

ATKINS Jacobs

**Reference Wheelchair
Research
Full report**

Specialist Professional & Technical Services 2 (SPaTS 2)

**Reference Wheelchair Research
Framework 2 (SPaTS 2)**

Table of Contents

Executive Summary	4
Glossary of Terms	7
1. Introduction	8
2. Literature Review	9
2.1. Introduction	9
2.2. Defining Mobility Aids	9
2.3. Trends in Size, Weight and Types of Wheeled Mobility Aids	10
2.4. Trends in Usership and Ownership	16
2.5. Current / New Standards for Built Environment	19
2.6. Vehicle Standards	22
2.7. Conclusion	24
3. Research Approach and Methodology	26
3.1. Introduction	26
3.2. Key Definitions	26
3.3. Study Methodology	26
3.4. Ethical Considerations and Standards	29
4. Results and Analysis	30
4.1. Introduction	30
4.2. Background and Demographic Information	30
4.3. Research Question One: Current types, prevalence, and nature of the use of wheeled mobility aids	32
4.4. Research Question Two: Nature of the activities and journeys that wheeled mobility aids are used for	53
4.5. Research Question Three: Experiences of mobility aid users on public transport services	59
4.6. Research Question Four: How users' needs, and mobility-aid dimensions and uses, are likely to change in the next 20 years	68
5. Key Findings and Next Steps	75
5.1. Reference Wheelchair Specification	75
6. References	80
Appendix A. Other research findings of interest	83
A.1. Other key findings and next steps for improving journey quality for mobility aid users on public transport	83
Appendix B. Persona Narratives	85
B.1. Rural living car dependent	85
B.2. Active hybrid user	85
B.3. Urban living, public transport dependent	85
B.4. Market town living, frequent taxis	86
B.5. Mobility scooter user	86
B.6. Infrequent and restricted traveller	86
Appendix C. Stakeholder Survey	87
Appendix D. User Survey	92
Appendix E. Focus Group Slide Deck Content	97

Tables

Table 2.1 Lengths (occupied)	13
Table 2.2 Widths (unoccupied)	14
Table 2.3 Weights (occupied)	14
Table 2.4 Type of Aid Used Across Previous Studies	15
Table 2.5 Estimated Number of Wheelchair Users Across Previous Studies	18
Table 2.6 Built Environment Standards Specifications	20
Table 2.7 Hackney Carriage Accessibility Conditions.....	24
Table 4.1 Measurements of manual wheelchairs, propelled by assistant	40
Table 4.2 Measurements of manual wheelchairs, propelled by user	41
Table 4.3 Measurement of electric wheelchairs.....	42
Table 4.4 Measurements of mobility scooters.....	43
Table 4.5 Percentage of mobility aid users that fit the height, length, and width reference wheelchair size.....	44
Table 4.6 Comparison of the sample sizes, maximum dimensions and 95 th percentiles across previous studies	44
Table 4.7 Types of mobility aid, segmented by large or bulky items being carried on the aid.....	70
Table 4.8 Measurements of occupied mobility aids where the user also carries large or bulky equipment attached to their aid	70
Table 4.9 Measurements of occupied mobility aids where the user does not carry large or bulky equipment attached to their aid	71

Figures

Figure 2.1 The total number of patients currently registered with England's NHS CCG Wheelchair Services (adults and children)	17
Figure 4.1 Responses to the question "Where do you live?"	30
Figure 4.2 - Responses to the question "What type of organisation are you representing?"	32
Figure 4.3 Responses to the question "What kind of mobility aid do you mainly use?"	33
Figure 4.4 Responses to the question "What would you say are the most commonly used types of wheeled mobility aids in 2021?" (colours correspond to order of key)	34
Figure 4.5 Responses to the question "You've told us that you use a mobility aid, what kind of mobility aid do you mainly use?" (colours correspond to order of key)	34
Figure 4.6 Responses to the question "What factors influence you when choosing a mobility aid?"	35
Figure 4.7 Responses to the question "Where did you obtain your main mobility aid?"	36
Figure 4.8 Responses to "Do you think the most commonly used wheeled mobility aids have changed over the last 20 years?"	37
Figure 4.9 Responses to "In your professional view, which of the following statements do you agree with?"	38
Figure 4.10 Manual Wheelchair Propelled by User.....	45
Figure 4.11 Manual Wheelchair Propelled by Assistant	46
Figure 4.12 Electric Wheelchair.....	47
Figure 4.13 Mobility Scooter (Class 2)	48
Figure 4.14 Mobility Scooter (Class 3)	49
Figure 4.15 Standing Wheelchair	50
Figure 4.16 Example Hybrid Mobility Aid – Wheelchair with Hand Cycle Attachment.....	50
Figure 4.17 Example Hybrid Mobility Aid – Wheelchair with Battery Attachment	51
Figure 4.18 Responses to the question "Do you currently use your mobility aid for travelling on any public transport modes?"	54
Figure 4.19 Responses to the question "What kind of mobility aid do you use?", public transport users only.....	54
Figure 4.20 Responses to "In your experience, how would you rank the most commonly used mobility aids on public transport?"	55
Figure 4.21 Responses to the question "What kind of additional mobility aid do you most use?" ...	56

Figure 4.22 Responses to the question "Please tell us what you mainly use your (most used) additional mobility aid for"	57
Figure 4.23 Response to the question "Do you use any other equipment while travelling with your mobility aid on public transport?"	58
Figure 4.24 Response to "Does your mobility aid ever stop you from making journeys on public transport?"	60
Figure 4.25 Response to "When considering your mobility aids, how would you rate your experience of each of the following public transport modes?"	62
Figure 4.26 Responses to "Thinking about how accessible public transport is when using a mobility aid, how would you rate the user experience of travelling on the following modes of transport?" ...	63
Figure 4.27 Responses to "What issues do you encounter when travelling on public transport with your mobility aid?"	64
Figure 4.28 Responses to "What issues do you think mobility aid users encounter when travelling on public transport with mobility aids? Please rank 1-10 from most relevant to least relevant issue"	64
Figure 4.29 Responses to the question "Would you consider using a hybrid mobility aid in the future"	69
Figure 4.30 - Responses to question "If there is a change in the size/weight of wheeled mobility aids in the UK, what do you believe is driving that change?"	72
Figure 4.31 Responses to "Do you anticipate any change in the size/weight of wheeled mobility aids in the following timeframes?"	73

Executive Summary

Introduction

This study has been undertaken to understand the adequacy of the current reference wheelchair specification in the UK, in terms of meeting the requirements of mobility aid users in 2021. This study also aimed to understand the characteristics, prevalence, and use of wheeled mobility aids in 2021, and whether there will be a need for changes to future accessibility standards for the design of rail, bus, taxi / private hire vehicles (PHVs) and transport infrastructure in order for these to be accessible for mobility aid users into the future.

- The aim of the research was to understand whether the reference wheelchair standard still provides a suitable reference point for the design of vehicles and transport infrastructure for people who use wheeled mobility aids.
- The study combined an assessment of relevant literature together with new primary research.
- This research provides a set of findings and next steps for the Department for Transport to consider, as part of the future-proofing of the transport network, ensuring that accessibility needs are built into transport infrastructure and vehicles in the years to come.

Below we provide a summary of the key aspects of the study methodology, findings and next steps.

Primary Research

Stakeholder survey

- An online survey of stakeholders, including health care professionals, manufacturers, transport operators, and third sector organisations was undertaken to understand their views on mobility aid prevalence, use and size, and their perceptions of the experience mobility aid users have when travelling on public transport services.
- The stakeholder survey was shared with representative organisations such as the Multiple Sclerosis Society, SCOPE, Carers UK, and other organisations representing a range of stakeholders with different conditions, perspectives, and requirements. A total of 72 valid responses from a broad cross-section of stakeholders were recorded and used as the basis for the analysis in this report.

Mobility Aid User survey and focus groups

- An online survey was developed to gather responses on mobility aid use, size and prevalence, and experiences of public transport services, from mobility aid users. Survey responses were provided by a panel of research participants, sourced from a specialist market research supplier, who were screened based upon their use of one or more mobility aids. A total of 154 valid responses were recorded, including 85 responses providing information on occupied mobility aid size.
- To further unpack the themes explored in the user survey, a series of focus groups with mobility aid users were held. Participants were recruited via the user survey, which included a question for participants to indicate their willingness to participate in a focus group discussion on mobility aid use and experiences of travel on public transport. Participants were contacted by the study research team and booked in to

attend one of the four focus group sessions, which were all held via Microsoft Teams. A total of 30 people participated across the four focus groups.

- The focus groups facilitated discussions on the use of mobility aids, the types of journeys participants made with their mobility aid, and a 'virtual journey' exercise to unpick experiences at each stage of the journey (planning, at the stop/station, on board the service, etc.).

The research activities focussed on answering the following high-level questions:

- Is the reference wheelchair specification fit for purpose? (why/why not from user and stakeholder perspectives);
- What are the characteristics, prevalence, and use of wheeled mobility aids in the UK? (from user and stakeholder experiences); and
- Does this research demonstrate that there will be a need for associated changes in the future to accessibility standards for the design of rail, bus, taxi / PHV vehicles and transport infrastructure?

Headlines

- The key finding from this study is that the current reference wheelchair specification accommodates 54% of all mobility aid users.
- In order to make sure transport infrastructure is future proof for mobility aid users, consideration should be given to accommodating a greater proportion of mobility scooters, hybrid aids and larger electric wheelchairs in the reference wheelchair specification. This is a cohort likely to grow according to this study.
- This report provides a set of options for consideration in terms of increasing the measurements of the reference wheelchair, to make this more inclusive. These options are set out in detail in section 5.3. They include: Ambitious inclusivity, electric and manual wheelchair inclusivity, and manual wheelchair inclusivity.

Other key study Findings

- Changes in the size and weight of mobility aids are being driven by consumer demands and expectations – mobility aid users expect devices to have increased functionality and range, which is causing devices to increase in size.
- Hybrid mobility aids are becoming increasingly popular, as mobility aid users seek devices, and adapt existing devices, to be capable of being used in more diverse environments and terrain.
- These two factors are contributing towards the trend for larger mobility aids – the reference wheelchair specification, and other standards, may need to be modified in coming years if public transport is to accommodate the increasing prevalence of hybrid mobility aids.
- There is a trade-off that needs to be determined between making transport more inclusive and the practicalities of accommodating larger and more diverse mobility aids within the physical space limits of conventionally sized public transport vehicles.
- The most frequently identified issues in this study included a lack of width of on-vehicle spaces, on-vehicle toilets being too small, insufficient height clearance in taxis and private hire vehicles, and insufficient space for hybrid mobility aids. Engagement with

vehicle designers on the challenge of achieving the most inclusive and flexible designs practicable should be undertaken so designs can guard against potential future changes.

- More detailed qualitative engagement with mobility device designers / manufacturers and those involved in selection of devices is required e.g. Wheelchair Therapists, to understand factors affecting device size and weight in further detail would be advantageous.
- It is important to note that the reference wheelchair is not expressly used to define a number of critical design requirements for transport vehicles and infrastructure; there is currently a large variance between the reference wheelchair specification and minimum design standards. Consequently, the impacts of increasing the size of the reference wheelchair specification must be evaluated against the relevant design requirements such as BS8300, RVAR, and PSVAR to fully understand the implications.

Glossary of Terms

The following terms are used throughout this report and are derived from research, previous reports, standards, and guidelines.

Active wheelchair: Wheelchairs which are self-propelled by pushing the rear wheels along, sometimes assisted with power add-ons. As such, they are generally much lighter than standard manual wheelchairs, and set up to allow an energy efficient drive so users can travel further and faster.

Attendant propelled wheelchair: Wheelchairs generally with small wheels at the rear and are pushed by an attendant (in this context, attendant refers to an assistant or carer who provides propulsion and assistance to the mobility aid user).

Class 2 Mobility Scooter: Electric powered wheelchairs and smaller, lighter, more compact mobility scooters. Typically, these are used indoors and outdoors and may be folded and stored, for example in car boots. Class 2 scooters are restricted to use on pavements and walkways and legally limited to a maximum speed of 4mph.

Class 3 Mobility Scooter: Larger mobility scooters that are intended to be used outdoors and are fitted with safety features such as lights, reflectors, horns, and side mirrors. In accordance with UK legislation, the speed of Class 3 vehicles is limited to 8mph on the road and 4mph off road.

Electric wheelchair: Motorised devices powered by battery and controlled by a small joystick or similar device. This includes wheelchairs designed for both indoor and outdoor use.

Hybrids: Typically, manual wheelchairs with attachments to provide electric motor driven movement, or in some cases hand driven devices.

Interpolated 95th Percentile: The value at which it is estimated 95% of the population will fall within.

Mobility scooter: Motorised devices steered with handlebars. These vary from large outdoor models that can travel on the public road, to smaller indoor/outdoor models.

New style manual chair: Wheelchairs manually driven by the user from the rear wheels and made of a modern lightweight construction. They are often identified by bright colours, negative camber on the rear wheels and adjustable wheelbase. Some models of this type of chair, such as those designed for sports, do not have brakes or handles for an attendant to push (Stait, Stone and Savil, 2000).

Old style manual chair: Wheelchairs manually driven by the user from the rear wheels and made to an old design (Stait, Stone and Savil, 2000).

Rear wheel drive modern chairs: Wheelchairs manually driven from the rear wheels but are of a modern lightweight construction. They are often recognizable by their bright colours, negative camber on the rear wheels and adjustable wheelbase (Stait and Savill, 1995).

Rear wheel drive traditional chairs: Wheelchairs manually driven from the rear wheels (Stait and Savill, 1995).

Self-propelled wheelchair: Wheelchairs propelled by the user from the rear wheels, and made of modern, lightweight materials.

1. Introduction

The Atkins-Jacobs Joint Venture (AJJV) was commissioned by the Department for Transport (DfT) to undertake research into the reference wheelchair specification, the characteristics, prevalence, and use of wheeled mobility aids; and whether there will be a need for associated changes in the future to accessibility standards for the design of rail, bus, taxi / private hire vehicles (PHVs) and transport infrastructure. The aim of the research is to understand whether the reference wheelchair standard provides a suitable reference point for the design of vehicles and transport infrastructure for those with mobility needs.

The research team identified a number of existing data sets and sources which were considered as a potential route to understand historic changes in the use and physical space requirements of wheeled mobility aids. These sources were used to develop an in-depth literature review to help understand historic trends and where possible allow comparisons to new data to be drawn. The literature review was also used to help develop a questionnaire set, which then formed the basis for online quantitative primary data collection. This was followed up with further qualitative data collection through a series of stakeholder/user workshops.

This final report evaluates the findings, implications, and impacts of this research into the reference wheelchair specification.

The report concludes with a set of next steps where changes to standards, regulation, and guidance for each of the modes might be needed, using an assessment of the primary research findings. These next steps reflect current and projected wheeled mobility-aid use. They consider the impact of the study findings on key wheeled mobility aids and on each of the public transport modes and for hackney carriage and private hire vehicles.

2. Literature Review

2.1. Introduction

A thorough review of existing published literature was undertaken to research and assess international standards for mobility aids across all relevant modes of transport. This included previous DfT studies into occupied and unoccupied wheelchair measurements and any other published academic, government, NHS, private sector and third sector research available. This literature review informed the research methodology and survey questions for mobility aid users and stakeholders. This literature review is important to support our understanding of what the new data from our primary research means in terms of future trends for mobility aid use and the reference wheelchair specification.

The search for relevant literature and the resulting literature review focussed on the following areas:

- The current types of mobility aids;
- Trends in the size and weight of mobility aids;
- Trends in mobility aid usage and ownership;
- The international standards, regulation, and guidance to understand the space allowances made internationally; and
- The relevant UK accessibility standards, regulation, and guidance for taxis/private hire vehicles and the related infrastructure for manual wheelchairs, powered wheelchairs, and electric scooters and hybrid-mobility aids.

Conducting this review involved searching for and identifying potential sources of data relating to the research questions to allow comparisons to new data and potential trends to be identified. Overall, the body of research around the trends in current mobility aid ownership, the size of mobility aids and projections of future trends for both ownership and size is limited. Additional information is drawn from a range of current vehicle regulations and built environment design guidance.

2.2. Defining Mobility Aids

Mobility aids are defined in a number of ways in different studies. The following definitions have been developed for this study from the literature review and will be referred to in the research analysis:

- Attendant propelled wheelchairs are chairs with small wheels at the rear and are pushed by an attendant (in this context, attendant refers to an assistant, carer or loved one who provides propulsion and assistance to the mobility aid user).
- Self-propelled wheelchairs are propelled by the user from the rear wheels, and made of modern, lightweight materials.
 - Some new style self-propelled manual chairs such, as those designed for sports, do not have brakes, or handles for an attendant to push.
- Electric wheelchairs are motorised devices powered by battery and controlled by a small joystick or similar device. This includes wheelchairs designed for both indoor and outdoor use.
 - Some electric wheelchairs can also be controlled / propelled by attendants.
- Mobility scooters are motorised devices steered with handlebars.
- Electric wheelchairs and mobility scooters are divided into the following categories based on their size and motor power (The Highway Code UK, 2021):

- Class 2: Electric powered wheelchairs and smaller, lighter, more compact mobility scooters. Typically, these are used indoors and outdoors and may be folded and stored, for example in car boots. Class 2 scooters are restricted to use on pavements and walkways and legally limited to a maximum speed of 4mph.
- Class 3: Larger mobility scooters that are intended to be used outdoors and therefore fitted with safety features such as lights, reflectors, horns, and side mirrors. In accordance with UK legislation, the speed of Class 3 vehicles is limited to 8mph on the road and 4mph off road.

The historic research studies discussed within this literature review each used their own definitions of wheeled mobility aids, according to the technology and market at the time. Consequently, there is variation in the definitions used across this area of research. Each term for a wheeled mobility device is listed and defined in the glossary of this report.

2.3. Trends in Size, Weight and Types of Wheeled Mobility Aids

2.3.1. The 1991 Study

A Survey of Occupied Wheelchairs to Determine their Overall Dimensions and Characteristics was conducted by Stait and Savill for the Transport Research Laboratory (TRL) and published in 1995. The work reports the results of a survey conducted in 1991 and therefore we refer to it as the 1991 Study.

This research involved collecting the overall dimensions and characteristics of 382 people in their wheelchairs at the 1991 Mobility Roadshow. During the roadshow a wide range of occupied wheelchair types were weighed and photographed. The height, length, and width of the occupied mobility devices were then measured from the photographs using background scaling and trigonometry, however it was noted that the widths obtained are actually of the device itself (effectively unoccupied). The weight of the occupied mobility devices was measured using a large-scale pad. The weight data was then analysed to determine whether the combined weight of wheelchairs and users were within the safe working load recommended for vehicle lifts. Of those photographed, 13% were carrying an additional walking aid, which added to either their weight and / or dimensions. Of those who carried additional aids, 75% carried it on the rear of the chair.

Prior to this study there was limited research which utilised recordings of the combined weight of wheelchairs and users, however, the results showed consistency with previous work published in 1985 by Hall and Silcock.

2.3.2. The 1999 Study

A Survey of Occupied Wheelchairs to Determine their Overall Dimensions and Weight was conducted by Stait, Stone and Savill for the TRL and published in 2000. The work reports the results of a survey conducted in 1999 and we therefore refer to it as the 1999 study.

The 1999 study followed a similar methodology to the 1991 study, using measurements determined from photographs, however it was noted that the widths obtained were effectively unoccupied because users positioned their hands on their laps and relaxed their arms when being photographed.

The final sample of the 1999 study was 745 wheelchair users, almost double the 382 participants photographed for the 1991 study. Observed differences in the height and length of chairs were not found to be statistically significantly compared to the 1991 data; however, the width of chairs showed the largest change from the 1991 to the 1999 study, with a 31mm increase in the width at the 95th percentile (as shown in Table 2.2 below).

The results of this work were compared to the following standards: the British Standard for lifts associated with vehicles, BS 6109: Part 2 (1989); the British Standard for powered lifting platforms for use by disabled persons, BS 6440 (1983); and the DfT code of practice for safety of passengers on buses, VSE 87/1 compared to the dimensions of unoccupied wheelchairs given in the International Standards Organisations ISO 7193 (1985).

When comparing the results to the associated standards listed, it was found that, from the chairs that were covered by the ISO Standard 7193, 30 (4%) of cases exceeded the maximum stated value for chair width, and the 95th percentile of 676mm lay just within the maximum value stated in the ISO standard. When comparing the sample with the British Standard for lifts and ramps associated with vehicles, BS 6109, and general lifting platforms for disabled persons, BS 6440 (1983) it was found that both the average weight (122kg) and 95th percentile (193kg) was within the safe working loads for BS 6109 and BS 6440. However, 28 (4%) instances of combined weights of over 200kg were identified. Additionally, when the weight of an attendant was added to the combined weight of the wheelchair and user, 16 (2%) of the cases exceeded 300kg.

Such findings are relevant, as the DfT's 1987 code of practice for the safety of wheelchairs on buses stipulated that, if adults in chairs are lifted with an attendant, then lift capacities must be at least 250kg. This survey found 61 (8%) cases exceeded this limit (excluding scooters).

2.3.3. The 2005 Study

A Survey of Occupied Wheelchairs and Scooters was conducted by Hitchcock et al. for the DfT and published in 2006. This research was the next significant study of interest and aimed to identify the overall masses and dimensions of occupied wheelchairs and mobility scooters. The work reports the results of a survey conducted in 2005 and will be referred to as the 2005 study in this report.

The 2005 study looked at mobility aid standards and updated the findings of the 1999 study. The work also built upon the previous two surveys by including children's wheelchairs (18%) in the research sample.

The inclusion of children has several implications for the comparison of this work with the two previous studies. Due to children's smaller size, their devices are often smaller which is likely to have lowered the average measurements. An association between the type of device used and the user age was identified using Chi-squared analysis which revealed that 30% of children's devices were propelled by an attendant, whilst only 10% of adults were. The proportion of adults and children using self-propelled wheelchairs and electric wheelchairs however was similar.

To facilitate comparison with the 1999 study, the same measurement process was used. For this study the width measurement was defined as width of device. The final sample consisted of 1356 participants, 1098 adults and 247 children. 11 participants who did not state their age. The number of participants in the 2005 study is almost double the number of participants in 1999 (745 participants) and quadruple the number of participants in the 1991 study (382 participants).

The comparison of the 2005 study and 1999 study found that across the four principal dimensions of all adult devices (height, weight, length, and width), there had been a significant increase in height, weight, and length and a significant decrease in width. The study also reported there had been an overall decrease in the average width of devices of 15mm over the six years between the 1999 and 2005 surveys. The 95th percentile had only decreased by 3mm over the period.

In summary, Mitchell (2016) revisited the findings of the 1991, 1999 and 2005 studies and found that:

- The length of occupied mobility devices increased between 1991 and 2005;
- The height of occupied mobility devices increased between 1991 and 2005;
- The weight of occupied mobility devices increased between 1991 and 2005; and
- The width of occupied devices increased between 1991 and 1999 but not thereafter.

2.3.4. The 2019 Study

Accessible Public Realm: Updating Guidance and Further Research was conducted by Barham, Greenshields, and Mitchell for the TRL on behalf of the DfT and published in 2020. The research sought to investigate the dimensions of wheeled mobility devices. The work reports the results of two surveys conducted in 2019 and therefore will be referred to as the 2019 study.

The 2019 study considered whether there have been changes in the key dimensions of wheeled mobility aids currently in use, and whether the minimum dimensions recommended need to be altered to ensure facilities remain accessible.

The methodology used for the study involved reviewing both academic publications and industry data on the dimensions of wheeled mobility aids available on the UK market, supplemented by taking measurements from a sample of occupied wheelchairs in the UK at two events mobility related events; Naidex and The Big Event. The methods used to measure the devices replicated those of the 1999 study and 2005 study, with a smaller sample size of 174 participants.

The results of the 2019 study indicated that there have been several changes to the mobility products available in the market. Most notably, there has been a rise in the prevalence of mobility scooters. Additionally, the empirical measurements and findings from the database showed that changes to the size of mobility devices includes increased length, decreased width and an increased lap height amongst users.

This research offers some useful insight on trends in sizes of mobility aids; however, it does not offer evidence on the prevalence of the use of wheeled mobility aids of varied types in the UK. The different types of wheeled mobility aid and their proportion of each previous study sample is collated for the other studies in Table 2.4 below.

Whilst current industry data showed greater market availability of wheeled mobility devices, there was no available information on the utilisation of such devices for journeys made by public transport. Consequently, it was decided in the 2019 study that there was not sufficient evidence to validate recommendations to update the minimum dimensions of public transport infrastructure. In addition, other existing evidence indicates that the minimum length specified in Inclusive Mobility (2002) is still adequate in the case of attendant-propelled wheelchairs, active wheelchairs, electric wheelchairs, and Class 2 mobility scooters.

Comparatively, according to the 2019 study manufacturers claim that the 95th percentile turning circle diameter of modern Class 2 devices is 1486mm and the figure for the 95th percentile turning circle for Class 3 devices is 1968mm. However, this is smaller than for similar vehicles measured in 1999. Inclusive Mobility (2002) states a turning circle of 2420mm for outdoor electric wheelchairs and 4350mm for electric pavement vehicles. The 2019 study suggests that this may indicate that larger wheeled mobility aids have enhanced significantly in both design and function in the last two decades.

The 2019 study also notes that changes to users' lap heights over time means a review of the guidance for designing ticket counters and information desks may be due. The evidence gathered across two mobility events analysed in the 2019 study revealed a range in knee heights of 600mm to 720mm and 550mm to 700mm, respectively. The range quoted in Inclusive Mobility (2002) is only 500mm to 690mm (based on the 1999 study), therefore, for designs which feature knee height as a significant parameter, the 2019 study advises a greater range of 550mm to 720mm should be considered.

2.3.5. Summary of Measurement Trends from Prior Research

To summarise the data discussed and compared surrounding the dimensions of wheelchairs collected across the last 30 years is collated in the following tables.

