when crossing streets without a raised edge.

Addressing **bus stop bypasses** and related infrastructure, Weetman et al. (2024) identified a number of barriers and a small number of facilitators, in addition to the impacts discussed in section 2.2. For people with visual impairments, the removal of kerbs between pavement and cycle tracks at bus stops created barriers by making it difficult to distinguish between the two, leading to feelings of being unsafe and uncertainty about being in the correct position to access the bus. The lack of colour and tone contrast across pavement, cycle tracks and carriageways were also highlighted as barriers These issues were worse in wet and dark conditions, although lighting after dark could improve visibility. Inadequate lighting, such as overly bright low-level lighting, could also reduce clarity and cause dazzle. The use of tactile paving created further barriers, particularly when slabs similar to those used at controlled crossings were used to indicate bus stops. This led to confusions about whether people with visual impairments were at side roads, main roads or at the bus stop. People with visual disabilities also reported issues with zebra crossings at bus bypasses as these markings were seen as less obvious than those at controlled crossings on wider roads with some not recognising the white lines as zebra crossings. This caused confusion around rights of way and whether people cycling would stop. Although barriers dominated, Weetman et al. (2024) also noted some facilitators. Bus announcements highlighting that passengers would be crossing a cycle path after alighting were seen as helpful. Wheelchair users described the lack of kerbs at bus stops as safer and improving accessibility.

In addition to the impacts outlined in section 2.2, the narrative review (Day 2024) reported that inconsistent and unpredictable street design, including varied crossing layouts and cycling infrastructure, exacerbated wayfinding difficulties for neurodivergent people, as each design required a different approach to navigation. Physical barriers included poorly maintained and uneven pavements, pavement parking, street clutter such as bins, recycling boxes and café seating, lack of dropped kerbs, narrow pavements, cycle infrastructure unsuitable for adapted bikes. The introduction of new active travel infrastructure, particularly the *Spaces for People* and other temporary projects during the Covid-19 pandemic, increased unpredictability and variance in infrastructure design for neurodivergent people. In addition, the variety, inconsistency, and lack of warning about **LTNs** were reported as especially difficult to cope with when making travel decisions.

The scoping review by Seetharaman et al. (2024), together with the impacts outlined in section 2.2, identified several barriers, including poor or inconsistent lighting, complex intersection layouts, and inadequate pedestrian signals, all of which reduced visibility and compromised crossing safety for people with visual impairments. Roundabouts were noted to reduce sightlines making crossings more difficult and unsafe. Tactile cues were sometimes ineffective due to slipperiness when wet, poor textural contrast and bumps causing white canes to get stuck, while well-placed, high contrast tactile surfaces were identified as facilitators. The review highlighted a number of facilitators for people with visual impairments including sufficient textural or tactile contrast between surfaces, which improved detectability, and visual contrast for partially sighted people, though this was reduced by poor lighting. The review also highlighted the importance of placement, with tactile paving on kerb ramps needing to be aligned with crossings to guide safe and direct travel.

The systematic review by Georgescu et al. (2024) examined internal and external factors influencing spatial accessibility in urban areas. Covering studies published between 2012 and 2022, it included 20 studies that explored barriers and facilitators of street elements affecting spatial accessibility and active mobility. Barriers to accessibility were frequently associated with pavements and surfaces. A lack of visual contrast between pavement and street created challenges for people with visual impairments, while cobblestones, uneven pavers, drain grates, and sidewalk gaps posed difficulties for those with mobility impairments and users of wheeled or walking assistive devices. Hard or soft surface textures further hindered access for wheelchair and scooter users, people with visual impairments and those with situational mobility restrictions. Tactile paving, although designed to aid orientation, was sometimes reported as a barrier for wheelchair and scooter users. Kerbs were seen to present conflicting accessibility challenges for different user groups. For wheelchair users, kerbs were often barriers when they were too high, narrow, steep, or lacked adequate landing space, making navigation difficult. In contrast, individuals with visual impairments preferred higher kerbs, as they provided a clear tactile signal marking the end of the pavement, whereas lowered kerbs were perceived as less helpful for orientation. At pedestrian crossings, barriers included the absence or malfunctioning of visual, audio, and accessible pedestrian signals, as well as poorly positioned push buttons that were inaccessible to wheelchair users. Facilitators were also identified and pavement and surface features, such as gaps, variations in texture, and tactile paving supported mobility for people with visual impairments. High kerbs were also preferred as navigation aids, as they clearly indicated the end of the pavement.

Several barriers were identified in the systematic review by Kapsalis et al. (2024), together with the impacts outlined in section 2.2. Pathway characteristics such as narrow, rough, uneven, or sloped pavements, as well as improper dropped kerbs, were consistently identified as major obstacles restricting outdoor MobAD accessibility. Uneven surfaces created by tactile guides running perpendicular to the direction of travel were reported to disrupt smooth mobility, creating barriers for a wide range of MobAD users.

### 2.3.1 Bottom line results for barriers related to bus stop designs

Disabled people reported numerous barriers related to **bus stop designs on accessibility** in three UK-based and one European study. The bus stop designs included **accessible/adapted bus stops** (Alciauskaite et al. 2020, Hatzakis et al. 2024), **FIBS** (Guide Dogs & UCL 2024, Weetman et al. 2024), **kerbside track arrangements and shared platform boarder arrangements** (Weetman et al. 2024), and **SBSB** (RNIB Cymru 2025). Study designs included mixed methods (Guide Dogs & UCL 2024), qualitative descriptive approaches (Alciauskaite et al. 2020, Hatzakis et al. 2024, Weetman et al. 2024) and a quantitative descriptive study (RNIB Cymru 2025).

*Bus stop height inconsistencies and access barriers (one study)*

- Height differences between pavements and bus stops prevented level boarding and, in some cases, required wheelchair users to cross or wait in the roadway to board. Inconsistent stop heights across locations highlighted a lack of uniform accessibility standards (Alciauskaite et al. 2020, Hatzakis et al. 2024).

*Navigational and spatial limitations of FIBS and SBSB (two studies)*

- Floating Island Bus Stops were frequently reported as too narrow, and locating the crossing point when exiting FIBS and SBSB was difficult, particularly for visually impaired users, as tactile paving identical to that used for controlled crossings caused confusion about whether to walk to the bus stop, cross a side road, or cross the main road (Guide Dogs & UCL 2024, Weetman et al. 2024).

*Sensory and environmental barriers at FIBS and SBSB (two studies)*

- Environmental noise made it difficult to detect approaching bicycles and inadequate lighting, including overly bright or low-level illumination, further reduced clarity and caused dazzle for people with visual impairments (Guide Dogs & UCL 2024, Weetman et al. 2024).

*Insufficient visual and tactile contrast at FIBS and SBSB (two studies)*

- Poor delineation between the footway and cycle lane, combined with inconsistent tactile paving design and limited colour or tonal contrast across pavements, cycle tracks, and carriageways, created uncertainty and reduced detectability for people with visual impairments (Guide Dogs & UCL 2024, Weetman et al.2024).

*Issues with cycle lane integration at FIBS and SBSB (three studies)*

- Issues with cycle lane integration at FIBS and SBSB included passengers disembarking directly into cycle lanes, people cycling weaving through waiting areas, confusing layouts, lack of give-way signage, and uncertainty about right of way (Guide Dogs & UCL 2024, Weetman et al. 2024, RNIB Cymru, 2025).

*Uncertainty around zebra crossings at cycle tracks (one study)*

- Zebra crossings at cycle tracks were less recognisable to users than those on wider carriageways, and participants were often uncertain about right of way or whether people cycling would stop, leading to confusion and hesitation when crossing (Weetman et al. 2024).

*Uncertainty around zebra crossings at cycle tracks (one study)*

- Zebra crossings at cycle tracks were less recognisable than those on wider carriageways and created uncertainty about right of way and whether people cycling would stop, leading to confusion and hesitation when crossing (Weetman et al. 2024).

### 2.3.2 Bottom line results for facilitators related to bus stop designs:

Disabled people reported facilitators that could help make **bus stop designs** more accessible in three studies, two from the UK and one conducted in Portugal. The bus stop designs included **FIBS** (Guide Dogs & UCL 2024, Weetman et al. 2024), **SBSB** (Guide Dogs & UCL 2024, Weetman et al. 2024), and **accessible/adapted bus stops** (Rosa et al. 2025). Study designs included mixed methods (Guide Dogs & UCL 2024) and qualitative descriptive approaches (Rosa et al. 2025, Weetman et al. 2024).

*Potential pedestrian infrastructure improvements to enhance perceived safety and accessibility in FIBS (two studies)*

- Disabled people identified several design features that could improve the safety and accessibility of FIBS. These included kerb-free street layouts that benefited wheelchair users, sufficient space to accommodate both people cycling and people walking and wheeling, and the consistent placement of tactile paving to support navigation for people with visual impairments (Guide Dogs & UCL 2024, Weetman et al. 2024).

*Audio announcements as a potential enhancement to perceived safety at SBSB (two studies)*

- Disabled people suggested that audio announcements reminding passengers they will be crossing a cycle lane when alighting could help them feel safer. (Guide Dogs & UCL 2024, Weetman et al. 2024).

*Accessible and adapted bus stop design features (one study)*

- People with mobility impairments reported that accessible/adapted bus stops should have well-lit shelters with a seating area. Surfaces on the platform should be non-slip and equipped with appropriate tactile warning strips, while tactile pavement and contrasting colours could be used on the boarding area. Bus stops should be elevated and have level boarding platforms with sufficient space for wheelchair manoeuvrability and ramps that have suitable inclines (Rosa et al. 2025).

### 2.3.3 Bottom line results for barriers related to pedestrian infrastructure

The barriers to **pedestrian infrastructure on accessibility for disabled and neurodivergent people** were explored across five included sources, comprising one UK-based study, one European study, two international reviews, and one predominantly UK-focused review. Five sources focused on **pavements and surfaces** including tactile paving (Alciauskaite et al. 2020, Hatzakis et al. 2024, Day 2024, Georgescu et al. 2024, Kapsalis et al. 2024, Ormerod et al. 2015), four on **kerbs and dropped kerbs** (Day 2024, Georgescu et al. 2024, Kapsalis et al. 2024, Ormerod et al. 2015), three on **crossings** (Georgescu et al. 2024), two on **continuous footways** (Guide Dogs & UCL 2024; Weetman et al. 2023), one on **segregated cycle footways** (Guide Dogs & UCL. 2024) and one on **wayfinding** (Day 2004). Study designs included mixed methods (Guide Dogs & UCL 2024) and qualitative descriptive approaches (Alciauskaite et al. 2020, Hatzakis et al. 2024, Ormerod et al. 2015, Weetman et al. 2023).

*Pavement design and surface characteristics as barriers to accessibility (four studies)*

- Narrow, rough, uneven, or sloped pavements were identified as major obstacles that restricted outdoor accessibility for people with disabilities who are walking and wheeling and neurodivergent people (Day 2024, Kapsalis et al. 2024). Cobblestones, hard or soft surfaces, pavement gaps, and drain grates created barriers for wheelchair users, scooter users, walking assistive device users, visually impaired individuals, and those with situational mobility restrictions (Georgescu et al. 2024). Discrepancies in pavement design, even between opposite pavements in the same location, also created barriers (Alciauskaite et al. 2020, Hatzakis et al. 2024).

*Physical obstructions on pavements for created barriers for navigation for neurodivergent people (one review)*

- Bins, café seating, and recycling boxes created barriers to navigation for neurodivergent people (Day 2024).

*Vehicles parked on pavements created barriers for navigation and movement (one review and one study)*

- Vehicles parked on pavements created barriers to navigation for neurodivergent people (Day 2024) and blocked movement for guide dog users (Weetman et al. 2023).

*Insufficient visual contrast and lighting in tactile paving and surface design (one study and one review)*

- A lack of visual contrast between pavement and street surfaces, inadequate tonal differences in tactile paving under varying light conditions, and inconsistent use of colour coding (red for controlled crossings and buff for uncontrolled) reduced detectability and clarity for people with mobility or visual impairments (Georgescu et al. 2024; Ormerod et al. 2015)

*Tactile paving as a barrier and navigational challenge (two studies and two reviews)*

- Tactile paving, including blister and other types, was reported as a barrier for wheelchair and scooter users (Kapsalis et al. 2024; Georgescu et al. 2024; Ormerod et al. 2015). Those who were not cane users found blister paving difficult to detect (Ormerod et al. 2015), while incorrect installation of tactile paving slabs made crossings undetectable for white cane users, creating significant navigational barriers (Alciauskaite et al. 2020; Hatzakis et al. 2024).

*Tactile paving at crossings was often ineffective for wayfinding (two studies)*

- Tactile paving at crossings was often ineffective for wayfinding. Those who were not cane users found it difficult to detect blister paving, limiting the ability to identify safe crossing points (Ormerod et al. 2015). In some locations, incorrect installation of tactile paving slabs during construction made crossings undetectable with a white cane, creating significant navigational barriers for people with visual impairments (Alciauskaite et al. 2020; Hatzakis et al. 2024).

*Kerb design and dropped kerb provision as barriers for wheelchair, mobility aid users, and neurodivergent people (one study and three reviews)*

- High, steep, narrow, or poorly designed kerbs and dropped kerbs, along with the absence of dropped kerbs and inadequate landing space, created access barriers for wheelchair users, mobility aid users, and neurodivergent people (Georgescu et al. 2024, Ormerod et al. 2015, Kapsalis et al. 2024, Day 2024).

*Barriers related to kerb removal, tactile paving, and obstructions at continuous footways and related infrastructures (two studies)*

- The absence of detectable kerbs, visual indicators, and consistent tactile paving at continuous footways and related infrastructure made navigation difficult for blind and partially sighted people who are walking, who often struggled to feel blister paving orientation or rely on colour contrast for safe alignment (Guide Dogs & UCL 2024; Weetman et al. 2023).

*Signal accessibility, functionality, and push button placement at crossings (one review)*

- The absence or malfunction of visual, audio, and accessible pedestrian signals, along with push buttons placed too high or too low, created barriers for wheelchair users and people with visual impairments (Georgescu et al. 2024).

*Lack of clear shared use path segregation (one study)*

- Guide dogs do not recognise boundaries between pedestrian and cycle zones and people who are blind or partially sighted who are walking struggled to identify or remember which side was designated for walking without continuous tactile or visual indicators (Guide Dogs & UCL. 2024).

*Wayfinding challenges linked to variations in street and crossing design for neurodivergent people (one review)*

- Variations in street layouts, crossing designs, and cycling infrastructure exacerbated wayfinding difficulties for neurodivergent people, as each design required different knowledge of rules and navigation (Day 2024).

### 2.3.4 Bottom line results for facilitators related to pedestrian infrastructure:

Disabled people reported facilitators that could help make **pedestrian infrastructure** more accessible in two UK-based studies and two systematic reviews. The pedestrian infrastructure included **continuous footways** (Guide Dogs & UCL 2024, Weetman et al. 2023), **pavements and surfaces** (Georgescu et al. 2024, Seetharaman et al. 2024), **kerbs and dropped kerbs** (Georgescu et al. 2024), and **segregated cycle-footways** (Guide Dogs & UCL 2024). Study designs included mixed methods (Guide Dogs & UCL 2024), and qualitative descriptive approaches (Weetman et al. 2023).

*Pedestrian infrastructure improvements to enhance the perceived safety of continuous footways (two studies)*

- Design features that could improve the perceived safety of continuous footways included kerb removal to support wheelchair users, and increased tactile paving, markings and surface contrast through the use of different materials to aid people with visual impairments (Guide Dogs & UCL, 2024; Weetman et al. 2023).

*General pavement and surface designs to improve orientation and perceived safety for people with visual impairments (two reviews)*

- Design features identified to enhance orientation and perceived safety for people with visual impairments included sufficient textural or tactile contrast between surfaces (e.g. pavement gaps, tactile paving) placed precisely to support orientation and direction, particularly at dropped kerbs and crossings. Visual contrast was also beneficial, although its effectiveness could be reduced by poor lighting or adverse weather conditions (Georgescu et al. 2024; Seetharaman et al. 2024).

*Kerb height and orientation for people with visual impairment (one review)*

- People with visual disabilities preferred high kerbs for navigation and perceived lowered kerbs as barriers, as kerb height signals the end of the pavement (Georgescu et al. 2024).

*Tactile paving and orientation at segregated cycle–footways for people with visual disabilities (one study)*

- People with visual impairments highlighted the value of tactile paving at the start of segregated cycle–footways for orientation, noting that repeated tactile cues along the route would provide additional support (Guide Dogs & UCL 2024).

### 2.3.5 Bottom line results for barriers related to streetscape modifications

Disabled people reported numerous barriers in relation to **streetscape modifications** in two UK-based studies, a narrative review and a systematic review. The streetscape modifications included **shared spaces** (Brown & Norgate 2019, Seetharaman et al. 2024), and **LTNs** (Day 2024, Transport for All 2021). Study designs included qualitative case study (Brown & Norgate 2019) and descriptive approaches (Transport for All 2021).

*Insufficient tactile, visual, and signal cues in shared spaces (one study and one review)*

- A lack of signals, tactile paving and clear demarcation such as kerbs between pavements, roads and cycle paths created orientation challenges and **perceived safety concerns** for people with visual impairments (Brown & Norgate, 2019; Seetharaman et al. 2024).

*Pavement and surface-related barriers in Low Traffic Neighbourhoods (one study)*

- Cluttered pavements with obstacles such as bins, signs, and car charging points, as well as steep, uneven, or bumpy surfaces caused by tree roots or cobblestones, made navigation difficult for disabled and neurodivergent people in LTNs. The absence of dropped kerbs and missing high-contrast tactile paving between pavements, cycle lanes, and roads reduced accessibility and detectability, while the lack of seating for resting further limited usability (Transport for All 2021).

*Inconsistent layouts and crossing design barriers in Low Traffic Neighbourhoods (two studies)*

- Inconsistent LTN layouts, including one-way systems, poor signage, shared spaces, and excessive bollards, created confusion and made navigation difficult for disabled and neurodivergent people. Road crossings were also reported to need clutter-free layouts, consistent placement at regular junctions, and the inclusion of dropped kerbs and appropriate tactile paving to support accessibility (Day, 2024; Transport for All, 2021).

### 2.3.6 Bottom line results for facilitators related to streetscape modifications:

Disabled people reported facilitators that could help improve **streetscape modifications,** specifically, making shared spaces more accessible in one UK-based study (Brown & Norgate 2019). The study design was qualitative case study approach.

*Street furniture as orientation aid in shared spaces (one study)*

- Street furniture, such as lampposts, were reported to facilitate orientation in shared spaces (Brown & Norgate 2019).

### 2.3.7 Bottom line results for barriers related to cycle infrastructure

Disabled people identified barriers to **general cycle infrastructure** in one predominantly UK-focused review narrative review (Day 2024).

*Barriers in general cycle infrastructure (one review)*

- Disabled people reported that available cycle infrastructure did not accommodate adapted cycles (Day 2024).

