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Capability, health and travel behaviour of older people

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Date: 23 January 2020
Prepared for: Department for Transport

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Introduction

This study analysed existing survey data from the English Longitudinal Study of Ageing (ELSA) and Understanding Society (USoc) to better understand the health profile of the population aged 50+ and the impact on travel behaviour.

Five different measures of health that have the potential to impact on travel were examined:

- health conditions (such as arthritis, cancer, diabetes) – USoc, UK-wide data
- impairments (or disabilities, such as issues with mobility, sight, hearing) USoc, UK-wide data
- difficulties with daily activities – ELSA, England only
- use of mobility aids – ELSA, England only
- self-reported health – ELSA, England only

This study built on previous work undertaken to understand the travel behaviour of people with disabilities.[1] Used in conjunction with official statistics and projections about age and prevalence of health conditions or impairments, this data could provide an insight into where transport difficulties are most prevalent for the older population and therefore where interventions would be most useful.

Prevalence of health conditions and impairments and their relationships with travel behaviour

In 2015-2017, almost six in ten (59%) people aged 50+ had one or more health condition [2]

- 28% had a single condition and 31% had more than one condition. The most common conditions were high blood pressure (28%) and arthritis (26%).
  - Of the 31% of people aged 50+ who had more than one health condition, the most common combination of health conditions was having both high blood pressure and arthritis, experienced by 24% of people aged 50+ with multiple conditions.
- Age was strongly related to having a health condition among those aged 50+: 57% of people aged 50-64 had no health conditions, compared with 17% of those aged 80+. Being a woman, not being in employment or living alone were also associated with having health conditions.

[1] *Disabled people's travel behaviour and attitudes to travel:* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647703/disabled-peoples-travel-behaviour-and-attitudes-to-travel.pdf

[2] This data on health conditions and long-term impairments comes from the USoc Wave 7 dataset, with data collected between 2015 and 2017.

A third (33%) of people aged 50+ had one or more impairments

- The most common impairments were around mobility and the ability to lift, carry or move objects, both experienced by around one in five people (19%).
- People with multiple health conditions were significantly more likely to have an impairment than those with a single health condition or none: 57% of people with multiple health conditions had at least one impairment, compared to 31% of those with a single condition, and 16% of those with no health conditions.

Most health conditions were related to a number of different impairments

- The relationships between specific and combinations of health conditions and impairments varied. People with arthritis were more likely than those without to report mobility issues. In contrast, those with diabetes, high blood pressure or clinical depression were less likely to report mobility issues (although people with high blood pressure in combination with arthritis, cancer, depression, or diabetes, were more likely to report mobility issues than those without this combination of conditions, suggesting that diabetes, high blood pressure and depression do not cause mobility issues in isolation but cause problems when they co-occur).
- 47% of people with heart disease in combination with another condition reported having difficulties carrying or moving objects, while 45% had difficulties with mobility.

Impairments, rather than health conditions, were found to affect the frequency of travel

- Impairments associated with mobility, lifting, dexterity, memory, physical co-ordination and difficulties with personal care were found to be related to a decline in the frequency of travel by car, bus, train and bicycle.
- However, the relationship between declining mode use and the severity of impairments varied. A mild version of an impairment associated with mobility, lifting, or dexterity did not impact on the frequency of car travel, but a severe version of these impairments did decrease it. Similarly, as some impairments became progressively more severe, the frequency of travelling by bus would decrease.
- People experiencing certain impairments appeared to reduce the frequency of their travel overall. There was little evidence of trade-offs between modes, bearing in mind that walking has not been examined as part of this study, so we do not know whether people took up walking to replace other transport modes.

The relationship between difficulties with daily activities and travel behaviour

Difficulties with daily activities had very few impacts on travel behaviour once health conditions and other characteristics had been accounted for

- Difficulties with daily activities were found to increase with age: according to 2014-2015 data, 89% of those aged 50-64 had no such difficulties, compared with just under half (47%) of those aged 80+. The most prevalent difficulty among those aged 80+ was with stooping, kneeling or crouching, identified as problematic by almost two-thirds (63%).
- None of the difficulties analysed were found to have an impact on the frequency of getting lifts from family or friends, or whether an individual drove a car or not.[3]

[3] The study analysed difficulties with four activities for daily living (dressing, walking across a room, using the toilet, eating); five instrumental activities for daily living (using a map, shopping for groceries,

- Where difficulties with daily activities were found to decrease transport use, this was less pronounced than impacts associated with specific health conditions or demographic characteristics.