Table 2.1 Lengths (occupied)

Data Source (study)	1991 (Stait and Savill, 1995)	1999 (Stait, Stone and Savill, 2000)	2005 (Hitchcock et al., 2006)	2019 group 1 (Barham, Greenshields, and Mitchell, 2020)	2019 group 2 (Barham, Greenshields, and Mitchell, 2020)
Sample size	382	745	927 (adult devices only)	84	90
Max dimension (mm)	1451	1549	1604	N/A	N/A
95 th Percentile (mm)	1243	1267	1339	1300	1300

Table 2.2 Widths (unoccupied)

Data Source (study)	1991 (Stait and Savill, 1995)	1999 (Stait, Stone and Savill, 2000)	2005 (Hitchcock et al., 2006)	2019 group 1 (Barham, Greenshields, and Mitchell, 2020)	2019 group 2 (Barham, Greenshields, and Mitchell, 2020)
Sample size	382	745	923 (adult devices only)	84	90
Max dimension (mm)	735	755	992	N/A	N/A
95th Percentile (mm)	664	695	692	617	700

Table 2.3 Weights (occupied)

Data Source (study)	1991 (Stait and Savill, 1995)	1999 (Stait, Stone and Savill, 2000)	2005 (Hitchcock et al., 2006)	2019 group 1 (Barham, Greenshields, and Mitchell, 2020)	2019 group 2 (Barham, Greenshields, and Mitchell, 2020)
Sample size	382	745	964 (adult devices only)	84	90
Max dimension (kg)	384	384	338.6	N/A	N/A
95th Percentile (mm)	200	206	230.2	N/A	N/A

The body of work discussed and summarised above highlights that the current reference wheelchair size excludes several mobility aid users. This is similar to the findings of research conducted by Mitchell (2016) which utilised the data collected in the 2005 study to conclude that the ISO 7193, which implies an overall length of 1250mm for devices, includes 95% of self-propelled wheelchairs but only includes 80% of the entire sample. To include 95% of all of the wheeled mobility aids surveyed, the length would need to be increased to 1345mm for attendant propelled wheelchairs, 1430mm for electric wheelchairs and 1415mm for scooters. When considering the height of the devices, the research concluded that a height of 1410mm is needed to accommodate 95 percent of wheelchairs, but not scooters. A height of 1490mm is required to accommodate 95 percent of scooters. Finally, the weights of the electric wheelchairs and scooters were similar, and a limit value of 275kg at least, preferably 300kg would accommodate 98% of all users.

2.3.6. Types of Wheeled Mobility Aids Used

Each study recorded the types of mobility aids used by the participants using definitions of wheeled mobility devices based on the technology and market availability at the time. The definitions of the terms are included in the glossary of this report. The changes to the definitions across the studies provides a good indication of changes to the nature of wheeled mobility aids as well as their uptake. Table 2.4 below lists the types of devices referred to and their proportion of the sample for the 1991, 1999, and 2005 studies. Data on the proportions of mobility aids used was not available for the 2019 study.

Table 2.4 Type of Aid Used Across Previous Studies

Type of Aid	Percentage of Study Sample
1991	
Rear wheel drive traditional chairs	48%
Rear wheel drive modern chairs	17%
Attendant-Propelled Wheelchairs	7%
Electric Wheelchairs	17%
Electric Scooters	6%
1999	
Old style manual chair	19%
New style manual chair	40%
Attendant-Propelled Wheelchair	7%
Electric Wheelchair	25%
Electric Scooter	9%
2005	
Self-Propelled Wheelchair	42%
Attendant-Propelled Wheelchair	13%
Electric Wheelchair	27%
Electric Scooter	18%

The most notable change across the three studies is the increase in the use of electric wheelchairs and electric mobility scooters.

2.4. Trends in Usership and Ownership

2.4.1. NHS Data

The NHS (2021) approximates that there are 1.2 million wheelchair users in the UK, two thirds of which are regular users. NHS England introduced a national wheelchair dataset in 2015/16 to establish the first centralised knowledge hub about expenditure on, access to, volume, and patient experience of wheelchair services. This dataset was designed to improve transparency of information regarding wheelchair use in the UK, as well as improve benchmarking against national targets.

This collection was published between July 2015 and December 2019, however, between January 2020 and June 2021 the collection was suspended due to the COVID-19 pandemic. The NHS defined the data collection as an 'experimental statistic' as it has not been collated and published before and the development of a robust approach to reporting the number of wheelchair users in the UK is ongoing.

The information on wheelchair commissioning in the NHS collected to date includes several gaps across different Clinical Commissioning Groups (CCGs), and at different time periods (yearly quarters). These gaps significantly reduce the reliability and accuracy of the dataset. Of the data which has been collected and published, the following indicative trends of the total number of patients currently registered with the service are shown in **Error! Reference source not found.** below.

According to this dataset, there were 701,813 wheelchair users registered with NHS Wheelchair Services (adults and children) in England as of Q3 of 2019. NHS England's website currently reports that there are currently around 1.2 million wheelchair users in the UK and that two thirds of them are regular users. However, the NHS have been reporting this figure since 2015. This demonstrates a gap in the data available between registered wheelchair services users reported in the most recently available NHS data, and the total number of wheelchair users in the UK. It has not been possible to validate why this data gap exists with the NHS. There is also no published information on the number of patients who are prescribed multiple mobility aids.

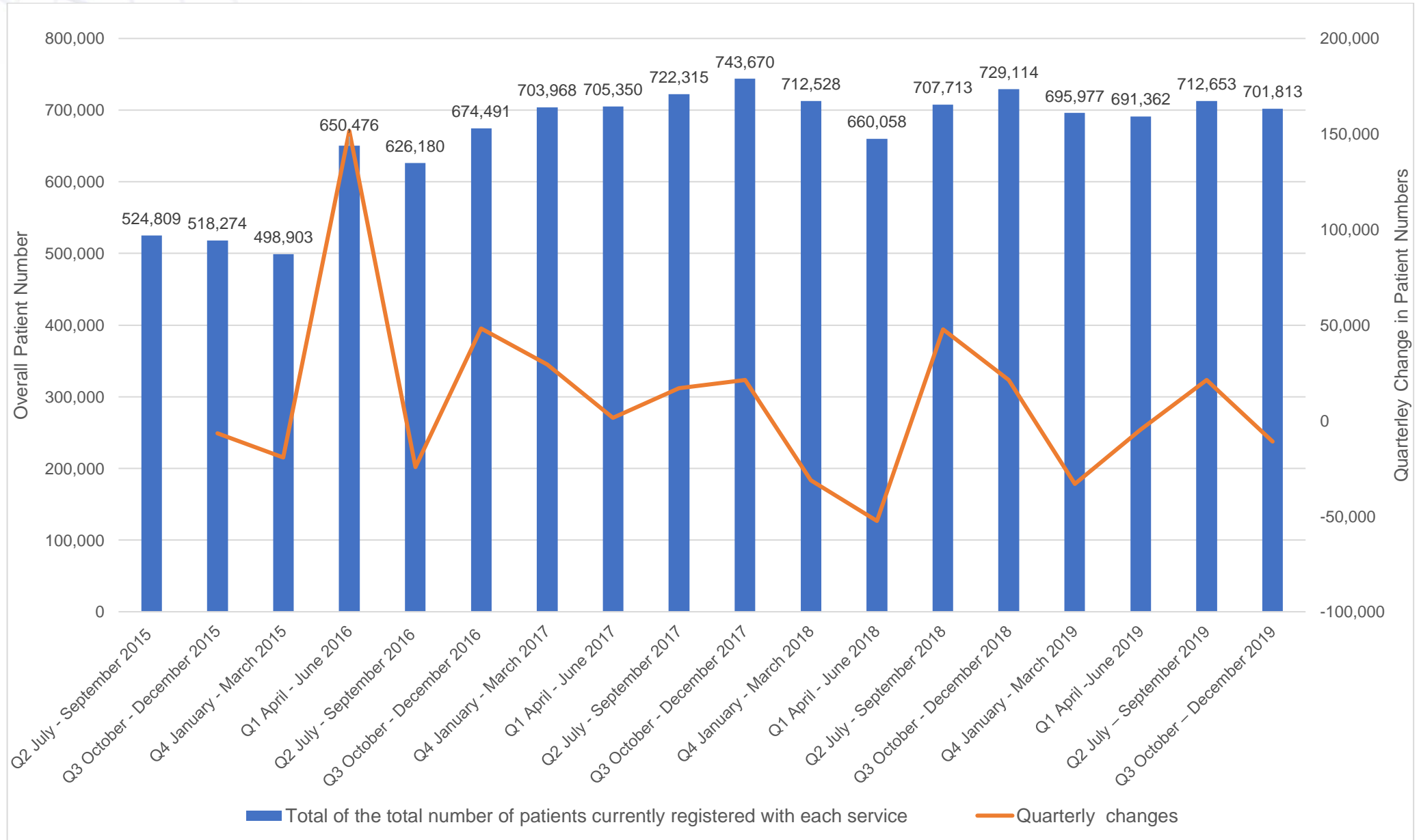


Figure 2-1 The total number of patients currently registered with England’s NHS CCG Wheelchair Services (adults and children)

The 2019 figure excludes the rest of the UK and does not account for those who use wheeled mobility aids which have not been prescribed by the NHS. This dataset and the associated figures do little to give an indication of levels of the ownership of wheeled mobility aids in England (or the UK). This is because it does not account for those who have acquired their mobility aid themselves (through private purchase, friends/family, or donations) rather than using an NHS prescribed device. It also does not account for those who have acquired additional wheeled mobility aids to the one prescribed to them by the NHS. Therefore, it is important to note that usership may not closely correlate with wheeled mobility aid ownership, and vice versa.

2.4.2. Historic Usership Estimates

Historic attempts to estimate the number of wheelchair users in England and Wales and England alone have been made, however, their geographical inclusion and methodologies have differed. Nevertheless, they still indicate that there has been a steady increase in the number of wheelchair users in England over the last four decades.

Table 2.5 Estimated Number of Wheelchair Users Across Previous Studies

Year	Source	Estimate	Scope
1986	Martin Et. Al. (1989)	360, 000	England and Wales
1988	Kettle and Rowley (1990)	500, 000	England
1996	Aldersea (1996)	710, 179	England
2000	Audit Commission (2000)	640, 000 – 750, 000	England and Wales
Current	NHS (unknown)	1.2 million	England

It is clear that there is no singular source of data regarding the number of wheeled mobility aid users in the UK, the level and type of usership (full time, part time, etc.) or the number of wheeled mobility aids owned in the UK. There is also very little known about the level of hybrid mobility aid and attachment ownership.

2.4.3. Mobility Scooter Ownership

Estimates made in Review of Class 2 and Class 3 Powered Wheelchairs and Powered Scooters (2004) were that there were 454,271 adult wheelchair users, 447,781 wheelchair using adults with mobility impairments and 44, 778 adult powered wheelchair / scooter users (Barham, Oxley, and Board, 2004).

Mobility Scooters: a market study (2014) was conducted to contribute to filling an evidence gap on the make-up and trends of the UK's mobility scooter market, with the aim of informing future policies. This research is informative to this study as it is important to consider the notable differences between wheelchairs and mobility scooters such as specification, manoeuvrability, and speed. The report highlights several of the transport and road policy areas which may be impacted by the continued growth in mobility scooters, including public transport carriages (buses, trains, taxis, etc.), which is highly relevant to this research.

This research reviewed data published by the commercial market and market studies conducted by Consumer Focus (2010) and the Office of Fair Trading (OFT) (2011) of the mobility products sector. Consultation with key industry stakeholders including the British Healthcare Trades Association (BHTA), Motability and other retailers and manufacturers was undertaken. It was found that a substantial proportion of the published commercial market data around mobility scooters is incomplete and / or inconsistent, so is therefore only

of limited value to policy makers. The research relied on best estimates to approximate the UK's annual sales value of mobility equipment at around £500 million (OFT) and the value of mobility scooters and wheelchairs at around £200 million (BHTA). The study approximated that there were around 80,000 annual mobility scooter sales, 300,000 – 350,000 scooter users annually (BHTA).

It is important to note that many mobility scooter users were found to own more than one scooter, and also to own other mobility aids, most commonly wheelchairs. Whilst data on the sales of the new devices may exist, following several requests to manufacturers and suppliers it was not made available for this purpose of this research.

In addition, there is also a second-hand market, which is likely to be more difficult to quantify. At the time of writing this review, a simple search on eBay for a mobility scooter, used condition and located in the UK generated 3,715 results. A search for a wheelchair, used condition and located in the UK generated 1,834 results. There are also multiple platforms on which people could purchase a second-hand mobility device, further complicating quantification efforts.

UK predictions for the growth in scooters indicated an annual rise in scooter sales of 5 – 10% (Barton, Holmes, and Jacobs, 2014). More recent (2020) assessments of global annual growth rates of mobility scooter purchases have estimated that it will reach 7.3% between 2020 and 2026 (without considering any impacts from the COVID-19 pandemic such as increased long-term health conditions impacting mobility) (Isaacson and Barkay, 2020).

2.4.4. Potential Impacts of COVID-19

In April 2021, the ONS reported that:

- 697,000 experienced long COVID for at least 12 weeks;
- 473,000 for over six months; and
- 70,000 for over one year

An international web-based survey of 3,762 adults with COVID-19 found that 9 out of 10 people who experience symptoms for at least 4 weeks will suffer effects for more than 35 weeks.

Bellan et al. (2021) followed 238 COVID-19 survivors in Northern Italy and found that:

- 52% of the participants had less than 80% normal lung function;
- 16% of the participants had less than 60% normal lung function; and
- 54% reported difficulty walking.

Statistics such as these indicate that the COVID-19 pandemic and resulting prevalence of long COVID may result in higher levels of mobility impairments across the population and consequently greater utilisation of mobility aids. The longevity of mobility impairments associated with cases of COVID-19 is currently unknown due to the novelty of the virus and pandemic.

2.5. Current / New Standards for Built Environment

This section summarises the current UK standards and examples of international standards in the EU, Australia, and the USA to understand the typical space allowances in the design of the built environment.

2.5.1. UK Standards

BS 8300: 2018

A key UK standard for the built environment is BS 8300: 2018 Design of an Accessible and Inclusive Built Environment. This standard was issued in 2018 and provides a comprehensive range of recommendations for the design of buildings to accommodate the widest range of users with different characteristics and capabilities. The recommendations apply predominantly to new buildings. However, they can also be utilised as a tool for reviewing the accessibility of existing buildings and assessing areas for improvement.

BS 8300: 2018 is relevant to this study due to its application to transport buildings, such as train stations, bus stations and airports. BS 8300: 2001 was based on the findings of ergonomic research commissioned in 1997 and 2001 by the DfT. BS 8300: 2018 is also based on the 2001 study which re-uses data from the 1999 study.

BS 8300: 2018 acknowledges the changing requirements related to the variety of mobility aids available in 2018 with its foreword stating:

“The provisions in BS 8300 are based on ergonomic research conducted in 1999. The Technical Committee responsible for BS 8300 is aware of changing requirements relating to the variety of mobility aids now available and the physical space needed to use such devices, as well as the implications of the increasing use of technology and new building construction methods. However, at the time of publication of this edition of the standard, the committee does not know of any new ergonomic research on which to base changes to the space recommendations within the standard.”

Consequently, the data guiding the accessibility of new buildings is 22 years old, during which time advances have been made in the design and size of many mobility aids. This further substantiates the widespread concern about current data on the space requirements of mobility aids.

Inclusive Mobility (2002)

The Inclusive Mobility report (2002) aims to provide guidance on established best practice however, it does not have any legal status.

The guidance established in Inclusive Mobility (2002) is based on the measurements taken at the 1999 mobility roadshow and presented in the 1999 study and states that:

“Within transport related buildings, the following should be taken as the minimum acceptable dimensions:

- *right angle turn (along corridor) 1200mm x 1200mm*
- *180° turn (within corridor) 1600mm (width) x 2000mm (length)*

Manoeuvring space is needed for a wheelchair to turn corners or turn around. Skilled users of manual wheelchairs can turn through 360° in a space no more than 1500mm x 1500mm, but this is insufficient for larger chairs, particularly outdoor electric wheelchairs (turning circle 2420mm), electric pavement vehicles (turning circle 4350mm) and for wheelchair users with extended leg rests.

Users of electric scooters and large electric chairs may need greater space than this for 180° turns, but the dimensions given (as minimum) will accommodate users of self-propelled wheelchairs and the majority of electrically powered wheelchairs”.

From this it can be seen that the minimums set out within the guidance did not accommodate a full range of users at the time it was written.

2.5.2. International Standards

ISO 21542: 2021

ISO 21542: 2021 is a global standard, designed to outline how buildings should be designed, built, managed, and maintained to ensure people can:

- Approach and enter the building;
- Utilise the buildings facilities, services, and information networks;
- Enter and exit the building in normal conditions; and
- Evacuate the building during emergencies.

The standard has been written with the intention of meeting the needs of the broadest majority of people and is designed to be a minimum standard of provision. The dimensions of wheelchairs stated in this standard are related to commonly used wheelchair sizes and user footprints. The dimensions for a wheelchair in this standard are specified in ISO 7176-5 and ISO/TR 13570-2 and are 800 mm wide and 1,300 mm long. For larger wheelchairs and scooters, the standards state that their product dimensions must be explicitly stated to accommodate them in the space under consideration.

The dimensions stated in this document, relevant to the use of wheelchairs, are related to the footprint of commonly used wheelchair sizes and users. The footprint for a wheelchair within this document is based on ISO 7176-5 and ISO/TR 13570-2 and has a width of 800mm and length of 1,300mm. For larger wheelchairs and scooters, their product dimensions need to be explicitly stated to accommodate them in the space in question. The standard is written for disabled adults; however, it does include some recommendations concerning the accessibility requirements of disabled children.

At a European level, a new functional CEN standard 17210:2021 has now been published however this is a functional standard only and does not provide dimensional information. A separate Technical Report, TR 17621 has been published and relies on information from ISO 21542.

CEN 17210:2021 was developed with the goal of contributing to the implementation of the UN Convention on the Rights of Persons with Disabilities in Europe in response to mandate M/420 of the European Commission. The standard is largely based on ISO 21542: 2011 now updated to ISO 21542: 2021, but where ISO 21542: 2011 is insufficient, it is supplemented with references to alternative and / or complementary documents.

It should be noted that the recommendations within standards such as BS8300 already exclude some users, for example Table G.7 (of BS8300) identifies that 1,600mm x 1,625mm would be needed for 90% of the sample to turn through 90 degrees. Similarly, table G.5 (of BS8300) has occupied dimensions of 1,520mm x 800mm to accommodate the complete range of self-propelled and electric wheelchairs when stationary.

Australian Standards

The current Australian Standards are based on research conducted in 1983, however, these were switched in 2009 from using the 80th percentile as a basis for defining the dimensions for an occupied wheelchair to the 90th percentile. Consequently, increasing the reference occupied device footprint of 740mm x 1, 250mm, to 800mm x 1, 300mm. This footprint matches the 95th percentile for occupied length found at both events measurements were taken for the TRL (2020) study. The width requirement is also similar to the figure currently recommended in Inclusive Mobility.

Caple (2014) sought to review the sufficiency of the increase to the footprint. The study gathered anthropometric data from manual and powered wheelchair users who

independently navigate the public realm. The methodology involved taking 21 measurements of occupied wheelchairs. The data collected was then compared to the current Australian Standard AS 1428. 1-2009. The results gathered found the majority of the measurements included in the AS 1428. 1-2009 were appropriate. Nevertheless, a number of instances of the 90th percentile exceeded these measurements. This included the dimensions required for the 180° turning circle, landing lengths, lift dimensions, hand basin design, shower recesses and the seating spaces in auditoriums of assembly spaces. Whilst these examples are unrelated to transport vehicles, they indicate a trend in wheelchairs requiring more space, which may translate into public transport requirements needing to be updated in time.

USA Standards

Accessibility standards in the United States of America are based on ICC A117.1 (2017). In 2017 the International Code Council updated ICC/A117.1 – the standard used to allow disabled people to get to, enter and use a site, facility, building or element with new spatial requirements. The standards do not apply to existing buildings or facilities but to all new construction and additions. The measurements are as follows:

- Wheelchair space
 - Pre-2017: 1200mm
 - Current: 1300mm
- Turning Space
 - Pre-2017: 1500mm
 - Current: 1700mm
- Door manoeuvring size
 - Pre-2017: 1200mm
 - Current: 1300mm
- Platform lifts
 - Pre-2017: 900mm x 1200mm
 - Current: 900mm x 1300mm.

2.6. Vehicle Standards

Public transport vehicles have specific accessibility standards and regulations in the UK. Wheelchair accessibility regulations for access to public transport use a specific reference wheelchair. The current reference wheelchair has: a total length of 1200mm including extra-long footplates, a total width of 700mm, a sitting height (from ground to top of head) of 1350mm, and a footrest 150mm above the ground (Barham, Greenshields, and Mitchell, 2020).

2.6.1. Rail Standards

Rail vehicle standards are set out in The Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations (2010). The regulations include the following specifications for wheelchair spaces, a wheelchair space must not be less than:

- 1300mm long measured parallel to the length of the rail vehicle;
- 750mm wide measured parallel to the width of the rail vehicle; and
- The wheelchair space must incorporate, at one end, a fitting with a minimum width of 700millimetres capable of preventing a reference wheelchair, with its back against the fitting, from moving or tipping towards the fitting.

2.6.2. Bus and Coach Standards

The Public Service Vehicles Accessibility Regulations (2000) apply across England, Scotland, and Wales and require all buses and coaches designed to carry over 22 passengers and used on local or scheduled routes to comply by the 1st of January 2020. Vehicles subject to the regulations must incorporate features to enable disabled people to travel safely and comfortably, including the provision of wheelchair spaces, and inclusion of a ramp or lift. All vehicles subject to the regulations must have at least one wheelchair space which must not be less than:

- 1300mm measured in the longitudinal plane of the vehicle;
- 750mm measured in the transverse plane of the vehicle; and
- 1500mm measured vertically from any part of the floor of the wheelchair space.

In Northern Ireland the Public Vehicles Accessibility Regulations (Northern Ireland) 2003 are the same as those specified above.

Work has been done to evaluate the accessibility of European public vehicle size specifications. Mitchell (2016) compared the data from the 2005 study against the recommendations included in 'COST 322 Low Floor Buses' and found that the specification included over 95% of users. Whereas COST 335 which relates to the wheelchair spaces in trains was deemed to be insufficient, and the current 1300mm length specification would need to be 1390mm to accommodate 95% of users. However, to allow a margin for manoeuvring, the space should be 1500mm.

2.6.3. Hackney Carriage and Private Hire Standards

The Equality Act 2010 included powers to introduce regulations to set a specification for wheelchair accessible hackney carriages / PHVs. However, these powers have not yet been used.

The Law Commission undertook a review in 2014 of hackney carriage and private hire licensing and recommended that reform of the law governing these services was needed. In relation to the availability of Wheelchair Accessible Vehicles (WAV), the report recommended that the Secretary of State should have the power to impose accessibility requirements on large operators/dispatchers. In particular, the power should permit the setting of quotas of accessible vehicles which must be available to such dispatchers.

Local authorities are responsible for setting the specifications for hackney carriages and PHVs. Some authorities, for example Edinburgh and Manchester, require all hackney carriages to be wheelchair accessible. Other authorities, however, such as Leeds, have mixed fleets (saloon vehicles and WAVs). There is also no national requirement for set proportions of WAVs and the UK government supports the provision of mixed fleets as the most effective way of ensuring taxi and PHV services meet a wide range of needs.

Transport for London has its Conditions of Fitness (2011) which set out a series of specifications for hackney carriage vehicles. The Conditions for Fitness include a series of requirements for certain facilities and size dimensions to enable the safe travel of disabled passengers. All taxis in London are required to meet these requirements. Manchester City Council's Conditions of Fitness (2013) include the same specifications to ensure the safe travel of disabled passengers. All hackney carriages must be able to allow the carriage of disabled people, specifically those using wheelchairs within the reference wheelchair size in the passenger compartment.

The specifications for London's Conditions of Fitness (2011) for hackney carriage vehicle measurements are:

- Unrestricted opening across vehicle doorways of at least 75cm;
- Minimum angle of a hinged door when opened must be 90°;
- The clear height of the doorway must not be under 1.2 metres;
- The top of the tread for entrances must not be more than 380mm above the ground; if an entrance is over 380mm from the ground an external interim step which is not more than 380mm must be available and must not be under 250mm deep;
- The vertical distance between the highest part of the floor and roof must not be less than 1.3 metres;
- There must be a minimum distance of 42.5cm between opposite seats;
- There must be a clear space of 66cm in front of all seats facing the front of the vehicle; and
- Loading ramps for wheelchair users must always be available and all ramps must have a safety lip and be a minimum of 70cm wide.

The specifications for hackney carriage vehicle measurements for several cities across the UK are summarised in Table 2.6 below. The regulations and specifications given do not specify the maximum size a mobility device can be.

Table 2.6 Hackney Carriage Accessibility Conditions

City	Fleet Type	Height (mm) - Door	Width (mm) - Door	Height (mm) - Inside	Width (mm) - Inside	Length (mm) – Inside	Ramp width (mm)
Leeds	Mixed fleet	1250	750	1400	750	1200	N/A
Manchester	100% WAV	1200	750	1300	N/A	N/A	700
Edinburgh	100% WAV	1100	530	965 when seated	N/A	N/A	N/A
Cardiff	Mixed fleet	N/A	N/A	812.8 when seated	1371.6	762	N/A
Belfast	100% WAV Class B	1235	750	1350	700	1200	700
London	100% WAV	1200	750	1300	N/A	n/a	700

2.7. Conclusion

This literature review highlights that the number of wheeled mobility aid users in the UK is increasing, however, there is insufficient comparable data to provide a reliable figure or identify trends. A central database which includes information for England, Wales, Scotland,

and Northern Ireland would provide a clearer picture. It has also identified that there is very little known about the overall number of wheeled mobility aids in circulation in the UK, particularly the second-hand market. In terms of mobility scooters, the best estimates available for the market highlight that it is growing, therefore, scooter use is increasing.

Previous research into the dimensions of mobility aids has found that devices are getting longer, this in turn impacts their associated turning requirement. Whilst there is some evidence of changes to width, this is not as noteworthy as that for changes to length. It should however be noted that most sources of existing data effectively capture width of an unoccupied device despite the study titles and users being in devices at the time.

A review of the current vehicle standards found that they are consistent across the UK for trains and buses. Whereas the proportion of wheelchair accessible hackney carriage vehicles and their specifications vary across different authorities. Some authorities mandate that all hackney carriages must be WAVs, others do not and have low numbers. Private hire vehicles are most commonly saloon cars and are therefore not wheelchair accessible. Whilst some may have enough boot space to carry a small, lightweight wheelchair, they may not have space for larger devices such as electric wheelchairs and scooters.

In 2021, many years after key research into mobility aid specifications took place, there is the potential for an increasing number of mobility aid users to be excluded from certain public transport vehicles and associated amenities due to insufficient space. The data collection work conducted for this research set out to investigate these issues and provide insight from mobility aid users and other stakeholders, such as manufacturers.

3. Research Approach and Methodology

3.1. Introduction

To assess the continued suitability of the reference wheelchair specification, research on the characteristics, use of and prevalence of different types of wheeled mobility aids, and experiences of travel on public transport services was undertaken with mobility aid users and stakeholders. A mixed methods research approach was utilised, balancing the need for a large sample with the collection of rich and deep insights. Data was analysed and synthesised to generate insights and inform study findings on whether there will be a need for future changes to accessibility standards for the design of transport vehicles and infrastructure.

3.2. Key Definitions

A glossary of the key terms referred to in this report and their definitions is available at the beginning of this report. As part of the literature review, it was noted that there was variation in the definitions used to categorise the results across the research in this area. Previous research reports have provided their own definitions of the wheeled mobility aids studied. Consequently, for the purpose of our study, it is necessary to also define the different types of mobility aid within the scope of this project and to agree what features define each type of mobility aid.