# 3. DISCUSSION

## 3.1 Summary of the findings

This review sought to address the question: *What is the impact of changes in active travel infrastructure on accessibility for disabled people?* The evidence reviewed highlights that changes to active travel infrastructure have had diverse and often contradictory impacts on accessibility for disabled people, depending on the design features, implementation, and the specific needs of different disability groups. While some interventions were experienced as improving mobility and independence, others were reported to introduce new hazards, reduce confidence and lead to the avoidance of public spaces. Unpredictable or inconsistent infrastructure was perceived to reduce safety and confidence, particularly for people with visual impairments.

Bus stop designs, particularly FIBS, SBSB and shared platform arrangements, were consistently associated with reduced accessibility for disabled people. These designs often required people walking and wheeling to cross cycle lanes, navigate unclear layouts and rely on inconsistent tactile or visual cues, which undermined confidence and independence. It was perceived that people cycling were prioritised over people walking and wheeling. For blind and visually impaired people who are walking, the lack of detectable boundaries and the increased risk of collisions led to heightened anxiety and avoidance of bus stops altogether. While kerb-free and well-aligned designs offered some benefits for wheelchair users, most evidence indicated that these layouts were widely regarded as unsafe and incompatible with independent travel, prompting calls for substantial redesign or removal of such features.

Continuous footways and the surrounding infrastructure improved access for some wheelchair users but often lacked clear tactile delineation, leading to confusion and misdirection into carriageways. Obstructed crossings further undermined accessibility. Similarly, segregated cycle-footways that relied solely on visual cues were less detectable and reduced confidence, underscoring the need for multi-sensory design elements in infrastructure design.

Pedestrian infrastructure changes also revealed mixed impacts across disability groups. Pavement surfaces, with tactile paving supported orientation for visually impaired users but simultaneously created barriers for wheelchair and mobility aid users. Uneven or sloped pavements and inadequate kerb design were perceived to compromise both physical safety and psychosocial wellbeing, contributing to reduced independence and avoidance of outdoor environments. Poorly designed or missing kerb drops and ramps were perceived as introducing a risk of tipping over and increasing the risk of injury, particularly for mobility-aid and wheelchair users, while uneven level changes were difficult to detect and perceived as unsafe by people with visual impairments who are walking.

Streetscape modifications, including LTNs and shared spaces, produced contrasting accessibility outcomes. Low traffic neighbourhoods were praised by some disabled users, including wheelchair users, people cycling using adapted bikes and people with visual impairments who are walking, for creating quieter, calmer environments that enhanced confidence and independence. However, others reported increased stress due to unsafe driving behaviours, dangerous cycling, restricted access routes and unclear navigation that limited mobility. Shared space designs, which remove traditional boundaries between pedestrian and vehicle zones, were particularly problematic for visually impaired people due to the absence of tactile and kinaesthetic cues, leading to disorientation and avoidance of these areas.

In contrast, changes to cycle track infrastructure showed promising potential for improving accessibility. Removing physical barriers on shared-use paths increased independence and participation in everyday activities. These findings suggest that inclusive design interventions, such as widening paths and eliminating unnecessary obstructions, can promote equitable access and increase active travel among disabled users.

This review also explored the barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure. The evidence revealed that while some design features, such as kerb-free layouts, clear tactile paving and well-marked crossings, acted as facilitators that improved accessibility, perceived safety and confidence, other features introduced barriers. These included unclear or inconsistent layouts, unsafe interactions between people cycling and people walking and wheeling, and inadequate tactile or visual cues.

The findings highlight that infrastructure changes can affect disabled people in complex and sometimes contradictory ways. The same feature may facilitate accessibility for one group while creating barriers for another. Some barriers were consistent across groups, such as steep pavements, steps, and permanent obstacles, whereas others were impairment specific. For example, tactile paving was valued by people with visual impairments for navigation, but wheelchair users p**erceived there is a risk of tipping over**, while kerb removal enhanced mobility for wheelchair users but reduced orientation and perceived safety for those with visual impairments. Vehicles parked on pavements created barriers to navigation for neurodivergent people and blocked movement for guide dog users. Overall, barriers were reported far more frequently than facilitators, underscoring the importance of co-designing and testing infrastructure changes to ensure accessibility for all disability groups.

Across all infrastructure types, a recurring theme across this review was the lack of consistent, inclusive design standards and the need for greater involvement of disabled people in the planning and implementation. Designs that failed to account for diverse mobility needs often resulted in unintended barriers, reduced confidence, and exclusion from active travel routes. Conversely, interventions that prioritised multisensory cues, accessible layouts and wayfinding support were more likely to enhance accessibility.

## 3.2 Strengths and limitations of the available evidence

The majority of included primary research evidence was identified from the grey literature. While these studies offered valuable insights, many lacked methodological detail, which affects the overall quality and raises concerns about the reliability of the conclusions drawn. Strengths included clearly stated aims and contextual detail in several studies, particularly regarding research locations, types of infrastructure evaluated, and the disabilities of participants. In most cases, conclusions and recommendations were supported by the reported data. However, limitations were widespread across many studies. Many qualitative studies lacked transparency about their guiding philosophy and the researcher's role, both of which are crucial to the interpretation of findings. Mixed-methods studies often failed to justify their methodological choices, omitting theoretical frameworks, and providing minimal detail on recruitment, data collection tools and analysis. This lack of clarity reduces the reliability and reproducibility of the findings. Systematic and scoping reviews were generally well-focused but suffered from incomplete search strategies and limited reporting on quality appraisal. These gaps in methodological rigour of the included studies reduce the overall strength and trustworthiness of the evidence base. Furthermore, while several studies referenced neurodivergent participants, most did not specify the type of neurodivergence involved, with only one study providing further detail.

As noted by Seetharaman et al. (2024), there is a lack of research addressing intersectional factors, such as the sociodemographic characteristics of people with disabilities, including gender, ethnicity, and socioeconomic status, and how these influence experiences of the built environment. No evidence was identified in this review on how the built environment is experienced differently according to these characteristics. This information was rarely collected as demographic data.

## 3.3 Strengths and limitations of this Rapid Review

The scope of this rapid review was limited to the impact of changes in active travel infrastructure on accessibility for disabled people, and barriers and facilitators experienced in response to these changes. Research focusing on general barriers related to active travel were not included in this report. Additionally, this rapid review focused on change in real life and everyday settings, thus studies solely focusing on research conducted in laboratory settings or using temporary experimental infrastructure were not included. The review included studies on wayfinding in relation to active travel, defined as the process by which people identify and navigate a route through the physical environment using cues such as signage, landmarks, auditory or tactile signals, maps and digital aids (Fang et al. 2015). However, studies focused solely on mobile phone–based applications, without relevance to active travel infrastructure, were excluded.

A strength of this review is that a comprehensive search strategy across multiple bibliographic databases and an exhaustive list of grey literature sources was developed to ensure relevant research were identified. Additionally, a thorough analysis of the quality and content of included studies and reports ensured that findings relevant to the research question were presented and adequately interpreted. The review focused exclusively on studies conducted in OECD countries, reflecting the intended scope of the work.

A limitation of this rapid review is that study selection based on titles and abstracts was performed by one reviewer and only 20% of records were checked by an independent second reviewer, thus it is possible that some studies may have been missed.

Some deviations from the original protocol were necessary because of the time constraints of the rapid review process. Firstly, although the protocol proposed a convergent segregated approach to synthesis, it was not feasible to undertake parallel qualitative and quantitative synthesis within the available timeframe. Instead, each included study was summarised narratively, and overarching bottom-line thematic summaries were developed by type of infrastructure. Secondly, while the review originally planned to include and evaluate only primary research studies, relevant secondary evidence in the form of systematic, scoping and narrative reviews was identified during screening that addressed the research questions on pedestrian and cycling infrastructure and streetscape modifications. The protocol proposed that reviewers screen the reference lists of these reviews, but the volume of potentially relevant primary studies made this impractical. Consequently, the decision was taken to include the reviews themselves. Finally, quality appraisal processes were adjusted to reflect the types of evidence included. The protocol specified the use of design-specific JBI tools, but these were found to lack nuance for certain study types, such as mixed-methods grey literature reports. For these studies, an alternative tool, the QuADS, was used. In addition, a formal assessment of the strength of the body of evidence, as originally planned, was not conducted to ensure the review could be completed within the required timeframe.

## 3.4 Implications for policy and practice

- The findings of this rapid review indicate that meeting conflicting accessibility needs (or access friction) of different groups of disabled people can be challenging when planning and implementing change in active travel infrastructure. For example, some tactile paving layouts aid people with visual impairments but hinder mobility aid and wheelchair users who perceive there is a risk of tipping over.
- Decision makers, highways authorities and street design practitioners will need to carefully balance accessibility needs when planning new infrastructure to ensure usability for all disabled people.
- Disabled people often reported cycling infrastructure being prioritised over their needs in designs such as shared spaces and floating island bus stops. Disabled people reported safety concerns and feelings of exclusion with regards to these infrastructures. Thus, it is important to ensure that designs aiming to increase safe cycling also support disabled people to feel secure when walking or wheeling.
- Inconsistent infrastructure designs across different spaces and regions can create confusion among disabled people and lead to them feeling unsafe or potentially being directed to harm's way. Therefore, a standardised use of active travel infrastructure designs across different regions and local authorities may be necessary.

## 3.5 Implications for future research

- The quality of the included literature was limited, with many studies lacking methodological detail, resulting in a general lack of high-quality evidence and highlighting the need for more robust and inclusive research to inform equitable infrastructure design.
- Sociodemographic data, such as gender, ethnicity, and socioeconomic status, were rarely reported in the included studies. Therefore, it is not possible to examine intersectionality, it is therefore unclear whether disabled people experience active travel infrastructure differently according to their sociodemographic differences. Future studies should make sure to collect and report sociodemographic data and examine whether these characteristics influence disabled people's experiences.
- There was a lack of studies including participants with learning disabilities. Future studies evaluating new active travel infrastructure may need to ensure inclusion of a wide range of disabilities.

## 4. ECONOMIC CONSIDERATIONS

*This section has been completed by the Centre for Health Economics & Medicines Evaluation (CHEME), Bangor University*

- Active travel infrastructure considerate of the needs of people living with a disability can generate positive economic impacts through improved access to goods and services. These economic impacts are sometimes called the ‘Purple Pound’. Local retail expenditure increases by as much as 30% through improvements in active travel infrastructure (Living Streets 2018).
- Transport providers may be losing out on as much as £58* million per month through lack of accessibility (Purple 2015).
- At the UK level, 52% of disabled people have reduced their essential travel because of the cost-of-living crisis, further evidencing the need for appropriate active travel infrastructure to support them (Sustrans 2023).

*Inflated to October 2025 prices using Bank of England inflation calculator https://www.bankofengland.co.uk/monetary-policy/inflation/inflation-calculator

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# 6. RAPID REVIEW METHODS

## 6.1 Eligibility criteria

The eligibility criteria for this rapid review was developed using the SPICE framework (Setting, Perspective, Intervention, Comparison, Evaluation), which is a tool designed to support question formulation and evidence selection, particularly in qualitative and mixed-methods research (Booth 2006).

**Table 3: Eligibility criteria**

| | Inclusion criteria | Exclusion criteria |
|---|---|---|
| Setting | Urban, suburban, or rural environments in OECD[a] countries where active travel[b] infrastructure has been implemented or changed. | |
| Perspective | Individuals with disabilities[c]<br>Which includes individuals with mobility impairments, sensory, or neurological conditions and those who use mobility assistive devices such as wheelchairs, mobility scooters, walking frames, and other aids. | Studies where disability is not a primary focus or where findings relating to disabled individuals cannot be clearly separated from the broader population |
| Intervention / Phenomenon of Interest | Changes or implementation of active travel infrastructure, such as:<br>- Dropped kerbs / kerbs ramps<br>- Continuous footways<br>- Bus stop bypasses (floating bus stops)<br>- Tactile paving<br>- Signalised pedestrian crossings<br>- Audible/tactile crossing signals<br>- Smooth, non-slip surfaces<br>- Decluttered footways<br>- Sufficient footway width for mobility aids<br>- Seating and rest areas<br>- Lighting and visibility<br>- Accessible cycle infrastructure<br>- Wayfinding<br>- Public transport integration<br>- Low traffic neighbourhoods<br>- Cycle tracks and pedestrian crossings of cycle tracks | General transport infrastructure (e.g. roads, motorways, bus/train systems) without integration into or impact on active travel infrastructure.<br><br>Focus exclusively on recreational or sport-based infrastructure (e.g. mountain biking trails, leisure parks) that are not designed for everyday utility travel. |
| Comparison | Not required for inclusion, but where reported, may include comparisons with non-disabled populations or pre-/post-intervention contexts | |
| Evaluation | The impact of infrastructure changes on accessibility to active travel, including but not limited to<br>- Use of active travel infrastructure (e.g. walking, wheeling, or cycling following changes)<br>- Frequency of active travel for transport (e.g. number of trips)<br>- Amount or duration of active travel (e.g. time or distance)<br>- Changes in mode of transport, including shifts to active travel or avoidance due to accessibility barriers<br><br>Experiences of disabled people in relation to changes or implementations of active travel infrastructure | Describe interventions aimed solely at behaviour change (e.g. walking campaigns, education, incentives) without accompanying infrastructure changes<br><br>Evaluate assistive technologies, apps, or navigation tools unless embedded within or directly influencing the design or accessibility of the physical travel environment. |

| | | |
|---|---|---|
| | Barriers and facilitators as they relate to those lived experiences. Barriers may include physical obstacles (e.g. narrow paths, lack of kerb drops), sensory challenges, unclear wayfinding, or design features that exclude certain users.<br>Facilitators may include inclusive design elements (e.g. tactile paving, seating, wider pavements), features that improve comfort or safety, or environmental factors that enable greater independence and mobility. | |
| Study designs | Primary research studies of any methodological design (qualitative, quantitative, or mixed methods) will be included, provided they contribute data relevant to the review question on how active travel infrastructure changes impact accessibility for disabled people. | Not based on empirical research, such as opinion pieces, editorials, letters, or policy briefs without primary or secondary data<br>Protocols or descriptions of planned studies without results<br>Systematic reviews, scoping reviews, or evidence syntheses<br>Dissertations and thesis |
| Language of publication | Studies published in English language only | Published in languages other than English. These will be excluded at full-text screening, and exclusions will be documented with study details (e.g. title, authors, abstract language) recorded. |
| Publication date | Studies published from 2014 onwards in alignment with the end date of the search by Gamache et al. 2019. | Studies published before 2014 |

[a] Organisation for Economic Co-operation and Development

[b] Active travel means making ordinary everyday journeys with any destination in physically active ways such as walking, wheeling (using a wheelchair or mobility aid), cycling (Wheels for Wellbeing 2024).

[c] This review adopts a broad, inclusive definition of disability informed by the International Classification of Functioning, Disability and Health (ICF) (WHO 2001) and the United Nations Convention on the Rights of Persons with Disabilities (CRPD) (United Nations 2006). The ICF frames disability as a dynamic interaction between a person's health condition and their personal and environmental context, incorporating impairments, activity limitations, and participation restrictions within a bio-psycho-social model. This approach acknowledges that individuals may experience difficulties related to their condition while also facing disabling barriers in society (WHO 2011). The CRPD further recognises disability as "an evolving concept" resulting from the interaction between persons with impairments and attitudinal and environmental barriers that hinder full and effective participation in society on an equal basis with others. Disability is therefore not an attribute of the person but seen as arising from the interaction between a person and their environment.

## 6.2 Literature search

### 6.2.1 Evidence sources

Comprehensive literature searches were conducted across the following bibliographic databases from 2014 to current date:

- SCOPUS
- Transport Research International Documentation (TRID) - https://trid.trb.org/
- Medline via OVID

We also searched the ICE Virtual Library (https://www.icevirtuallibrary.com/).

### 6.2.2 Search Strategy

Preliminary searches were undertaken during the development of the protocol in Scopus and PubMed using a combination of (active travel OR active commuting OR active transport OR active accessibility OR bikeability OR walkability OR cycling for transport OR walking for transport OR wheeling for transport) AND (physical environment OR built environment OR infrastructure OR built form OR urban form) AND (disabled OR disability OR disabilities). Identified articles were then reviewed and analysed for the text words contained in the titles and abstracts. This informed the development of a comprehensive search designed in Medline (Ovid) and adapted for the other bibliographic databases (see Appendix 1).

To identify relevant grey literature, we searched the websites of key UK third sector and government organisations (see Appendix 2), the Overton database and Google Advanced (see Appendix 3). For Overton and Google Advanced, we reviewed the first ten pages of search results and retrieved any potentially relevant documents. Organisational websites were searched using their internal search functions where available; otherwise, site-specific Google advanced searches were employed. If a search returned 100 results or fewer, all results were screened. For searches yielding more than 100 results, only the first 100 results were screened.

Following the bibliographic database searches, forward and backward citation tracking was conducted for any included published papers, using a combination of both Citation Chaser™ and Scopus. Relevant studies identified through this process were added to the review.

### 6.2.3 Reference management

All citations retrieved from the database searches were imported or entered manually into EndNote™ (Thomson Reuters, CA, USA) and duplicates removed. At the end of this process, remaining citations were exported as a TXT file and imported into the software package Rayyan™, where any remaining duplicates were removed.

## 6.3 Study selection process

For the literature identified through bibliographic databases, two reviewers dual screened 20% of citations using the information provided in the titles and abstracts via Rayyan™ and resolved any conflicts as needed. The remaining citations were screened by a single reviewer. For citations that appeared to meet the inclusion criteria, or where a definitive decision could not be made based on the title and/or abstract alone, full texts were retrieved. These full texts were screened for inclusion by two reviewers, with any disagreements resolved by a third reviewer.

Documents retrieved from Overton, Google Advanced, and targeted website searches were briefly reviewed at full text by a single reviewer. Documents that appeared eligible, or where eligibility could not be determined based on the initial scan, underwent full screening by two independent reviewers. Disagreements were resolved through discussion, with involvement of a third reviewer if required.

To support feasibility within the rapid review timeframe, and in line with guidance for rapid qualitative evidence synthesis (Booth et al. 2024), a stepwise sampling approach to qualitative studies was planned. All potentially eligible qualitative studies were initially screened, with the intention that a second-stage sampling process would then focus data extraction and synthesis on those providing richer qualitative data. However, this approach was not required, as the number of eligible qualitative studies was manageable within the available timeframe, and full data extraction was undertaken for all included studies.

## 6.4 Quality appraisal

To assess the methodological quality of qualitative primary research studies, the 10-item JBI checklist for qualitative research was used (Lockwood et al. 2015). For the systematic and scoping reviews, methodological quality assessment was conducted using the 11-item JBI critical appraisal checklist for systematic reviews and research syntheses (Aromataris et al. 2015). When a study met a criterion (question answered as "Yes") in a JBI checklist, a score of one was given. When the answer to an item was regarded as "unclear" or "no", it was given a score of zero. When a question was regarded as "not applicable" this point was taken off the total score. Overall scores were presented by adding up points for each applicable question.

To assess the methodological quality of quantitative studies and the mixed methods studies, including those where only the qualitative or quantitative components were relevant to the review, the 13-item Quality Assessment for Diverse Studies (QuADS) tool was used (Harrison et al. 2021). Items were rated on a scale of zero to three. A score of zero meant that the item was not met, as the study did not mention or report the methodological issue at all. Items were scored one if methodological information was provided, but it was limited or generic. A score of two was given if there was evidence that a methodological issue was considered and the authors provided basic justification. The highest score of three was considered for items where study authors provided detailed justifications for their methodological approach. An overall numerical score was presented in a tabular format by adding up the numbers for each item. The QuADS has no cut-off scores to categorise studies into low or high quality. Instead, the tool encourages the narrative discussion of each quality item across the body of the evidence.