The relationship between use of mobility aids and travel behaviour

Starting to use a mobility aid was related to a decline in public transport use

- Use of each type of mobility aid was found to increase with age: according to 2014-2015 data, canes or walking sticks were used by 6% of those aged 50-64 compared with 46% of those aged 80+.
- Starting to use any mobility aid (with the exception of crutches), was associated with a decrease in the frequency of travel by public transport. There was no link between starting to use a mobility aid and the likelihood of driving a car, getting lifts from friends or family, using a taxi, taking door-to-door community transport, or using hospital/day-centre/lunch club transport.

The relationship between self-reported health and travel behaviour

A decline in self-reported health was associated with greater public transport use

- Overall describing one's health as 'excellent' or 'very good' declined with age; according to 2014-2015 data, 48% of people aged 50-64, compared with 38% and 25% of those aged 65-79 and 80+ respectively.
- Individuals who perceived their personal health to have declined reported using public transport more frequently compared to those who had perceived no change. There was no evidence that this increase was offset by a decline in the use of other transport modes such as taxis, hospital/day care transport, lifts or driving a car (there was no data on walking).
- The relationship between self-reported health and public transport use was modified by the presence of health conditions. As the number of health conditions increased, having a poorer perception of one's health resulted in a reduction in the use of public transport.

Overarching findings

- Health problems were found to increase markedly with age, especially when comparing the 65-79 and 80+ age groups. Someone aged 80+ can typically be expected to have more health conditions, more impairments and a greater number of difficulties with daily living compared to someone younger. They are also more likely to use a mobility aid, as well as have worse self-reported health.
- Of the measures of health examined, the development of impairments is associated with the greatest number and most marked changes in travel behaviour, rather than broader health conditions or combinations of conditions, which themselves consist of a number of impairments.
- Health problems, most notably impairments, are typically associated with a decline in travel, including both private and public transport – with little evidence of mode

recognizing when in physical danger, taking medications, managing money) and nine other activities (reaching or extending arms, sitting for about two hours, getting up from a chair after sitting for long periods, climbing several flights of stairs without resting, lifting or carrying weights over 10lbs, climbing one flight of stairs without resting, pulling or pushing large objects, walking 100 yards, picking up a 5p coin from the table).

substitution. It Is unclear to what extent this decline in travel reflects individual preferences or accessibility issues preventing individuals using particular modes as much as they would like (as documented in previous research).[4]

[4] Previous research has shown that older people with disabilities report not using various modes of transport as much as they would like, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647703/disabled-peoples-travel-behaviour-and-attitudes-to-travel.pdf

2 Introduction

The Department for Transport (DfT) is the ministerial body with responsibility for transport policy in the UK. DfT is supported by 21 agencies and partners with whom it works to support the UK's transport network. It plans and invests in transport infrastructure to keep the UK on the move. This encompasses both private and public transport, including the rail network.

The UK has an ageing population. The latest projections from the Office for National Statistics (ONS) indicate that the population aged 65+, which equated to 12% of the overall population in 2016, will constitute 18% and 20% of the overall population in 2041 and 2065 respectively[5]. The DfT wants to understand how the health conditions, functioning and capabilities of people aged 50+ will change over the next 30 years, how this will impact on their travel behaviours, and what the implications for policy and infrastructure development could be.

This project is part of a wider body of work seeking to understand what an ageing population means for the future of transport. It aims to understand how the (travel-related) capabilities of different generations will evolve as they age over the next 30 years and how assistive technologies will potentially help older people with reduced capabilities to keep mobile.

2.1 Aims of the analysis

The overarching aim of this research is to better understand the health conditions, functioning and capabilities of people aged 50+, how these change with age and their impacts on the travel behaviour of this population. The research has been broken down into five sub-themes, each containing a set of specific research questions:

- **Sub-theme 1: Health conditions and travel behaviour**
    - How many older people have multiple impairments and health conditions, and in what combinations?
    - What is the relationship between different health conditions and the prevalence of different impairments?
    - How do different combinations of health conditions impact on travel behaviour?