Building on the information provided during the quality submission tendering process, this research adopts the following types of mobility aid for this study:

- Manual, self-propelled wheelchairs;
- Manual, attendant propelled wheelchairs;
- Electric wheelchairs;
- Mobility scooters; and
- Hybrids: typically, manual devices with attachments to provide electric motor driven movement, or in some cases hand driven devices.

3.3. Study Methodology

3.3.1. Work Package 1

Task 1 included all project management activities, evidence reviews and confirmation of research methodology and research questions.

As part of Task 1 work included the provision of existing knowledge from within the research team (including the expert panel), input from the DfT, and initial engagement with the NHS Wheelchair Services, industry bodies representing manufactures and suppliers and third sector assistive technology / mobility organisations such as Motability, Designability and Motivation. These organisations shared their experience and perspectives on the appropriateness / adequacy of mobility aid designs and likely trends for the future. This provided insight in relation to people's differing requirements and within different circumstances for which current provision may not yet adequately cater and for which design innovation may yet be possible.

3.3.2. Work Package 2

As part of Work Package 2, the following was undertaken:

- Primary research:
 - Survey question development and set-up – for mobility aid users survey and other stakeholders survey (for manufacturers, healthcare providers, transport operators and other relevant stakeholders)
 - Recruitment of 150 survey respondents across a range of appropriate sampling criteria – mobility aid users only
 - Recruitment of up to a maximum of 40 research participants for four qualitative focus groups (virtual) with mobility aid users
 - Focus group questions development (informed by survey responses and current knowledge gaps)

Survey Question Development

The methodology for the primary research activities and all survey questions was finalised with the DfT and Steering Group prior to commencing the research, and activities were conducted in an inclusive and accessible way, meeting or exceeding DfT standards for accessibility.

The development of the research questions for the user survey and the stakeholder survey was informed by the literature review conducted in Work Package 1, the expert panel identified key themes and knowledge gaps, and the final questions were then approved by the DfT project sponsor.

Stakeholder Survey

A survey of stakeholders, including health care professionals, manufacturers, transport operators, and third sector organisations was undertaken to understand their views on mobility aid prevalence, use and size, and their perceptions of the experience mobility aid users have when travelling on public transport services.

The stakeholder survey was shared with representative organisations such as the Multiple Sclerosis Society, SCOPE, Carers UK, and other organisations representing a range of stakeholders with different conditions, perspectives, and requirements. A total of 72 valid responses from a broad cross-section of stakeholders were recorded and used as the basis for the analysis in this report.

A link to the survey was circulated via email, with follow up emails to ensure a high rate of completion.

User Survey

In collaboration with a specialist survey recruitment agency¹, an online survey was developed to gather responses on mobility aid use, size and prevalence, and experiences of public transport services, from mobility aid users. Survey responses were provided by this supplier's panel of research participants, who were screened based upon their use of one or more mobility aids. A total of 154 valid responses were recorded, including 85 responses providing information on occupied mobility aid size.

Both the user and stakeholder surveys were set up on Microsoft Forms to collect quantitative and qualitative data.

¹ MIS Group

Focus Groups with Mobility Aid Users

To further unpack the themes explored in the user survey, a series of focus groups with mobility aid users were held. Participants were recruited via the user survey, which included a question for participants to indicate their willingness to participate in a focus group discussion on mobility aid use and experiences of travel on public transport. Participants were contacted by the study research team and booked in to attend one of the four focus group sessions, which were all held via Microsoft Teams. A total of 30 people participated across the four focus groups.

The focus groups each began with a short introduction to the aims of the study, and information on the reference wheelchair specification was provided to participants. The focus groups facilitated discussions on use of mobility aids, the types of journeys participants made with their mobility aid, and a 'virtual journey' exercise to unpick experiences at each stage of the journey (planning, at the stop/station, on board the service, etc.). The sessions were recorded, with detailed notes also taken. The notes were verified and finalised, and thematically analysed using open coding to identify key themes and findings.

The research activities focussed on answering the following high-level questions:

- Is the reference wheelchair specification fit for purpose? (why/why not from user and stakeholder perspectives);
- What are the characteristics, prevalence, and use of wheeled mobility aids in the UK? (from user and stakeholder experiences); and
- Does this research demonstrate that there will be a need for associated changes in the future to accessibility standards for the design of rail, bus, taxi / PHV vehicles and transport infrastructure?

The research team also engaged with key organisations such as NHS Wheelchair Services, the British Assistive Technology Association (BATA), British Healthcare Trades Association (BHTA) and Global Cooperation on Assistive Technology (GATE). Following requests to access their data sources, a small number of new data sets were collected from the NHS and manufacturers of mobility aids.

The outcomes of Work Package 2 were rigorous qualitative and quantitative data sets on the use of mobility aids on different transport modes, which are written up in Chapter 4.

3.3.3. Work Package 3

Research Analysis

Following the analysis of the three separate datasets collected by this study, the research team identified where findings overlapped or contradicted, used the collective body of research alongside their experience to iteratively synthesise an overarching narrative of findings, which in turn informed the iterative development of emerging findings, which were finalised during a workshop held with all members of the study team.

The following activities were undertaken in support of the development of Work Package 3 – Survey Analysis (Qualitative and Quantitative).

Analysis of the results was done for (i) manual wheelchairs, (ii) powered wheelchairs and mobility scooters, and (iii) hybrid mobility-aids. The quantitative data is reported in tables and graphs and each of the three types of mobility aid has a brief commentary on the results of this data.

The data details each specific mobility aid in relation to:

- Current active use in the United Kingdom;
- Most common uses by mobility-aid owners;
- Ease of access to vehicles or infrastructure which are designed around the current reference wheelchair standard;
- Projected popularity in the British mobility-aid market; and
- The unoccupied size (length, width, height), and occupied size (length, width, height) of each mobility-aid included in our data set.

The quantitative data has been used alongside qualitative data from the focus groups, user surveys and stakeholder surveys (for example, manufacturers of trains, buses, and PHVs), to inform an in-depth understanding of mobility aid user attitudes to and experiences of travelling on public transport and in private hire taxis with their mobility aids. Qualitative data was thematically coded, and the key themes are reported in Chapter 4 below.

In addition, the results of this analysis were used to create user personas; archetypal users to represent different groups with specific requirements, desires, and characteristics. Narrative research (qualitative) and the quantitative research results provide context to the findings and help bring archetypal user stories to life as part of this research project. Personas were developed in the context of using a mobility-aid in the context of a 'complete journey', through the public realm, expanding on the basic quantitative results. The Persona Narratives can be found in Appendix A.

3.4. Ethical Considerations and Standards

All participants in this research, and many study stakeholders, were mobility aid users, with many self-identifying as disabled. To facilitate participation in the research, or shaping of the study, the following steps were taken:

- All documents and publications provided in an accessible format, where possible ensuring legibility for those with vision impairment, and compatibility with screen readers;
- Reasonable adjustments made to overcome barriers presented by impairments or health conditions;
- All engagement and research undertaken via Microsoft Teams and other digital platforms to avoid travel during the ongoing Covid-19 pandemic, preventing engagement with those required to shield, or who are anxious regarding their health and wellbeing;
- Alternative forms of engagement provided where participants are unable to join sessions via digital platforms e.g. dial in to conference calls via telephone; and
- All reported results have been anonymised.

4. Results and Analysis

4.1. Introduction

The following chapter presents a synthesised analysis of the stakeholder survey, mobility aid user survey, and the focus groups undertaken with mobility aid users. The chapter is structured around four research questions:

1. Current types, prevalence, and nature of the use of wheeled mobility aids
2. Nature of the activities and journeys that wheeled mobility aids are used for
3. Experiences of mobility aid users on public transport services
4. How users' needs, and mobility-aid dimensions and uses, are likely to change in the next 20 years.

These research questions were developed to address the core requirements of this commission, with each research question drawing on insights from across the three datasets collected as part of this study (see section 4.2) to provide an overarching narrative. All names used are pseudonyms to preserve anonymity, but to help individualise and humanise each participant's unique experiences.

4.2. Background and Demographic Information

4.2.1. User Survey

A total of 154 valid responses were received. 51% of respondents identified as female, 48% as male, and 1% as non-binary.

Some 9% of respondents were aged 39 or under, 62% of respondents were aged between 40 and 59, while 28% of respondents were over the age of 60.

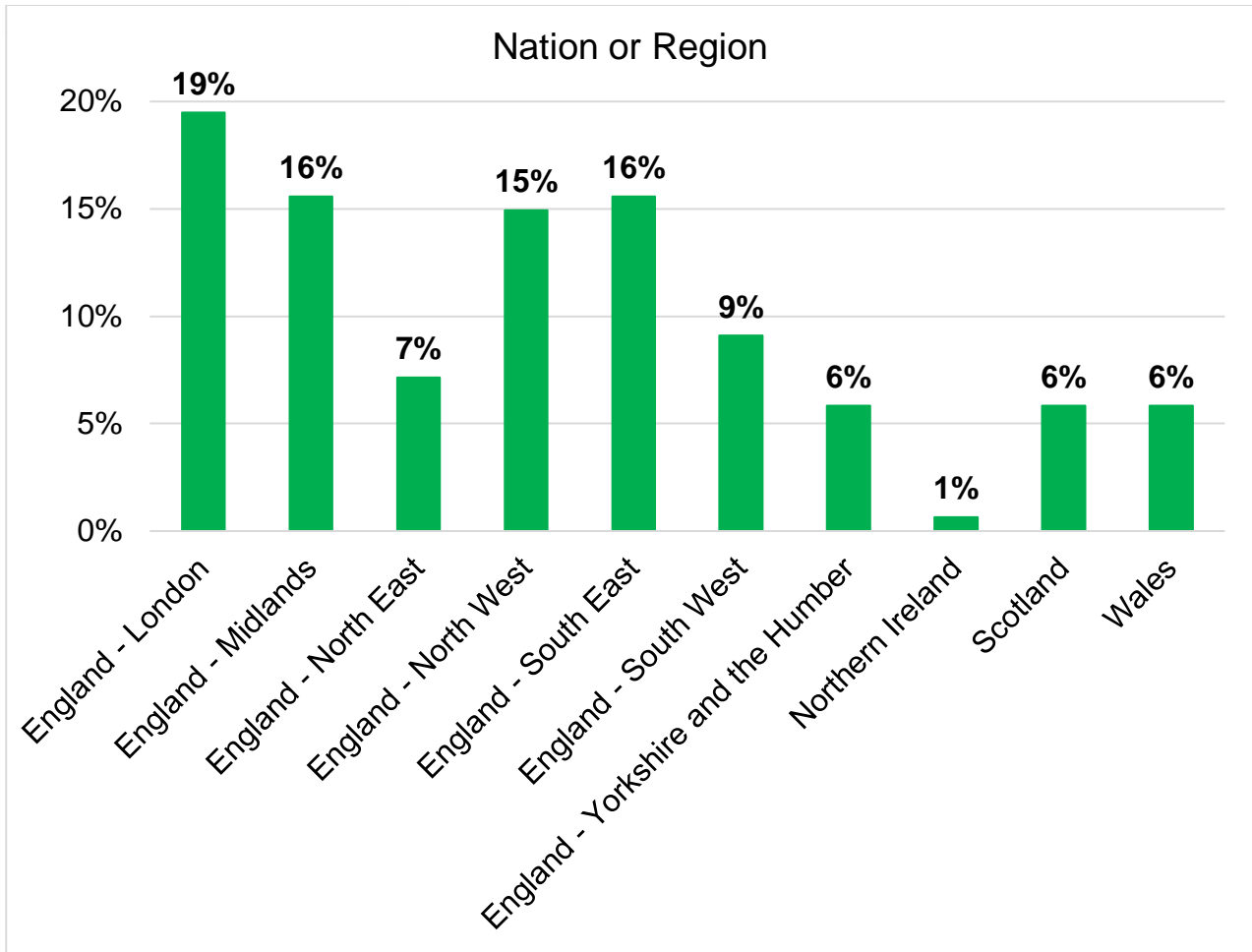


Figure 4.1 Responses to the question “Where do you live?”

Some 88% of respondents were from England, 1% from Northern Ireland, and 6% from each of Wales and Scotland. Attempts were made by the study team to increase the proportion of responses from Northern Ireland, Scotland, and Wales by contacting stakeholders and passenger representatives from these nations and encouraging them to share a link to the survey with relevant customer groups.

4.2.2. Stakeholder Survey

A total of 72 responses were received, 53% were from transport operators, 26% from charities and related groups, 10% from healthcare professionals, 7% from advisory bodies, and 4% from mobility aid manufacturers.

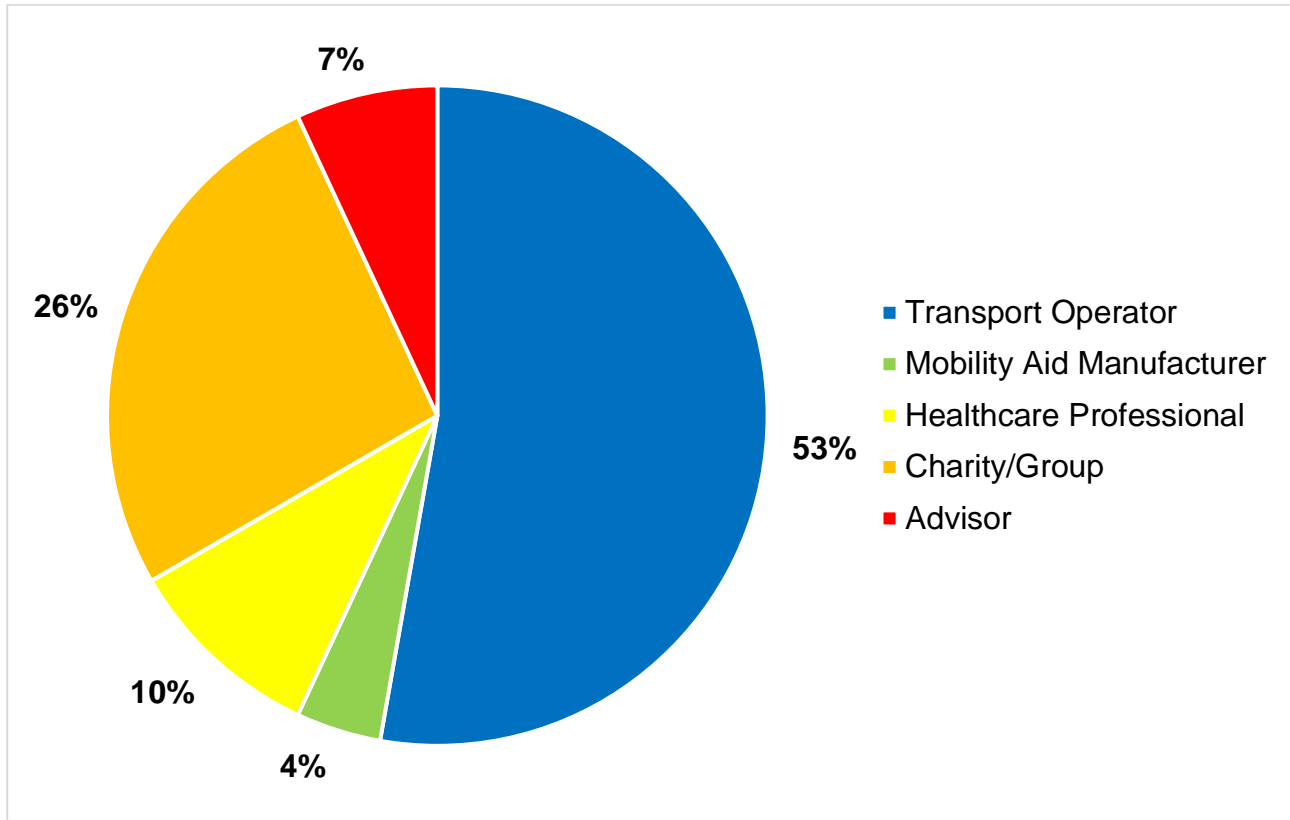


Figure 4.2 - Responses to the question "What type of organisation are you representing?"

4.3. Research Question One: Current types, prevalence, and nature of the use of wheeled mobility aids

In order to understand the baseline position of mobility aid use amongst public transport users in 2021, respondents to our mobility aid user survey, stakeholder survey, and participants in focus group discussions, were all asked about the use of mobility aids by themselves or their customers, and the type(s) of mobility aids used by themselves or their customers.

4.3.1. Types of Mobility Aids Used

A wide range of mobility aids were used by mobility aid users surveyed as part of this study. Figure 4.3 and Figure 4.5 outline the primary mobility aid used by respondents to our mobility aid user survey, and whether it was new or second hand when purchased.

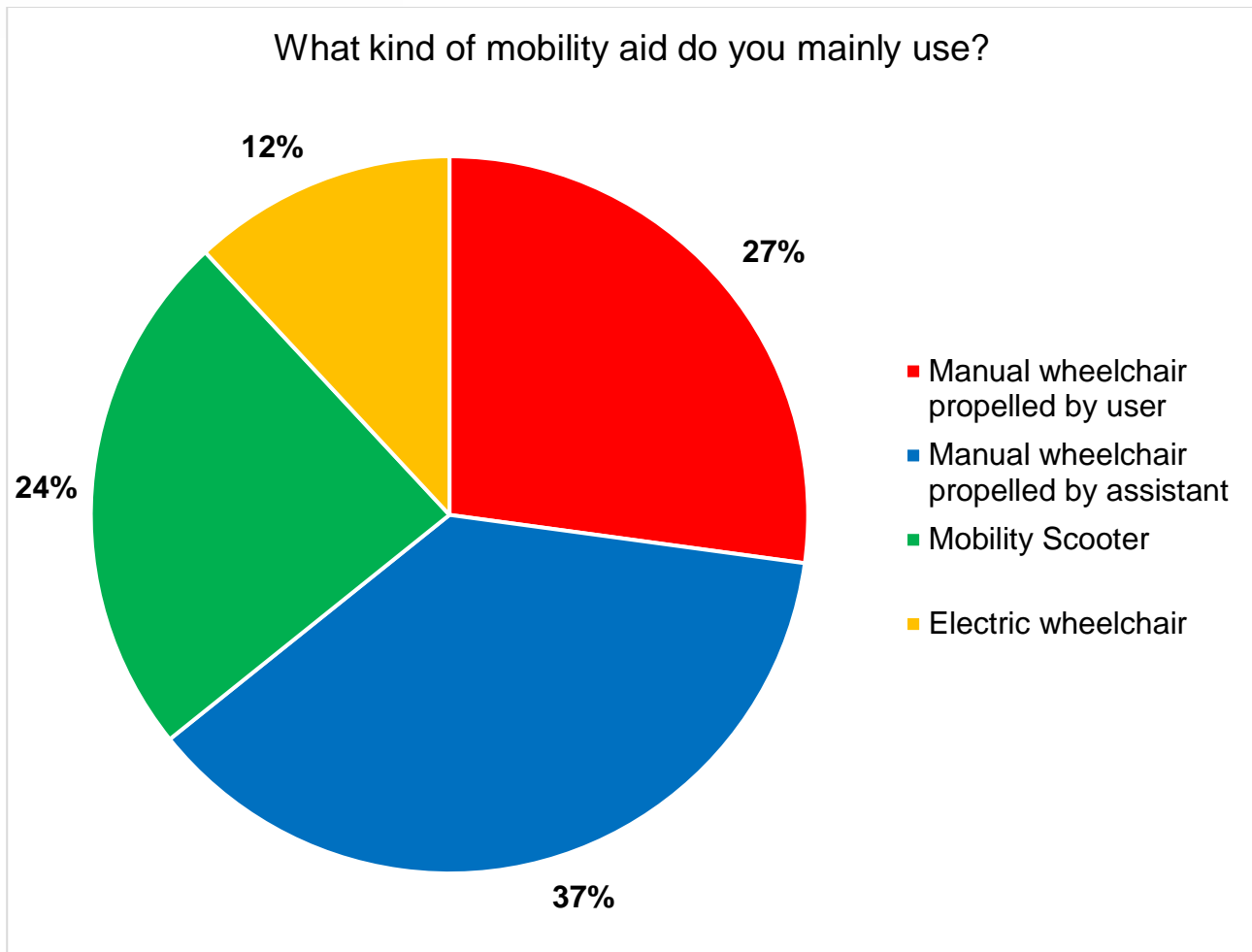


Figure 4.3 Responses to the question "What kind of mobility aid do you mainly use?"

Figure 4.3 identifies manual wheelchairs as the most popular type of mobility aid, followed by mobility scooters and electric wheelchairs. This differs from the findings of previous studies (see Table 2.4), which identified a greater prevalence of electric wheelchairs, and a much lower prevalence of assistant propelled manual wheelchairs and mobility scooters.

Across the studies preceding this work there has been a clear change in the proportion of mobility aids used, for example, the percentage of participants using mobility scooters increased from 6% to 18% between 1991 – 2005 and made up 24% of our sample. Changes to the type of mobility aid used - particularly a shift from manual wheelchairs to commonly larger, heavier electric devices - have implications for the user's level of access. As discussed later in this chapter, many participants favoured mobility scooters over other types of mobility aid.

A similar question was also posed to stakeholders. Figure 4.4 outlines the responses to this question, highlighting a perception amongst stakeholders regarding the popularity of electric wheelchairs which is not shared by mobility aid users who responded to our survey. Similarly, stakeholders perceived manual wheelchairs propelled by an assistant to be less commonly used, whereas this was the most commonly reported mobility aid by respondents to our mobility aid user survey.

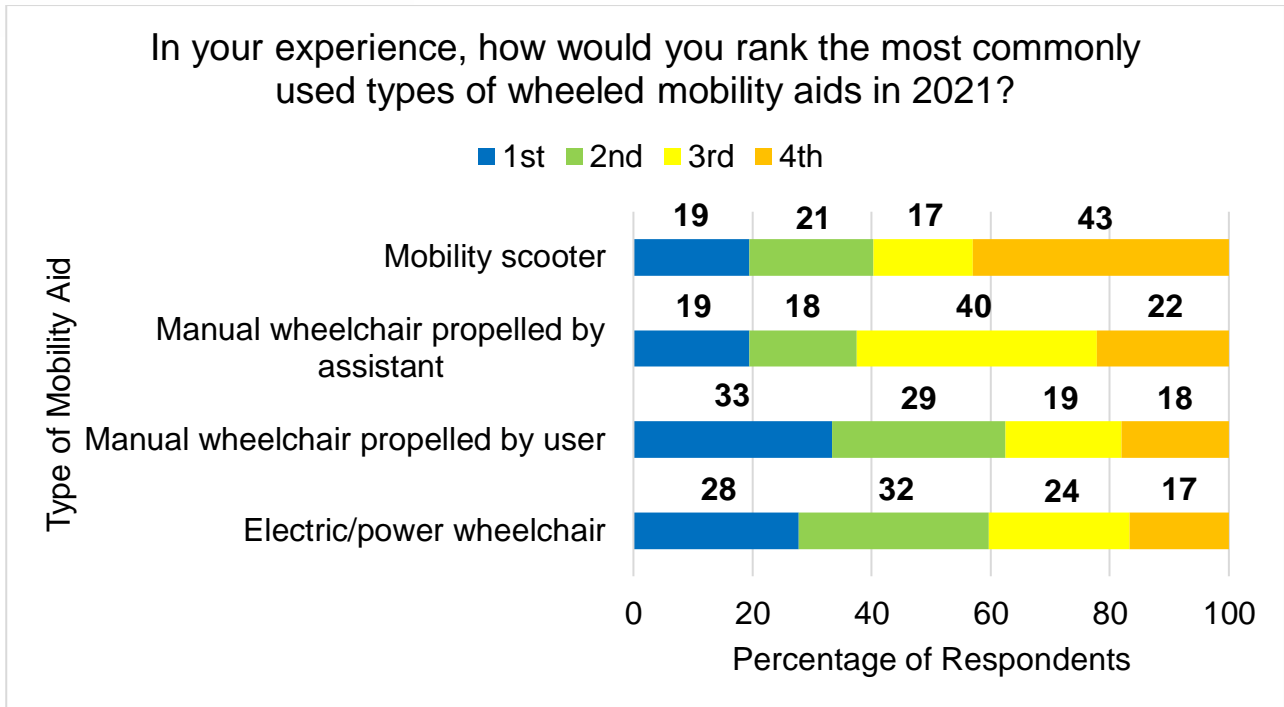


Figure 4.4 Responses to the question "What would you say are the most commonly used types of wheeled mobility aids in 2021?" (colours correspond to order of key)

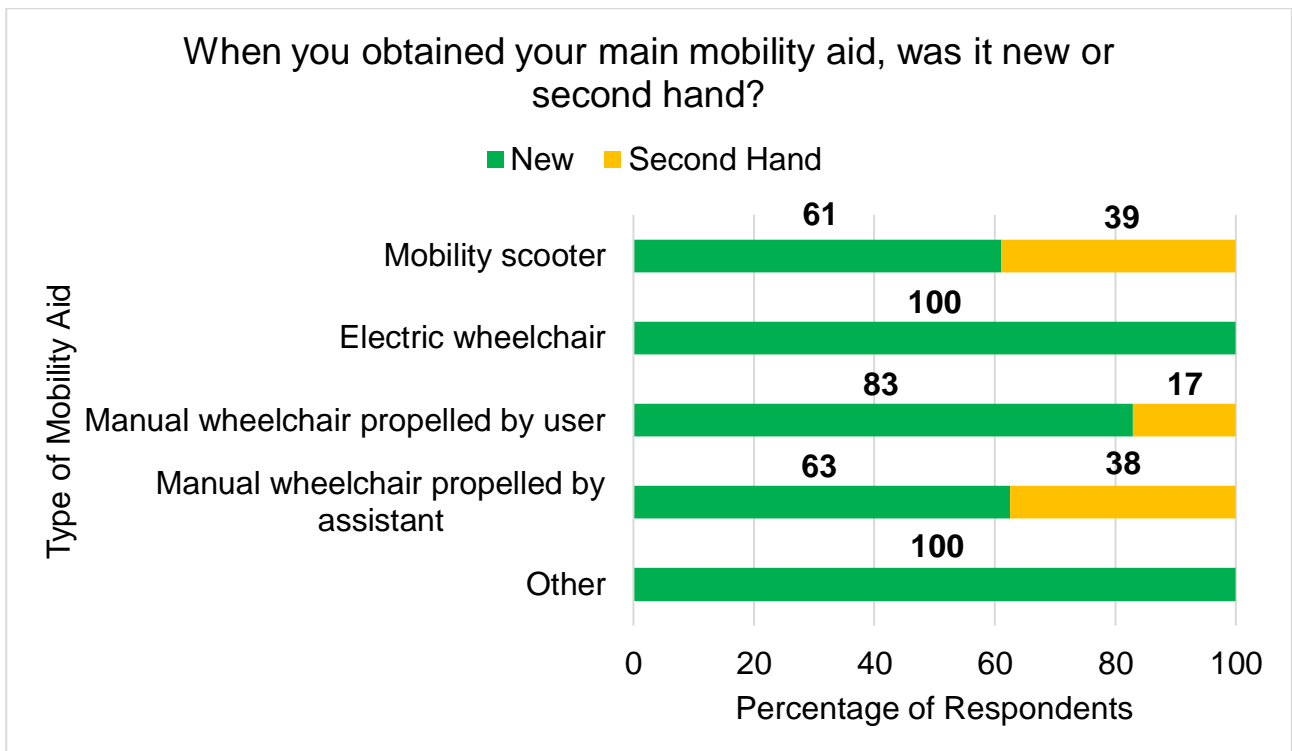


Figure 4.5 Responses to the question "You've told us that you use a mobility aid, what kind of mobility aid do you mainly use?" (colours correspond to order of key)

Figure 4.5 identifies that over a third of assistant propelled manual wheelchairs and mobility scooters were purchased second hand, with a lower proportion of self-propelled manual wheelchairs, and no electric wheelchairs being purchased second hand, indicating certain

devices are likely to be kept by their original owners for longer, or are perhaps custom built and therefore used by their original owner for the duration of their service life.