Quality appraisal was conducted by one reviewer and independently checked by another. Any disagreements were resolved through discussion or, where necessary, by involving a third reviewer. In addition to presenting overall numerical scores of each tool in a tabular format, a textual description of methodological quality was also provided for the included studies and reviews.

## 6.5 Data extraction

All relevant data were extracted directly into tables by one reviewer and independently checked by another. Extracted data included bibliographic details, the country in which the study was conducted, setting, study aim/s and design. Participant characteristics included disability type (including the use of mobility aid if applicable) age, gender, ethnicity and socioeconomic status. Information on the type of active travel infrastructure, any changes (existing or planned) and the aspect of the review question addressed (impact, barriers or facilitators) was also recorded. Methodological details such as data collection and data analysis methods were included. Results of the critical appraisal of included studies were added to the table upon completion. A data extraction template was developed and piloted for each of the included study designs, with minor amendments made following the pilot phase.

## 6.6 Synthesis

Although the protocol set out to follow a convergent segregated approach, it was not feasible within the available timeframe to conduct parallel synthesis of qualitative and quantitative data. Instead, each included study was reported as a narrative summary, with overarching "bottom line" thematic summaries developed and presented by type of infrastructure. These "bottom line" summaries integrated evidence across study types and were informed by the methodological strengths and limitations of the included studies. This provided a clear synthesis of the impact, barriers, and facilitators associated with changes in active travel infrastructure for disabled people.

## 6.7 Assessment of body of evidence

Given the time constraints of this rapid review, we did not conduct a formal assessment of the strength of the evidence supporting the conclusions.

# 7. EVIDENCE

## 7.1 Search results and study selection

The flow of citations through each stage of the review process is displayed in a PRISMA flowchart (Page et al. 2021). The searches identified 2,481 records (2,423 from databases and 58 from other sources). After removal of 643 duplicates, 1,838 records remained for screening. Following title and abstract screening, 92 records were sought for retrieval, and all were successfully retrieved. These full-text reports were assessed for eligibility, resulting in the exclusion of 76 reports. The details of these records and reasons for exclusion are shown in Appendix 4. In total, 16 reports (comprising 11 primary research studies reported across 12 publications[6], and four reviews) were included in this rapid review.

## 7.2 Overview of study characteristics

An overview of study characteristics are provided in the following tables. Table 4 presents the characteristics of the included studies, and Table 5 summarises the reviews.

## 7.3 Quality appraisal

The quality appraisal of the included studies are provided in the following tables. Table 6 presents the JBI critical appraisal checklist for qualitative research. Table 7 the Quality Assessment for Diverse Studies (QuADS) criteria and Table 8 presents the JBI critical appraisal scores for systematic reviews and research syntheses

## 7.4 Data extraction of findings

Table 9 presents the extracted primary research findings relevant to the review, and Table 10 presents the secondary research findings, each categorised as barriers, facilitators, and impacts.

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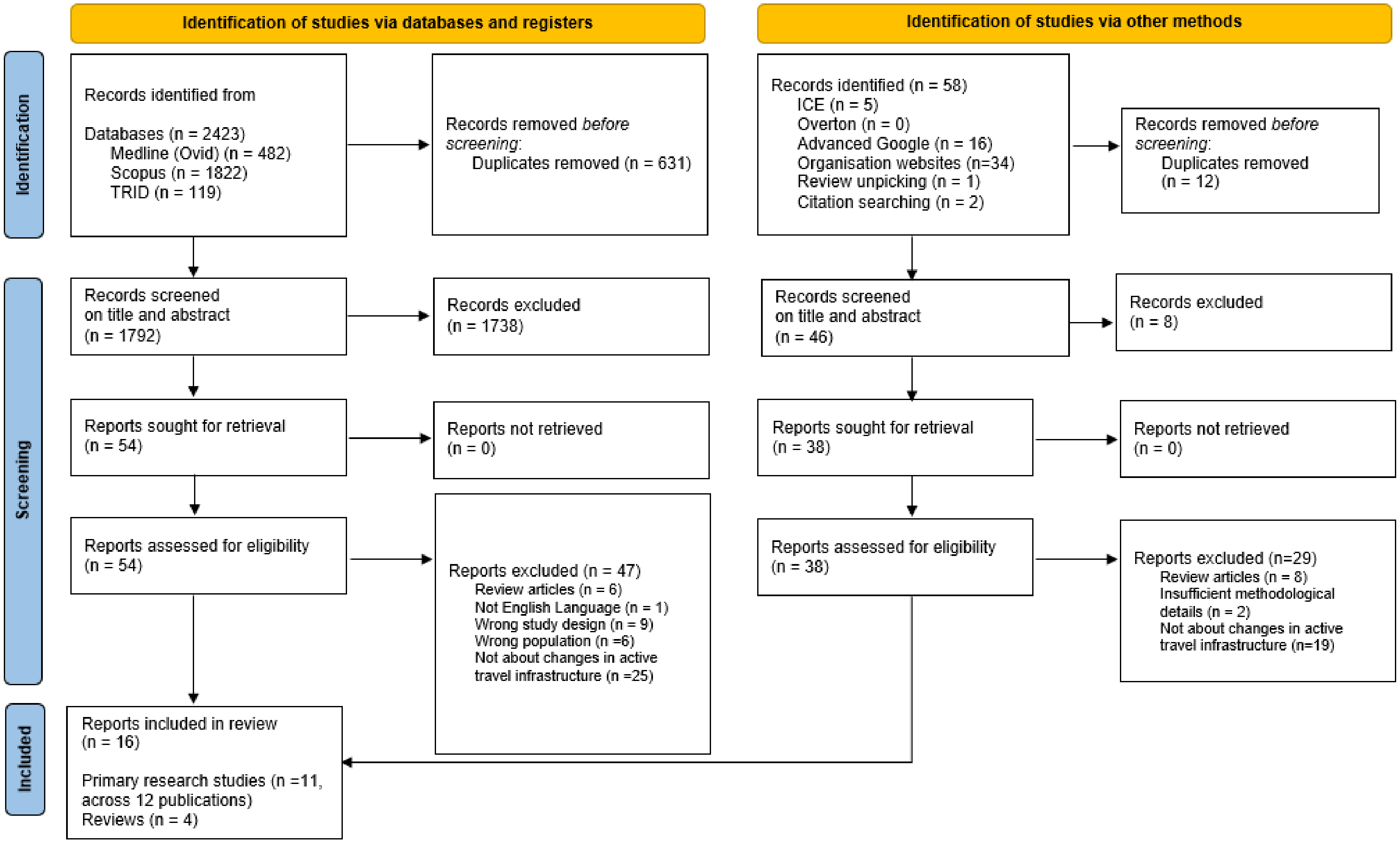
[6] Alciauskaite et al. 2020, Hatzakis et al. 2024 both report on the TRIPS study

**Figure 1: PRISMA Flow Diagram**




Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

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**Table 4: Characteristics of included primary research studies**

| **Author, Year**<br>**Setting and Country**<br>**Aim**<br><br>**Quality appraisal** | **Study design**<br>**Data collection methods**<br>**Data collection dates**<br>**Type of Infrastructure** | **Population** | **Aspect of review question addressed**<br>**Data analysis** |
|---|---|---|---|
| Alciauskaite et al. 2020<br>Hatzakis et al. 2024<br><br><u>Setting and country</u><br>Brussels (urban city centre); Belgium<br>Sofia (urban city centre); Bulgaria<br>Zagreb (urban city centre); Croatia<br>Lisbon (urban city centre); Portugal<br>Cagliari (small town centre); Sardinia<br>Stockholm (urban city centre); Sweden<br>Europe<br><br><u>Aim</u><br>Alciauskaite et al 2020 explores needs, barriers, and preferences concerning mobility and evaluates barriers to the adoption of future inclusive mobility systems, based on research conducted during the EU-funded project TRIPS.<br><br>Hatzakis et al 2024 discusses the experiences of persons with disabilities when moving around cities on foot or wheels, based on research conducted during the EU-funded project TRIPS.<br><br><u>Quality appraisal</u><br>7 out of 10 items met on the JBI critical appraisal checklist for qualitative research | <u>Study design</u><br>Qualitative descriptive study as part of a wider mixed methods study<br><u>Data collection methods</u><br>Interviews (online video chat or phone due to COVID-19 pandemic)<br><u>Data collection dates</u><br>June and September 2020<br><u>Type of Infrastructure</u><br>Adapted bus stops<br>Crossings<br>Pavements and surfaces (including tactile surfaces)<br><br><u>Change</u><br>Participants discussed and described their experiences adapted bus stops, pedestrian crossing with tactile paving slabs and pavements that had already been implemented across UK cities | <u>Participants</u><br>41 people with disabilities from 6 of the 6 European cities involved in the wider TRIPS project<br><u>Disability</u><br>Physical impairments (n=26)<br>Hearing impairments (n=4)<br>Visual impairments (n=8)<br>Visual / physical impairments (n=1)<br>Hearing / visual impairments (n=1)<br>Neurodivergent people (n=1)<br><u>Use of mobility aids</u><br>Electric wheelchair (n= 5)<br>Motorised wheelchair (n=2)<br>Manual wheelchair/wheelchair (n=12)<br>Manual & electric wheelchair (n=1)<br>Wheelchair and crutches (n=1)<br>Walking cane (n=1)<br>Walker (n=2) / Scooter (n=1)<br>Braces and electric scooter (n=1)<br>White cane / stick (n=1)<br>Guide dog and white cane (n=1)<br>Hearing aid and implant (n=1)<br>Not too loud environment (n=1)<br>Not reported (n=11)<br><u>Gender</u><br>Female n=18, 44%<br><u>Age</u> | <u>Aspect of review question addressed</u><br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><u>Data analysis</u><br>Participants of the peer-to-peer interview were asked: What are the main barriers you encounter when using public transport? (consider the entire journey and all its different phases: getting information, planning the trip, bookings, accessing the chosen service, reaching the station, vehicles, getting to the desired destination)<br><br>Hatzakis et al 2024 presented answers to the questions in relation to walkability which were categorised into the following groups:<br>• Inaccessible physical infrastructure<br>• Inconsiderate handling of maintenance works<br>• Confusing signage and measures<br>• Unpredictable public infrastructure design<br>Alciauskaite et al. 2020 focused on public transport and eight categories |

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| | | Range 21-70 years, Mean 44.4 years<br>Ethnicity<br>NR<br>Socio-economic status<br>Secondary school/high school education, diploma (n=13)<br>Vocational training (n=2)<br>Higher education degree (n=23)<br>Unfinished education (n=1)<br>NR (n=2) | were developed, one of which was barriers related to challenges disabled people face during their end-to-end trips<br>There were seven subcategories of barriers identified and these included regulations, public awareness and assistance, information provision and communication, *infrastructure,* vehicles, stops and stations, and general service quality. COVID-19 related barriers were later added as a new subcategory.<br><br>*Barriers and facilitators were then identified across each of these themes that were relevant to changes to active travel infrastructure* |
| Brown & Norgate 2019<br><br>Setting and country<br>Poynton (small town centre)<br>UK<br><br>Aim<br>To understand in real-time, the perceptions, thoughts and emotions about their interaction with the shared space, to enable the facilitators and barriers users encountered to be identified<br><br>Quality appraisal<br>7 out of 10 items met on the JBI critical appraisal checklist for qualitative research | Study design<br>Qualitative case studies (n=5)<br>Data collection methods<br>Verbal protocol analysis<br>Data collection dates<br>NR<br>Type of infrastructure<br>Urban shared space<br>Change (already implemented)<br>Traditional kerbs, traffic signals, and road markings were removed at the central junction and replaced with a "shared space" layout intended to calm traffic and prioritise people walking and wheeling in 2013 as part of the Poynton Regenerated Project. | Participants<br>People who are blind or visually impaired adult who are walking (n=5)<br>Participants were recruited at an event day hosted by a charity for people with visual disabilities.<br>Disability<br>Totally blind (n=2);<br>Partially sighted (n=3)<br>Use of mobility aids<br>Cane and walking stick (n=1)<br>Guide dog (n=1) / Cane user (n=2)<br>GPS navigation (n=1)<br>Gender<br>Female n=2, 40%<br>Age<br>21-54 years<br>Mean age 54 years | Aspect of review question addressed<br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><br>Data analysis<br>Thematic analysis - five themes were identified which included lack of kerb edge (distinction between carriageway and space to walk), crossing, street furniture, mobility aids and emotions.<br><br>*Barriers, facilitators and impact were then identified across each of these* |

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| | There was no designated pavement but there was the provision of tactile paving around an informal crossing area. The route was additionally surfaced with paved bricks and there was a boundary between the path and space for vehicle use | Ethnicity and socio-economic status<br>NR | *themes that were relevant to changes to active travel infrastructure* |
| Guide Dogs & UCL 2024<br><br>Setting and country<br>London (urban city centre)<br>Cardiff (urban city centre)<br>Glasgow (urban city centre)<br>Birmingham (urban city centre)<br>Belfast (urban city centre)<br>UK<br><br>Aim<br>To understand how disabled people feel about bus stops designed to accommodate cycle lanes<br>To explore the specific challenges for blind and visually impaired people as well as wider groups of disabled people<br>To measures the effects of bus stop designs on disabled people by measuring physiological response within a controlled environment<br><br>Quality appraisal<br>Overall score is 23 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | Study design<br>Mixed Methods study<br>Data collection methods<br>Focus groups: 5 groups (12 participants each) with disabled people who had experience of FIBS and/or SBSB. Discussions explored challenges in using the bus system.<br>Site visits: 6 participants attended accompanied visits to a FIBS, a SBSB, and a continuous footway. Open questions/topics were used to guide reflections.<br>Experiments: 24 participants took part in full-scale trials of FIBS, SBSB, segregated cycle–footways with different delineators, and continuous footways (with and without tactile paving). Participants pressed a button when they became aware of people cycling and when they felt it was no longer safe to cross, across multiple scenarios.<br>Post-experiment survey (n=24)<br>Data collection dates<br>NR | Participants<br>Blind or visually impaired people, along with other groups of disabled people who experienced challenges using the bus system and had experience with either FIBS, SBSB, or both.<br>Recruitment details not provided<br>Focus groups (n=60)<br>Site visit: (n=6)<br>Experiments (n=24)<br>Experiments: guide dogs requested a sample of participants with varied demographics, including age, gender and a range of mobility and vision disabilities<br>Disability<br>*Focus groups:* Blind or visually impaired people, and people with hearing loss, neurodivergence, or mobility disabilities (numbers not reported).<br>*Site visit*: neurodivergent people (n=3) visually impaired (n=1) blind (n=1), stroller user (n=1)<br>*Experiment*: neurodivergent people (n=6), visually impaired (n=10), blind (n=3), mobility impaired (n=5) | Aspect of review question addressed<br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br>Data analysis<br>Focus groups and site visits: findings were presented narratively, structured around bus stop types and discussion topics, and described what participants experienced at each bus stop type (e.g. FIBS, SBSB).<br><br>Experiments: findings reported quantitatively (e.g. detection distances, “not safe to cross” thresholds, heart rate variability) and through post-experiment questionnaires<br><br>*For the purposes of this review, reported “challenges” and “experiences” relevant to changes to active travel infrastructure were interpreted and categorised as barriers and facilitators* |

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| | Type of infrastructure:<br>• Focus groups: FIBS; SBSB; Continuous Footways<br>• Site visits: FIBS; SBSB; Continuous Footways<br>• Experiments: FIBS; SBSB; Segregated cycle–footways with different delineators; Continuous Footways (with and without tactile paving)<br>Change (already implemented):<br>• Focus groups: Participants discussed and described their experiences of using bus stop and street designs that had already been implemented across UK cities<br>• Site visits: These designs had already been implemented at the sites visited, and participants described their experiences on-site<br>Change (experimental)<br>• Experiments: Experimental layouts were constructed specifically for testing | Use of mobility aids<br>Focus groups: NR<br>Site visits: NR<br>Experiments: Crutch user (n=1)<br>Wheelchair – carer assisted (n=2)<br>Wheelchair – powered (n=2)<br>Gender<br>Focus groups: NR<br>*Site Visit:* Female n=3, 50%<br>*Experiment:* Female n=15, 60%<br>Age<br>*Focus groups:* NR<br>*Site Visits*<br>45-64 (n=2, 33%)<br>25-55 (n=3, 50%)<br>Over 65 (n=1, 17%)<br>*Experiment:*<br>Over 65 (n=4, 16%)<br>45-64 (n=11, 48%)<br>25-55 (n=9, 36%)<br>Ethnicity and socio-economic status<br>NR | |
| Ormerod et al. 2015<br><br>Setting and country<br>Edinburgh (urban city centre)<br>UK<br><br>Aim<br>To identify older people's perceptions and approach to using tactile paving, the | Study design<br>Qualitative descriptive<br>Data collection methods<br>On-site interviews at crossing sites<br>Data collection dates<br>NR<br>Type of infrastructure | Participants<br>Adults aged over 65 years with no significant health issue who walk or wheel (n=200)[a]<br>People with mobility impairments who walk or wheel (n=8)<br>People with moderate/severe vision impairments who are walking (n=30)<br>Recruitment details not provided | Aspect of review question addressed<br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br>Data analysis<br>For participants with mobility impairments, the findings were reported narratively, but no direct quotes were provided |

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| context of which was blister tactile paving at road crossings<br><br><u>Quality appraisal</u><br>1 out of 10 items met on the JBI critical appraisal checklist for qualitative research | Tactile paving at 8 selected road crossing sites:<br>• Pelican (n=3)<br>• Signalised junction (n=4)<br>• Uncontrolled crossing (n=2)<br><u>Change</u><br>Crossings were chosen where the installation, including tactile paving that conformed to regulations | <u>Disability</u><br>Mobility impairment (n=8)<br>Moderate/severe vision impairment (n=30)<br><u>Use of mobility aids</u><br>People with mobility impairments:<br>• Wheelchair users (n=4)<br>• Mobility scooters (n=4)<br>• Self-propelling (n=5)<br>• Pushed by another (n=3)<br>People with visual impairments:<br>• White cane users (n=8)<br>• Guide dog users (n=8)<br>• Companion for support (n=14) | For participants with moderate to severe visual impairments, six recurrent themes were identified, though no descriptions or supporting quotes were provided<br>*For the purposes of this review, the narrative detail relevant to changes to active travel infrastructure for people with mobility and visual impairments (n=38) was summarised and categorised into barriers and facilitators* |
| RNIB 2025<br><br><u>Country</u><br>UK<br><br><u>Aim:</u><br>Explored participants' experiences of bus, train and pedestrian journeys (this report focuses on the buses)<br><br><u>Quality appraisal</u><br>Overall score is 7 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | <u>Study design</u><br>Quantitative descriptive survey[b]<br><u>Data collection methods</u><br>Online Survey<br><u>Data collection dates</u><br>February 2025<br><u>Type of infrastructure</u><br>Floating Island Bus Stops<br><u>Change</u><br>The survey asked questions about bus users experience of Floating Island Bus Stops that had already been implemented across the UK | <u>Participants</u><br>Blind and partially sighted bus users (n=1197) recruited via email and social media<br><u>Disability</u><br>Severely sight impaired (blind) (54%)<br>Partially sighted (28%)<br>Have sight loss but not registered (15%)<br>No other demographic information was provided | <u>Aspect of review question addressed</u><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><u>Data analysis</u><br>The findings were reported narratively, with descriptive statistics summarising closed-ended responses and verbatim quotations presented for open-ended responses<br>The survey also explored broader experiences of getting to the bus stop and bus travel<br><br>*For the purposes of this review, narrative detail and verbatim responses relevant to changes to active travel infrastructure were interpreted and categorised into impacts* |