- **Sub-theme 2: Impairments and travel behaviour**
    - How does the prevalence and level of impairments vary among older adults?
    - How do different types of impairments impact on travel behaviour?

- **Sub-theme 3: Ageing, daily tasks and travel behaviour**
    - How many older people are having difficulties undertaking key tasks required for daily living, independent daily living, and using transportation?
    - How do these difficulties impact on travel behaviour?

[5] These data, released in August 2018, are available at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/articles/livinglongerhowourpopulationischangingandwhyitmatters/2018-08-13#how-is-the-uk-population-changing.

- **Sub-theme 4: Mobility aids and travel behaviour**
    - How does the use of different mobility aids change with age, after controlling for the relationship between impairment and age?
    - How does the use of mobility aids impact on travel frequency and mode use?

- **Sub-theme 5: Self-reported health and travel behaviour**
    - What is the relationship between self-reported health and mobility in older adults?
    - Is this relationship affected by diagnosed health conditions and other impairments? Do some health conditions and impairments have a greater impact on the relationship than others?

This project is designed to build on DfT's recent report on disabled people's travel behaviour and attitudes to travel, published in 2017.[6] This report sought to begin to address gaps in the broad evidence base on the travel behaviour of people with disabilities. It focussed on three distinct areas: travel behaviour; factors affecting travel behaviour; and change by area and life-stage – seeking to expand our understanding in relation to the adult population with disabilities as a whole, as well as identifying variation within it.

This project seeks to address some of the evidence gaps identified by, and in response to, the 2017 report – focussing on the older population (aged 50+) and on those people with health problems specifically. These gaps relate to health conditions (both single and multiple)[7] and travel behaviour, specific transport tasks, the impact of mild and severe impairments, the use of mobility aids, and the relationship between self-reported health and travel behaviour in older adults. Overall, DfT is keen to establish how many people have difficulties with the different tasks required to use transport or currently use mobility aids to address them, the relationships between different health conditions, impairments and perceptions of individual health, different difficulties (and combinations of difficulties) and the use of mobility aids – and their impacts on travel behaviour. Used in conjunction with projections about age and health conditions for the future population, this information will enable the Department to identify where difficulties with transport are likely to be most prevalent in the future and where the development of policy and infrastructure should therefore be focused.

2.2 Overview of report

Section 3 contains an outline of the datasets and methods used, Section 4 reports findings from analysis of the relationships between health conditions (both single and in combination), impairments and travel behaviour (sub-themes 1 and 2), Sections 5, 6 and 7 report findings on ageing, daily tasks and travel behaviour, mobility aids and travel, and general health and travel behaviour respectively (sub-themes 3, 4 and 5). In Section 8 we tie together findings from across the different research themes, while Section 9 sets out the prevailing research gaps in this area and indicates how they might be addressed going forward.

[6] The full report is available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647703/disabled-peoples-travel-behaviour-and-attitudes-to-travel.pdf

[7] Multiple morbidities of long-term conditions (which we describe as 'multiple health conditions' in this report) are estimated to exceed 20% of the older population and multi-morbidity is now considered the norm for people over 65. Smith, S. and O'Dowd, T. (2007) Chronic diseases: what happens when they come in multiples? British Journal of General Practice 57(537), 268–270.

3 Methodology and data

In this section, we present an overview of the data-sets and analysis methods used in this project and consider their limitations.

3.1 Datasets

The findings in this report are based on the analysis of two datasets: Understanding Society (USoc) and the English Longitudinal Study of Ageing (ELSA). These are both large-scale surveys with sample sizes large enough to permit robust analysis of people aged 50+. Both these surveys are longitudinal, meaning that individuals have been surveyed at a number of different time points, allowing us to identify changes in their health, circumstances, and travel behaviours over time.

The table below summarises the methodological features of these two surveys and their coverage of the topics relevant to this project.