Respondents to our mobility aid user survey were also asked whether they used a mobility aid prescribed by the NHS. 16% of respondents reported they used a mobility aid provided by the NHS, 88% of which are manual wheelchairs, with 12% of respondents being provided with an electric wheelchair.

When choosing a mobility aid, respondents to our mobility aid user survey considered a number of factors, as outlined by Figure 4.6.

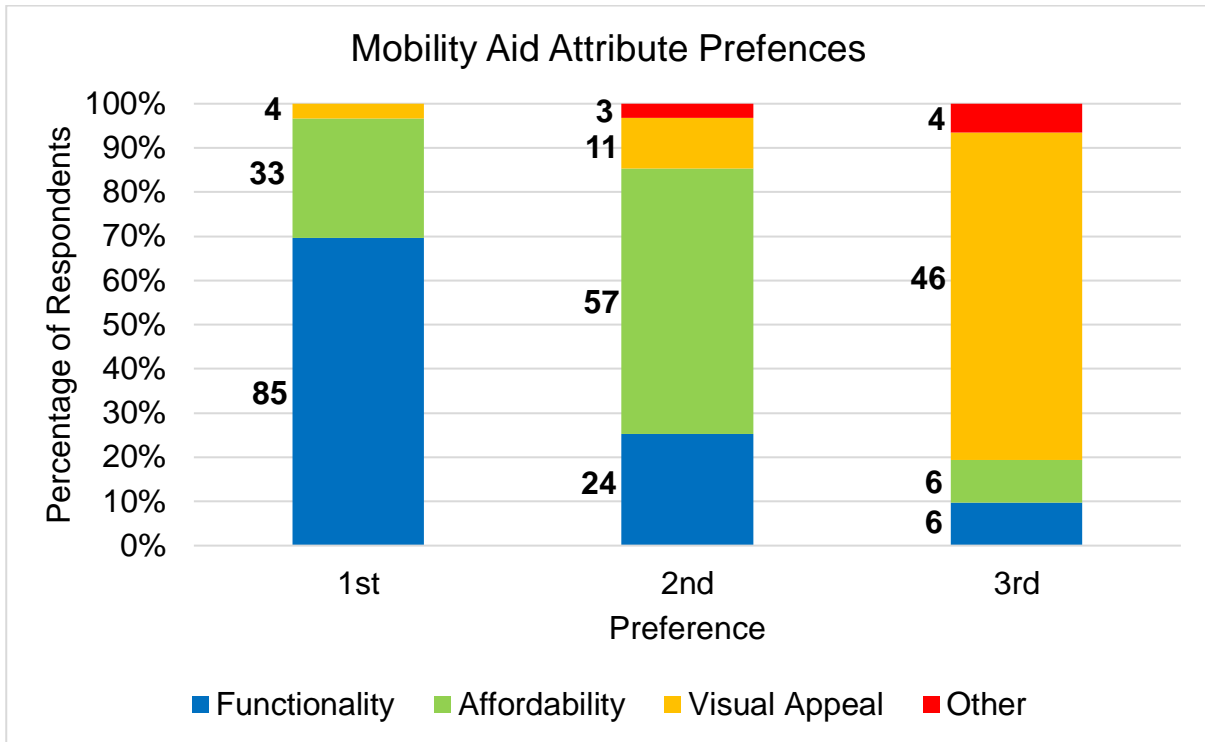


Figure 4.6 Responses to the question "What factors influence you when choosing a mobility aid?"

The primary factor for participants in our study was usability/functionality, with 70% of respondents identifying this as the primary factor determining their choice of mobility aid. The second most important factor for respondents was price/affordability, while looks/aesthetics was the least important factor. For around a quarter of respondents, price/affordability was the most important factor; similarly, usability/functionality was ranked as the second most important factor by a similar proportion of respondents.

4.3.2. Acquisition of Mobility Aids

Participants obtained their primary mobility aid from a number of different suppliers, as outlined by Figure 4.7. The most common source was a specialist shop (27%), followed by the NHS (22%).

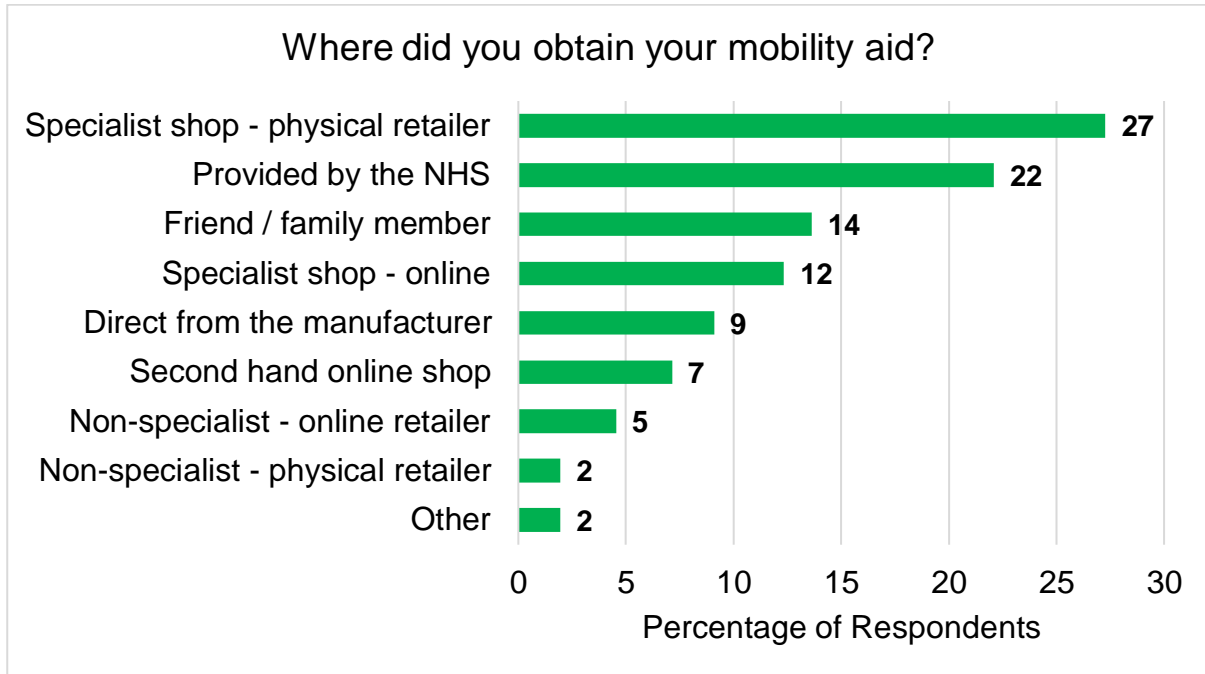


Figure 4.7 Responses to the question "Where did you obtain your main mobility aid?"

4.3.3. Prevalence of Mobility Aids

To understand how the prevalence of mobility aids is perceived, stakeholders were asked whether or not they think commonly used wheeled mobility aids have changed over the last 20 years since the 1991 study took place. Over half (55%) reported that they think the most commonly used wheeled mobility aids have changed over the last 20 years. This result is congruent with the changes to devices and presence of new models identified by this study compared to the 1991 study.

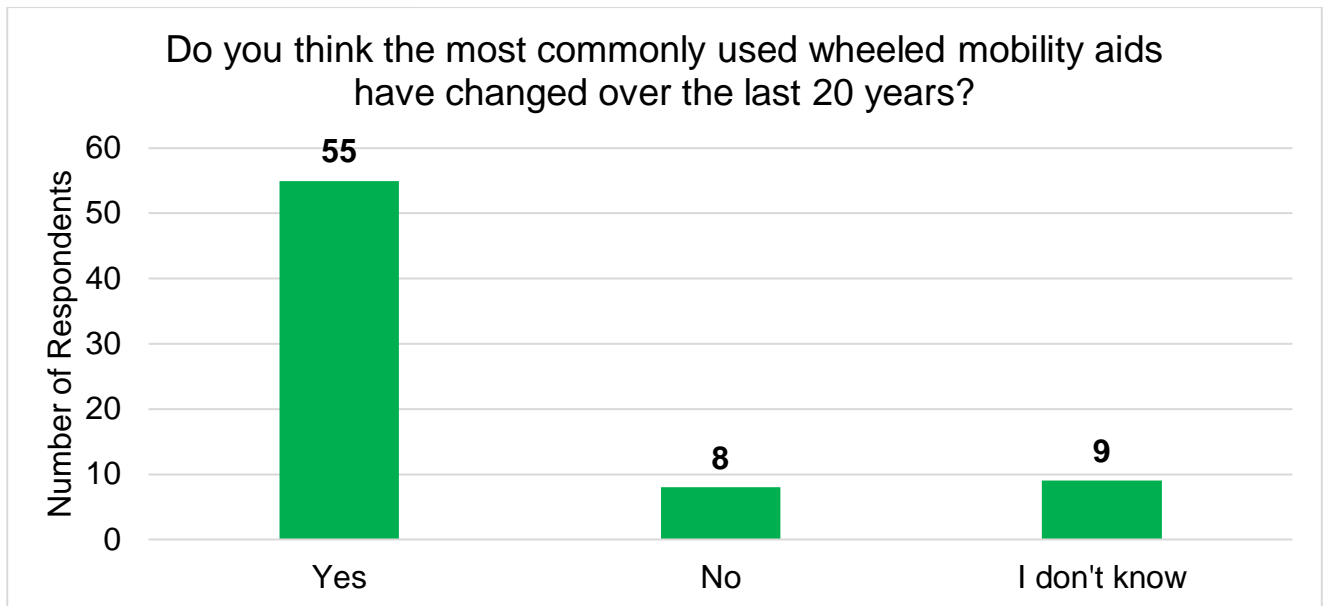


Figure 4.8 Responses to “Do you think the most commonly used wheeled mobility aids have changed over the last 20 years?”

Differences between the mobility aids identified in the 1991 study and this research include an improvement in the quality and ergonomics of mobility aids, particularly manual wheelchairs which are propelled by the user. Other differences include vast increases in the capabilities of electric devices, for example, the introduction of easily folded, disassembled electric wheelchairs and scooters. On the other end of the spectrum of change, much larger devices are available such as improved all terrain wheelchairs, standing wheelchairs and wheelchairs which can climb stairs. Changes in size and weight were the most reported changes by stakeholders surveyed as part of this study.

4.3.4. Size of Mobility Aids

Using their knowledge and experience, stakeholders were asked to give their view on a number of statements relating to changes in the size of wheeled mobility aids.

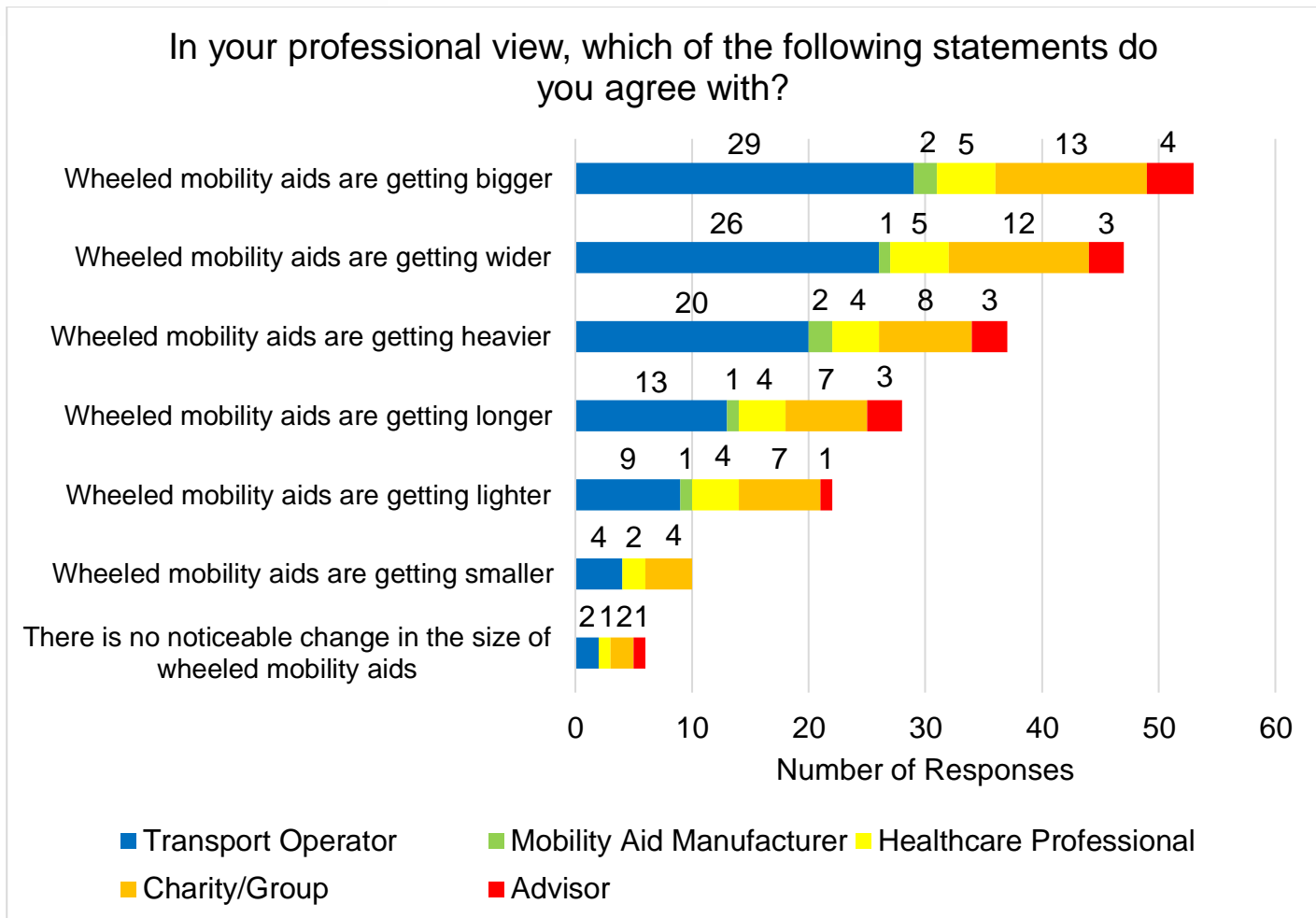


Figure 4.9 Responses to “In your professional view, which of the following statements do you agree with?”

The responses clearly indicate a perception that devices are getting bigger, however it is also possible that users are just trying to use larger devices on public transport than they previously have.

In order to verify stakeholder perceptions that wheeled mobility aids are increasing in size, respondents to our mobility aid user survey were invited to provide measurements of the occupied size of their primary mobility aid. The following section presents analysis of the measurements recorded for each type of mobility aid in comparison to the reference wheelchair specification.

Occupied measurements were provided by a subset of respondents to our mobility aid user survey. It was not possible to obtain measurement data from all respondents, as an assistant would be required to undertake the measurement. For some participants, such as those who live alone, this would not be possible.

Unoccupied width data was collected by the study team using the make and model information provided by respondents, with data being obtained from the mobility aid’s user manual and manufacturer’s website. Unoccupied width data was specifically collected and reported to allow comparison with earlier studies such as the 1999 and 2005 studies in which the measurements were effectively unoccupied width. Not all respondents were able to provide complete or accurate information on the model of their mobility aid. Consequently, the sample size for unoccupied size (obtained from the manufacturers information) is different from the occupied data (obtained from the survey). Previous studies have used

unoccupied data as part of their analysis, hence its inclusion in this study to ensure accurate comparisons can be made.

Before obtaining the descriptive statistics for the occupied height, width, and length of each type of mobility aid, it was important to validate the self-reported measurements provided by respondents were correct. From the initial 154 respondents, 90 were able to provide measurements for the size of their occupied mobility aid; however, following verification of the data, it was found only 70 respondents gave plausible measurements for their mobility aid's height, length, and width. The measurement data was inspected by two researchers who decided in consensus to remove measurements based on the following criteria:

- the measurements provided did not make sense (e.g., a mobility aid with a width measurement of 20cm); or
- the measurements provided by the respondents were smaller than the measurement reported in the mobility aid's user manual (the user manuals for each mobility aid brand were obtained online).

While every step was taken to ensure the validity of the remaining 70 responses, as the measurements were self-reported, they could still be subject to human error.

Of the remaining 70 respondents, 24 used a manual wheelchair propelled by assistant, 16 used a manual wheelchair propelled by the user, 10 used an electric wheelchair and 20 used a mobility scooter.

Table 4.1 Measurements of manual wheelchairs, propelled by assistant

	Sample Size	Mean	Minimum Dimension	Maximum Dimension	Reference Wheelchair	Percentage of respondents within reference specification	Interpolated 95th Percentile
Height of occupied mobility aid (cm)	24	123.68	90	153	135	62.5%	152.55
Width of unoccupied mobility aid (cm)	17	59.58	50	77	N/A	94.1%	N/A
Width of occupied mobility aid (cm)	24	70.86	52	115	70	70.8%	106.70
Length of occupied mobility aid (cm)	24	94.16	50.5	163	120	95.8%	120

Table 4.1 outlines measurements of assistant propelled manual wheelchairs collected as part of this study, alongside measurements for the reference wheelchair. When occupying their mobility aid, only 62.5% of participants were accommodated within the reference wheelchair height specification, and 70.8% were accommodated within the width specification. 95.8% of participants were accommodated within the reference wheelchair length specification. The interpolated 95th percentile identifies the measurements which 95% of assistant-propelled manual wheelchairs are estimated to fall within. This provides evidence to potentially enlarge the height and width of the reference wheelchair specification to better accommodate attendant propelled devices.

Table 4.2 Measurements of manual wheelchairs, propelled by user

	Sample Size	Mean	Minimum Dimension	Maximum Dimension	Reference Wheelchair	Percentage of respondents within reference specification	Interpolated 95th Percentile
Height of occupied mobility aid (cm)	16	108.38	78	140	135	93.8%	133.25
Width of unoccupied mobility aid (cm)	20	60.45	50	75	N/A	85%	74.05
Width of occupied mobility aid (cm)	16	61.75	45	90	70	87.5%	78.75
Length of occupied mobility aid (cm)	16	91.78	65	110	120	100%	108.5

Table 4.2 outlines measurements of user propelled manual wheelchairs collected as part of this study, alongside measurements for the reference wheelchair. When occupying their mobility aid, 93.8% of participants were accommodated within the reference wheelchair height specification, 87.5% were accommodated within the width specification, and 100% were accommodated within the reference wheelchair length specification. The interpolated 95th percentile identifies the measurements which 95% of self-propelled manual wheelchairs are estimated to fall within. This provides evidence to potentially enlarge the width of the reference wheelchair specification to better accommodate the size of user-propelled manual wheelchairs currently in use.

Table 4.3 Measurement of electric wheelchairs

	Sample Size	Mean	Minimum Dimension	Maximum Dimension	Reference Wheelchair	Percentage of respondents within reference specification	Interpolated 95th Percentile
Height of occupied mobility aid (cm)	10	112.26	90	155	135	90%	143.75
Width of unoccupied mobility aid (cm)	11	90	50	68	N/A	100%	67
Width of occupied mobility aid (cm)	10	155	53	91	70	80%	88.3
Length of occupied mobility aid (cm)	10	135	59.7	128.6	120	80%	126.98

Table 4.3 outlines measurements of electric wheelchairs collected as part of this study, alongside measurements for the reference wheelchair. When occupying their mobility aid, 80% of participants were accommodated within the reference wheelchair width and length specifications, and 90% were accommodated within the reference wheelchair height specification. The interpolated 95th percentile identifies the measurements which 95% of electric wheelchairs are estimated to fall within. This provides evidence to potentially enlarge the height, width, and length of the reference wheelchair specification to better accommodate the dimensions of electric wheelchairs currently in use.

Table 4.4 Measurements of mobility scooters

	Sample Size	Mean	Minimum Dimension	Maximum Dimension	Reference Wheelchair	Percentage of respondents within reference specification	Interpolated 95th Percentile
Height of occupied mobility aid (cm)	20	131.43	87.3	178	135	50%	176.84
Width of unoccupied mobility aid (cm)	20	56.47	48	72	N/A	90%	71.05
Width of occupied mobility aid (cm)	20	60.90	48	102	70	87.5%	83
Length of occupied mobility aid (cm)	20	112.78	64	170	120	70%	161.45

Table 4.4 outlines measurements of mobility scooters collected as part of this study, alongside measurements for the reference wheelchair. When occupying their mobility aid, only 50% of participants were accommodated within the reference wheelchair height specification, 70% were accommodated within the reference wheelchair length specification, and 87.5% of participants were accommodated within the reference wheelchair width specification. The interpolated 95th percentile identifies the measurements which 95% of mobility scooters are estimated to fall within. This provides evidence to potentially enlarge the height, width, and length of the reference wheelchair specification to accommodate the dimensions of mobility scooters currently in use.

Table 4.5 Percentage of mobility aid users that fit the height, length, and width reference wheelchair size

	Overall percentage	Manual wheelchair propelled by assistant	Manual wheelchair propelled by user	Electric wheelchair	Mobility scooter
Percentage of mobility aid users that fit the height, length, and width limits	54%	46%	81%	60%	40%

Table 4.5 provides an overview of the proportion of mobility aid users surveyed in this study who use a mobility aid, which when occupied, is compliant with the reference wheelchair specification. User propelled manual wheelchairs were found to have the most closely matching dimensions to the reference wheelchair specification, with mobility scooters exceeding the dimensions by the greatest amount. However, 19% of user propelled wheelchairs were found to exceed the reference wheelchair specification, potentially excluding these individuals from using public transport services. For other types of mobility aid, particularly assistant propelled manual wheelchairs and mobility scooters, the majority of occupied mobility aids exceed the reference wheelchair specification, meaning users of these types of device are more likely than not to be excluded from using public transport services at present.

Table 4.6 Comparison of the sample sizes, maximum dimensions and 95th percentiles for length across previous studies

Data Source (study)	T0047 (this study)	2019 Group 1	2019 Group 2	2005	1999	1991
Sample Size	70	84	90	1356	745	382
Maximum Dimension (cm)	170	N/A	N/A	160	155	145
95th Percentile (cm)	156	130	130	134	127	124

Table 4.6 provides a comparison between the occupied length data recorded by this study, and previous studies on mobility aids. It should be noted that the 95th percentile size occupied length recorded by all studies exceeds the reference wheelchair specification. The occupied length is seen to increase across all three studies, with more recent studies recording larger measurements for both maximum dimension and 95th percentile. This study, however, has noted a significant increase in size, both the maximum dimension and 95th percentile, which therefore adds further evidence that the reference wheelchair may no longer be representative of the mobility aids most commonly used. The following section provides reference images of the kinds of mobility aids used by the participants of this research with the addition of newer styles, such as standing wheelchairs and wheel attachments, which were not identified in the 1991 study.

4.3.5. Wheeled Mobility Aid Types



Figure 4.10 Manual Wheelchair Propelled by User



Figure 4.11 Manual Wheelchair Propelled by Assistant



Figure 4.12 Electric Wheelchair



Figure 4.13 Mobility Scooter (Class 2)



Figure 4.14 Mobility Scooter (Class 3)



Figure 4.15 Standing Wheelchair



Figure 4.16 Example Hybrid Mobility Aid – Wheelchair with Hand Cycle Attachment



Figure 4.17 Example Hybrid Mobility Aid – Wheelchair with Battery Attachment

4.3.6. Summary and Key Findings

The analysis outlined above adds further evidence that the reference wheelchair may no longer be representative of the mobility aids most commonly used.

- Manual wheelchairs, followed by mobility scooters, were the preferred mobility aids amongst respondents to this study.
- Mobility aids are generally purchased based upon their functionality, followed by affordability. Specialist shops, and the NHS, are the most common acquisition channels for respondents to this study.
- Stakeholders identified mobility aids are increasing in size and weight, especially width.
- 54% of respondents occupied mobility aids fitted within the reference wheelchair specification. Self-propelled manual wheelchairs were most likely to fit within the reference wheelchair specification (81%), with assistant propelled wheelchairs (46%) and mobility scooters (40%) the least likely to conform to the reference wheelchair specification.

4.4. Research Question Two: Nature of the activities and journeys that wheeled mobility aids are used for

4.4.1. Use of mobility aids on public transport

Participants in this study used their mobility aids for a variety of activities and journeys. In order to understand how mobility aids are used on public transport services, respondents to our mobility aid user survey were asked whether they currently use their mobility aid when travelling on public transport.

Figure 4.18 identifies that the majority (53%) of respondents currently use their mobility aid to travel on public transport services sometimes, often, or always. 47% of respondents do not currently use their mobility aid to travel on public transport. Of those participants who do not currently use their mobility aid on public transport, 60% identified their mobility aid as a barrier to accessing public transport. Respondents identified the following issues which currently prevent them from using their mobility aid on public transport services:

“I don't attempt to use public transport for several reasons - either there isn't sufficient space for me, or the space supposedly for wheelchair users is taken up by prams and pushchairs or other items which shouldn't be there. It's also very risky as they often don't have seatbelts and/or any way of securing my chair to the floor, which is very dangerous. There's no guarantee e.g., with trains, that because you could access a train at the departure station, you will have wheelchair access at the station you arrive at. Some buses don't have properly working/maintained ramps, very few staff are able/willing to help. The list of issues goes on and on.”