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| RNIB Cymru 2025<br><br><u>Country</u><br>Wales<br>Semi-rural (50%)<br>Urban (41%)<br>Rural (9%)<br><br><u>Aim</u><br>To understand blind and partially sighted people's experience of travelling by bus<br><br><u>Quality appraisal</u><br>Overall score is 7 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | <u>Study design</u><br>Quantitative descriptive survey<br><u>Data collection methods</u><br>Online survey<br><u>Data collection dates</u><br>2024 – no further information<br><u>Type of infrastructure</u><br>Floating Island Bus Stops<br>Shared Bus stop boarders<br><u>Change</u><br>The survey asked questions about bus users experience of new bus stop designs such as Floating Island Bus Stops or Shared Bus Stop Boarders that had already been implemented across Wales | <u>Participants</u><br>Blind and partially sighted people (n=146)<br>Recruited via email and social media<br><u>Disability</u><br>Formally registered visually impaired (79%); Registered site impaired (34%)<br>Vision impairment not registered (16%)<br><u>Use of mobility aids</u><br>Most respondents used at least one mobility aid and some used a combination<br>The most common including some form of cane (68%), walking sticks (20%), guide dogs (17%)<br><u>Age</u><br>18 and 35 (13%); 35 and 54 (20%)<br>55 and 64 (26%); Over 65 (41%)<br>No other demographic information was provided | <u>Aspect of review question addressed</u><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><u>Data analysis</u><br>The findings were reported narratively, with descriptive statistics summarising closed-ended responses and verbatim quotations presented for open-ended responses<br><br>The survey also explored broader experiences of getting to the bus stop and bus travel<br><br>*For the purposes of this review, narrative detail and verbatim responses relevant to changes in active travel infrastructure were interpreted and categorised into impacts. However, there was only one open ended survey response that was relevant to this review* |
| Rosa et al. 2025<br><br><u>Setting and country</u><br>Faro International Airport<br>Portugal<br>(Engineering Institute of the University of Algarve)<br><br><u>Aim</u><br>To co-design a smart, sustainable, and accessible bus stop at Faro International Airport, Portugal, that enhances mobility for older tourists and individuals with | <u>Study design</u><br>Mixed methods<br><u>Data collection methods</u><br>• Surveys: quantitative data on participants' perceptions of accessibility and mobility features<br>• Walking schemes: participants, including individuals with mobility and visual disabilities, who navigated the study sites at Faro Airport and surrounding pedestrian networks (n=32) | <u>Participants</u><br>Older tourists from different countries (n=851) of which 25.3% reported mobility impairments<br>Participants were recruited through local tourism organisations, accessibility networks, and community outreach efforts<br>Stakeholders which included architects, urban planners, individuals with disabilities, accessibility | <u>Aspect of review question addressed</u><br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><u>Data analysis</u><br>Descriptive statistics (survey)<br>*For the purposes of this review, descriptive statistics relating to active travel infrastructure for people with mobility issues were extracted and categorised into barriers and facilitators* |

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| disabilities, using inclusive and universal design principles<br><br><u>Quality appraisal</u><br>Overall score is 22 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | • Workshops (n=2) which aimed to facilitate co-design sessions where participants contributed to designing an inclusive bus stop<br><u>Data collection dates</u><br>Questionnaires and walking schemes: 2019<br><u>Type of infrastructure</u><br>Bus stop at Faro airport and surrounding pedestrian network including pavements, pedestrian, tactile paving<br><u>Change</u><br>The data will be used to assist with the design process of an age friendly accessible bus stop at Faro airport (the bus stop was never implemented) | advocates and representatives from local authorities (n=37)<br><u>Disability</u><br>25.3% reported mobility impairments:<br>• Mobility impairments (61.6%)<br>• Hearing impairments (15.2%)<br>• Visual impairments (14.8%<br>• Orientation difficulties (1.7%)<br><u>Use of mobility aids</u><br>17.4% used technical aids:<br>• Canes (31.3%)<br>• Crutches (16.2%)<br>• Tripod/quadripod (12.3%)<br>• Wheelchairs (12.3%)<br><u>Gender</u><br>Not reported<br><u>Age</u><br>60-69 years (45.8%); 70-79 years (39.9%); 80+ (15.4%)<br><u>Ethnicity</u><br>NR<br><u>Socio-economic status</u><br>Retired (70.3%); Full-Time working (21.7%); Part-Time working (4.3%)<br>Vocational training (54%)<br>Higher Education (20.3%) | Walking scheme findings were reported in combination with workshop data and could not be extracted separately<br>Eight recurring themes were identified from participants' suggestions:<br>• Accessibility features<br>• Seating preferences<br>• Barrier-free surfaces<br>• Ramp slope<br>• Manoeuvring space<br>• Tactile pavement<br>• Pavement contrast colour<br>• Audio-visual displays<br>*As these themes related to the co-design of a new bus stop, they were outside the remit of this rapid review and were not extracted into the synthesis* |
| Sustrans 2024<br><br><u>Setting and country</u><br>Foss Islands Path<br>York (urban city centre)<br>UK<br><br><u>Aim</u> | <u>Study design</u><br>Mixed methods<br><u>Data collection methods</u><br>Counts of path users were conducted using video monitoring at two points on the path for 12 hours a day over a two-month period | <u>Participants</u><br>Path users (counts of path users over a two-month period, daily numbers not reported)<br>Path users (interviews) recruited from Facebook (n=13) of which there were three users with disabilities<br><u>Disability</u> | <u>Aspect of review question addressed</u><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><u>Data analysis</u><br>Descriptive data was presented for users counts |

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| To identify how barrier removal and redesign changed the type and frequency of path use<br><br>Quality appraisal<br>Overall score is 10 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | Interviews<br><br>Data collection dates<br>Retrospectively in 2023<br><br>Type of infrastructure<br>Shared use path<br><br>Change<br>The site was completed in 2016<br><br>Removing 30 restrictive barriers and replacing them with alternative facilities designed to maintain access for all users | Multiple sclerosis (n=1)<br>Paralysis of left arm & leg (n=1)<br><br>Use of mobility aids<br>Adapted cycles as their main form of transport (n=2)<br>• E trike<br>• Recumbent tricycle<br><br>No other demographic information was provided | Thematic analysis - five themes were identified which included convenience and accessibility, diversity of users and modes of transport, motorbikes and other issues which require attention<br><br>*Impact was then identified across each of these themes that were relevant to changes to active travel infrastructure* |
| Transport for All 2021<br><br>Setting and country<br>London (urban city centre)<br>Newcastle (urban city centre)<br>Manchester (urban city centre)<br>Yorkshire (mixed urban and semi-urban settings<br>Woking (small town centre)<br>Oxford (urban city centre)<br><br>Participants from 19/21 London boroughs that have implemented LTNs and 5 locations outside on London<br><br>Aim<br>To understand the impact of LTNs on disabled residents.<br><br>To understand the emotions and perceptions underlying how disabled people feel about LTNs to identify needs and generate ideas for solutions<br><br>Quality appraisal | Study design<br>Qualitative descriptive<br>(authors describe their approach as "ethnographic" and "grounded theory," but methods align more closely with content analysis)<br><br>Data collection methods<br>Interviews (in person and online)<br><br>Data collection dates<br>Not reported<br><br>Type of Infrastructure<br>Low traffic neighbourhoods<br><br>Change<br>LTNs which started to emerge across London in May 2020<br><br>By October 2020 there were around 30km$^2$ of LTNs across 21 boroughs in London | Participants<br>Disabled people (anyone identified as disabled or having a disability/belonging to any and all impairment groups) or a person who provides primary care and support for a disabled person participants lived either inside, or close to, a LTN OR whose daily activities would be directly affected by the LTN<br><br>n=84 (78 deemed eligible for analysis)<br><br>Disability<br>Mobility impairments (61%)<br>Chronic illness/long term conditions (29%)<br>Visually impaired/blind (9%)<br>Deaf/hard of hearing (5%)<br>Mental health conditions (8%)<br>Neurodivergent/cognitive impairment/learning disability (12%)<br>Parent/carer (14%)<br><br>Use of mobility aids | Aspect of review question addressed<br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><br>Data analysis<br>Data were analysed using coding, where interview transcripts and written responses were categorised into topics using a key. This process transformed qualitative, opinion-based data into quantitative form by assigning codes and counting how many participants raised each issue. Frequencies were then tallied to summarise the main themes<br><br>The barriers to active travel for disabled people<br>• Medical |

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| 2 out of 10 items met on the JBI critical appraisal checklist for qualitative research | | Wheelchair (22%); Stick/crutches (19%); Long cane (6%); Mobility scooter (4%); Walking frame (3%); Car as mobility aid (3%); Cycle (2%) / Guide dog (2%); Other (1%) / No Mobility Aid (25%)<br><br><u>Age</u><br>8-89 years old<br><br>No other demographic information was provided | • Physical (infrastructure)<br>• Financial<br>• Attitudinal<br>• Societal<br><br>The impacts of LTNs on disabled people<br>• General observations<br>• Positive impacts for disabled residents<br>• Negative impacts for disabled residents<br><br>*Barriers, facilitators and impact were then identified across each of these themes that were relevant to changes to active travel infrastructure* |
| Weetman et al. 2023 (Living Streets)<br><br><u>Setting and Country</u><br>*Focus groups and site visits*<br>London<br>Glasgow<br><br>*Detailed study sites*<br>Cardiff<br>Leeds<br>Edinburgh<br>London<br>Glasgow<br><br>UK<br><br><u>Aim</u><br>The research project studied whether continuous footways make streets more inclusive or less inclusive, why they | <u>Study design</u><br>Mixed methods<br><br><u>Data collection methods</u><br>Literature review<br>Mapping and GIS work<br>Structured interviews (and further work) with professional informants<br>Work with disabled people<br>• Site visits (n=4)<br>• Focus groups (n=4)<br>• Follow up solutions workshop<br>Detailed-study site work<br>• In-person study of 10 continuous footways, using both structured techniques and less formal approaches<br>• Analysis of behaviours at these sites using fixed-cameras | <u>Participants</u><br>*Focus groups and site visits*<br>People with disabilities who walk or wheel (n=20)[c]<br><br>TfA sought contact with people who might be interested in being involved, and selected only some of those replying – seeking to ensure that participants had a range of disabilities and ages<br><br><u>Disability</u><br>Visual impairments (n=5) with some having other disabilities alongside<br>No further details reported<br><u>Use of mobility aids</u><br>Number not reported but some references to wheelchair users, cane users and guide dogs | <u>Aspect of review question addressed</u><br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><br><u>Data analysis</u><br>The report does not formally present themes or discuss its analytical approach. Instead, the findings are organised under a series of headings<br>• Definitions and design purposes<br>• Extent of exclusion<br>• Kerbs and crossing techniques<br>• Wider challenges for people who are blind or partially sighted who are walking<br>• Tactile paving |

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| might do so, and what might make the difference between one and the other<br><br>Objective of the work with disabled people:<br>- To understand the variety of experiences that different disabled people face<br><br><u>Quality appraisal</u><br>Overall score is 16 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | (alongside shorter segments of video footage taken by researchers), supported by the use of artificial intelligence processing<br><br><u>Data collection dates</u><br>2019 to May 2023<br><br><u>Type of Infrastructure</u><br>Continuous footways<br><br><u>Change</u><br>Continuous footways had already been implemented at the study sites | No other demographic information was provided | • The effect on people with multiple disabilities<br>• Effects of open areas on people who are blind or partially sighted who are walking<br>• Other problems and comments<br><br>*Barriers, facilitators and impact were then identified across each of these headings that were relevant to changes to active travel infrastructure* |
| Weetman et al. 2024<br><br><u>Setting and Country</u><br>*Focus groups and site visits*<br>London<br>Glasgow<br><br>*Detailed study sites*<br>Cardiff<br>Leeds<br>Edinburgh<br>London<br>Glasgow<br><br>UK<br><br><u>Aim</u><br>The purpose of this work was to investigate:<br>- What effect designers were aiming for in continuing a cycle track past a bus stop<br>- What designs currently exist on the streets | <u>Study design</u><br>Mixed methods<br><br><u>Data collection methods</u><br>Literature review<br><br>Mapping and GIS work<br><br>Structured interviews (and further work) with professional informants<br><br>Work with disabled people<br>• Site visits (n=4)<br>• Focus groups (n=4)<br>• Follow up solutions workshop<br><br>Detailed-study site work<br>• In-person study of 10 continuous footways, using both structured techniques and less formal approaches<br>• Analysis of behaviours at these sites using fixed-cameras (alongside shorter segments of video footage taken by | <u>Participants</u><br>People with disabilities or wheel (n=25)<br>*Focus groups (n=12), site visits (n=2), both (n=11)*<br><br>TfA sought contact with people who might be interested in being involved and selected only some of those replying – seeking to ensure that participants had a range of disabilities and ages.<br><br><u>Disability</u><br>Visual impairment (n=7)<br>Hearing loss (n=5)<br>Mobility impairment (n=14)<br>Learning disability (n=4)<br>Mental health condition(s) (n=9)<br>Long-term health condition(s) or chronic illness (n=14)<br>Over half the participants had multiple conditions (n=15)<br><br><u>Use of mobility aids</u> | <u>Aspect of review question addressed</u><br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><br><u>Data analysis</u><br>The report does not formally present themes or discuss its analytical approach. Instead, the findings are organised under a series of headings<br>• Visual impairment, clarity and kerbs<br>• Visual impairment and broad navigation issues<br>• Broad frustrations with changes to streets<br>• Broad fears and frustrations about interacting with people cycling<br>• Limitations of zebra crossings<br>• Problems around general bus stop accessibility |

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| - Whether these arrangements achieve the desired effects<br>- What concerns were held by those worried about inclusion<br><br>Objective of the work with disabled people:<br>- To understand the variety of experiences that different disabled people face<br><br><u>Quality appraisal</u><br>Overall score is 17 out of 39 on Quality Assessment for Diverse Studies (QuADS) criteria | researchers), supported by the use of artificial intelligence processing<br><br><u>Data collection dates</u><br>2019 to May 2023<br><br><u>Type of infrastructure</u><br>Bus stop bypasses<br>Kerbside track arrangements<br>Shared platform boarder arrangements<br>Hybrids of these approaches<br><br><u>Change</u><br>Bus stop bypasses, Kerbside track arrangements[d], Shared platform boarder arrangements[e] and hybrid variations of these approaches had already been implemented at the study sites | Walking stick / frame (n=4)<br>Wheelchair (n=11)<br>Long cane /guide dog (n=4)<br>Mobility scooter (n=3)<br>A few participants used more than one mobility aid (n=5) while some participants did not use any (n=8)<br><br><u>Gender</u><br>Female (n=9, 36%) / NR (n=2, 8%)<br><br><u>Age</u><br>16-25 years (n=2, 8%)<br>26-45 years (n=8, 32%)<br>46-65 years (n=11, 44%)<br>66+ years (n=4, 16%)<br><br><u>Ethnicity</u><br>White (n=15, 60%)<br>Black/African/Caribbean (n=4, 16%)<br>Asian or Asian British (n=3, 12%)<br>Mixed (n=2, 8%)<br>Other ethnic group (n=1, 4%)<br><br><u>Socio-economic status</u><br>NR | • Other comments and ideas<br><br>*Barriers, facilitators and impact were then identified across each of these headings that were relevant to changes to active travel infrastructure* |

**Notes**

[a] We did not extract the findings for the people with disabilities aged over 65 years with no significant health issue (n=200)
[b] The report states that two focus groups of 13 people were conducted on people April 2025, but no data is provided in the report
[c] Not all the participants took part in both the focus groups and site visits
[d] Kerbside track arrangements – the cycle track runs directly alongside the kerb, with the bus stopping in the carriageway. Passengers board and alight from the bus into the cycle track area, creating potential conflict between people cycling and people walking and wheeling.
[e] Shared platform boarder arrangements – the cycle track and bus stop platform are at the same level and location, so both people cycling and bus passengers share the boarding/footway space. This creates a shared zone where people cycling and people walking and wheeling interact.