“There is no room for mobility scooters on public transport”

“I need a helper and don't feel confident in travelling on busy trains and buses”

“For me it would be the hassle of getting to the closest bus stop, which is around half a mile away and up a steep hill, then trying to get onto a bus. Also, as the local buses do not tend to go where I want, I would need to get two buses which would end up with me being in extreme pain trying to get on and off and then having to do a return journey it would just be a nightmare”

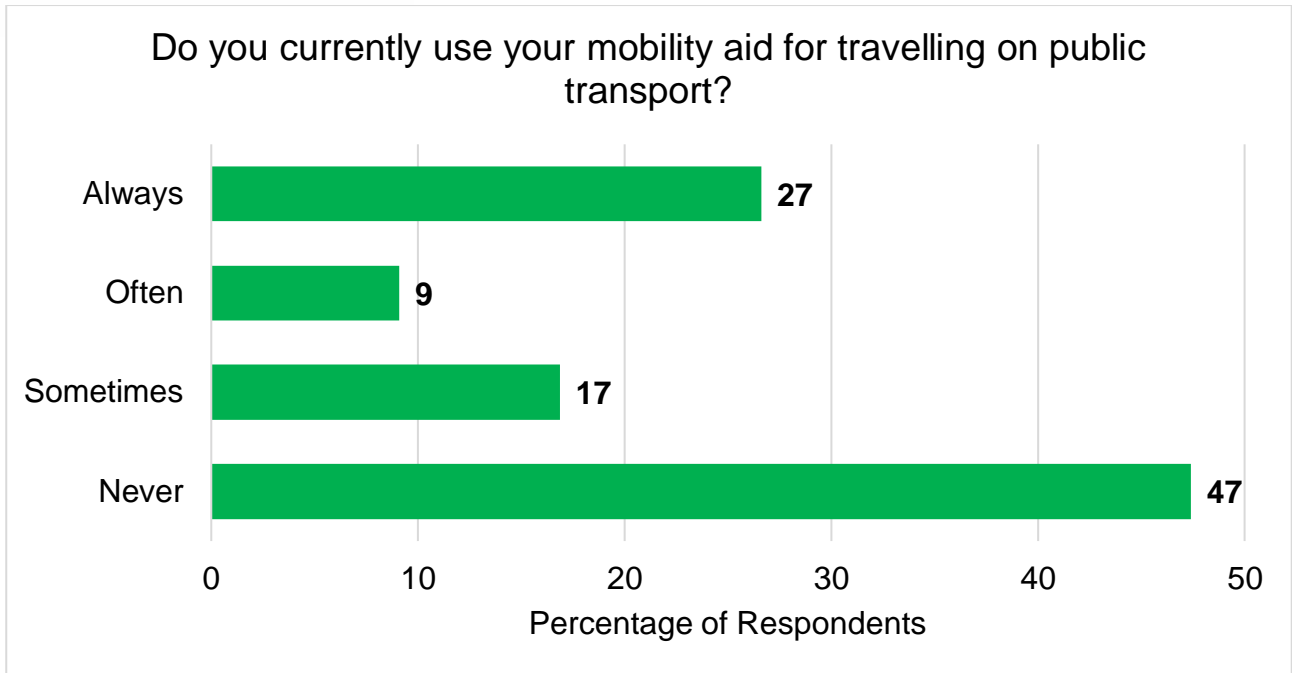


Figure 4.18 Responses to the question "Do you currently use your mobility aid for travelling on any public transport modes?"

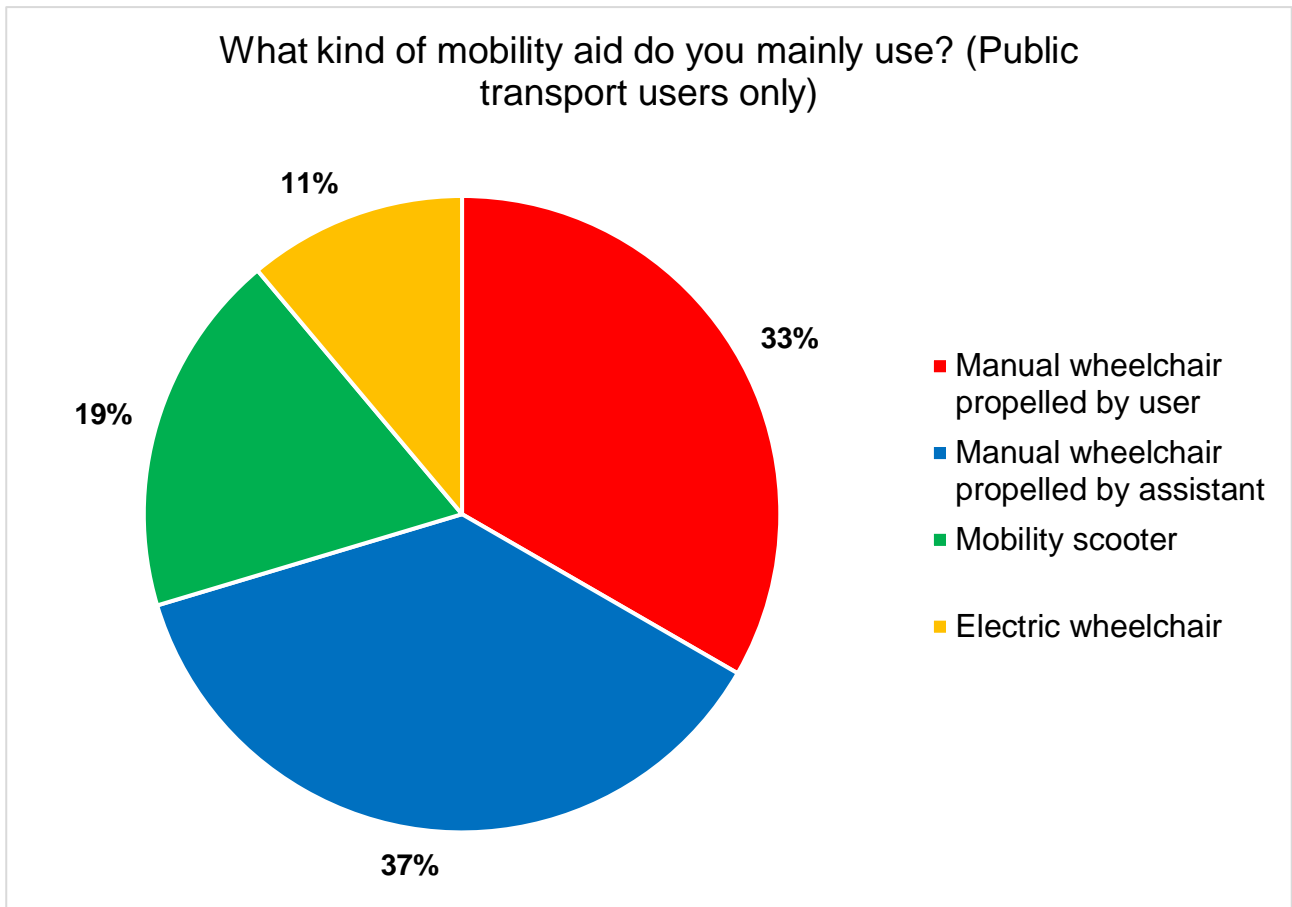


Figure 4.19 Responses to the question "What kind of mobility aid do you use?", public transport users only

Manual wheelchairs are the most commonly used primary mobility aid amongst those who use public transport, followed by mobility scooters, and finally electric wheelchairs. This contrasts with the stakeholder perception of mobility aid use, as shown by Figure 4.20.

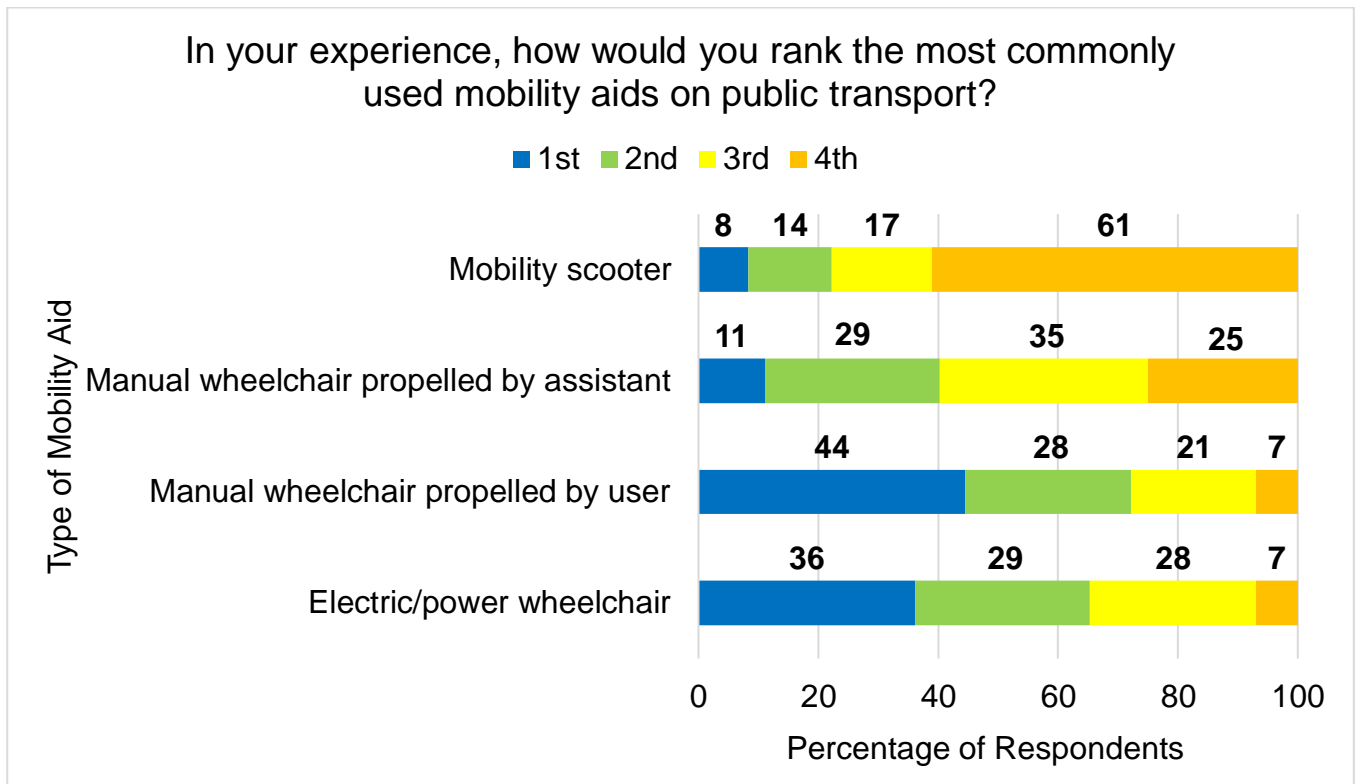


Figure 4.20 Responses to “In your experience, how would you rank the most commonly used mobility aids on public transport?”

Stakeholders were asked to rank which wheeled mobility aids they believed were most commonly used on public transport services. Stakeholders identified manual self-propelled wheelchairs, and electric wheelchairs, as being most commonly used on public transport services. Stakeholders perceived mobility scooters and assistant-propelled wheelchairs to be less commonly used on public transport services. These results contrast with the results of the mobility aid user survey, which identified a greater preference for assistant-propelled wheelchairs and mobility scooters.

While it should be noted the user survey results refer to respondent’s choice of primary mobility aid, these results were verified during the focus groups with mobility aid users, which further reinforced the importance of mobility scooters to participants in this study, and therefore their desire to be able to take their mobility scooter with them on public transport services. For example, Wendy explained “we cannot take the scooter on the bus, so we use a folding wheelchair, my partner is quite heavy so where they are hills, we have to hire a scooter”. Despite owning a scooter, Wendy’s husband must use his manual wheelchair to access public transport and then to be independent during his trip, hire another scooter. Other participants expressed that they would like to hire mobility aids for trips, however, they found this to be expensive, suggesting intersecting economic barriers also being at play. Instead, some participants who had access to a car, would instead travel by private transport as it guaranteed they were able to transport their preferred aid with them to their destination.

4.4.2. Use of additional mobility aids

Respondents to our mobility aid user survey were asked whether there are periods during the day when they don't use their mobility aid. 38% of respondents stated they always used their mobility aid, while 62% stated they sometimes do not need to use a mobility aid.

Respondents to our mobility aid user survey were also asked whether they ever use an additional mobility aid. The majority of participants (59%) use an additional mobility aid. Figure 4.21 outlines the range of additional mobility aids used by participants in this study.

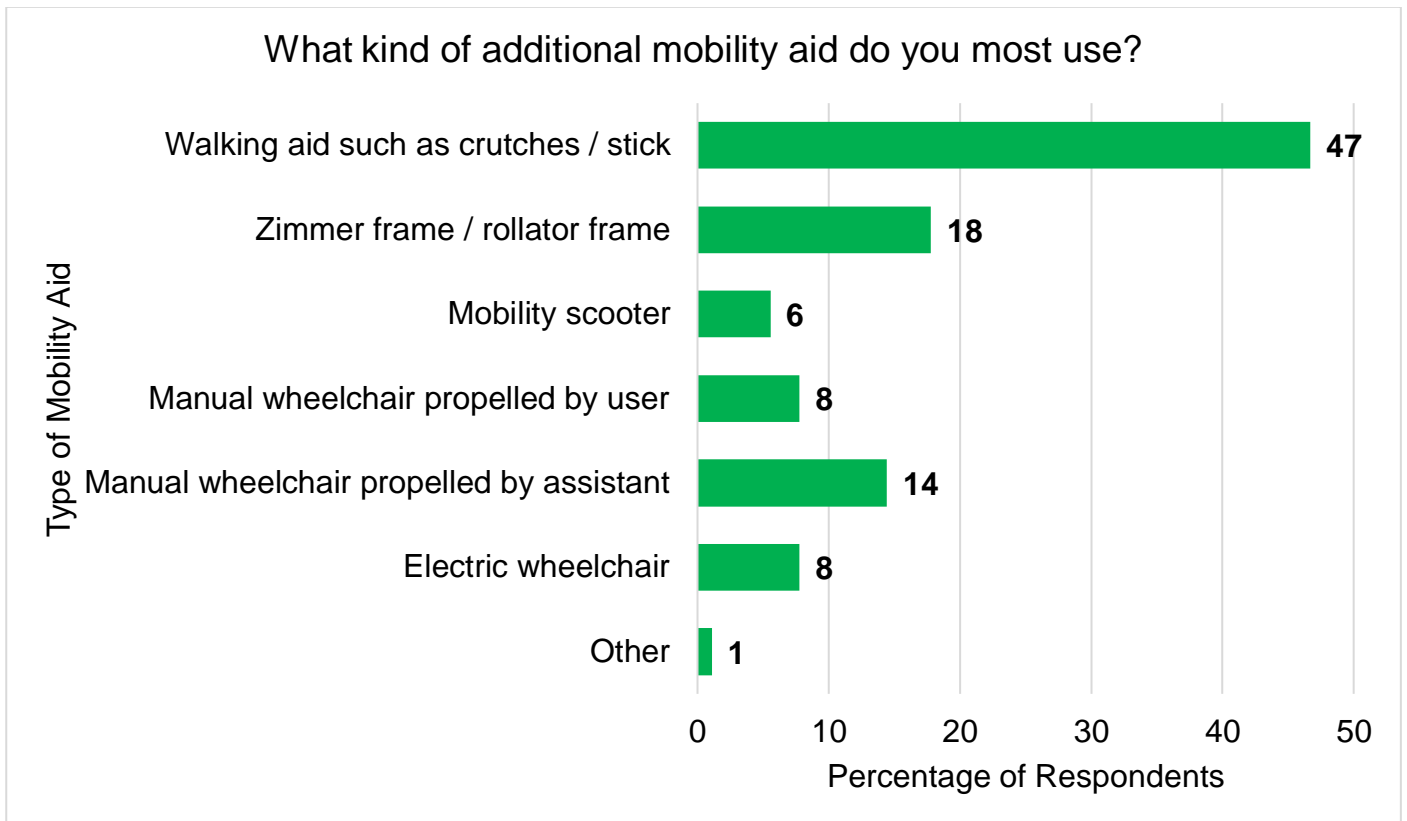


Figure 4.21 Responses to the question "What kind of additional mobility aid do you most use?"

The most commonly used additional mobility aid was crutches or a stick, used by 46% of respondents to the survey. 18% of respondents used a Zimmer or rollator frame, while 14% of respondents sometimes used a manual wheelchair propelled by an assistant.

Figure 4.22 outlines the factors which lead to participants using their additional mobility aid. 38% of respondents stated they always use their additional mobility aid, 19% of respondents stated they use their additional aid when their health or mobility is poorer, 15% use their additional aid for leisure activities, while 11% use their additional aid when they need to take a particular mode of transport.

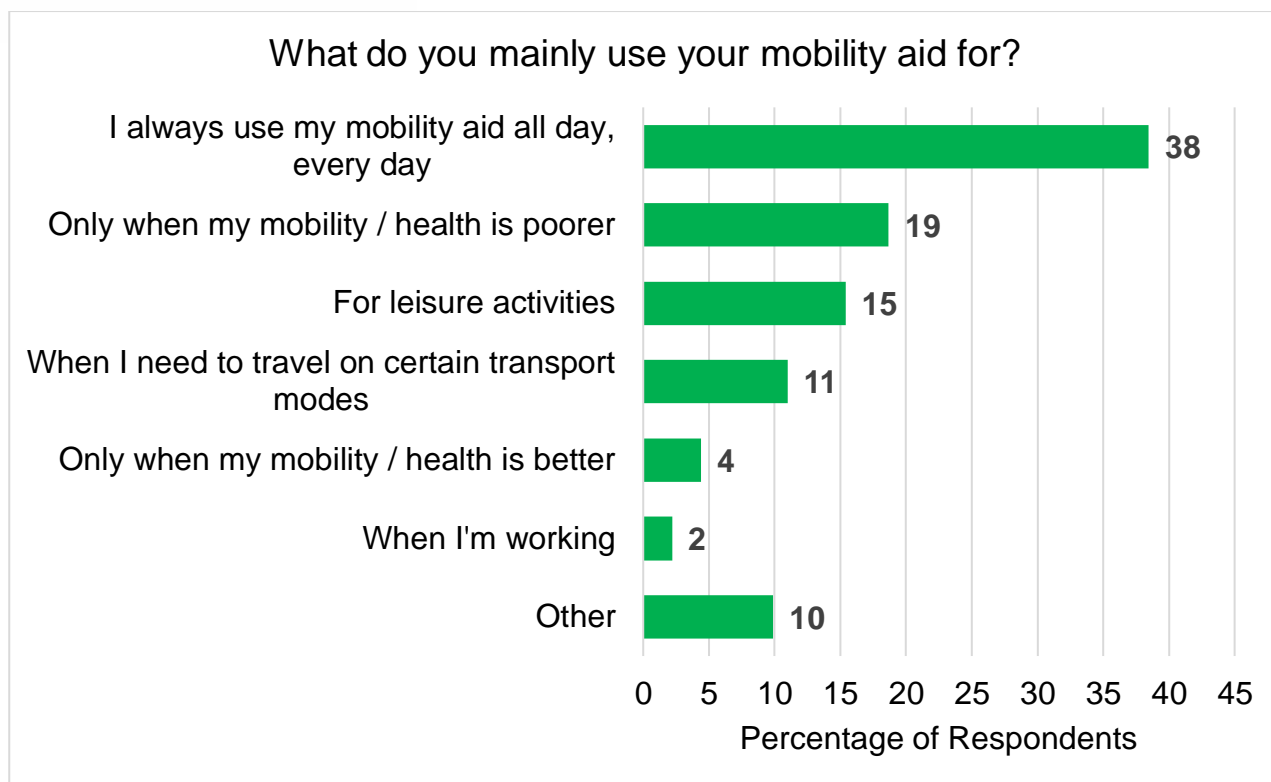


Figure 4.22 Responses to the question "Please tell us what you mainly use your (most used) additional mobility aid for"

For participants who have multiple mobility aids, a number of factors determine their choice of aid. For many participants, their health and wellbeing are the primary factors, particularly amongst those with conditions which fluctuate.

"I use my stick for very short distances and my wheelchair for medium to long journeys or places where I know I'll get tired or in pain quicker."

"If I'm going a fair distance, I use my scooter as I don't know how my mobility will be from hour to hour but if I am only going a short distance and am not in too much pain, I will use my sticks"

Public transport, or access at destination, was also a factor for some participants:

"I use electric wheelchair for long distances or hills. Manual wheelchair if going on transport with someone with me"

"I use the walking aids to walk around the house. The scooter is used if we are going anywhere that is not difficult to manoeuvre. The manual wheelchair is pushed by my husband if going to busy places or using public transport. I am not confident to use my scooter in crowded places"

These themes were further explored in the focus groups held with mobility aid users, where Aisha stated, "I have multiple mobility aids, but for public transport I would only use my wheelchair". Most of the participants reported using multiple aids, this included aids they own and hired aids. The choice of which aid to use when undertaking a journey depended on the mode used for the journey, the purpose of the journey and whether they would be travelling independently. Aisha explains her rationale for using different mobility aids in the following quote, which exemplifies the wider views and experiences of the focus group participants.

“I use different mobility aids depending on whether I am accompanied or not. I have mixed reviews for transport. I will use different mobility aids depending on how I am travelling, if I have got somebody with me I will use my wheelchair, if I haven’t and it is a small distance, I’ll use my stick”.

Another participant, Bethany, furthered this point by saying that of the adults she assists *“generally people use their wheelchair to travel, people feel more comfortable in wheelchairs than using frames. Sometimes we will take the wheelchair and the frame, but this requires additional assistance from staff”.*

For participants who use a manual wheelchair and an accessory aid such as a walking stick, crutches, or rollator, they tend to rely on their manual wheelchair for longer distances. For participants who own a scooter and a wheelchair, they often use a scooter for journeys too long to walk or too short to require public transport. For those journeys which do involve public transport, several participants explained that because they cannot take their electric wheeled mobility aid (scooter or electric wheelchair) they use a manual wheelchair. Aisha explained that *“for the last mile my husband must push me because I can’t take an electric wheelchair on the train. This takes away a lot of independence which I do have when I use an electric aid”.*

4.4.3. Use of additional equipment

Many participants surveyed use additional equipment besides their mobility aid. Of those respondents who do use public transport with their mobility aid, 33% carry and use additional equipment some or all of the time, as shown in Figure 4.23.

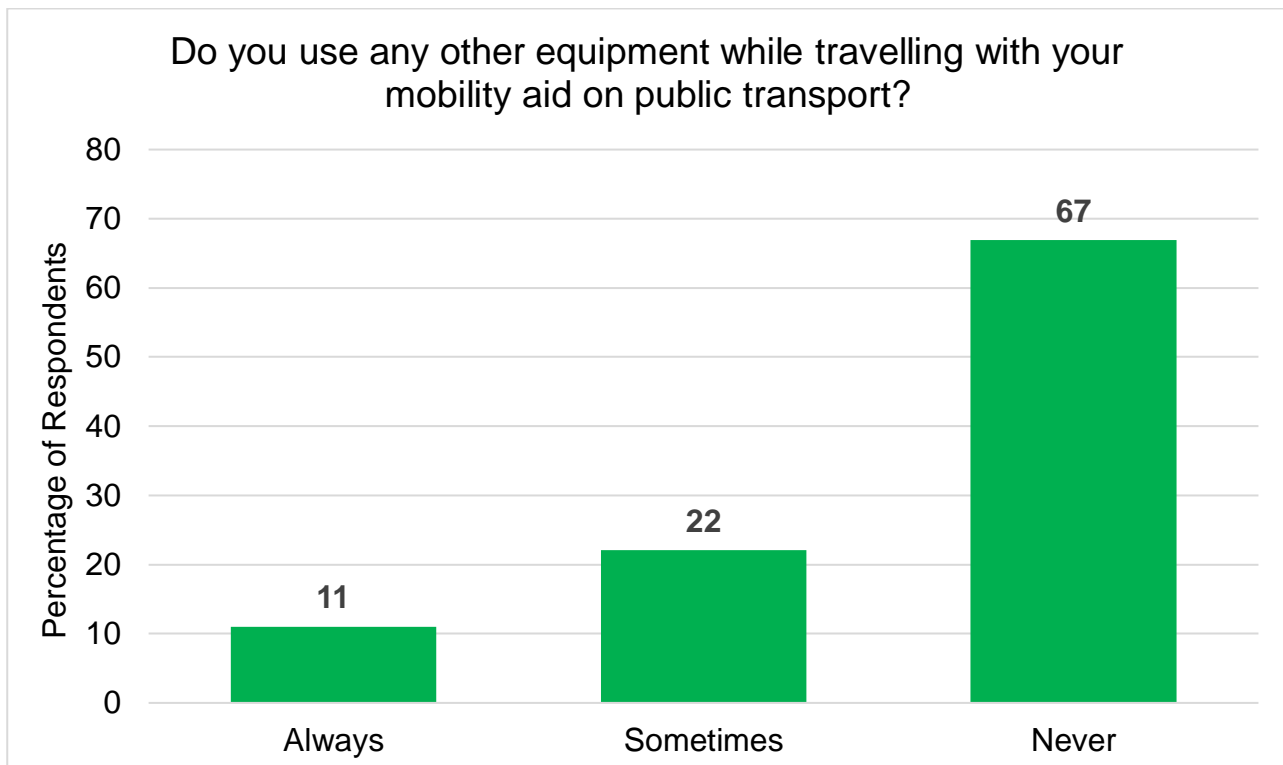


Figure 4.23 Response to the question “Do you use any other equipment while travelling with your mobility aid on public transport?”

The most popular additional equipment used by participants in this study includes:

- Basket / bag
- Walking stick (1 or 2)

- Foot support pump
- Crutch (1 or 2)
- Foldable walking frame
- Medical equipment e.g., oxygen tank, portable nebuliser

Carrying additional equipment whilst travelling has implications for the weight and dimensions of occupied devices; many focus group participants for example mentioned travelling with sticks or crutches which may add to their height when travelling. It also explains why occupied and unoccupied mobility aid measurements differ markedly. This in turn indicates that wheelchair space allowances may better accommodate users if they account for more than just the primary wheeled mobility device, and instead consider the overall holistic size and needs of many mobility aid users.

4.4.4. Summary and key findings

- Nearly 50% of respondents currently do not use their mobility aid on board public transport services. Respondents felt public transport services provided insufficient room for their preferred mobility aid.
- Manual wheelchairs and mobility scooters were the most commonly used mobility aids on board public transport services amongst respondents to this study.
- Many respondents used an additional mobility aid, most commonly crutches or a stick. Carrying additional aids increases the space envelope required for mobility aid users onboard public transport services.

4.5. Research Question Three: Experiences of mobility aid users on public transport services

4.5.1. Barriers to using public transport services

As highlighted in Figure 4.18, many study participants do not currently use their mobility aid on public transport. This could be for several reasons, however, as shown in Figure 4.24 one reason may be issues encountered whilst attempting to do so, some of which prevent them being able to make journeys using their mobility aid all together. Around half of the manual wheelchair users and mobility scooter users reported that they have been prevented from making a journey on public transport because of their mobility aid, while over 60% of electric wheelchair users have been prevented from using public transport because of their mobility aid.

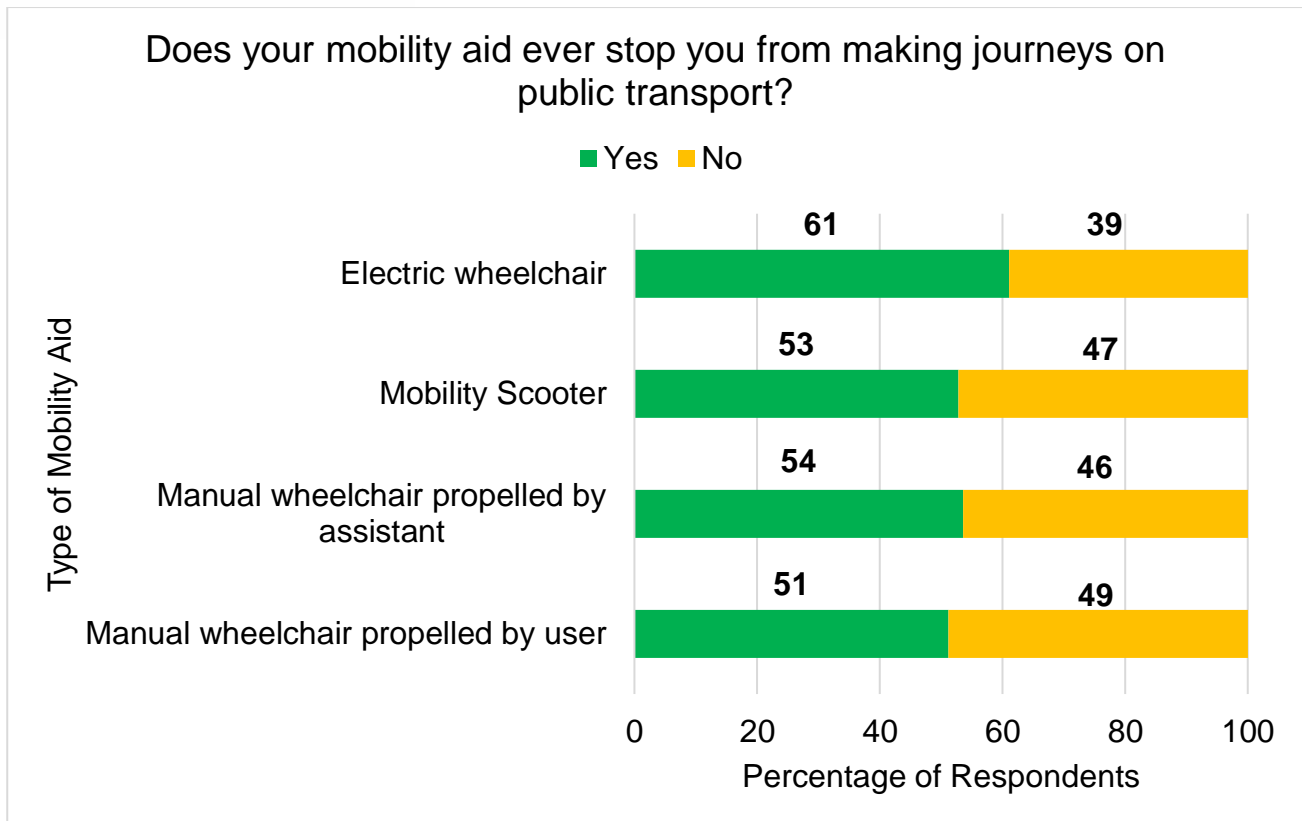


Figure 4.24 Response to “Does your mobility aid ever stop you from making journeys on public transport?”

During the focus groups, participants identified a wide range of barriers which prevent them from using public transport with their mobility aid. For many participants, the size of their occupied mobility aid was a significant barrier. Simeon explained “*I would like to be able to use taxis, but I am quite tall, so I can’t use the ramp*”. Despite describing himself as being “*quite tall*”, Simeon was not unique in facing this issue, Hayley noted that “*to travel in the black cab, you must bend forward otherwise your head is hitting the roof, but it is very sore to do*”.

The participants’ experiences of using taxis varied significantly, both across private hire and hackney carriage services and across locations, linked to the variety of standards in place across the UK (see section 2.6.3). Those with positive experiences put this down to good private hire vehicle firms and established rapports with their drivers. However, others explained that due to their aid private hire vehicle firms tried to charge “*over the odds*”, are unwilling to take them, would only take them on “*long journeys*”, or want to send a minibus which would incur a higher cost. “*Waiting for a taxi to accept me can be a wait*” according to Aisha based on her experiences at taxi ranks. Whilst there was praise of the accessibility of hackney carriages amongst many of the participants, the aforementioned issues encountered by Simeon and Hayley, as well as “*cabbies (who) won’t get out the cab to use the tool to open the ramp*” they are often inaccessible. Overall, the accessibility of taxis in terms of the vehicles themselves and attitudes of the operators is inconsistent. This significantly lowered some participants willingness to attempt to use them.

For those participants whose mobility aid fitted on their chosen mode of transport, other barriers could be experienced, for example the height of ticket machines at public transport stops. Bethany, who works in supported living, captured the experiences of those who cannot use the ticket machines at certain stations, explaining that “*on trams the issue is one*

of the ladies is very independent, but she cannot use the ticket machine as she cannot reach, it would be better for her if the machines were lower for wheelchairs so she could pay independently.” Participants who travel without a carer commented that they *“buy my tickets online to avoid buying a ticket at the booth as I cannot reach”*.

The weight of aids also presented a physical barrier, for example, Julie said:

“I find the weight of the mobility scooter to be a barrier to using taxis as not all firms are prepared to take the mobility scooter. I live in a hilly rural village so there are limited taxis and public transport options which make me dependent on the car”.

For other participants, the weight of their mobility aid is an insurmountable barrier. For example, Wilf remarked that he’d *“like to use public transport because it is cheap, but I wouldn’t dream of trying to get my buggy on, it weighs 40kgs and it’s one of the lighter ones on the market”*.

Other participants have found that whilst they may be able to use their wheeled mobility aid on public transport in its basic form, they are *“reluctant to use extra attachments [such as a hand cycle attachment] as it will be a hassle when travelling as it will not be able to enter or access places, for example, lifts because of its length”*. This prohibits hybrid mobility aid users from undertaking exercise, travelling in their preferred way, and travelling on certain terrains at their destination, potentially impacting people's ability to use active travel modes.

Mary elaborated on this explaining that her daughter:

“uses a manual wheelchair for public transport, but we also have an attachment to allow for off road travel, but we could not manage to take that on public transport. Say we are going for a day trip, for example, a country walk, the additional wheel helps. However, I couldn’t manage the third wheel and wheelchair on public transport, so we rely on the car. There must be a lot of planning to use public transport, including booking spaces, which takes a lot of time. Not taking the attachment limits what we can do if they arrive somewhere by public transport. I would like to use public transport more for my daughter’s experience and from a green aspect, however, it’s just is easier to drive.”

4.5.2. Experiences when travelling on public transport

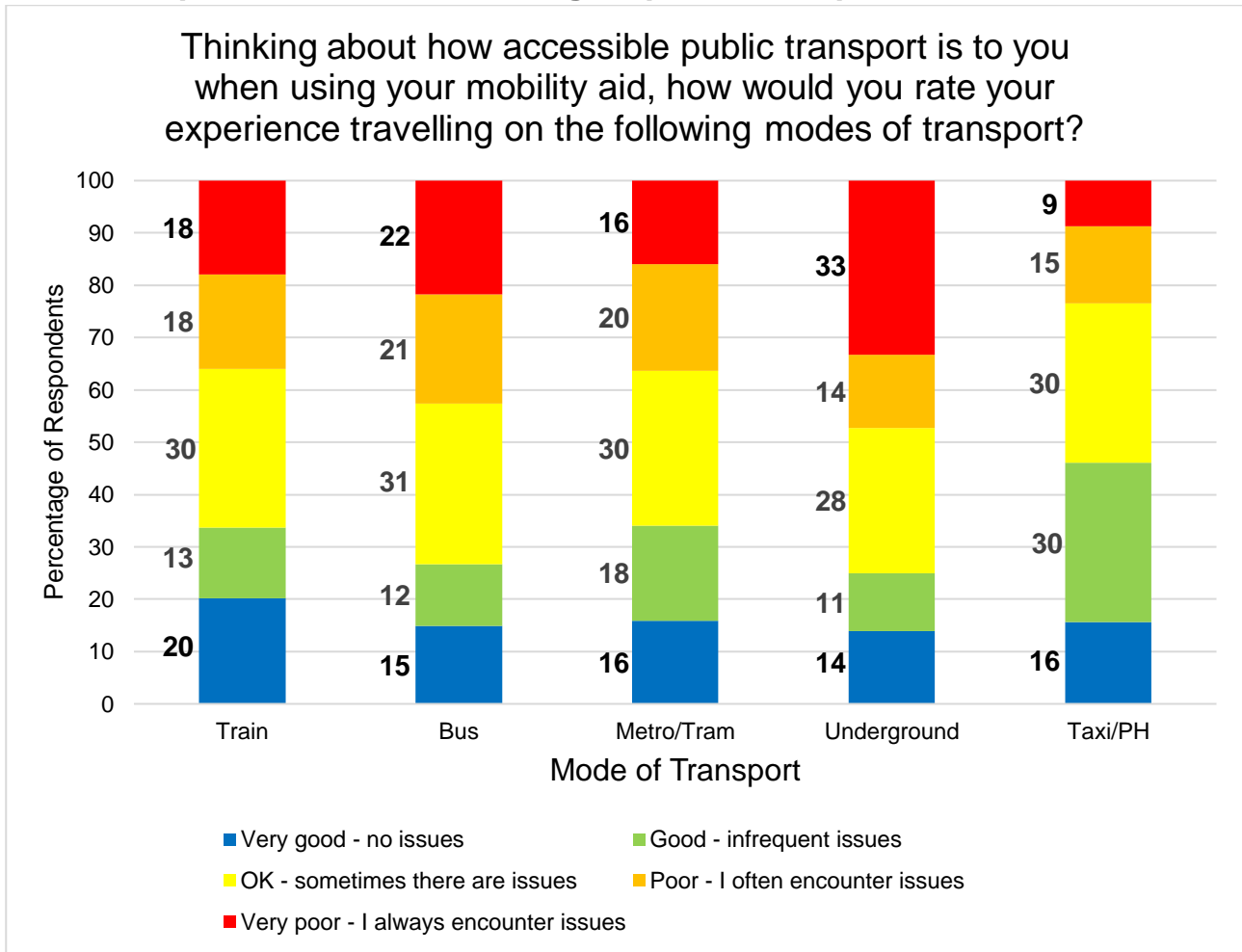


Figure 4.25 Response to “When considering your mobility aids, how would you rate your experience of each of the following public transport modes?”

Of those participants who use public transport (defined in this study as trains, buses, metros/trams, the underground and/or taxis/private hire vehicles), the majority sometimes, often, or always encounter issues. Participants identified the Underground as offering the poorest experience, followed by Bus, Train, and Metro/Tram. Taxi/Private Hire vehicles offered the best experience, with fewest issues reported.

Stakeholders were asked to consider this issue and rate their perception of the user experience for people travelling with mobility aids on public transport. Figure 4.26 identifies that stakeholders perceive the user experience similarly to mobility aid users. However, stakeholders perceive the user experience of bus services slightly better than the lived experience of mobility aid users, while the experience of train services is rated lower than lived experience. For other modes, stakeholders rank the user experience lower than the lived experience ratings provided by mobility aid users.

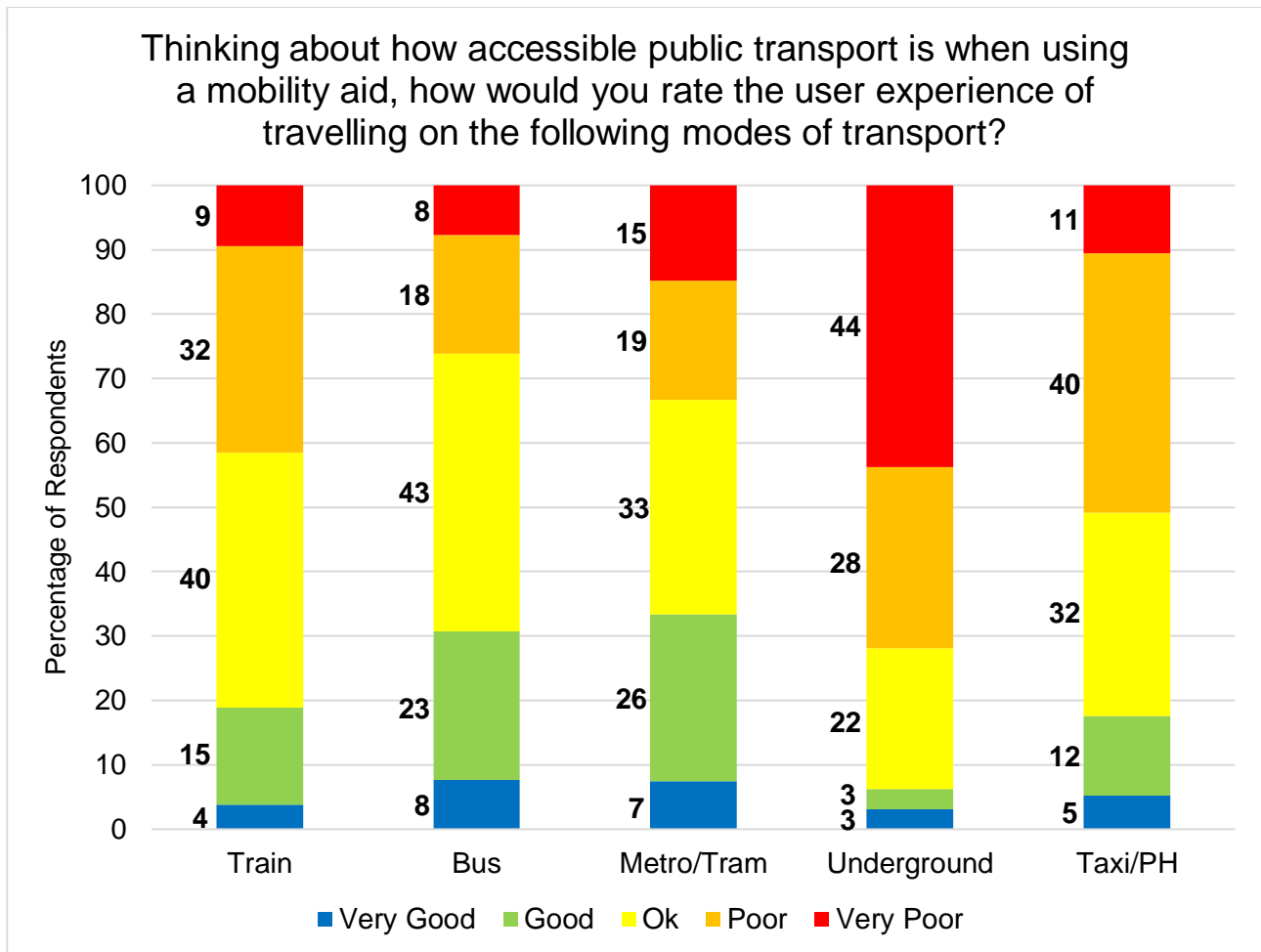


Figure 4.26 Responses to “Thinking about how accessible public transport is when using a mobility aid, how would you rate the user experience of travelling on the following modes of transport?”

Mobility aid users and stakeholders were asked to identify elements of the journey where problems were most likely to be encountered. Figure 4.27 outlines responses from mobility aid users, identifying issues are most frequently encountered when boarding or alighting vehicles, accessing a seat or space, using ramps or lifts, and getting assistance from staff. The view of stakeholders, illustrated by Figure 4.28, broadly aligns with the user perspective, with stakeholders also identifying issues with boarding and alighting transport services, and problems finding space and seating.

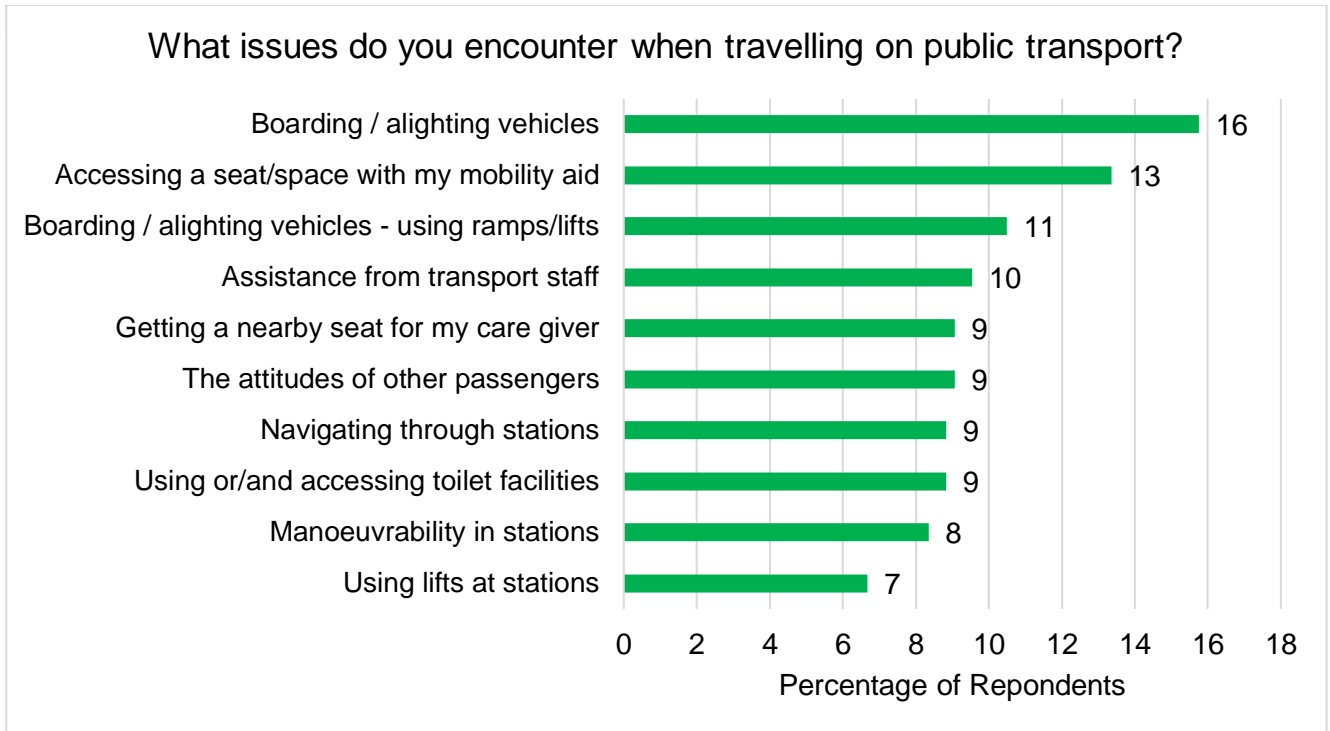


Figure 4.27 Responses to “What issues do you encounter when travelling on public transport with your mobility aid?”

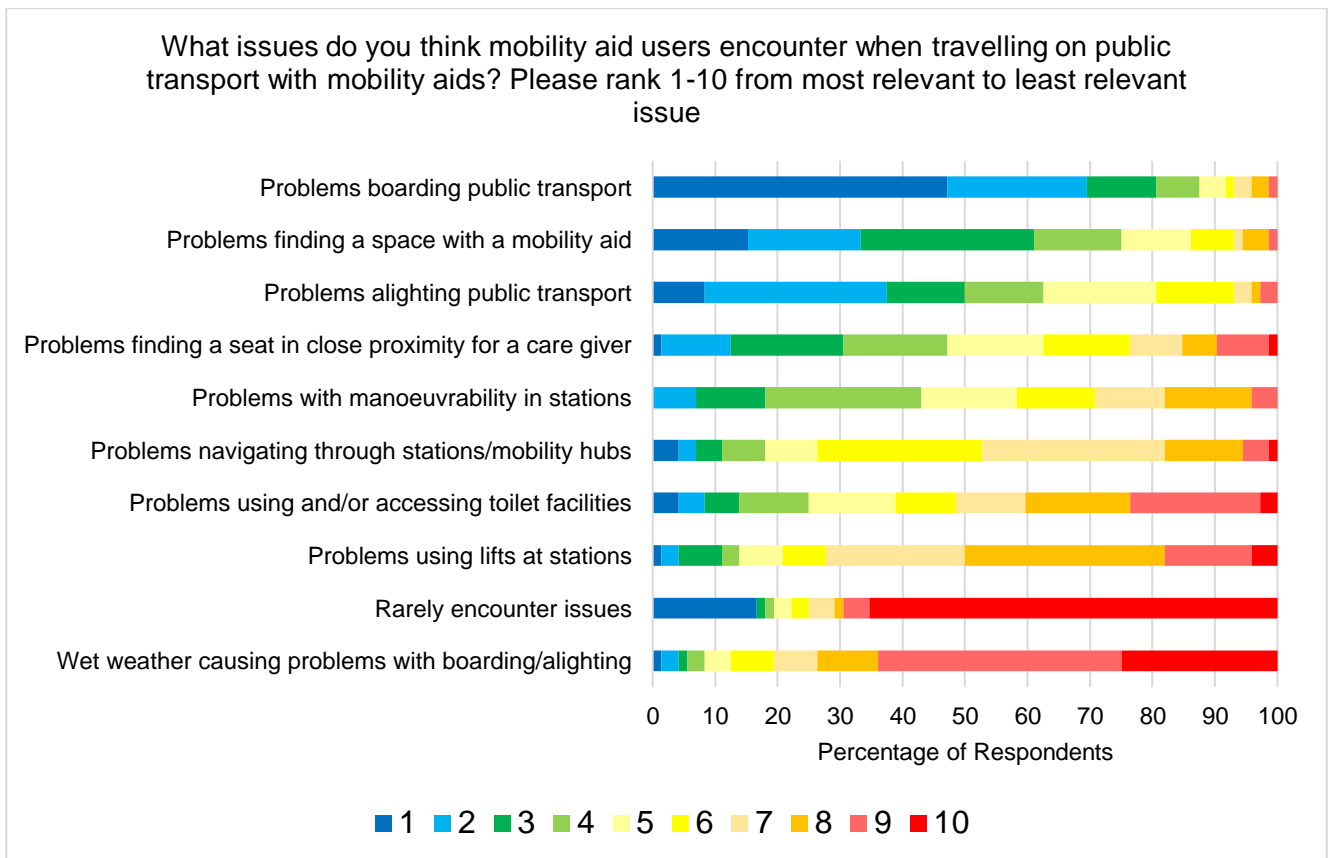


Figure 4.28 Responses to “What issues do you think mobility aid users encounter when travelling on public transport with mobility aids? Please rank 1-10 from most relevant to least relevant issue”

4.5.3. Journey narratives

During the focus groups, participants were encouraged to each describe a journey they either currently or would like to make, and to outline the factors they need to consider, or barriers they face, when making this journey. The following sections provide an overview of themes identified from these journey narratives, which exemplify many of the issues mobility aid users currently face when travelling on public transport services.

A key theme was the insufficient accommodation of disabled people both on board vehicles and in the infrastructure surrounding public transport. This took various forms, including; access, space to move, seating, staff, and public attitudes. When discussing access to buses, many of the participants stressed that they *“would prefer level boarding for buses”*. Bill, for example, who uses sticks for short distances and a scooter for longer distances *“wouldn’t dream of taking the scooter on a bus because you can’t rely on the bus that comes having a kneeling function”*. He then went on to explain that because of this he has to use his wheelchair on the bus, however:

“there’s a big gap to which is hard to negotiate. There is a designated space on board, however, there isn’t means of securing the wheelchair and I find that drivers are rough, so I feel uneasy being unsecured on buses going around corners”.

Chris also reported *“things that can be an issue is getting on and off the bus and once you’ve tapped in, negotiating the sharp bend on the bus to get to the scooter bay”*.

Several participants gave accounts of distressing experiences being turned away from buses due to insufficient space, inappropriate use of the wheelchair space or vehicle malfunctions. *“I found my confidence was extremely knocked by having to leave the bus [because the wheelchair space was inappropriately occupied], so I haven’t attempted to use the bus with my wheelchair since”* said Chloe, which captured the response of several participants to bad experiences on buses. Sharon, who uses an assistant-propelled wheelchair, however continued attempting to use the bus despite regularly being *“turned away from the bus or driven past”* due to the disabled space being *“full of buggies”*. She also experienced occasions where *“drivers have come to pull the ramp down and it’s fused together so I’ve missed appointments, going to school, stuff like that”* this accumulation of bad experiences and failed journeys resulted in Sharon feeling she *“had to make the decision to get a mobility car”*.

“Space in public transport is a problem”, with many participants raising issues around insufficient space on board services. Participants who had not experienced this themselves knew of other disabled people who had struggled to travel on public transport services due to insufficient space. Whilst the main issues raised were poor access to public transport services, and inappropriate use of wheelchair spaces, participants also discussed the space being too small and the lack of provision for wheelchair users and carers to sit together. Issues were experienced on all modes of public transport, but buses were particularly singled out by participants. This discussion was offered as an explanation for the survey finding that 54% (83) of the participants’ mobility aid had prevented them from travelling on public transport services.

Mary described how being separated from her daughter whilst travelling is a problem by saying:

“People find it difficult if wheelchair users and carers cannot sit together due to limited space. I don’t use the bus with my daughter who uses a wheelchair as I cannot sit

away from her. My daughter needs a lot of reassurance. [...] Trains have been a better experience overall, but my daughter couldn't go unassisted. However, I have had occasions where I have had to carry the wheelchair through inaccessible spaces. The metro service is accessible, but I do worry about using them in case there is limited capacity [at peak times]."

Whilst insufficient space put many off altogether, Sophie and her husband "try to travel first class, as we get extra space for legs in first class".

Hayley, however, has:

"to travel with parents and the outer doors of the train are fine to get through but inside it's more difficult, either no turning room or wheelchair spaces that are nearly impossible to get into. I have found that the second class carriage is slightly easier to get into, the first class carriage has ornate panelling and the rims of the wheelchair jam against it, and you can't get through – my dad had to lift me out the wheelchair and at the time I had a wheelchair that folded, so my mum had to quickly fold the wheelchair, shove it through, and drop me back in the chair. There was a wheelchair table that is supposed to fold down to get the wheelchair in, but the table was broken in the up position and I had to travel to London with my feet in the aisle and people stepping over me. I have CRPS (complex regional pain syndrome), and the slightest touch causes me extreme pain, so it was a nightmare journey".

Sophie and Hayley's words highlight participants' shared encounters with differing levels of access even within the same vehicle type. Poor access within trains was raised in several discussions, toilets on trains are found to be "far too small", "always broken and you can't get the chair in anyway".

Wendy, who cares for her husband explained that accessing toilets was an issue both inside trains and train stations:

"Boarding and alighting shouldn't be an issue but on board my partner couldn't use the toilet due to the moving train and there wouldn't be enough room for me to help him inside the toilet so we would need to use toilet facilities at stations. The toilet stations always seem to be far away. If we don't have the chair it's virtually impossible due to the distance to get to the accessible toilets. Whenever we have a break in the journey, we must allow a lot of time to allow for toilet breaks. I spend hours planning because you don't know what accommodations will and won't be made".

Poor experiences with journey care and booked assistance was also a common theme, Wendy, and her husband "go all over the place, to Edinburgh, to Manchester, to Liverpool and we always have the same experience, we book, and they say assistance will come and it never does. Sometimes the guard leaves it to me to get us onto the train and off which is difficult because it is heavy. Sometimes we wonder if it is worth it".