**Key:** FIBS: Floating island bus stops, LTN: low traffic neighbourhood; NR: Not reported; SBSB: Shared bus stop boarders; TfA: Transport for All

**Table 5: Characteristics of included secondary research**

| **Author / Year**<br>**Review purpose**<br>**Type of review**<br>**Quality of the primary research**<br>**Quality of the review** | **Review details** | | **Aspect of review question addressed**<br>**Data analysis** |
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| Day 2024<br>(Sustrans)<br><br><u>Review purpose</u><br>How do various neurodivergent conditions impact on people's active travel choices and active travel experiences?<br><br><u>Type of review</u><br>Narrative review<br><br><u>Appraisal scale</u><br>N/A<br><u>Appraisal rating</u><br>N/A<br><u>Review appraisal score</u><br>N/A | <u>Review period</u><br>NR<br><br><u>Included study designs</u><br>NR<br><br><u>Outcomes of interest</u><br>• How various neurodivergent conditions affect people's travel choices and travel experiences<br>• How neurodivergent people currently experience their active journeys from mode choice to travel environment<br>• The various barriers to and enablers of active travel for neurodivergent people | <u>Number of included studies</u><br>NR<br><u>Population</u><br>Individuals with neurodivergent conditions<br>(There was recognition of the paucity of literature directly related to neurodivergence and active travel so research about general disabilities that included neurodivergent conditions is included in the review)<br><u>Countries</u><br>Mainly UK<br>Sources from Ireland and USA also included<br><u>Type of infrastructure</u><br>Pavements and surfaces<br>Crossings<br>Low Traffic Networks<br>Cycling infrastructure<br><u>Change</u><br>Infrastructure was already in place | <u>Aspect of review question addressed</u><br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><br><u>Data analysis</u><br>The narrative review included a section on barriers and enablers to travel, organised under the following headings.<br>• Sensory overwhelm<br>• Wayfinding<br>• Physical accessibility of the travel environment<br>• Personal safety<br>• Safety from traffic and other people<br>• Transport poverty<br>• Barriers to decision making<br>• Travel causes fatigue and distress<br><br>*Barriers and facilitators were then identified across each of these headings that were relevant to changes to active travel infrastructure* |
| Georgescu et al. 2024 | <u>Review period</u><br>2012-2022 | <u>Number of included studies</u><br>n=20 | <u>Aspect of review question addressed</u> |

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| <u>Review purpose</u><br>To provide a comprehensive and structured state of knowledge concerning internal and external factors that impact spatial accessibility in urban areas<br><br><u>Type of review</u><br>Systematic Review<br><br><u>Appraisal scale</u><br>None<br><br><u>Appraisal rating</u><br>None<br><br><u>Review appraisal score</u><br>6 out of 11 items met on the JBI critical appraisal checklist for systematic reviews and research synthesis | <u>Included study designs</u><br>Quantitative (n=4) and qualitative (n=16) study designs<br><br><u>Outcomes of interest</u><br>Barriers and facilitators of street elements that impact participants' spatial accessibility and active mobility | <u>Population</u><br>Individuals with mobility impairments<br>(further categorized as manual wheelchair users, powered wheelchair users, scooter users and users if walking assistive devices)<br>Visually disabled individuals<br>Individuals with situational mobility restriction) i.e. using strollers)<br>Older adults<br>Age: 18+<br>All ages (n=5)<br>Younger than 65 (n=3)<br>Older Adults (n=8)<br>Didn't specify (n=4)<br><u>Countries</u><br>North America (n=7)<br>One study from each of the following countries Belgium, Italy, Croatia and Ireland, Ecuador, Chile, China, Malaysia, Taiwan, South Korea, New Zealand)<br>Missing data (n=2)<br><u>Years Included</u><br>2013-2022<br><u>Type of infrastructure</u><br>Kerbs and dropped kerbs<br>Pavements and surfaces (including tactile paving)<br>Crossings<br><u>Change</u><br>Infrastructure was already in place | Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><u>Data analysis</u><br>The included studies identified various street elements influencing participants' spatial accessibility and active mobility. Street elements were coded as barriers or facilitators, grouped by population, and their frequency across studies was manually counted, allowing comparison of how different mobility assistive device users experienced the built environment.<br>*Barriers*<br>• Sidewalks<br>• Sidewalk smoothness<br>• Sidewalk material<br>• Permanent obstacles<br>• Temporary obstacles<br>• Pedestrian crosswalks<br>• Difficult features of crosswalks<br>• Signals at crosswalks<br>• Pedestrian areas<br>• Open spaces<br>• Lack of …<br><br>*Facilitators*<br>• Sidewalk<br>• Cross walk<br>• Other elements<br><br>*Barriers and facilitators were then identified across each of these categories that were relevant to changes to active travel infrastructure* |
| Kapsalis et al. 2024. | <u>Review period</u> | <u>Number of included studies</u> | <u>Aspect of review question addressed</u> |

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| Review purpose<br>To compile a list of the most obstructive physical barriers for MobAD users in public urban spaces and investigate the effects of inaccessible public urban spaces on the quality of MobAD users<br><br>Type of review<br>Systematic Review<br><br>Appraisal scale<br>MMAT<br><br>Appraisal rating<br>39 studies scored at least 80%, of which 15 scored 100%<br><br>Review appraisal score<br>9 out of 11 items met on the JBI critical appraisal checklist for systematic reviews and research synthesis | January 2005 – December 2021<br><br>Included study designs<br>Quantitative (n=22), Qualitative (n=12) and mixed methods (n=14)<br><br>Outcomes of interest<br>• MobAD accessibility of the urban environment<br>• Impact of physical barriers on aspects of QoL of MobAD users | n=48<br><br>Population<br>Mobility Assistive Device users (manual or powered wheelchairs, mobility scooters, canes, crutches, walkers and strollers)<br>Age: Not consistently reported.<br>Older adult (n=1)<br>Young people (n=2)<br><br>Countries<br>• UK (n=3)<br>• Europe (n=12) (France (n=2) Germany (n=1) Norway (n=1) Sweden (n=3) Denmark (n=1) Netherlands (n=1), Turkey (n=2)<br>• North America (n=23) (USA (n=14) Canada n=9)<br>• Australia (n=1); Singapore (n=2); Saudi Arabia (n=1)<br>• Bangladesh (n=1); Taiwan (n=1); Korea Republic (n=1)<br>• Botswana (n=1), Ghana (n=1), South Africa (n=1)<br><br>Type of infrastructure explored<br>Kerbs and dropped kerbs<br>Pavements and surfaces (including tactile paving)<br><br>Change<br>Infrastructure was already in place | Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people<br><br>Data analysis<br>A coding scheme was developed to extract article characteristics and objective-related insights; the included studies on public space accessibility for mobility assistive device users were synthesised into four broad macro-environment categories based on spatial location and function, with some codes further divided into sub-categories for deeper analysis.<br>• Outdoor environments<br>• Transport physical facilities<br>• Building approach<br>• Indoor facilities<br><br>*Barriers and facilitators were then identified across each of these categories that were relevant to changes to active travel infrastructure*<br><br>The review authors subsequently analysed how these factors affected the quality of life of MobAD users |
| Seetharaman et al. 2024<br><br>Review purpose<br>To explore the scope and range of extant literature on the community mobility of persons with visual disabilities, focusing specifically on | Review period<br>Years 2000-2020<br>Follow -up searches conducted between 2020 and 2022<br><br>Included study designs | Number of included studies<br>n=43<br><br>Population<br>Community-dwelling adults with visual impairments<br>Age: 18+ | Aspect of review question addressed<br>Barriers and facilitators experienced by disabled people in response to changes in active travel infrastructure<br><br>Impact of changes in active travel infrastructure on accessibility for disabled people |

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| the influence of the outdoor built environment.<br>1.What aspects of the built environment affect the community mobility of persons with visual impairments?<br>2.How does the built environment affect the community mobility of persons with visual impairments?<br><br><u>Type of review</u><br>Scoping Review<br><br><u>Appraisal scale</u><br>N/A<br><br><u>Appraisal rating</u><br>N/A<br><br><u>Review appraisal score</u><br>6 out of 8 items met on the JBI critical appraisal checklist for systematic reviews and research synthesis | Quantitative (n=11)<br>Qualitative (n=28)<br>Mixed methods (n=4)<br><br><u>Outcomes of interest</u><br>Barriers to outdoor mobility<br>Cues for spatial perception and navigation | <u>Countries</u><br>North America (n=16)<br>Europe (n=16)<br>Australia (n=2)<br>New Zealand (n=4)<br><br><u>Type of infrastructure</u><br>• Pavements and crossings<br>• Kerbs and dropped kerbs<br>• Tactile paving<br>• Shared spaces<br><br><u>Change</u><br>Infrastructure was already in place | <u>Data analysis</u><br>Data was analysed using an inductive approach and general qualitative coding. A coding framework was developed, and the key findings were consolidated under two broad themes<br>1.Barriers to outdoor mobility, and<br>2.Cues for spatial perception and navigation<br><br>*Barriers to outdoor mobility*<br>The included studies highlighted multiple aspects of the built environment acting as barriers to the community mobility of people with visual impairments; these were further organised by the review authors into six sub-themes<br>• Sidewalk and ground surface quality issues<br>• Suboptimal-level changes<br>• Waist height or eye-level objects<br>• Ambient conditions, such as poor lighting<br>• Barriers at street crossings<br>• Fixed and mobile/temporary obstructions<br><br>*Barriers were then identified across each of these categories that were relevant to changes to active travel infrastructure*<br><br>Cues for spatial perception and navigation<br>This theme was further categorised into 3 sub themes<br>• Tactile cues<br>• Kinaesthetic cues<br>• Auditory cues<br>• Visual cues<br><br>*For the purposes of this review the narrative detail relevant to changes to active travel infrastructure were interpreted and categorised as facilitators* |

**Key:** N/A: not applicable; MobAD: Mobility Assistive Device users' QoL: quality of life

**Table 6: JBI critical appraisal checklist for qualitative research**

| Study | JBI Appraisal items | | | | | | | | | | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | |
| Alciauskaite et al 2020<br>Hatzakis et al 2024 | N | Y | Y | Y | Y | N | N | Y | Y | Y | 7/10 |
| Brown & Norgate 2019 | N | Y | Y | Y | Y | N | U | Y | Y | Y | 7/10 |
| Ormerod et al. 2015 | N | U | U | U | U | N | U | U | N | Y | 1/10 |
| Transport for All 2021 | N | U | Y | N | N | N | N | N | U | Y | 2/10 |

**Key**: Y – Yes, N – No, U – Unclear, n/a - not applicable

Q1. Is there congruity between the stated philosophical perspective and the research methodology?
Q2. Is there congruity between the research methodology and the research question or objectives?
Q3. Is there congruity between the research methodology and the methods used to collect data?
Q4. Is there congruity between the research methodology and the representation and analysis of data?
Q5. Is there congruity between the research methodology and the interpretation of results?
Q6. ere a statement locating the researcher culturally or theoretically?
Q7. Is the influence of the researcher on the research, and vice- versa, addressed?
Q8. Are participants, and their voices, adequately represented?
Q9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?
Q10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?

**Table 7: Quality Assessment for Diverse Studies (QuADS) criteria**

| Study | QuADS items | | | | | | | | | | | | | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | |
| Guide Dogs & UCL 2024 | 0 | 3 | 3 | 3 | 1 | 1 | 3 | 2 | 1 | 0 | 2 | 3 | 1 | 23 |
| RNIB 2025 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 7 |
| RNIB Cymru 2025 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 7 |
| Rosa et al. 2025 | 3 | 3 | 2 | 2 | 1 | 2 | 0 | 2 | 1 | 0 | 2 | 3 | 1 | 22 |
| Sustrans 2024 | 0 | 1 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 10 |
| Weetman et al. 2023 | 0 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 1 | 16 |
| Weetman et al. 2024 | 0 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 2 | 17 |

**Key:**
0 – no mention at all
1 – general description of research area or very limited information provided
2 – evidence of consideration or basic justifications
3 – explicit discussions of the item or detailed justifications provided

Q1. Theoretical or conceptual underpinning to the research
Q2. Statement of research aim/s
Q3. Clear description of research setting and target population
Q4. The study design is appropriate to address the stated research aim/s
Q5. Appropriate sampling to address the research aim/s
Q6. Rationale for choice of data collection tool/s
Q7. The format and content of data collection tool is appropriate to address the stated research aim/s
Q8. Description of data collection procedure
Q9. Recruitment data provided
Q10. Justification for analytic method selected
Q11. The method of analysis was appropriate to answer the research aim/s
Q12. Evidence that the research stakeholders have been considered in research design or conduct
Q13. Strengths and limitations critically discussed

**Table 8: JBI critical appraisal scores for systematic reviews and research syntheses**

| Study | JBI Appraisal items | | | | | | | | | | | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | |
| Georgescu et al. 2024 | Y | Y | N | Y | N | N | N | Y | N | Y | Y | 6/11 |
| Kapsalis et al. 2024 | Y | Y | N | Y | Y | Y | Y | Y | N | Y | Y | 9/11 |
| Seetharaman et al. 2024 | Y | Y | N | Y | n/a | n/a | N | Y | n/a | Y | Y | 6/8 |

**Key**: Y – Yes, N – No, U – Unclear, n/a - not applicable

Q1. Is the review question clearly and explicitly stated?
Q2. Were the inclusion criteria appropriate for the review question?
Q3. Was the search strategy appropriate?
Q4. Were the sources and resources used to search for studies adequate?
Q5. Were the criteria for appraising studies appropriate?
Q6. Was critical appraisal conducted by two or more reviewers independently?
Q7. Were there methods to minimize errors in data extraction?
Q8. Were the methods used to combine studies appropriate?
Q9. Was the likelihood of publication bias assessed?
Q10. Were recommendations for policy and/or practice supported by the reported data?
Q11. Were the specific directives for new research appropriate?

**Table 9: Data extraction of findings from primary research relevant to the review**

| **Alciauskaite et al. 2020 / Hatzakis et al. 2024** |
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| *Bus stop heights – barriers*<br>• Adapted bus stops constructed higher than pavements, preventing level access (Cagliari wheelchair user)<br>• Users needing to cross the street and remain in the roadway to board buses due to height differences (Cagliari wheelchair user)<br>• Inconsistencies in bus stop heights across locations, reflecting lack of cohesion in accessibility regulations and construction practices (Brussels, wheelchair user)<br>*Pedestrian crossings incorrect tactile paving slabs -barriers*<br>• Incorrect tactile paving slabs installed during construction, making crossings undetectable with a white cane (Brussels visual impairment)<br>*Pavement design - barriers*<br>• Discrepancies in pavement design, even between opposite pavements in the same location (Brussels wheelchair user) |
| **Brown & Norgate 2019** |
| *Crossing (informal space) – barriers*<br>• Being aware there was any informal crossing available<br>• Negotiating conflicts<br>• Being able to perceive how far away the other side of the road is<br>• Being aware when finished crossing<br>• Needing support<br>*Crossing (informal space) – barriers*<br>• The role of tactile surfaces<br>*Distinction between carriageway and space to walk - barriers*<br>• Lack of demarcation<br>*Distinction between carriageway and space to walk - facilitators*<br>• None<br>*Mobility aid – impact*<br>Participants talked about the interactions between those who used canes and the shared space<br>• Cane users needed a kerb or contact point to orient safely<br>• Cane risked extending into the carriageway, creating danger from passing traffic (especially electric cars, difficult to detect)<br>• Lack of kerb made trailing with the cane difficult<br>*Emotions – facilitators*<br>• Self-efficacy in walking with a guide dog<br>*Emotions – impact* |

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| • Area perceived as unsafe or unsuitable for independent travel by blind participants<br>• Lack of kerb/trailing edge caused disorientation and fear of wandering into traffic<br>• Feelings of confusion, disconcertion, and lack of safety while navigating<br>*Street furniture – impact*<br>• Street furniture obstructed the walking path and pushed participants toward traffic, increasing safety concerns<br>*Street furniture – facilitators*<br>• Lampposts acted as useful orientation points, easier to detect than road boundaries |
| **Guide Dogs & UCL 2024** |
| *Impact*<br>• Neither Floating Island Bus Stops nor Shared Bus Stop Boarders were perceived as safe, leading to fear and avoidance of bus services.<br>• Shared Bus Stop Boarders caused greater concern than Floating Island Bus Stops.<br>• Mixing of people cycling and people walking and wheeling increased stress, with some ceasing to use public transport altogether.<br>• Participants expressed a shared view that these designs could not be made safe and should be removed.<br>*Experiences of general infrastructure*<br>• Potential clash sites for people cycling and people walking and wheeling in addition to bus stops issues: shared paths, crossing, continuous footways (FG)<br>*Experiences of Floating Island Bus Stops (FIBS)*<br>• Width of the floating island (too narrow) (FG)<br>• Location of buses at the bus stop (finding the location of the crossing to leave the island (FG)<br>• Consistent design (blister paving always in the same place in the island in relation to the bus stops) (FG)<br>• Control of the speed of people who cycle at the bus stop (Detecting a bicycle and risk of collision causing stress and anxiety) (FG)<br>• Some people had experienced them working well in other countries – generally those that had space for everyone (FG)<br>• Confusing layout, lack of signage for people cycling to give way, environmental noise (difficulty detecting approaching bicycles), crowding, no consistent shelter/flag placement (SV)<br>*Experiences of shared bus stop borders (SBSB)*<br>• Announcements when alighting the bus that there is a cycle lane at a bus stop are helpful (FG)<br>• Not knowing where things are and feeling unprotected when alighting a bus (FG)<br>• Problem for guide dog users when alighting the bus into a cycle lane at a SBSB (FG)<br>• Problem for carers assisting wheelchair users when alighting the bus into a cycle lane as unable to detect oncoming bicycles detect an oncoming bicycle, before having to push the wheelchair into the cycle lane (FG)<br>• 2-way cycle lanes are confusing, dangerous at a bus stop (FG)<br>• Difficult to navigate (considered much more challenging than FIBS), poor delineation (the difficulty in distinguishing the boundary between the footway and cycle lane), safety concerns, alighting danger (narrow buffer zone and lack of tactile guidance) (SV)<br>*Experiences of continuous footways*<br>• Lack of tactile paving and visual cues, undetectable transitions between pavement and the road (SV)<br>*Experiences of segregated cycle-footways* |

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| • Guide dogs do not recognise cycle–footway boundaries (FG)<br>• Tactile paving at the start of the path can help, but orientation is lost further along if there are no repeat cues (FG)<br>• Difficulty for blind and vision-impaired people in identifying whether they are on the pedestrian or cycle side of the delineator (FG)<br>• Forgetting which side is pedestrian vs cycle without continuous tactile or visual indicators; suggestions included repeat icons and colour contrast (FG)<br><br>*Experiences of Continuous paving: - facilitators*<br>• Surface contrast: differences between asphalt vs concrete were helpful when present. Increased tactile paving and markings would improve safety (SV)<br><br>*Floating Island Bus Stops*<br>• Detection rate ranged from 2m downstream to 20m upstream (Ex)<br>• Heart rate variability showed that FIBS are slightly less stressful (Ex)<br>• FIBS slightly better than SBSB but still problematic (Post ExQ)<br><br>*Shared Bus Stop Boarders*<br>• Detection ranged from 1m downstream to 25m upstream (Ex)<br>• Had more downstream (late) responses (Ex)<br>• Lower heart rate variability at SBSB indicated higher stress (Ex)<br>• SBSB rated lowest for safety, detectability and confidence (Post ExQ)<br><br>*Segregated cycle–footways - with different delineators*<br>• Best: continuous razed trapezoidal delineator (Ex)<br>• Worst: painted line and kerb delineators (Ex)<br>• Gaps in delineators reduced detectability and confidence (ex)<br><br>*Continuous footways (with and without tactile paving)*<br>  ○ Without tactile paving: participants, especially those visually impaired, had difficulty identifying crossing points and felt unsafe (Ex)<br>  ○ With tactile paving: detection improved, but concerns remained about unpredictable vehicle behaviour and lack of clarity in priority (Ex) |
| **Ormerod et al. 2015** |
| Participants with mobility disabilities<br>• Blisters in the tactile paving were an issue especially for those who used a wheelchair as feel every bump - barrier<br>• People with disabilities who self-propelled were more accepting of the bumpy feeling of the blisters – barrier<br>• Lack of dropped kerb provision - barrier<br><br>Participants with moderate/severe vision disabilities<br>6 recurrent themes (but no theme description or supporting quotes):<br><br>*Different types of tactile paving - barriers*<br>• The different types of tactile paving caused confusion about the appropriate behaviour for participants. different types caused confusion<br><br>*Colouring - barriers*<br>• The point of colouring often missed (red at controlled crossing points and buff at uncontrolled) |