Negative experiences occurred during both boarding and alighting vehicles; Chloe summarised a poor experience boarding a train service:

"I was on a national train service with a friend in a wheelchair and the whole train was held up by 15 minutes to find a member of staff who could use the ramp. The member of staff was then rude and questioned why we needed to use the ramp and told us

that we were holding up the whole train. This angered other passengers on the train due to the delay. We had prebooked access as well, but this still happened”.

Simeon summarised common experiences alighting vehicles:

“There have been times where I have just been left on trains instead of being brought down. Lift access is also an issue as sometimes they don’t work. [...] I have been told that ramps weren’t working because there wasn’t any staff who were trained to use them.”

Difficulties boarding and alighting vehicles was not limited to those who use wheeled mobility aids. Thomas said, *“I find it difficult with my crutches to board and alight, I find conditions cramped, I feel cramped”.*

Within the station itself, Bill told us his “worst experience” on public transport occurred:

“taking the electric scooter on the railway, where I had to go to an intermediate station where the lift was the size of the scooter so I couldn’t get it in, the scooter couldn’t get in, so I had to be helped downstairs and meet the scooter at the bottom of the lift”.

“It gives me a lot of anxiety, not knowing if the lift is full, if the lift isn’t working”, several participants noted stress around not knowing “whether there is a lift or not”. Lifts not working was also a common issue, particularly in tram networks, the result of which is some participants “not being able to get out”. Margaret highlighted that when the lift to her local tram platform is not working then there is “no information on what to do or where to go”. When using the London Underground, Ricky has been forced to “fold and carry my chair down an escalator before as the lift wasn’t working which puts me off”.

When discussing undertaking a journey on public transport, Aisha highlighted several intersecting barriers she frequently encounters:

“I must go to the back entrance to at my local station to get the lift to get onto the concourse to get to the ticket machine, but you have to go through the barriers. So, then you get stopped at the barriers and questioned like somebody that doesn’t have a ticket every single time so then you have to explain to them that you’ve come through the disabled entrance at the bottom, you get a very funny look and then they’ll let you through. I’ve only had one occasion where he was very rude to me and said no you haven’t got a ticket so I said no I need to buy one, but I can’t get through the main entrance. So that is the first barrier. At our home station they are very helpful, but they know my husband because he was a train driver with them for a long time so there is always someone there to help me onto the train. On the train I cannot use the toilet because the turning circle in the toilet is far too small, so I’m stuck not using the toilet. Then there is a risk that no one will be there to let me off, you’ve got about a one out of ten chance someone will be there to let me off. This is dangerous as sometimes the gaps are fairly sized, and the wheels get a bit caught underneath them. Then I must get a taxi and I must wait for a black taxi to fit the wheelchair inside. Waiting for taxi to accept me can be a wait. Then we must get back home again, getting to the London station again, I’ve got there before and because I hadn’t booked, they said they couldn’t take me, so I had to wait an hour and fifteen minutes until the next train. I did complain and I don’t like to complain so it was a last nerve thing. Getting home again is the same problem wondering if someone will be there.

The ticket machines at my local station are too high and there aren't ones for disabled people, so I struggle. The only good things are the lifts which are good sizes."

Some are put off public transport altogether following some of the negative experiences highlighted, Sameera for example expressed being *"traumatised by public transport"*:

"Just the whole experience for me is very overwhelming I think I'd be panicking the whole time. I'd rather get a car and be driven in comfort. I think I've been traumatised by using public transport so I don't think I can use it anymore. I would rather pay a friend to take me than pay for public transport. Then my wheelchair, luggage and daughter can all fit in comfortably".

However, some participants, such as Chris, feel that whilst *"there is room for improvement"*, public transport vehicles are improving for disabled people as *"now when they replace things, they do make more considerations than the last generations in terms of space"*.

4.5.4. Summary and key findings

- Participants reported they were often unable to access public transport services using their preferred mobility aid. This varied across modes, with some modes (such as Underground) providing poor levels of accessibility, while other modes offered a more mixed picture depending on location (taxi and private hire vehicles)
- Boarding and alighting public transport services, and findings a seat or space on board the vehicle, were the primary barriers identified by respondents
- Many participants faced an intersecting range of issues when using public transport services, which required great perseverance to overcome

4.6. Research Question Four: How users' needs, and mobility-aid dimensions and uses, are likely to change in the next 20 years

4.6.1. Factors driving change in mobility aid size and weight

As outlined above, over the past 20 years there have been a number of advances in mobility aid design and technology, which has led to changes in the size of mobility aids. Participants in this study who currently use a hybrid mobility aid, or an attachment to a traditional mobility aid, were able to clearly articulate the benefits their aid brought (for example, being able to navigate difficult terrain or longer distances at their destination), while simultaneously identifying additional barriers they face when attempting to use public transport services (lack of space on stops/stations and on board vehicles for hybrid mobility aids). 8% of respondents to the mobility aid user survey stated they currently used a hybrid mobility aid on public transport services. Further exploration during the focus groups identified that a larger proportion of study participants preferred to use a hybrid mobility aid, however they did not currently use it on public transport services as it was too large or difficult to manoeuvre on board services and at stops and stations.

Respondents to the mobility aid user survey were asked whether they would consider using a hybrid mobility aid in the future.

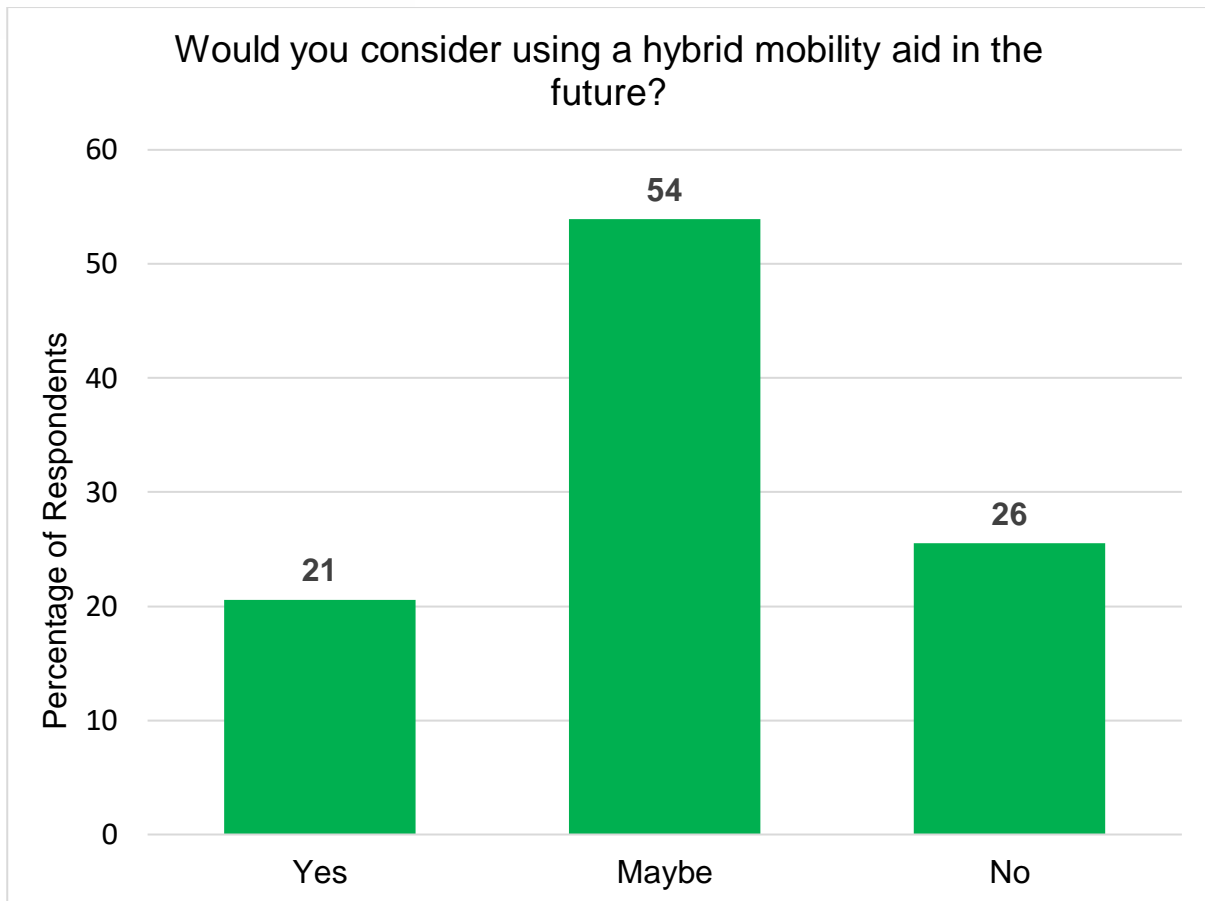


Figure 4.29 Responses to the question "Would you consider using a hybrid mobility aid in the future"

When asked whether or not they would consider using a hybrid mobility aid in the future, just over half of mobility aid user survey respondents reported that they might consider using a hybrid mobility aid, with just over a fifth stating they would definitely consider a hybrid mobility aid in the future.

Besides the mobility aid itself, a potential factor leading to changes in size could be the need for mobility aid users to carry large or bulky items on their aid, increasing its spatial envelope. Respondents to the user survey who were able to provide measurements of the occupied dimensions of their mobility aid were segmented according to whether or not they attach large or bulky items to their mobility aid. Table 4.7 reveals a roughly equal split of manual wheelchairs propelled by user, electric wheelchairs, and mobility scooters. A larger proportion of respondents who use a manual wheelchair propelled by an assistant do not carry large or bulky items attached to their mobility aid.

Table 4.7 Types of mobility aid, segmented by large or bulky items being carried on the aid

	Manual wheelchair propelled by assistant	Manual wheelchair propelled by user	Electric wheelchair	Mobility Scooter
Bulky items carried on aid	9	9	4	9
No bulky items carried on aid	15	7	6	11

Table 4.8 Measurements of occupied mobility aids where the user also carries large or bulky equipment attached to their aid

	Sample Size	Mean	Minimum Dimension	Maximum Dimension	Reference Wheelchair	Percentage of respondents within reference specification	Interpolated 95 th Percentile
Height of occupied mobility aid (cm)	31	117.39	78	176.78	135	74%	153.5
Width of occupied mobility aid (cm)	31	66.62	45	106.7	70	81%	104.35
Length of occupied mobility aid (cm)	31	102.71	50.50	170	120	81%	156.40

Table 4.9 Measurements of occupied mobility aids where the user does not carry large or bulky equipment attached to their aid

	Sample Size	Mean	Minimum Dimension	Maximum Dimension	Reference Wheelchair	Percentage of respondents within reference specification	Interpolated 95 th Percentile
Height of occupied mobility aid (cm)	39	123.44	87.30	178	135	67%	153.20
Width of occupied mobility aid (cm)	39	64	46	115	70	79%	97.30
Length of occupied mobility aid (cm)	39	97.7	60	163	120	92%	126.90

Comparisons between Table 4.8 and Table 4.9 identifies a complex picture. A larger proportion of occupied mobility aids where the user carries large or bulky items fit within the reference wheelchair height and width specification in comparison to mobility aid users who do not carry large or bulky items. However, a smaller proportion of mobility aid users who carry large or bulky items fit within the reference wheelchair length specification. However, the 95th percentile occupied width and length measurements of mobility aids where the user carries large or bulky items attached to the aid are larger. This suggests that some respondents carry particularly large or bulky items on their mobility aid, requiring a much greater width and length envelope.

Respondents reported carrying the following large or bulky items on their mobility aid:

- Walking sticks, crutches, or cane
- Additional mobility aid such as foldable walking frame
- Oxygen cannister or other medical equipment
- Bags containing shopping or personal belongings.

Stakeholders were asked to consider the factors which are driving the changes in mobility aid size which have been reported. Figure 4.30 identifies that the primary factor stakeholders believe is driving a change in mobility aid size is mobility aid users obtaining devices based on their functionality. The second highest ranked factor is that mobility aid users are increasing in size, and therefore need larger aids. A large proportion of stakeholders identified greater personalisation in the mobility aid market as also driving a change in size.

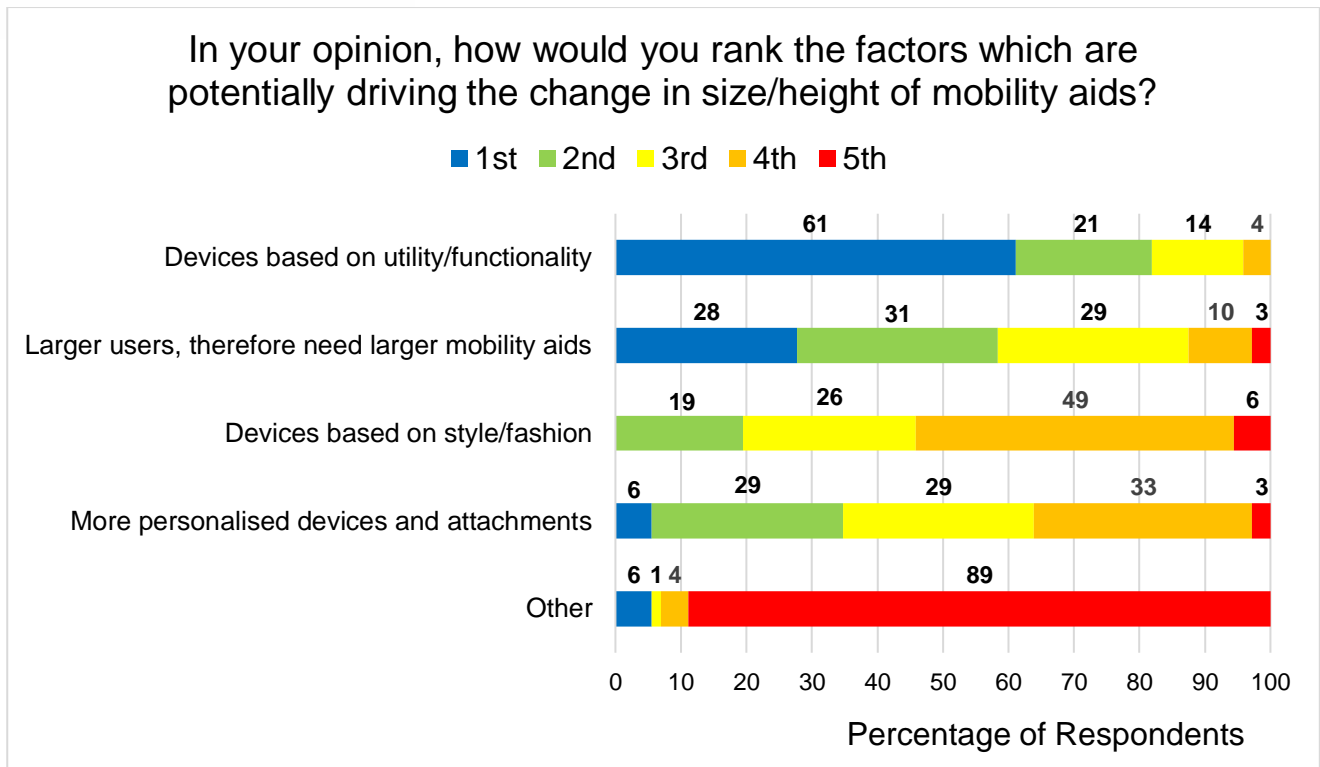


Figure 4.30 - Responses to question "If there is a change in the size/weight of wheeled mobility aids in the UK, what do you believe is driving that change?"

Some respondents provided additional detail in support of their response:

"Mobility scooters - which seem to be becoming more popular, in particular the larger ones which are suitable for on road use but cannot be brought on to buses (type 3 scooters)"

"The variety and choice of mobility equipment has increased to reflect (1) the ageing population and the benefits mobility equipment can bring to older people and (2) people with certain conditions living much longer than in the past and the design of mobility equipment reflecting increasingly complex mobility requirements. Generally, design of mobility equipment has improved over the past 20 years, given many people the choice of equipment more suited to their personal requirements"

"It would be fair to say that the mobility device manufacturing sector has identified and responded to user requirements, to create product capable of providing access to work, education, leisure, and simply general social inclusion. A wonderful outcome of initiatives kicked off by DfT policies back in the 90's and 2000's. Products have been developed to provide mobility for small children, active young adults, provide postural support for complex conditions which include tilt wheelchairs and heavy powered wheelchairs with additional services that help mature users with management of deteriorating conditions"

4.6.2. Horizons for further change in mobility aid size and weight

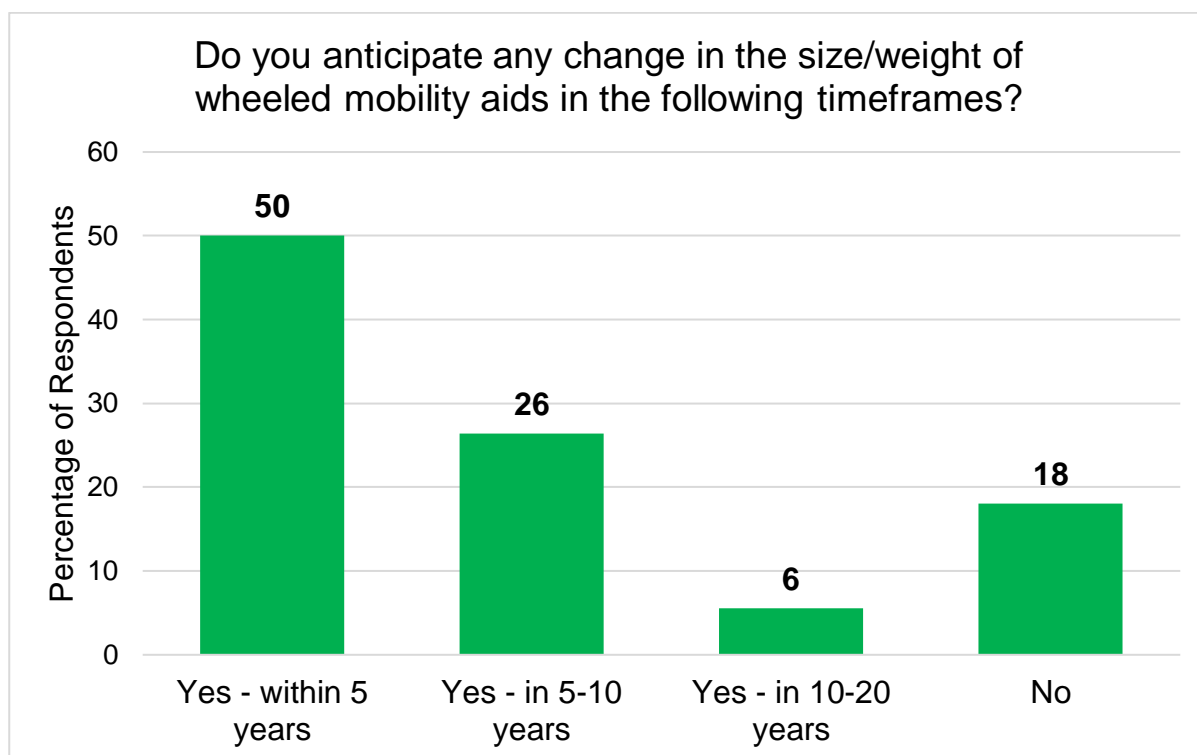


Figure 4.31 Responses to “Do you anticipate any change in the size/weight of wheeled mobility aids in the following timeframes?”

Half of stakeholders surveyed stated they believed further changes in the size and weight of wheeled mobility aids would be encountered within the next 5 years, while 32% believed this would happen within 5 and 20 years. 18% of stakeholders felt there would be no further changes in size or weight of mobility aids, beyond those already witnessed.

4.6.3. Rationale for changing mobility aids

The future needs of the mobility aid users who participated in this study were discussed during the focus groups, and subsequently grouped into three broad categories. The first group expressed a desire to ‘upgrade’ their current mobility aid as technology and finances allow, enabling them to take advantage of newer devices with increased functionality. *“I think bigger aids are more comfortable so are the obvious way to go”*. Those who wanted to upgrade their aid had various reasons, including, comfort, visibility, accessing varied terrain, elevating themselves and enhancing their *“freedom and independence”*. This commonly meant exchanging a type of manual wheelchair for a self-propelled wheelchair, electric wheelchair, hybrid wheelchair or scooter.

Chloe, for example, is:

“likely to buy a larger mobility aid in the future as I can only self-propel in certain circumstances and I can’t drive at the moment. I would like an electric or potentially hybrid aid to allow me to use public transport and travel independently”.

As shown under research question one, those who currently use larger aids raised size and weight of their aid as an issue and a barrier to accessing certain modes of transport and locations. They explained that they would *“like a lighter scooter, it would help if it was*

available". The issues faced by those with larger aids were also a factor for participants. For example, Wilf thinks a larger aid would be more comfortable but worries that it *"would put a stop to using public transport"*. Many who want to upscale and / or upgrade their aid also explained that they *"can't however, due to the cost"* and not wanting to *"burden the NHS"*.

For the second group of participants, changing their mobility aid would be driven primarily by changes to their health and wellbeing. For Shelia, changing her aid will be dictated by changes to her condition which *"will deteriorate in time so I will have to use a wheelchair more, so then I will get an automatic one which would be larger than my current aid"*. Aadhar however, will *"hopefully not need to use a larger mobility aid in the future as I'm expecting an improvement following surgery in my knee"*.

The final group of participants hoped to not need a large mobility aid in the future. *"I hope not to use a larger mobility aid in the future"* was a particularly common sentiment of the older participants in the groups and was expressed on behalf of older disabled people by participants who cared for them. Reasons included *"having no need"* and not being *"good enough with technology"*.

4.6.4. Summary and key findings

- Changes in the size and weight of mobility aids are being driven by consumer demands and expectations – mobility aid users expect devices to have increased functionality and range, which is causing devices to increase in size
- Hybrid mobility aids are becoming increasingly popular, as mobility aid users seek devices, and adapt existing devices, to be capable of being used in more diverse environments and terrain
- These two factors are contributing towards the trend for larger mobility aids – the reference wheelchair specification, and other standards, may need to be modified in coming years if public transport is to accommodate the increasing prevalence of hybrid mobility aids
- These findings are not universal – some participants hope to not need a larger/different mobility aid, while for others, mobility aid use is dictated by their health and wellbeing, and they will need to change their aid in line with future changes in their mobility, which may be unknown.

5. Key Findings and Next Steps

5.1. Reference Wheelchair Specification

The 700mm width of the reference wheelchair is based on the dimensions of the device itself with no evident allowance for hands, elbows, or possessions. This study has identified a maximum unoccupied width of 77cm (the largest unoccupied width of a device used by a respondent to this study), which is 7cm more than the reference wheelchair width. However, this study has also collated data on the occupied widths of devices to better reflect user needs in context, identifying a maximum occupied width of 115cm (again determined by the max width of attendant propelled devices). There are a range of possible explanations for the increase in width which are discussed in section 4.6.1. In order to accommodate users' needs and expectations, this study recommends the use of occupied dimensions to inform future changes to the reference wheelchair standard (and wider design standards) as this would better reflect the reality of attempting to use public transport.

Based upon the evidence presented in preceding chapters, this study provides the following findings:

- The key finding from this study is that the current reference wheelchair specification accommodates 54% of all mobility aid users and 60% of wheelchair users. Should the DfT choose to update the reference wheelchair specification, it may wish to consider:
 - The trade-offs between making transport more inclusive for all passengers and the practicalities for transport operators to accommodate larger and more diverse mobility aids within the physical space limits of conventionally sized public transport vehicles.
 - Accommodating a greater proportion of mobility scooters, hybrid aids and larger electric wheelchairs, which are a cohort likely to grow according to this study.
 - Gathering data on the available space on-board a range of transport vehicles that are in service. The most frequently identified issues in this study included a lack of width of on-vehicle spaces, on-vehicle toilets being too small, insufficient height clearance in taxis and private hire vehicles, and insufficient space for hybrid mobility aids. There is variation between vehicles, and some already mitigate many of the issues identified in this study. For example, buses with step free central doors provide far easier manoeuvring for wheeled devices. As existing vehicles, these would provide a readymade benchmark of what is already technically possible. This exercise should specifically look at turning spaces, manoeuvrability, and ease of access to transport modes across different classes of mobility aid.
 - Engagement with vehicle designers on the challenge of achieving the most inclusive and flexible designs practicable so designs can guard against potential future changes.

- More detailed qualitative engagement with mobility device designers / manufacturers and those involved in selection of devices e.g., Wheelchair Therapists, to understand factors affecting device size and weight in further detail.
- This study has produced data which can allow consideration of a number of options for increasing the reference wheelchair specification, these include:
 - **Mobility aid inclusivity 100:** these dimensions would accommodate all mobility aid users who participated in this study and would therefore provide the greatest level of inclusion possible. This would require a height of 178cm, width of 115cm, and length of 170cm.
 - **Mobility aid inclusivity 95:** these dimensions would accommodate 95% of all mobility aid users and therefore provide a high level of inclusion. This would require a height of 177cm, width of 107cm, and length of 162cm.
 - **Electric and manual wheelchair inclusivity 100:** these dimensions would accommodate 100% of all wheelchair users only. This would require a height of 155cm, width of 115cm, and length of 163cm.
 - **Electric and manual wheelchair inclusivity 95:** these dimensions would accommodate 95% of all wheelchair users only. Height of 155cm, width of 107cm, and length of 127cm.
 - **User propelled wheelchair inclusivity 95:** to accommodate 95% of self-propelled manual wheelchair users, the current reference wheelchair height dimension of 135cm and length dimensions of 120cm can be retained, but the width dimension would need to be increased to 79cm.
- Besides the options outlined above, when developing future policy positions, it may be helpful to consult the following tables which outline the minimum dimensions to accommodate a stated proportion of the mobility aid users who participated in this study:

Table 5.1 - Minimum dimensions based on % of all Mobility-Aid users

Percentage	Height	Width	Length
60%	128 cm	63 cm	103 cm
65%	130 cm	64 cm	107 cm
70%	135 cm	65 cm	110 cm
75%	137 cm	68 cm	113 cm
80%	140 cm	71 cm	120 cm
85%	144 cm	81 cm	120 cm
90%	152 cm	91 cm	128 cm

Table 5.2 - Minimum dimensions based on % of all Wheelchair users

Percentage	Height	Width	Length
60%	126 cm	64 cm	99 cm
65%	127 cm	65 cm	100 cm
70%	130 cm	67 cm	105 cm
75%	132 cm	70 cm	109 cm
80%	137 cm	74 cm	110 cm
85%	139 cm	87 cm	117 cm
90%	143 cm	96 cm	120 cm

Table 5.3 - Minimum dimensions based on % of User Propelled Wheelchair users

Percentage	Height	Width	Length
60%	115 cm	62 cm	98 cm
65%	123 cm	64 cm	98 cm
70%	126 cm	64 cm	99 cm
75%	127 cm	67 cm	105 cm
80%	128 cm	69 cm	107 cm
85%	129 cm	72 cm	107 cm
90%	134 cm	80 cm	109 cm

- Updating the current wheelchair specification may future proof public transport services, as:
 - The majority of stakeholders surveyed by this study anticipate further changes in the size and weight of wheeled mobility aids within the next 10 years. Many current mobility aid users expressed a desire to change to an aid with increased functionality (potentially resulting in a larger occupied size) within the coming years.
 - Stakeholder representatives for transport, mobility aids, and healthcare sectors surveyed for this study also anticipate that the UK's disabled population will continue to become larger and older across the coming decades.
 - It will accommodate for more mobility-aid users in the future and will allow users to travel more independently (e.g. in electric wheelchairs or mobility scooters rather than relying on being assisted in a manual wheelchair). This change will improve quality of life and reduce inequality of opportunity to the growing number of mobility aid users.