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| *Subtleties of tonal contrast - barriers*<br>• Subtleties of tonal contrast between the tactile paving and the surrounding paving were often inadequate. Weather (strong sunlight , shade) and inadequate lighting exacerbates this (assumes participants only go out int he daylight)<br>*Difficulty detecting blisters for wayfinding*<br>• Tactile paving limited in terms of wayfinding for participants who were not cane users as they find it difficult to detect blisters – limited support detecting crossing, knowing where it was safe to cross<br>*Other cues:*<br>• Participants relied more heavily on other cues such as familiar sounds from people and shops; information from their cane or guide dog; the sound of the beep from the crossing<br>*Investment:*<br>• Participants felt local authority resources should be invested in providing better quality footways that were safe from slips, trips and falls as a result of uneven pavements |
| **RNIB 2025** |
| *Floating Island Bus Stops -Impact*<br>• Have severe effects on blind/partially sighted people’s ability and willingness to travel by bus.<br>• Of the 30 per cent who’ve encountered this kind of bus stop:<br>- 87% find it harder to reach the bus stop<br>- 59% stop using certain bus stops<br>- 55% change routes<br>- 49% make fewer journeys to avoid<br>- 14% no longer go out<br>*Open survey responses to Floating Island Bus Stops - impacts*<br>• Participant was knocked down when crossing the cycle path to reach a bus<br>• Reported bus stop designs are not safe to navigate for them and their guide dog<br>• Design described as inconsistent; crossings may or may not be present<br>• No safe mechanism to stop people who cycle or people who use e-scooters when crossing<br>• Considered dangerous and unsuitable for blind and vision-impaired people<br>• Participant no longer visits the area due to these bus stops<br>• Vision-impaired friends also avoid meeting there |
| **RNIB Cymru 2025** |
| *Open survey responses to Floating Island Bus Stops and Shared Bus stop boarders - impacts*<br>• A respondent reported that some bus stops in their area have cycle lanes where passengers disembark<br>• They stated they cannot see if they are walking into a person cycling and people who cycle weave through waiting crowds<br>• They expressed that this design “should not be allowed” |
| **Rosa et al. 2025** |
| *Accessibility features at bus stops (survey data) – facilitators* |

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| % respondents with mobility issues or disabilities who considered different features as particularly important<br>• seating areas within shelters (72.4%)<br>• non-slip waiting platforms (65.0%)<br>• level boarding platforms (63.6%),<br>• well-lit shelters (62.6%)<br>• ramps with suitable inclines (59.3%)<br>• elevated bus stops (50.9%)<br>• sufficient wheelchair manoeuvrability on waiting platforms (50.0%)<br>• tactile warning strips on waiting platforms (50.0%)<br>• non-slip floor and regular surface (65.0%)<br>• tactile pavement in the boarding area (48.6%)<br>• boarding area pavement with a contrasting colour (47.2%) |
| **Sustrans 2024** |
| *Impact*<br>Across sites, an average of 45 daily trips were recorded using modes such as pushchairs, wheelchairs, and cargo bikes—types of transport that may not have been able to use the path before the barrier changes (user counts)<br><br>Following the changes, both interviewees using non-standard cycles reported being able to access more of the path, enabling them to use it more frequently for commuting, hospital visits, and other personal journeys (interview data) |
| **Transport for All 2021** |
| *Barriers to active travel in Low Traffic Neighbourhoods*<br>42% of participants brought up accessibility issues with the street space<br><br>*Barriers to Walking/Wheeling in Low Traffic Neighbourhoods*<br>• Pavements cluttered by obstacles<br>- Such as bins, signs, car charging points, A-boards, chairs/tables, bikes and e-scooters<br>- Difficult to navigate for those with mobility disabilities and can pose a hazard to those with visual disabilities<br>- Confusing and overwhelming for those who are neurodivergent<br>• Pavements that are steep, uneven, or bumpy are<br>- Particularly difficult for wheelchair users<br>- Tree roots, cobblestones, poorly laid paving<br>• Lack of dropped kerbs<br>- Entire sections of pavement/walkways can be no-go zones for wheelchair users<br>- Trip hazard to visually impaired people<br>• *Lack of alcoves/benches*<br>- People are unable to stop and rest<br>• *Hazards* |

- Cycle lanes that are integrated with the pavement,
- Widening gap between road and pavement
- Often not marked with a high contrasting colour or tactile paving. These can be easily missed, leading to injury

- *Confusing street scape layout*
  - One-way systems, poor signage, shared space, excess of bollards)
  - Distressing and anxiety inducing
- *Road crossings*
  - Must have appropriate tactile paving and dropped kerbs.
  - Be clear of obstruction from signs or clutter.
  - Be at regular junctions to avoid overcrowding

*Negative impacts for disabled participants*

- *Increase in traffic danger*
  - 33% of participants reported an increase in traffic danger
  - These participants reported that they felt less safe.
  - Participants reported instances of drivers ignoring the signs and driving through the barriers, or of an increase in 'road rage'
  - and dangerous driving
  - There were also several reports of dangerous cycling
- *Negative impact on mental health and negative emotions*
  17% of participants reported that the LTN has had a negative impact on their mental health
- *Sense of independence*
  Many participants also told us about the impact the LTN was having on their independence, with 19% of participants reporting that the LTN had caused this to decrease
- *Lack of communication*
  (72%) of participants reported issues with how changes had been communicated, including the lack of information provided, poor quality or inaccessible formats, and not receiving any prior warning before an LTN was installed.

*Positive impacts disabled participants*

- *Less danger due to traffic*
  - 18% of participants reported a decrease in traffic danger
  - Most prominently among Deaf and visually impaired participants
- *Sense of independence*
  - 6% of participants discussed feeling more independent or felt that they had gained more independence and freedom to travel
  - Fewer cars on the roads make it safer for wheelchair users to roll down the road, instead of having to use the pavements
  - People who cycle felt in areas where there are fewer/no cars on the road that they have been granted the freedom and independence to cycle without fear (this is a particular benefit for those cycling on adapted cycles)
- Less noise
  - 17% of participants reported a decrease in noise
  - Particularly prominent in the responses of neurodivergent participants)
  - Quieter roads mean less chance of experiencing uncomfortable sensory overload
  - Less noise also benefits visually impaired residents, who rely on auditory signals more than others to determine when to cross the road, and being able to hear these more clearly contributes to them feeling safer in their neighbourhood

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| • Easier and more pleasant journeys<br>- 14% of participants reported that their journeys had become easier or more pleasant<br>- Participants reported that easier journeys mean disabled people find themselves with more confidence and freedom to go out, explore, and try out new routes<br>• Benefits to physical health<br>- 4 participants reported a positive impact on physical health and wellbeing<br>- These participants reported that they were making more active travel journeys in their local area as a result of the LTN measures - either by walking, wheeling, or cycling<br>• Benefits to mental health<br>- 5 participants reported a positive impact on mental health<br>- These participants reported feeling able to make more journeys: exercising more, having more freedom and independence and finding navigating around their local areas easier and more pleasant |
| **Weetman et al. 2023** |
| *Design purposes - impact*<br>- Perceived prioritisation of people cycling at the expense of people walking and wheeling.<br>*Extent of exclusion – impact*<br>- Using buses for very short journeys due to local accessibility issues.<br>- New infrastructure turning previously secure routes into a “guessing game” for blind people.<br>- Difficulty avoiding oncoming people cycling when moving slowly (e.g. not being able to “jump out of the way”<br>*Kerbs and crossing techniques - barrier*<br>Parked vehicles blocking access for guide dog users, preventing safe movement between carriageway and footway.<br>*Kerbs and crossing techniques - impact*<br>Because vehicles blocked the space needed to move between pavement and carriageway, guide dog users had to walk along the road to the next junction, creating safety risks.<br>*Tactile paving - barriers*<br>- The loss of detectable kerbs at continuous footways or raised side road surfaces complicated navigation for individuals with visual disabilities.<br>- Non-standard tactile paving arrangements created additional confusion.<br>- Many people who are blind or partially sighted who are walking struggled to feel the orientation of blisters on blister-style tactile paving, making it difficult to orient themselves for crossing.<br>- Dropped kerbs often sloped in directions that did not align with the desired path of travel.<br>*Tactile paving – Impact*<br>- Blister-style tactile paving at dropped kerbs can suggest a crossing direction that takes blind and partially sighted pedestrians into the main carriageway.<br>- Angled slopes at dropped kerbs combined with tactile paving create risks of tipping for wheeled mobility aids such as mobility scooters.<br>- Large, complex, or inconsistently oriented tactile paving layouts create confusion and reduce confidence for blind and partially sighted pedestrians.<br>*The effect on people with multiple impairments – barrier*<br>- Continuous footways and other junctions are inaccessible for people who are partially sighted and rely on colour contrast rather than tactile paving.<br>*The effect on people with multiple impairments – impact* |

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| - People who are both partially sighted, and wheelchair users struggle to see the edge of footways, leading them to stay close to the building line to remain safe and avoid falling off the footway.<br><br>*Footway crossovers – barrier*<br>- At footway crossovers created for car park access, the removal of kerbs blurred the distinction between footway and carriageway, leading to vehicles parking on areas intended for footway and blocking access.<br><br>*Kerbs - facilitator*<br>- The removal of kerbs provided beneficial effects for wheelchair users, who reported feeling safer when crossing streets.<br><br>*Tactile paving and dropped kerbs – barrier*<br>- Tactile paving at dropped kerbs creates difficulties for some people because of balance issues or pain when walking across it.<br><br>*Tactile paving and dropped kerbs – impact*<br>- One wheelchair users steered his wheelchair over mid-height kerbs rather than using dropped kerbs that had blister-style tactile paving before them.<br>- While kerb removal improved safety and confidence for wheelchair users, the same street layout was criticised by participants with visual impairments.<br><br>Detailed site study work not extracted |
| **Weetman et al. 2024** |
| *Visual impairment, clarity and kerbs - barriers*<br>- Individuals with visual disabilities reported that the absence of **kerbs** distinguishing **cycle tracks** from pavements was unnerving, leaving them uncertain whether they were in a safe place or correctly positioned to access a bus.<br>- Individuals with visual disabilities highlighted that when cycle tracks at bus stops had no kerbs, it was difficult to determine whether they were on the bus bypass (cycle track) or the pavement.<br>- Individuals with visual disabilities emphasised the importance of colour and tone contrast, particularly in wet conditions or after dark, but noted that inconsistent changes in material, tone, and colour across pavements, cycle tracks, and carriageways created confusion and uncertainty.<br>- Individuals with visual disabilities noted that lighting after dark could both improve visibility of contrasts and reduce clarity, with brighter low-level lighting sometimes causing dazzle.<br><br>*Visual impairment and broad navigation issues - barriers*<br>- Individuals with visual disabilities reported difficulty locating bus stops positioned on islands, as the only indication was tactile paving that was identical to paving used for **controlled crossings**, creating confusion about whether to walk to a bus stop, cross a side road, or cross the main road.<br><br>*Visual impairment and broad navigation issues - impacts*<br>- Ambiguity in **tactile paving** use created uncertainty and navigation difficulties for visually impaired individuals.<br><br>*Broad frustrations with changes to streets - impacts*<br>- Street changes introduced avoidable difficulties, leading to broad frustration among participants.<br>- People walking and wheeling were perceived as being deprioritised in favour of people who cycle, undermining trust in decision-makers.<br>- Floating bus stops were described negatively, with concerns they created "cycle-only" areas and reduced inclusivity.<br>- **Cycle tracks** at bus stops were viewed as unsafe, creating uncertainty when people cycling approached passengers and lowering confidence in navigation.<br><br>Limitations of zebra crossings – barriers<br>- **Zebra crossings at cycle tracks were** less obvious to users than crossings on wide carriageways, with some participants not recognising the white lines as zebra crossings. |

- **Zebra crossings at cycle tracks** created uncertainty about who had the right of way, with participants unsure whether people cycling would stop or whether they needed to wait.

*Limitations of zebra crossings – impacts*

- Even when zebra crossing markings were visible, participants did not always perceive them as safe;
- Some said they did not perceive the danger as much on cycle lanes, as if they were crossing the road they would go out of their way to find a zebra crossing or a light-controlled crossing instead

*Problems around general bus stop accessibility - impacts*

- Wheelchair users reported that when bus drivers failed to line up correctly with the kerb, ramps could not be deployed smoothly, and small bus stop islands were seen to create additional challenges for drivers in positioning buses.
- Individuals with disabilities, including wheelchair users, long-cane users, and guide dog users, highlighted the physical difficulty of negotiating crowds in the restricted space of bus stop islands, alongside social pressures such as embarrassment and fear of irritating others.
- Wheelchair users described how sloping surfaces on bus stop islands, which tilted toward the cycle track, made it difficult to travel along the island, pulling their wheelchairs sideways.
- The slope also created barriers to boarding and alighting, as wheelchair users could not gain momentum to ascend the bus ramp and struggled to control their chairs when descending.

*Other comments and ideas - impacts*

- Wheelchair users described frustration when pedestrians did not remain in designated spaces, leading to unexpected conflicts on cycle tracks.
- kerb-free arrangements were described as enhancing independence and confidence when navigating to everyday destinations.

*Other comments and ideas - facilitators*

- Participants reported that bus announcements reminding passengers they would be crossing a cycle track after alighting were helpful for improving awareness and safety.
- Kerb-free street designs were identified as beneficial by wheelchair users, who found them to provide safer and more accessible routes.

**Key**

LTN: Low Traffic Neighbourhoods

**Table 10: Data extraction of findings from secondary research relevant to the review**

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| **Day 2004** |
| *Variations in street design – barrier*<br>Variations in street design, including crossing designs and cycling infrastructure, also exacerbate wayfinding issues, as each design requires a different set of knowledge of rules and navigation<br><br>*Variations in street design – impact*<br>Some neurodivergent people report not making journeys at all or turning back half-way when wayfinding becomes too difficult<br>Other neurodivergent people report using taxis to overcome wayfinding struggles, which adds cost to travel that would not be incurred if transport systems were more accessible.<br><br>*Physical accessibility of the travel environment - barriers*<br>- Poorly maintained and uneven pavements<br>- Pavement parking<br>- Street clutter, including bins and recycling boxes, café seating, etc.<br>- Lack of dropped kerbs<br>- Narrow pavements<br>- Cycle infrastructure which is not suitable for adapted bikes<br>- Barriers and bollards on cycle or mixed use paths<br><br>*Safety from traffic and other people – barriers*<br>The introduction of new active travel infrastructure – especially the Spaces for People and other temporary infrastructure Neurodiversity and Active Travel – an evidence review projects introduced during the Covid-19 pandemic exacerbated the issue of unpredictability and variance in infrastructure design for neurodivergent people.<br><br>*Barriers to decision making - barriers*<br>Neurodivergent people reported in other research that they found the variety, inconsistency and lack of warning about LTNs especially difficult to cope with. |
| **Georgescu et al. 2024** |
| *Pavements and surfaces – barriers*<br>- Lack of visual contrast between pavement and street was reported as a barrier for people with visual disabilities.<br>- Cobblestones or uneven pavers with large joints created difficulties for people with mobility disabilities.<br>- Drain grates were a barrier for people using wheeled mobility devices.<br>- Sidewalk gaps and hard or soft surfaces created barriers for wheelchair users, scooter users, walking assistive device users, visually impaired individuals, and those with situational mobility restriction.<br><br>*Tactile paving - barriers*<br>- Tactile paving was reported as a barrier for wheelchair users and scooter users.<br><br>*Kerbs - barrier*<br>- The height of kerbs was a barrier for wheelchair users, making it challenging to traverse the kerb and causing wheels to get stuck.<br>Street elements such as kerbs were often reported as being improperly designed, too narrow, too steep, or without adequate landing space, resulting in barriers. |

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| *Crossings - barriers*<br>- Signals at crossings, including visual, audio, and accessible pedestrian signals (APS), were barriers for both wheelchair users and people with visual disabilities when absent or not functioning.<br>- Push button placement at crossings was also a barrier, as when positioned too high or too low it can become inaccessible for wheelchair users.<br><br>*Pavements and surfaces – facilitators*<br>- Sidewalk gaps and hard or soft surfaces facilitated mobility for visually impaired individuals.<br><br>*Tactile paving – facilitator*<br>- Tactile paving was reported as a facilitator for visually impaired individuals.<br><br>*Kerbs – facilitator*<br>- People with visual disabilities preferred high kerbs for navigation and perceived lowered kerbs as barriers, as kerb height signals the end of the pavement. |
| **Kapsalis et al. 2024** |
| Problematic pathway– barrier<br>- Pathway characteristics such as narrow, rough, uneven, sloped sidewalks or improper curb ramps were consistently identified as major obstacles that restricted outdoor MobAD accessibility.<br><br>*Problematic pathway - impact*<br>- Narrow, rough, uneven, sloped sidewalk pathway or improper curb ramps features frequently resulted in trips and falls.<br><br>*Tactile paving – barrier*<br>- The uneven surfaces created by tactile guides running perpendicular to the direction of travel were reported to disrupt smooth mobility, creating barriers for a wide range of MobAD users.<br><br>*Tactile paving – impact*<br>- The uneven surfaces created by tactile guides running perpendicular to the direction of travel were found to cause fatigue and increase instability for MobAD users, highlighting a clash of accessibility provisions where Tenji blocks support navigation for visually impaired individuals but act as a barrier for those relying on mobility<br><br>*Safety concerns and subordinate effects due to inaccessible pathways- impact*<br>- Narrow pathways led to injurious accidents, limited self-esteem, navigation challenges, and an unwillingness to socialise.<br>- Rough and non-uniform pathways resulted in injurious accidents, fatigue and physical pain, and an unwillingness to socialise.<br>- Uneven pathways caused injurious accidents, limited self-esteem, navigation challenges, an unwillingness to socialise, and a loss of contact with nature.<br>- Sloped pathways contributed to cardio-respiratory strain, navigation challenges, safety risks, an unwillingness to socialise, and a loss of contact with nature.<br>- Improper curb-ramps created navigation challenges, safety risks, and an unwillingness to socialise.<br><br>- Safety fears from problematic pathway characteristics had spill-over effects on the independent navigation of MobAD users.<br>- Curb ramps that failed to meet accessibility guidelines posed risks of tipping over or being struck by traffic.<br>- The absence of curb ramps created significant inconvenience for MobAD users in city-centre environments.<br>- Insecure pathway conditions often left MobAD users psychosocially dysfunctional.<br>- Inaccessible pathways coerced MobAD users into isolating themselves from urban life and society and imposed psychological harm on vulnerable individuals.<br>- Cracked or rough surfaces were associated with harmful whole-body vibrations<br>- Cross-sloped pathways exceeding 8% were linked to increased physiological strain.<br>- Infrastructure elements such as poorly designed or absent dropped kerbs posed a risk of tipping and consequently increasing the risk of being struck by traffic. |

| Seetharaman et al. 2024 |
|---|
| *Sidewalk and ground surface quality issues – barriers*<br>- Cracks, bumps, undulation, unevenness, potholes, and slipperiness hinder mobility for people with visual disabilities.<br>- Suboptimal level changes such as small or uneven kerbs, minimal separation between adjacent kerb ramps, and unmarked stairs create obstacles for people with visual disabilities.<br>- Level changes such as displaced concrete slabs and steps on the pavement are difficult for people with visual disabilities to detect and need to be highlighted with hazard signs or contrast warning.<br><br>*Sidewalk and ground surface quality issues – impact*<br>- For people with visual disabilities, poor surface conditions such as cracks, bumps, undulation, unevenness, potholes, and slipperiness create depth perception difficulties and increase the risk of trips, falls, and injury.<br>- People with visual disabilities find it harder to detect kerbs, drop-offs, and other obstacles at eye level, which increases the risk of falls and injury, while surface-level obstacles are easier to detect.<br>- People with visual disabilities are more likely to avoid walking in areas with uneven level changes, such as kerbs, ramps, stairs, or displaced slabs, if they perceive them to be unsafe.<br><br>*Ambient conditions - barrier*<br>- Poor or inconsistent lighting hinders the use of built environment features such as kerbs, kerb ramps, and landmarks, creating confusion and reducing the identifiability of features for people with low vision.<br><br>*Street crossings - barriers*<br>- Lack of pedestrian signals, defunct signals, or insufficient crossing time hinder safe mobility for people with visual disabilities.<br>- Complex intersection layouts, such as roundabouts, reduce clear sightlines for pedestrians and drivers, making crossings difficult and unsafe.<br><br>*Tactile cues – barriers*<br>- Negative characteristics of tactile cues include slipperiness when wet, poor textural contrast, and bumps that cause white canes to get stuck.<br><br>*Tactile cues– facilitators*<br>- Sufficient textural or tactile contrast between surfaces improves the detectability of tactile cues.<br>- Partially sighted people may also detect tactile cues through visual contrast with surrounding surfaces, although this can be compromised by snow, moisture, or poor lighting at night.<br>- Precise placement of tactile cues is important; for example, textural markings and tactile surfaces on kerb ramps should be aligned with crossings to guide people with visual disabilities safely along a straight path across the street.<br><br>*Kinaesthetic cues – barrier*<br>- A lack of tactile and kinaesthetic cues, such as the absence of kerbs or clear demarcation between road, bike path, and pedestrian path, as seen in “Shared Space” designs, can be disorienting for people with visual disabilities.<br><br>*Kinaesthetic cues – impact*<br>- The absence of tactile and kinaesthetic cues, as in Shared Space designs without kerbs or demarcations, makes it difficult for people with visual disabilities to distinguish pedestrian zones from roads, creating unsafe situation |

### 7.5 Information available on request

The protocol is available online: https://osf.io/sv9nc/
Search strategies and list of excluded studies is presented below in the Appendices.

## 8. ADDITIONAL INFORMATION

### 8.1 Conflicts of interest

The authors declare they have no conflicts of interest to report.


### 8.2 Acknowledgements

The authors would like to thank Lisa Hurt, Beti-Jane Ingram, Catherine Purcell and Tom Wharf for their time, expertise, and contributions during stakeholder meetings in guiding the focus of the review and interpretation of findings.

# 9. APPENDIX

## Appendix 1: Database searches

### Ovid MEDLINE(R) ALL <1946 to July 23, 2025>

| # | Query | Results from 24 July 2025 |
|---|---|---|
| 1 | (active travel* or active transport* or active commuting or active mobility or active accessibility or active transit or active living).mp. | 24,625 |
| 2 | (walkability or bikeability or cyclability).mp. | 4,012 |
| 3 | walk*.tw. | 166,285 |
| 4 | exp Walking/ | 74,389 |
| 5 | (wheeling or wheelchair or mobility aid* or mobility assistive device* or mobility scooter*).tw. | 9,485 |
| 6 | exp Wheelchairs/ | 5,836 |
| 7 | (cycling or bicycle or bicycling or bike or biking or e-bike or ebike).tw. | 109,679 |
| 8 | exp Bicycling/ | 13,797 |
| 9 | (accessible travel or sustainable travel or sustainable mobility or equitable mobility).tw. | 200 |
| 10 | (non motori#ed transport* or human powered transport*).tw. | 28 |
| 11 | (green commuting or low carbon travel).tw. | 21 |
| 12 | pedestrian*.tw. | 8,365 |
| 13 | 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 | 342,204 |
| 14 | exp Built Environment/ | 1,774 |
| 15 | exp Environment Design/ | 9,307 |
| 16 | exp Architectural Accessibility/ | 1,513 |
| 17 | ((built or build or physical or street or neighbo?rhood or urban*) adj2 (environment* or attribute* or characteristic*)).tw. | 48,840 |
| 18 | (built form or urban form).tw. | 358 |
| 19 | (environment design or sidewalk design).tw. | 175 |
| 20 | (environment* barrier* or environment* characteristic* or structural barrier*).tw. | 8,507 |
| 21 | infrastructur*.tw. | 74,416 |
| 22 | streetscape*.tw. | 155 |
| 23 | (walkable neighbo?rhood* or low traffic neighbo?rhood* or public transport integration).tw. | 255 |

| | | |
|---|---|---|
| 24 | (bus stop* or cycle track* or cycle lane* or continuous footpath* or continuous footway* or continuous sidewalk* or pedestrian intersection* or boarding ramp* or exit construction* or dropped kerb* or dropped curb* or curb ramp* or kerb ramp* or tactile paving or lighting or visibility or wayfinding or inclusive sign*).tw. | 39,879 |
| 25 | (pedestrian* adj friend*).tw. | 76 |
| 26 | ((time or audible or tactile) adj2 crossing).tw. | 437 |
| 27 | ((pedestrian or zebra or pelican or puffin or toucan) adj crossing).tw. | 219 |
| 28 | ((footpath* or footway* or sidewalk*) adj2 (width or clutter* or declutter*)).tw. | 12 |
| 29 | shared space.tw. | 212 |
| 30 | ((15 minute* or fifteen minute*) adj (city or cities)).tw. | 23 |
| 31 | 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 | 175,871 |
| 32 | exp Persons with Disabilities/ | 78,285 |
| 33 | Persons with Visual Disabilities/ | 2,964 |
| 34 | exp Persons with Hearing Disabilities/ | 3,498 |
| 35 | exp Amputees/ | 4,747 |
| 36 | exp Mobility Limitation/ | 5,625 |
| 37 | exp Vision Disorders/ | 82,546 |
| 38 | exp Hearing Disorders/ | 102,627 |
| 39 | exp Developmental Disabilities/ | 23,701 |
| 40 | exp Intellectual Disability/ | 110,448 |
| 41 | exp Persons with Intellectual Disabilities/ | 3,722 |
| 42 | (disability or disabilities or disabled).tw. | 297,092 |
| 43 | (blind or deaf or partially sighted or low vision).tw. | 250,580 |
| 44 | ((hearing or sensory or visual* or mobility) adj1 (challenge* or deficit or impair* or limitation or limited or reduc* or restrict*)).tw. | 58,836 |
| 45 | (neurodivergen* or neurodivers*).tw. | 901 |
| 46 | (developmental delay* or developmental disab* or intellectual* disab*).tw. | 54,048 |
| 47 | 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 | 879,861 |
| 48 | 13 and 31 and 47 | 777 |
| 49 | limit 48 to yr="2014 -Current" | **482** |

**Scopus: 24/07/2025**

| **#** | **Query** | **Results from** |
|---|---|---|

| | | 24 July 2025 |
|---|---|---|
| 1 | TITLE-ABS-KEY ("active travel*" or "active transport*" or "active commuting" or "active mobility" or "active accessibility" or "active transit" or "active living") | 45,035 |
| 2 | TITLE-ABS-KEY (walkability or bikeability or cyclability) | 14,858 |
| 3 | TITLE-ABS-KEY (walk*) | 442,110 |
| 4 | TITLE-ABS-KEY (wheeling or wheelchair or "mobility aid*" or "mobility assistive device*" or "mobility scooter*") | 27,775 |
| 5 | TITLE-ABS-KEY (cycling or bicycle or bicycling or biking or e-bike or ebike) | 368,408 |
| 6 | TITLE-ABS-KEY (“accessible travel" or "sustainable travel" or "sustainable mobility" or "equitable mobility") | 6,061 |
| 7 | TITLE-ABS-KEY ("non motori?ed transport*" or "human powered transport*") | 641 |
| 8 | TITLE-ABS-KEY ("green commuting" or "low carbon travel") | 275 |
| 9 | TITLE-ABS-KEY ( pedestrian* ) | 69,713 |
| 10 | OR 1-9 | 342,204 |
| 11 | TITLE-ABS-KEY ((built or build or physical or street or neighbo*rhood or urban*) W/2 (environment* or attribute* or characteristic*)) | 308,946 |
| 12 | TITLE-ABS-KEY ("built form" or "urban form") | 9,352 |
| 13 | TITLE-ABS-KEY ("environment design" or "sidewalk design") | 12,229 |
| 14 | TITLE-ABS-KEY ("environment* barrier*" or "environment* characteristic*" or "structural barrier*") | 24,237 |
| 15 | TITLE-ABS-KEY (infrastructur*) | 639,532 |
| 16 | TITLE-ABS-KEY (streetscape*) | 1,603 |
| 17 | TITLE-ABS-KEY ("walkable neighbo*rhood*" or "low traffic neighbo*rhood*" or "public transport integration") | 561 |
| 18 | TITLE-ABS-KEY ("bus stop*" or "cycle track*" or "cycle lane*" or "continuous footpath*" or "continuous footway*" or "continuous sidewalk*" or "pedestrian intersection*" or "boarding ramp*" or "exit construction*" or "dropped kerb*" or "dropped curb*" or "curb ramp*" or "kerb ramp*" or "tactile paving" or lighting or visibility or wayfinding or "inclusive sign*") | 279,272 |
| 19 | TITLE-ABS-KEY (pedestrian* W/1 friend*) | 705 |
| 20 | TITLE-ABS-KEY ((time or audible or tactile) W/2 crossing) | 5,079 |
| 21 | TITLE-ABS-KEY ((pedestrian or zebra or pelican or puffin or toucan) W/1 crossing) | 3,884 |
| 22 | TITLE-ABS-KEY ((footpath* or footway* or sidewalk*) W/2 (width or clutter* or declutter*)) | 215 |
| 23 | TITLE-ABS-KEY ("shared space") | 3,176 |
| 24 | TITLE-ABS-KEY ("15 minute city" OR "15 minute cities" OR "fifteen minute city" OR "fifteen minute cities") | 355 |
| 25 | OR 11-24 | 1,248,053 |
| 26 | TITLE-ABS-KEY (disability or disabilities or disabled) | 627,146 |
| 27 | TITLE-ABS-KEY (blind or deaf or "partially sighted" or "low vision") | 548,046 |
| 28 | TITLE-ABS-KEY ((hearing or sensory or visual* or mobility) W/1 (challenge* or deficit or impair* or limitation or limited or reduc* or restrict*)) | 269,298 |

| | | |
|---|---|---|
| 29 | TITLE-ABS-KEY (neurodivergen* or neurodivers*) | 3,478 |
| 30 | TITLE-ABS-KEY ("developmental delay*" or "developmental disab*" or "intellectual* disab*") | 103,952 |
| 31 | TITLE-ABS-KEY (amputee*) | 13,784 |
| 32 | OR 26-31 | 1,407,951 |
| 33 | 10 and 25 and 32 | 2491 |
| 34 | limit 33 to yr="2014 -Current" | **1822** |

**TRID: 25/07/2025**

| # | **Query:**<br>Source: **TRIS, ITRD, TRB, RIP, UTC, ATRI, USDOT, STATEDOT**<br>**2014 - 2025** | **Results from 25 Jul 2025** |
|---|---|---|
| 1 | Articles and papers title containing "active travel*" or "active transport*" or "active commuting" or "active mobility" or "active accessibility" or "active transit" or "active living" | 638 |
| 2 | Articles and papers abstract containing "active travel*" or "active transport*" or "active commuting" or "active mobility" or "active accessibility" or "active transit" or "active living" | 1804 |
| 3 | Articles and papers title containing walkability or bikeability or cyclability | 383 |
| 4 | Articles and papers abstract containing walkability or bikeability or cyclability | 787 |
| 5 | Articles and papers title containing walk* | 1495 |
| 6 | Articles and papers abstract containing walk* | 6299 |
| 7 | Articles and papers title containing wheeling or wheelchair or "mobility aid*" or "mobility assistive device*" or "mobility scooter*" | 67 |
| 8 | Articles and papers abstract containing wheeling or wheelchair or "mobility aid*" or "mobility assistive device*" or "mobility scooter*" | 216 |
| 9 | Articles and papers title containing cycling or bicycle or bicycling or biking or e-bike or ebike | 3098 |
| 10 | Articles and papers abstract containing cycling or bicycle or bicycling or biking or e-bike or ebike | 7208 |
| 11 | Articles and papers title containing “accessible travel" or "sustainable travel" or "sustainable mobility" or "equitable mobility" | 260 |
| 12 | Articles and papers abstract containing “accessible travel" or "sustainable travel" or "sustainable mobility" or "equitable mobility" | 1129 |
| 13 | Articles and papers title containing "non motorized transport" or "non motorised transport*" or "human powered transport*" | 25 |
| 14 | Articles and papers abstract containing "non motorized transport" or "non motorised transport*" or "human powered transport*" | 99 |
| 15 | Articles and papers title containing "green commuting" or "low carbon travel" | 16 |
| 16 | Articles and papers abstract containing "green commuting" or "low carbon travel" | 55 |
| 17 | Articles and papers title containing "pedestrian travel" | 14 |
| 18 | Articles and papers abstract containing "pedestrian travel" | 61 |
| 19 | OR 1-18 | 13,982 |
| 20 | Articles and papers title containing "built environment" or "build environment" or "physical environment" | |

| | | |
|---|---|---|
| 21 | Articles and papers abstract containing "built environment" or "build environment" or "physical environment" | 2745 |
| 22 | Articles and papers title containing "built form" or "urban form" | 142 |
| 23 | Articles and papers abstract containing "built form" or "urban form" | 467 |
| 24 | Articles and papers title containing "environment design" or "sidewalk design" | 8 |
| 25 | Articles and papers abstract containing "environment design" or "sidewalk design" | 30 |
| 26 | Articles and papers title containing "environment* barrier*" or "environment* characteristic*" or "structural barrier* | 64 |
| 27 | Articles and papers abstract containing "environment* barrier*" or "environment* characteristic*" or "structural barrier*" | 620 |
| 28 | Articles and papers title containing streetscape* | 69 |
| 29 | Articles and papers abstract containing streetscape* | 171 |
| 30 | Articles and papers title containing "walkable neighborhood*" or "walkable neighbourhood*" or "low traffic neighborhood*" or "low traffic neighbourhood*" or "public transport integration" | 26 |
| 31 | Articles and papers abstract containing "walkable neighborhood*" or "walkable neighbourhood*" or "low traffic neighborhood*" or "low traffic neighbourhood*" or "public transport integration" | 117 |
| 32 | Articles and papers title containing "bus stop*" or "cycle track*" or "cycle lane*" or "continuous footpath*" or "continuous footway*" or "continuous sidewalk*" or "pedestrian intersection*" or "boarding ramp*" or "exit construction*" or "dropped kerb*" or "dropped curb*" or "curb ramp*" or "kerb ramp*" or "tactile paving" or lighting or visibility or wayfinding or "inclusive sign*" | 909 |
| 33 | Articles and papers abstract containing "bus stop*" or "cycle track*" or "cycle lane*" or "continuous footpath*" or "continuous footway*" or "continuous sidewalk*" or "pedestrian intersection*" or "boarding ramp*" or "exit construction*" or "dropped kerb*" or "dropped curb*" or "curb ramp*" or "kerb ramp*" or "tactile paving" or lighting or visibility or wayfinding or "inclusive sign*" | 4479 |
| 34 | Articles and papers title containing "pedestrian friendly" | 9 |
| 35 | Articles and papers abstract containing "pedestrian friendly" | 153 |
| 36 | Articles and papers title containing "audible crossing" or "tactile crossing" | 0 |
| 37 | Articles and papers abstract containing "audible crossing" or "tactile crossing" | 0 |
| 38 | Articles and papers title containing "pedestrian crossing" or "zebra crossing" or "pelican crossing" or "puffin crossing" or "toucan crossing" | 226 |
| 39 | Articles and papers abstract containing "pedestrian crossing" or "zebra crossing" or "pelican crossing" or "puffin crossing" or "toucan crossing" | 595 |
| 40 | Articles and papers title containing "shared space" | 59 |
| 41 | Articles and papers abstract containing "shared space" | 122 |
| 42 | Articles and papers title containing "15 minute city" OR "15 minute cities" OR "fifteen minute city" OR "fifteen minute cities" | 43 |
| 43 | Articles and papers abstract containing "15 minute city" OR "15 minute cities" OR "fifteen minute city" OR "fifteen minute cities" | 58 |
| 44 | Articles and papers title containing clutter or declutter | 14 |
| 45 | Articles and papers abstract containing clutter or declutter | 103 |
| 46 | Articles and papers title containing "footpath width" or "sidewalk width" | 0 |

| | | |
|---|---|---|
| 47 | Articles and papers abstract containing "footpath width" or "sidewalk width" | 48 |
| 48 | OR 20-47 | 9112 |
| 49 | Articles and papers title containing infrastructur* | 3883 |
| 50 | Articles and papers abstract containing infrastructur* | 15000 |
| 51 | OR 49-50 | 16,585 |
| 52 | Articles and papers title containing disability or disabilities or disabled | 315 |
| 53 | Articles and papers abstract containing disability or disabilities or disabled | 1187 |
| 54 | Articles and papers title containing blind or deaf or "partially sighted" or "low vision" | 163 |
| 55 | Articles and papers abstract containing blind or deaf or "partially sighted" or "low vision" | 621 |
| 56 | Articles and papers title containing "hearing impair*" or "sensory impair*" or "visual* impair*" or "mobility impair*" | 69 |
| 57 | Articles and papers abstract containing "hearing impair*" or "sensory impair*" or "visual* impair*" or "mobility impair*" | 248 |
| 58 | Articles and papers title containing "hearing deficit*" or "visual* deficit*" or "mobility deficit*" | 1 |
| 59 | Articles and papers abstract containing "hearing deficit*" or "visual* deficit*" or "mobility deficit*" | 5 |
| 60 | Articles and papers title containing "limited hearing" or "limited mobility" | 2 |
| 61 | Articles and papers abstract containing "limited hearing" or "limited mobility" | 37 |
| 62 | Articles and papers title containing "reduced hearing" or "reduced vision" or "reduced mobility" or "restricted hearing" or "restricted vision" or "restricted mobility" | 62 |
| 63 | Articles and papers abstract containing "reduced hearing" or "reduced vision" or "reduced mobility" or "restricted hearing" or "restricted vision" or "restricted mobility" | 105 |
| 64 | Articles and papers title containing neurodivergent or neurodiversity | 1 |
| 65 | Articles and papers abstract containing neurodivergent or neurodiversity | 2 |
| 66 | Articles and papers title containing "developmental delay*" or "developmental disab*" or "intellectual* disab*" | 10 |
| 67 | Articles and papers abstract containing "developmental delay*" or "developmental disab*" or "intellectual* disab*" | 22 |
| 68 | Articles and papers title containing amputee* | 0 |
| 69 | Articles and papers abstract containing amputee* | 0 |
| 70 | OR 52-69 | 2139 |
| 71 | 19 AND 48 AND 70 | 81 |
| 72 | 10 AND 51 AND 70 | 54 |
| 73 | 71 OR 72 | **119** |