- However, it is important to note that the reference wheelchair is not expressly used to define a number of critical design requirements for transport vehicles and infrastructure; there is currently a large variance between the reference wheelchair specification and minimum design standards. For example, the design standard for a wheelchair space on board a train is 750mm x 1,300mm, which is larger than the 700mm x 1,200mm dimensions of the reference wheelchair, but smaller than many of the occupied mobility aid measurements collected by this study. Consequently, the impacts of increasing the size of the reference wheelchair specification must be evaluated against the relevant design requirements in BS8300, RVAR, and PSVAR to fully understand the implications. Indicatively, the following standards would require revision in line with any changes made to the reference wheelchair specification:

Trains (governed by RVAR)

Design element	Current standard	Estimated Fit with study findings
Wheelchair Spaces	1,300 x 750 mm	84%
Accessible toilet	Must accommodate reference wheelchair	54%
Door widths	850 mm	89%
Passageways on accessible route	850 mm	89%
Lifts to access trains	1,200 x 750 mm	84%

Buses (governed by PSVAR)

Design element	Current standard	Fit with study findings
Wheelchair Spaces	1,300 x 750 mm	84%
Exits and entrances	800 mm	86%
Gangways	700 mm	80%

Built environment (governed by BS8300)

Design element	Current standard	Fit with study findings
Lifts	Minimum 1400 mm depth	93%
Doors	1,000mm at entrances and 800mm internally	94% at entrances, 86% internally
Toilets	1,500 mm turning space	94%
Lobbies	1,570 mm	96%

- Alongside the barriers faced when travelling on board public transport services, participants in this study also raised a number of wider issues which would have an impact on supporting infrastructure, such as doors that are too narrow, lifts which are too small to accommodate their preferred wheeled mobility aid, ticket machines

and ticket counters positioned at an unsuitable height, and poor accessible toilet facilities at stops and stations.

- Any changes to the design standard of transport vehicles and infrastructure as a result of any modifications to the reference wheelchair specification would inevitably take some time to have an impact. It is likely that many vehicles and transport environments would remain unchanged for some time, causing further uncertainty regarding accessibility. Nevertheless, uncertainty occurs with any changes and improvements (and is still the case following previous improvements to accessibility), stressing the importance of both managing expectations and of clear and accurate information with regards differing elements along a journey. Consequently, communication that is aimed at aiding mobility aid user's journey planning, forms an important part of any change that may come as a result of this report. This should include the provision of information on the types and sizes of mobility aid that a service, mode of transport and/or associated premises can accommodate, reducing uncertainty and concern for customers.

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Appendix A. Other research findings of interest

A.1. Other key findings and next steps for improving journey quality for mobility aid users on public transport

This study has highlighted a number of issues mobility aid users face when using public transport and private hire taxi vehicles. These are not directly linked to the reference wheelchair specification or the research questions for this study and are already known to the DfT. However, we have listed these below as ethical best practices, to ensure up to date insight on these issues is shared with the DfT.

Improved training for operational staff such as bus drivers and station staff on the best ways to communicate with and support mobility aid users to access services.

- The issue that most impacted mobility aid user experience when trying to access public transport from this study was poor staff and public attitudes. Therefore, improved training would improve journey experience for mobility aid users who currently fit within the current wheelchair specification but choose not to use public transport services as they have experienced poor treatment and unfriendly attitudes by transport staff when trying to make a journey in the past. Improved treatment by public transport staff would help mobility aid users to feel welcome and less awkward on public transport and would help improve the consistency of customer service for mobility aid users across the UK.

Raise public awareness of mobility aid user requirements and experiences on public transport, to build empathy and improve public behaviour.

- This study identified poor public attitudes and rude behaviour by members of the non-disabled travelling public as another key reason for mobility aid users avoiding public transport journeys. Our focus groups provided many examples of situations where disabled seats were being used inappropriately by prams, luggage, or non-disabled travellers, and where these seats would not be given up for a mobility aid user. Other issues included rude and/or aggressive remarks related to taking too much space or time. These kinds of interactions were found to be traumatic for mobility aid users and significantly impacted their confidence in using public transport services in the future. Many mobility aid users in our focus groups reported avoiding certain modes altogether as they were too anxious about harassment or lack of support they may face.
- Increasing access to micro mobility modes for disabled passengers, including the hire of mobility scooters at destination stations, would limit the extent to which mobility aids have to be taken on public transport, and would therefore open travel up to a greater number of mobility aid users. This is a recommendation that members of our Atkins delivery team recently provided to Transport for the North, as part of a recent report, focussed on the Visitor Economy in the North of England.
- Further research into the availability of public transport to mobility aid users in practice (i.e., a choice in competition with private car/lift share/taxi) and the potential for improving sustainable travel behaviours among this group

should be considered as a research questions to be included in next steps of this work.

Appendix B. Persona Narratives

The following persona narratives have been developed in response to the findings of the focus groups conducted for this research and aim to represent the key mobility aid user segments and their experiences. The personas do not relate to one individual experience, but instead have been developed to represent a particular archetype and their broader experiences. The personas were developed in response to the amalgamated research findings by identifying key themes and commonalities of experience, and also through consultation with experts in access consultancy to ensure accuracy and the capture of the widest set of experiences.

B.1. Rural living car dependent

Roberta lives in a rural area, with limited public transport options. A long-term health condition means Roberta has limited mobility and uses multiple mobility aids – rollator around the house, and a wheelchair when outside. Her village has an infrequent bus service which runs during daytime hours only. The bus stops do not have raised curbs, making it hard for her to manoeuvre her wheelchair onto the vehicle. Roberta has an independent and active life, and frequently travels to meet friends and family. Roberta drives her adapted private car for most of her journeys and this is her preferred way to travel. Roberta would like to use public transport more often but is put off by the inconvenient services. She therefore finds it more convenient to use her car.

B.2. Active hybrid user

Simon lives in a large city, with a reputation for excellent transport links. Following an accident, a number of years ago, Simon is now a full-time wheelchair user. Simon has always been active, and this remains the case now. Alongside his manual wheelchair, Simon has a hand cycling attachment to enable him to exercise. He regularly uses public transport for both local and longer distance journeys, and Simon regularly encounters issues despite years of improvement works. Simon's cycling attachment, increases the dimensions of his wheelchair, preventing it from fitting in some lifts and on board some vehicles. Because of this, Simon doesn't use the hand cycling attachment when travelling on public transport in case it prevents him boarding or using a lift. Simon finds this frustrating, as he would like to travel with this attachment that helps him to stay active, fit, and healthy.

B.3. Urban living, public transport dependent

Elijah lives in a large town, with a reasonably dense network of bus services and a mainline railway station. Elijah lives in a suburb and uses the bus to travel into the town centre as he does not have a car and is dependent on public transport. Elijah is sometimes frustrated by this as services do not always meet his needs. Buses along his route can be busy, making it hard to board and navigate crowded services. Sometimes buses can be too full to board, or someone may be using the wheelchair space for their pushchair, which frustrates Elijah. He sometimes uses the train, but again has faced issues with staff not being available to assist him on and off services, and the need to pre-book assistance makes it hard to be spontaneous. Despite the challenges, Elijah persists in using public transport as he prefers to travel independently when possible.

B.4. Market town living, frequent taxis

Grace lives in a market town in a shire county. Her deteriorating health and mobility mean she is no longer able to drive, and she needs the support of a mobility aid when out and about. Grace has a preferred local taxi company who she relies on for short journeys within her local area. This taxi company have proven to be reliable, the drivers are kind and patient, and will load and unload her mobility aid at each end of the journey despite it being bulky. Grace has tried other taxi companies, but sometimes the drivers wouldn't carry her preferred mobility aid. Grace is worried what may happen in the future if her taxi company were to cease trading – she has built a relationship with their regular drivers and trusts them to get her to the shops and back in a kind and compassionate manner.

B.5. Mobility scooter user

Meng has a long term health condition which is likely to deteriorate over time. She finds it hard to walk or stand for extended periods, uses a stick, and has recently purchased a mobility scooter to use when out and about. Meng enjoys visiting neighbouring towns and cities and having her mobility scooter with her makes these trips much easier and more comfortable. Meng values the freedom and independence her scooter provides. While Meng would like to use public transport, she finds there often isn't enough space on board for her mobility scooter. Meng has an inconsistent travel experience, as some operators will let her ride the scooter onto the train, whereas others make her fold the scooter before boarding, which is inconvenient and can be uncomfortable. Because of these inconsistencies, Meng often drives in her car instead as then she knows the scooter can be taken with her, and she is guaranteed to have a comfortable journey.

B.6. Infrequent and restricted traveller

Abdul has a long-term health condition which has worsened over time. His wife Parveen is his primary carer and supports him with everyday activities. Getting out and about has become increasingly difficult for Abdul, particularly since the emergence of the COVID-19 pandemic which meant he and Parveen had to shield for many months. Abdul and Parveen last took public transport to a neighbouring city to attend a hospital appointment a couple of years ago – they found the experience traumatic and exhausting, and vowed to not use public transport again. The train stopped for a very short time, making boarding stressful. The train was busy, and they did not see any staff during the journey so were unsure whether assistance would be provided at their destination to assist them off the train. The whole experience was off-putting, and they hope to avoid taking public transport again in the future.

Appendix C. Stakeholder Survey

If you are a transport provider/operator/charity/manufacturer with knowledge and views on wheeled mobility aids used on public transport we want to hear from you. We are carrying out a survey on behalf of the Department for Transport (DfT), to understand if the size, weight, and other mobility aid characteristics in the UK are changing, and what this means for wheeled mobility aid users and transport services.

You can help us by answering our questions. This survey should take approximately 15-20 minutes to complete and will make a difference to considering how UK wheeled mobility aids are referenced in the future.

Please note: your data will be handled by Atkins Global (part of the SNC Lavalin Group) and Jacobs Engineering Group as part of a joint venture, on behalf of DfT and in accordance with GDPR legislation. Your data will never be shared with any third parties.

* 1. Please provide your organisation and an email address (we need this to track which of our stakeholders have responded to this engagement)

* 2. Are you: *

- A transport provider/operator
- A charity
- A manufacturer of mobility aids
- Other (please specify)

3. In your experience, what would you say are the most commonly used types of wheeled mobility aids in 2021? Please rank your answers from 1 (most commonly used) to 4 (least commonly used) *

- Electric wheelchair
- Manual wheelchair propelled by user
- Manual wheelchair propelled by assistant
- Mobility scooter

4. From your professional knowledge, do you think you have a good idea of which mobility aids are most popular with users of public transport? *

- Yes - I have a good understanding based on evidence from my industry
- Yes - I have anecdotal evidence and some opinions about this
- No - I don't have any views or information about this

5. Which wheeled mobility aids would you say are the most commonly used on public transport? Please rank your answers from 1 (most commonly used) to 4 (least commonly used) *

- Electric wheelchair
- Manual wheelchair propelled by user
- Manual wheelchair propelled by assistant
- Mobility scooter

6. Do you think the most commonly used wheeled mobility aids have changed over the last 20 years? *

- Yes
- No
- I don't know

7. Why do you think this is the case? Please provide as much detail as possible *

8. In your professional view, which statements do you agree with? Please select all that apply *

- Wheeled mobility aids are getting bigger
- Wheeled mobility aids are getting smaller
- Wheeled mobility aids are getting wider
- Wheeled mobility aids are getting longer
- Wheeled mobility aids are getting lighter
- Wheeled mobility aids are getting heavier
- There is no noticeable change in the size of wheeled mobility aids
- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
- Don't know

9. If there is a change in the size/weight of wheeled mobility aids in the UK, what do you believe is driving that change? Please rank your answers from 1 (most significant driver of change) to 5 (least significant driver of change) *

- Users are getting wheeled mobility aids based on utility / functionality
- Users are getting devices based on style/fashion
- People are getting larger, therefore need larger mobility aids
- Users have more personalised devices and attachments (luggage, medical and communication devices)
- I don't believe there has been any recent change in the size of wheeled mobility aids

10. Please provide further details regarding what you think is driving any change to the size/weight of wheeled mobility aids *

11. Do you anticipate any change in the size/weight of wheeled mobility aids in the below timeframes (please tick all that apply) *

- Yes - within 5 years
- Yes - in 5-10 years
- Yes - in 10-20 years
- No, I don't anticipate any change in the length/width/height of wheeled mobility aids

12. What changes do you anticipate and why? Please provide as much detail as possible *

13. If regulations required an increased amount of space for wheeled mobility aids on public transport in the UK, what implications, if any, would this have for your organisation or wider industry? *

* 14. Do you have any data on the prevalence of mobility aid types in use, or the physical size and weight of devices that you could share with our research team? *

- Yes – data on prevalence of mobility aid types in use
- Yes – data on physical size and weight of mobility aids
- No
- Other (please specify)

15. Please provide a brief description below. One of our team will be in touch with you if you have indicated you have data to share.

* 16. Hybrid mobility aids are when an additional piece of equipment is added to a mobility aid to change its functionality, such as an add-on scooter, hand propelled front wheel, hybrid wheels (e-motion, e-fix), etc.

Do you have any views on hybrid mobility aids that could be relevant for this study? E.g., prevalence of hybrid aids in recent years, impact on public transport services, etc.

- Yes
- No

17. Please provide any details below

18 Sometimes mobility aid users travel/need to travel with equipment which adds bulk, for example, an oxygen tank/other respiratory equipment, crutches, large bags, etc.

Do you have any views on this which may be useful to this study? E.g., Prevalence and impact on/implications for public transport services. *

- Yes
- No

19. Please provide details below *

*20. Sometimes mobility aid users travel on different types of mobility aid, depending on which transport mode they are using.

Do you have any views on whether mobility aid users use multiple types or models of mobility aids for different travel purposes/modes? *

- Yes
- No

21. Please provide details below *

22. Do you have any information or views on what influences mobility aid choice for public transport users?

E.g., some public transport modes are more friendly for wheelchairs/mobility scooters than others etc. *

- Yes
- No

23. Please provide details below *

24. * Thinking about how accessible public transport is for those using mobility aids, based on your professional knowledge, how would you rate the user experience of travelling on the following modes of transport? *

25. What issues do you think mobility aid users encounter when travelling on public transport with mobility aids? Please rank from 1 most relevant issue to 9 least relevant issue *

- I don't think mobility aid users encounter issues/rarely encounter issues
- Problems boarding vehicles - e.g., getting through the door/s in a mobility aid
- Problems getting a space with a mobility aid
- Problems getting a seat for a care giver/assistant in close proximity to me when travelling with a mobility aid
- Problems travelling on vehicles - e.g., manoeuvrability, accessing information, pressing buttons
- Problems alighting vehicles - e.g., use of ramps and lifts, and access to opening the doors
- Problems navigating through stations/mobility hubs - e.g., entrances/exits, ticket purchasing

- Problems using lifts at stations Problems using or/and accessing toilet facilities in stations/on board trains/coaches Wet weather making it difficult to transfer in and out of a transport mode

26. Please provide any additional detail about issues you think mobility aid users face when using public transport with a mobility aid. Please provide detail based on direct knowledge/experience only *

27. What improvements could be made to help solve any issues mobility aid users face when using public transport? Please provide detail based on direct knowledge/experience only *

28. Would you be willing to take part in a phone interview to discuss your feedback in further depth if required? If you are selected to take part, we will contact you. *

Yes

No

29. Please provide your preferred email address so that our team can contact you, should your organisation be chosen to take part in a phone interview.

30. Thank you for taking part in our survey. Please provide any additional comments in the box below. If you have any additional feedback, please contact

Appendix D. User Survey

If you are a mobility aid user (wheelchair, mobility scooter or other wheeled aid) we want to hear from you.

We are carrying out a survey on behalf of the Department for Transport to understand if the size, weight, and other mobility aid characteristics in the UK are changing, and what this means for public transport services and for mobility aid users. This study will help to inform any changes to public transport to make this more accessible for wheelchairs and other wheeled mobility aids. You can help us by answering our questions.

This survey should take approximately 15-20 minutes to complete, and you'll be incentivised for your time.

* Required 1. You've told us that you use a mobility aid, what kind of mobility aid do you mainly use?

- Electric wheelchair
- Manual wheelchair propelled by user
- Manual wheelchair propelled by assistant
- Mobility scooter
- Other

2. What factors influence you when choosing a mobility aid? (Please rank from 1 the most important to 5 the least important) *

- Usability/functionality
- Price/affordability
- Looks/aesthetics
- I use the mobility aid I am prescribed by the NHS
- I use the mobility aid I have been given by a charity/friend/family/community member
- Other (open box – please specify)

3. Thinking about the mobility aid you use most often, please provide the make and model in the text box below. If you also have the date of manufacture, this would be additional useful information for us. *

4. This survey is to help the Department for Transport understand if the space users with mobility aids need on public transport is changing over time, therefore, we need you to provide three measurements of your body in your main mobility aid.

To give us accurate measurements, we recommend you get someone to help you, and you will need a tape measure for this question.

Please see the images below - these show you the three measurements we need:

1. Height of occupied mobility aid (measure from the ground to the top of your head, or higher if you normally have something higher than your head when travelling such as crutches),

2. Width of occupied mobility aid (measure the total width you need across the widest part of your device, or if your body is wider than the device, across your body), and finally

3. The length from the tip of your toes to the back of your device of any object that is normally attached to the back when travelling.

Please provide your three measurements below in the following format: Height: Width: Length: Please be as accurate as you can, thank you.

5. A Hybrid mobility aid is a device that can be added to a traditional mobility aid in order to improve or change functionality. For example, an add-on scooter, hand propelled front wheel, hybrid wheels such as e-motion, e- fix, etc.

Do you ever use a hybrid mobility aid while travelling on public transport? *

- Yes
- No

6. Would you consider using a hybrid mobility aid on public transport in the future? For example, an add-on scooter, hand propelled front wheel, etc.

- Yes definitely
- Maybe, I'm not sure
- No definitely not

7. Do you use any other equipment which adds bulk while travelling with your mobility aid on public transport? For example, an oxygen tank/other respiratory equipment, crutches, etc.

- Yes – all the time
- Yes – sometimes
- No never

8. Please tell us the date you obtained your main mobility aid (purchased or were given) *
(date format)

9. When you obtained your main mobility aid, was it new or second hand? *

- New
- Second hand

10. Where did you obtain your main mobility aid? *

- Direct from the manufacturer
- Specialist shop - physical retailer
- Specialist shop - online
- A non-specialist physical shop – e.g., Argos
- A non-specialist online shop – e.g., Amazon
- A second hand online shop/site e.g., eBay

- Provided by the NHS
- From another person e.g., friend, family, community contact
- Other (blank text box)

11. Are there times when you use an alternative mobility aid? E.g., you mainly use an electric wheelchair but sometimes also use a manual wheelchair or a walking stick. *

- Yes
- No

12. What kind of additional mobility aid do you most use? *

- Electric wheelchair
- Manual wheelchair propelled by user
- Manual wheelchair propelled by assistant
- Mobility scooter
- Walking aid such as crutches/stick
- Zimmer frame/rollator frame
- Other (blank text box)

13. Please provide the make and model of your (most used) additional mobility aid in the text box below.

If you also have the date of manufacture, this would be additional useful information for us.
*

14. Please tell us what you mainly use your (most used) additional mobility aid for *

- I always use my mobility aid all day, every day
- When I'm working
- For leisure activities
- Only when my mobility/health is poorer
- Only when my mobility/health is better
- When I need to travel on certain transport modes
- Other (blank text box)

15. Please tell us what influences your choice of mobility aid if you use different ones for different purposes.

For example, 'I use a walking aid or manual chair if I may not be able to get into/out of my mode of transport with a powered chair.'

15 Do you ever not use your mobility aid at all? *

- Yes
- No

16. Do you currently use your mobility aid for travelling on any public transport modes?
(Bus, Train, Tram, metro) *

- Yes – I always use my mobility aid when travelling on public transport
- Yes – I often use my mobility aid on public transport
- Yes – I sometimes/rarely use my mobility aid on public transport
- No – I never use my mobility aid on public transport

17. Does your mobility aid ever stop you from making journeys on public transport? *

18. Please tell us more about this, give as much detail as you can.

19. Thinking about how accessible public transport is to you when using your mobility aid, how would you rate your experience travelling on the following modes of transport? *

Scale: Very good – no issues, good – infrequent issues, OK – sometimes there are issues, Poor – I often encounter issues, Very poor – I always encounter issues, N/A I don't use this mode.

- Bus
- Train
- Metro/Tram
- Underground
- Taxi/private hire vehicle

20. What issues do you encounter when travelling on public transport with your mobility aid? Please select all that apply *

- Problem's boarding/alighting vehicles - e.g., getting through the door/s in my mobility aid
- Problem's boarding/alighting vehicles - using ramps/lifts
- Problems accessing a seat/space with my mobility aid
- Problems getting a seat for my care giver/assistant in close proximity to me when travelling with my mobility aid
- Problems with manoeuvrability, accessing ticket machines, pressing buttons
- Problems navigating through stations/mobility hubs - e.g., entrances/exits
- Problems using lifts at stations
- Problems using or/and accessing toilet facilities in stations/on board trains/coaches
- Problems getting assistance from transport staff
- Problems related to the attitudes of other passengers - e.g., refusal to move from priority seats / space
- Other (please specify - text box)

21. Please provide additional detail about any issues you face using public transport when using your mobility aid

E.g., are some modes of transport more accessible than others and why *

22. What improvements could be made to help solve any issues you face when using public transport with your mobility aid? *

23. What part of the UK do you live in? *

- England - London
- England - South East
- England - South West
- England - North East
- England - North West
- England - Midlands
- England - Yorkshire and the Humber
- Scotland
- Wales
- Northern Ireland

24. Please provide your postcode, excluding the final character. E.g., for the postcode 'M1 7HR' I would type 'M1 7H' *

25. Would you be willing to take part in an online focus group to discuss your experiences of using your mobility aid on public transport? You would be paid for your time. If you are selected to take part, we will contact you. *

- Yes
- No

29. Please provide your preferred email address for our team to contact you should you be chosen to take part

30. Thank you for taking part in our survey. Please provide any additional comments

Appendix E. Focus Group Slide Deck Content

Mobility Aids Research

Transport User Focus Group – August 2021

Agenda

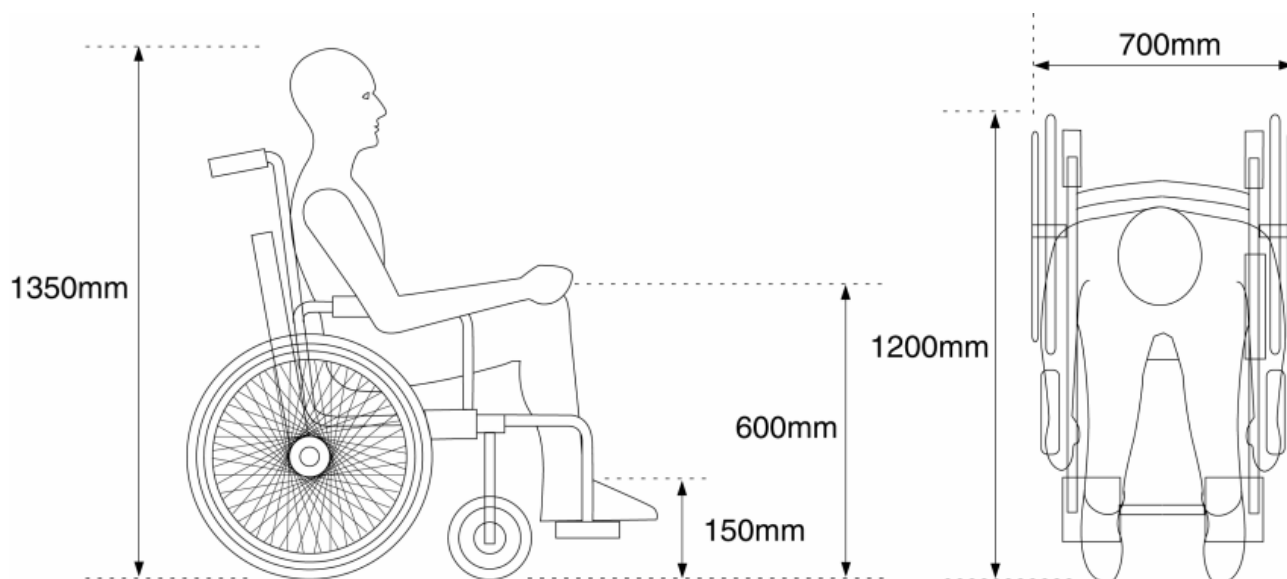
- Introductions
- Background and aims of today's session
- Discussion one: Your use of mobility aids
- Discussion two: Where and how do you travel
- Comfort break
- Discussion three: 'Virtual journey'

Introductions

Background

- The Atkins Jacobs Joint Venture have been commissioned by the Department for Transport to review the Reference Wheelchair Standard
- The Reference Wheelchair Standard is used to define the size and weight of wheelchairs and other mobility aids which can be accommodated on public transport services

Reference Wheelchair



Background to this study

- Since the Reference Wheelchair Standard was introduced, mobility aids have become more diverse in size and sophisticated in function
- This study is investigating whether the Reference Wheelchair Standard needs to be updated in line with current trends for mobility aid design and use

Purpose of Today's Session

- To understand the types of mobility aids you use when travelling on buses, trains, trams, metro/underground, and taxis/private hire vehicles
- To understand the types of journeys you make
- To understand your experiences of travelling with your mobility aid, and how this could be improved, specifically with regards to any issues with size of your mobility aid while using public transport

Discussion Session One

Your use of mobility aids

- What types of mobility aid do you use? Do you have more than one mobility aid?
- Have you always used the same type of mobility aid, or has this changed?
- Would you be likely to use a larger mobility aid in the future?

Discussion Session Two

Where and how do you travel with your mobility aid?

- What journeys do you currently make using public transport?
- Has this changed over time? Are there some modes that you don't currently use?
- Do you use a different type of mobility aid depending on how and why you are travelling?

Comfort Break

Discussion Session Three

'Virtual Journey'

Imagine you're making a journey to somewhere you'd really like to go; this could be somewhere you've been before, or somewhere you haven't been because of concerns about travelling with your mobility aid.

Imagine you are taking a journey by public transport. What are your experiences of the following?

- Planning your journey
- Getting to your stop/station
- At the stop/station – buying a ticket, facilities, accessing help
- Boarding and alighting



Reference Wheelchair Research
Framework 2 (SPaTS 2)

- On board the service
- Your 'last mile' to your destination

Specialist, Professional and
Technical Services

Thank you for taking part in today's session