## Appendix 2: List of organisational websites searched

| |
|---|
| Active Travel England<br>https://www.activetravelengland.gov.uk/ |
| All-Party Parliamentary Group for Cycling and Walking (APPGCW)<br>https://appgcw.org |
| CIHT<br>https://www.ciht.org.uk/ |
| Cycling UK<br>https://www.cyclinguk.org/ |
| Department for Infrastructure<br>https://www.infrastructure-ni.gov.uk/ |
| Department of Transport<br>https://www.gov.uk/government/organisations/department-for-transport |
| Disability Wales<br>https://www.disabilitywales.org/ |
| Disabled Persons Transport Advisory Committee (DPTAC)<br>https://www.gov.uk/government/organisations/disabled-persons-transport-advisory-committee |
| Dutch Cycling Embassy<br>https://dutchcycling.nl/ |
| EU Urban Mobility Observatory<br>https://urban-mobility-observatory.transport.ec.europa.eu/index_en |
| Institution of Civil Engineers<br>https://ice.org.uk/ |
| Inclusive design for getting outdoors<br>https://www.idgo.ac.uk/ |
| Inclusive Mobility and Transport Advisory Committee<br>https://www.imtac.org.uk/ |
| Living Streets<br>https://www.livingstreets.org.uk/ |
| Motability Foundation<br>https://www.motabilityfoundation.org.uk/ |
| National Centre for Active Travel<br>https://www.ncat.uk/ |
| National Transport Authority<br>https://www.nationaltransport.ie |
| Pedal Power<br>https://www.cardiffpedalpower.org/about-us |
| Physical Activity Through Sustainable Approaches (PASTA)<br>https://www.pastaproject.eu/ |
| POLIS<br>https://www.polisnetwork.eu |

| |
|---|
| Public Health Scotland<br>https://www.publichealthscotland.scot/ |
| Public Health Wales<br>https://phw.nhs.wales |
| Royal National Institute of Blind People (RNIB)<br>https://www.rnib.org.uk/ |
| Sustrans<br>https://www.sustrans.org.uk/ |
| Transport for All<br>https://www.transportforall.org.uk/ |
| Transport for Quality of Life<br>www.transportforqualityoflife.com |
| Transport for Scotland<br>https://www.transport.gov.scot/ |
| UK Health Security Agency<br>https://researchportal.ukhsa.gov.uk/en/searchAll/index/?search=active+travel&pageSize=25&showAdvanced=false&allConcepts=true&inferConcepts=true&searchBy=PartOfNameOrTitle |
| Walking Scotland<br>https://walkingscotland.org.uk/ |
| Welsh Government<br>https://www.gov.wales |
| Welsh Parliament – Senedd Research<br>https://research.senedd.wales/ |
| Wheels for Wellbeing<br>https://wheelsforwellbeing.org.uk/ |

## Appendix 3: Supplementary searches

### ICE (Emerald insight)

Searched 30th July 2025

| Search |
|---|
| Advanced Search: Title: “active travel” |
| Advanced Search: Title: active travel |
| Advanced Search: “active travel” AND disability |
| Advanced Search: “active travel” AND mobility |
| Advanced Search: “active travel” AND impaired |
| TOTAL |

### Overton

Searched 31st July 2025 and 6th August 2025

| Search |
|---|
| title: "active travel" AND ("built environment" OR "physical environment" OR infrastructur*) AND (disabil* OR disabled OR impair* OR blind OR deaf OR mobility OR immobile* OR neurodivergen* OR neurodivers*) |
| abstract: "active travel" AND ("built environment" OR "physical environment" OR infrastructur*) AND (disabil* OR disabled OR impair* OR blind OR deaf OR mobility OR immobile* OR neurodivergen* OR neurodivers*) |
| title: "active travel" AND (disabil* OR disabled OR impair* OR blind OR deaf OR mobility OR immobil* OR neurodivergen* OR neurodivers*) |
| abstract: "active travel" AND (disabil* OR disabled OR impair* OR blind OR deaf OR mobility OR immobil* OR neurodivergen* OR neurodivers*) |
| Title: “active travel” from OECD members: 2014-2025 |

### Google Advanced Search

Searched 7th August 2025

| Search |
|---|
| in title:"active travel" AND (disabil* OR disabled OR impair* OR blind OR deaf OR mobility OR immobil* OR neurodivergen* OR neurodivers*) |
| in text:"active travel" AND (disabil* OR disabled OR impair* OR blind OR deaf OR mobility OR immobil* OR neurodivergen* OR neurodivers*) |
| |

| Database | Search Results |
|---|---|
| ICE | 5 |
| Overton | 0 |
| Google | 16 |
| Organisational websites | 34 |
| Review unpicking (grey literature) | 1 |
| Review unpicking (primary research) | 0 |
| Total | 56 |
| Manual De-duplication | 12 |
| New Total for title and abstract screening | 44 |
| New total for full text screening | 36 |
| Included primary research | 5 |
| Included review | 1 |
| Excludes | 30 |

## Appendix 4: Studies excluded from the review on full text screening

### Studies excluded from database searches

**Reason for exclusion: Languages other than English**

**1.** da Silva Pereira, R. S. Martins, M. M. F. P. Gomes, B. P. Dornelles Schoeller, S. D. Laredo-Aguilera, J. A. Ribeiro, I. and Cunha, P. (2018).
Municipalities and the promotion of architectural accessibility.
https://doi.org/10.12707/RIV18022

**Reason for exclusion: Evidence synthesis - No relevant studies identified**

2. Dogra, S. Lochan-Aristide, M. Patterson, M. Tan, M. C. and Lloyd, M. (2025).
Barriers and facilitators to active transportation in people of color and people with disabilities: a rapid review.
https://doi.org/10.1007/s10389-024-02393-x

3. Gamache, S. and Routhier, F. and Morales, E. and Vandersmissen, M. H. and Boucher, N. (2019).
Mapping review of accessible pedestrian infrastructures for individuals with physical disabilities.
https://doi.org/10.1080/17483107.2018.1449018

**Reason for exclusion: Evidence synthesis – Not about active travel**

4. Prescott, M. Labbé, D. Miller, W. C. Borisoff, J. Feick, R. and Mortenson, W. B. (2020).
Factors that affect the ability of people with disabilities to walk or wheel to destinations in their community: a scoping review.
https://doi.org/10.1080/01441647.2020.1748139

**Reason for exclusion: Wrong study design – Narrative review (cannot be unpicked)**

5. Rahman Bhuiya, M. M. R. Shao, W. Jones, S. and Liu, J. (2025).
Toward a comprehensive framework for accessibility measures for movement-challenged persons
https://doi.org/10.1177/03611981241270162

6. Ramirez-Saiz, A. Baquero Larriva, M. T. Jiménez-Martín, D. and Alonso, A. (2025).
Enhancing urban mobility for all: the role of universal design in supporting social inclusion for older adults and people with disabilities
https://doi.org/10.3390/urbansci9020046

7. Venkataram, P. S. Flynn, J. A. Rahman Bhuiya, M. M. R. Barajas, J. M. and Handy, S. (2024).
Availability and usability of transportation for people with disabilities depending on what the user is expected to do.
https://doi.org/10.1016/j.trip.2023.100960

**Reason for exclusion: Wrong study design – Laboratory studies or prototypes**

8. Bentzen, B. L. Barlow, J. M. Scott, A. C. Guth, D. Long, R. and Graham, J. (2017).
Wayfinding problems for blind pedestrians at noncorner crosswalks novel solution.
https://doi.org/10.3141/2661-14

9. Bentzen, B. L. Scott, A. C. Myers, L. (2020).
Delineator for Separated Bicycle Lanes at Sidewalk Level English.
https://doi.org/10.1177/0361198120922991

10. Bentzen, B. L. Scott, A. C. Barlow, J. M. Emerson, R. W. and Graham, J. (2022).
Guidance surface to help vision-disabled pedestrians locate crosswalks and align to cross.
https://doi.org/10.1177/03611981221090934

11. Farries, K. Baldock, M. Thompson, J. Stokes, C. and Unsworth, C. A. (2024).

| |
|---|
| Entrapment and extraction of wheelchairs at flange gaps with and without flange gap fillers at pedestrian railway crossings. https://doi.org/10.1080/17483107.2023.2296954 |
| 12. Lauria, A. Secchi, S. and Vessella, L. (2019).<br>Visual wayfinding for partially sighted pedestrians - The use of luminance contrast in outdoor pavings.<br>https://doi.org/10.1177/1477153518792978 |
| 13. Scott, A. C. Myers, L. Schroeder, B. Worth O'Brien, S. Kent, M. Mello, M. and Bentzen, B. L. (2025).<br>Making quick-build sidewalk extensions accessible to pedestrians with vision disabilities.<br>https://doi.org/10.1177/03611981241275539 |
| 14. Shin, K. McConville, R. Metatla, O. Chang, M. Han, C. Lee, J. and Roudaut, A. (2022).<br>Outdoor localization using ble rssi and accessible pedestrian signals for the visually impaired at intersections.<br>https://doi.org/10.3390/s22010371 |
| **Reason for exclusion: Wrong study design – Guideline development** |
| 15. Gamache, S. Routhier, F. Morales, E. Vandersmissen, M. H. Boucher, N. McFadyen, B. J. and Noreau, L. (2020).<br>Methodological insights into the scientific development of design guidelines for accessible urban pedestrian infrastructure.<br>https://doi.org/10.1080/10630732.2019.1632677 |
| 16. Jeong, D. Kim, J. Shrestha, S. Yeo, H. and Lim, L. (2025).<br>Accessible bus stops: evaluating bus stop design guidelines for diverse transportation-disadvantaged groups.<br>https://doi.org/10.1080/13574809.2025.2505742 |
| **Reason for exclusion: Wrong population** |
| 17. Baquero, B. I. Berney, R. Romano, E. F. T. Hicks, O. Getch, R. Hall, C. Mooney, S. J. Rosenberg, D. Shannon, K. L. and Saelens, B. E. (2024).<br>Advancing active transportation through mobility justice and centering community.<br>https://doi.org/10.1089/heq.2024.0087 |
| 18. Bozovic, T. Hinckson, E. and Smith, M. (2024).<br>Pedestrian crossings: Design recommendations do not reflect users' experiences in a car-dominated environment in Auckland, New Zealand.<br>https://doi.org/10.1016/j.tra.2024.104169 |
| 19. Earl, R. Falkmer, T. Girdler, S. Morris, S. L. and Falkmer, M. (2018).<br>Viewpoints of pedestrians with and without cognitive impairment on shared zones and zebra crossings.<br>https://doi.org/10.1371/journal.pone.0203765 |
| 20. Jayakody, R. R. J. C. Keraminiyage, K. Alston, M. and Dias, N. (2018). Design factors for a successful shared space street (SSS) design. https://doi.org/10.3846/ijspm.2018.3685 |
| 21. MacKnight, H. Ohlms, P. and Donna Chen, T.(2022).<br>Curb ramp and accessibility element upgrade prioritization: a literature review and analysis of multi-state survey data<br>https://doi.org/10.17411/jacces.v12i1.334 |
| 22. Rosa, M. P. (2022)<br>Experimental education of collaborative design. the case of an inclusive bus stop for a tourist transportation hub. International Journal of Engineering Education, 38(3), p. 589-599. |
| **Reason for exclusion: Not about change in active travel infrastructure** |
| 23. Andrade, A. Escudero, M. Parker, J. Bartolucci, C. Seriani, S. and Aprigliano, V. (2024). |

| | |
|---|---|
| | Perceptions of people with reduced mobility regarding universal accessibility at bus stops: a pilot study in Santiago, Chile.<br>https://doi.org/10.1016/j.cstp.2024.101190 |
| 24. | Bozovic, T. Hinckson, E. Stewart, T. and Smith, M. (2024).<br>How street quality influences the walking experience: an inquiry into the perceptions of adults with diverse ages and disabilities<br>https://doi.org/10.1080/17549175.2021.2005121 |
| 25. | Buliung, R. Niece, J. and Solomon, R. (2024).<br>Toward an understanding of disabled person's satisfaction with pedestrian infrastructure in Toronto, Canada.<br>https://doi.org/10.32866/001c.123970 |
| 26. | Campisi, T. Ignaccolo, M. Inturri, G. Tesoriere, G. and Torrisi, V. (2021).<br>Evaluation of walkability and mobility requirements of visually impaired people in urban spaces.<br>https://doi.org/10.1016/j.rtbm.2020.100592 |
| 27. | Clayton, W. Parkin, J. and Billington, C. (2017).<br>Cycling and disability: a call for further research.<br>https://doi.org/10.1016/j.jth.2017.01.013 |
| 28. | Cox, B. and Bartle, C. (2020).<br>A qualitative study of the accessibility of a typical UK town cycle network to disabled cyclists<br>https://doi.org/10.1016/j.jth.2020.100954 |
| 29. | Finnigan, K. A. (2024).<br>Sensory responsive environments: a qualitative study on perceived relationships between outdoor built environments and sensory sensitivities.<br>https://doi.org/10.3390/land13050636 |
| 30. | Harada, T. and Waitt, G. (2023).<br>Geographies, mobilities and politics for disabled people: power-assisted device practice.<br>https://doi.org/10.1080/00049182.2023.2187512 |
| 31. | Harris, F. Yang, H. Y. and Sanford, J. (2015).<br>Physical environmental barriers to community mobility in older and younger wheelchair users.<br>https://doi.org/10.1097/TGR.0000000000000043 |
| 32. | Jelijs, B. Heutink, J. de Waard, D. Brookhuis, K. A. and Melis-Dankers, B. J. M. (2019).<br>Cycling difficulties of visually impaired people<br>https://doi.org/10.1177/0264619619830443 |
| 33. | Korotchenko, A. and Hurd, L. (2014).<br>Power mobility and the built environment: the experiences of older Canadians<br>https://doi.org/10.1080/09687599.2013.816626 |
| 34. | Koutsoklenis, A. and Papadopoulos, K. (2014).<br>Haptic cues used for outdoor wayfinding by individuals with visual impairments.<br>https://doi.org/10.1177/0145482x1410800105 |
| 35. | Lakoud, M. Morales, E. Ruiz-Rodrigo, A. Feillou, I. Mathieu, S. and Routhier, F. (2024).<br>Enhancing shared street accessibility in heritage sites for individuals with visual disabilities: a Canadian perspective.<br>https://dx.doi.org/10.3389/fresc.2024.1419446 |
| 36. | Larrington-Spencer, H. (2025).<br>Autoethnography of disability and active travel in Greater Manchester: encountering (non)citizenship through access controls on traffic-free walking, wheeling and cycling paths.<br>https://doi.org/10.1177/00420980241311728 |

| | |
|---|---|
| 37. McAllister, K. and McBeth, A. and Galway, N. (2022).<br>Autism spectrum condition and the built environment .<br>https://doi.org/10.1080/23748834.2022.2139210 |
| 38. Oliveira Soares, B. and Glaser, M. (2025).<br>Beyond infrastructure: Unpacking the complexity of exclusion and implications for just mobility transitions.<br>https://doi.org/10.1016/j.jtrangeo.2025.104202 |
| 39. Pritchett, R. Bartington, S. and Neil Thomas, G. (2024).<br>Exploring expectations and lived experiences of Low Traffic Neighbourhoods in Birmingham, UK.<br>https://doi.org/10.1016/j.tbs.2024.100800 |
| 40. Pinto, P. C. Assunção, H. and Rosa, M. P. (2020).<br>Senior Tourists' perceptions of tactile paving at bus stops and in the surrounding environment: Lessons learned from project ACCES4ALL.<br>https://doi.org/10.18280/ijsdp.150401 |
| 41. Rosa, M. P. and Pinto, P. C. and Assuncao, H. (2020).<br>An evaluation of the universal accessibility of bus stop environments by senior tourists.<br>https://doi.org/10.18280/ijsdp.150606 |
| 42. Scott, C. Casey, A. F. and Terashima, M. (2025).<br>A guided photovoice approach to explore experts with disabilities' lived experiences of accessibility and usability while engaging in active transportation in a rural Canadian community.<br>https://doi.org/10.1016/j.jth.2025.101994 |
| 43. Shoman, M. and Imine, H. (2023).<br>Assessing the accessibility of cycling infrastructure for wheelchair users: insights from an on-road experiment and online questionnaire study.<br>https://doi.org/10.3390/vehicles5010018 |
| 44. de Oliveira, A. B. E. Bastos Silva, A. M. C. and Ribeiro, A. S. N. (2025).<br>Inclusive pedestrian safety: addressing the needs of blind and non-blind pedestrians in 15-minute cities.<br>https://doi.org/10.3390/land14061190 |
| 45. Remillard, E. T. Campbell, M. L. Koon, L. M. and Rogers, W. A. (2022).<br>Transportation challenges for persons aging with mobility disability: qualitative insights and policy implications.<br>https://doi.org/10.1016/j.dhjo.2021.101209 |
| 46. Velho, R. (2019).<br>Transport accessibility for wheelchair users: a qualitative analysis of inclusion and health.<br>https://doi.org/10.1016/j.ijtst.2018.04.005 |
| 47. Wasfi, R. Steinmetz-Wood, M. and Levinson, D. (2017).<br>Measuring the transportation needs of people with developmental disabilities: A means to social inclusion. https://doi.org/10.1016/j.dhjo.2016.10.008 |


## Studies excluded from grey literature searches


| **Reason for exclusion: Insufficient methodological detail** |
|---|
| 1. Matthews, B. Hibberd, D. Carsten, O. (2024).<br>Road and street crossings for blind and partially sighted people: The importance of being certain. a paper for the Guide Dogs for the Blind Association.<br>The Guide Dogs for the Blind Association<br>Reading |

https://www.guidedogs.org.uk/-/media/project/guidedogs/guidedogsdotorg/files/about-us/what-we-do/research/road-and-street-crossings.pdf

2. Royal National Institute of Blind People (2022).
Voice of the customer: travel and transport.
Royal National Institute of Blind People
London
https://www.rnib.org.uk/professionals/research-and-data/reports-and-insight/voice-of-the-customer-report-travel-and-transport/


**Reason for exclusion: – not about changes in active travel infrastructure**


3. Atkins-Jacobs Joint Venture (2021).
Reference Wheelchair Research - Full Report.
Atkins-Jacobs Joint Venture
https://assets.publishing.service.gov.uk/media/6230946ce90e070ed04a1d6f/reference-wheelchair-report.pdf

4. Bromley, E. McCarthy, H. Vey, H. Liley, C. Thorton, C. Khriakova, E. Moller, L. (2024).
Accessibility and inclusivity of bus and coach.
National Centre for Social Research
London
https://assets.publishing.service.gov.uk/media/66b4f714ce1fd0da7b593558/dft-accessibility-and-inclusivity-of-bus-and-coach-travel.pdf

5. Burns, T. Clermont, A. Holding, R. Oram, M. M. Claris, S. Meeran, G. Kalatha, G. Mazur, P. Lee, R. Arrowsmith, H. Fusco, R. (2022).
Walking for everyone - Making walking and wheeling more inclusive.
Living Streets, London
ARUP, Cardiff
Sustrans, Bristol
https://www.sustrans.org.uk/media/11493/sustrans-arup-walking-for-everyone-inclusive-walking-report.pdf

6. Clery, E. Kiss, Z. Taylor, E. Gill, V. (2017).
Disabled people’s travel behaviour and attitudes to travel.
Department of Transport
London
https://assets.publishing.service.gov.uk/media/5a82f1c6ed915d74e62386b6/disabled-peoples-travel-behaviour-and-attitudes-to-travel.pdf

7. Department of Transport (2021).
Research on experiences of disabled non-users of rail.
Department of Transport
London
https://assets.publishing.service.gov.uk/media/62a840e0e90e0703a1a2243b/research-on-experiences-of-disabled-non-users-of-rail.pdf

8. Gaffga, G. Hagemeister.; C. (2016).
Space for tricycles and bike trailers: necessary provisions.
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Our dedicated team works together with Welsh Government, the NHS, social care, research institutions and the public to deliver vital research to tackle health and social care challenges facing Wales.

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