Table 3.1 Data source overview

Dataset	Survey description	Sample characteristics	Data availability		
			Health	Availability of transport	Travel behaviour
Understanding Society (USoc)	Annual mixed-mode (face-to-face, online) survey of each member of nationally representative sample of households (for England, Wales, Scotland and Northern Ireland) – seven waves since 2009 and incorporates BHPS responses from 1991-2009.	General population sample for UK with ethnic minority and immigrant boost samples (28,194 households at Wave 7 (2015-17, 19,669 people aged 50+).	Questions ask about 17 health conditions and 11 impairments. Respondents can select more than one impairment or health condition.	Whether has a driving licence, cars in household, car available for personal use.	Frequency of using car, bus, train, bicycle (Waves 4 (2012-14) and 6 (2014-16)). Driving licence and miles travelled by car (Waves 1 (2009-11) and 4(2012-14)).
English Longitudinal Study of Ageing (ELSA)	Nationally (England) representative cohort study with face-to-face interview every two years - eight waves since 2002.	Persons aged 50+ in England (12,100 individuals in Wave 1 (2002-03)). Sample drawn from members of Health Survey for England.	Comprehensive information on health conditions, updated each wave.	Car available for personal use, concessionary bus pass.	Whether drives car, frequency of using public transport, lifts, taxis, community transport.

3.1.1 Understanding Society

Understanding Society is the largest longitudinal study of its kind, having had over 40,000 households contribute to it since its inception. It covers a wide range of topics, touching all aspects of daily life in the United Kingdom – family life, education, health and well-being to name but a few. As such, it can provide meaningful insights into the

interaction between health, impairments, and transport habits for a cross-section of UK households.

Understanding Society began in 2008 and was established as the successor to the British Household Panel Survey (BHPS), which was smaller-scale. Seven waves of the survey have been completed to date, the last of which – Wave 7 – concluded in 2017. In addition to each of the main waves, the Understanding Society Innovation Panel has been conducted annually since 2008 for specific methodological purposes – including to test different approaches to improving survey response or asking questions about particular topics.

The Understanding Society survey contains a core sample of households designed to be representative of the UK general population living in private households. This is composed of households drawn from a random selection of addresses. In addition, the survey has an immigrant boost sample, to facilitate more detailed analysis of groups defined by minority ethnic or immigrant status. For the purposes of this report, only those core survey respondents aged 50+ were considered.

Further details are available at: https://www.understandingsociety.ac.uk/

3.1.2 English Longitudinal Study of Ageing

ELSA is a longitudinal panel study that aims to understand the social and economic conditions, and the health and well-being of older people aged 50+ living in England. Funding for ELSA is provided by the US Institute on Aging (NIA) and a consortium of British Government departments (Health, Work and Pensions and Transport). Eight waves of ELSA have been carried out, and the additional value of the study comes from its longitudinal design.

The ELSA sample was designed to be representative of people aged 50+ living in private households in England. The original cohort (Wave 1) was selected from households who had previously responded to the Health Survey for England (HSE) in 1998, 1999, and 2001. The first ELSA interviews took place in 2002-03, providing the baseline for the study. Interviews with core members and their partners have been attempted every two years following Wave 1 (2002-03). The sample has been 'refreshed' (i.e. new members recruited) on a number of occasions to ensure it is representative.

Around 10,000 interviews are carried out in each ELSA wave, though an increasing proportion of these are with partners who are not part of the core sample, and the sample is due to be refreshed in Wave 9 (2018-19) owing to attrition since the last refreshment in Wave 6 (2012-13).

It should be noted that the ELSA population tends to be healthier than the general population of people aged 50+, this is because a number of health measures, such as blood pressure and lung function, are taken in ELSA and the results are fed back to respondents. This encourages ELSA respondents to be more aware of their health and may impact on their behaviour.

Further details are available at: https://www.elsa-project.ac.uk/ and in the ELSA technical reports.[8]

[8] Bridges, S Hussey, D and Blake, M (2015) The dynamics of ageing: The 2012 English Longitudinal Study of Ageing (Wave 6) Technical Report https://www.elsa-project.ac.uk/publicationDetails/id/7778

3.2 Analysis methods

As flagged above, both Understanding Society and ELSA are longitudinal studies, where individuals are followed up at different time points. This design has the benefit of allowing us to conduct analysis of change over time for individuals (rather than repeat cross-sections of the population), enabling deeper insight about the impacts of changes in health and personal circumstances on travel behaviour.

A mixture of descriptive analysis and longitudinal modelling was used to produce the findings presented in this report. In the first instance, descriptive analysis was used to assess the degree to which associations between demographic characteristics, health conditions, impairments, difficulties with daily activities, mobility aid use and self-rated health exist. In some cases, these were then supplemented with analysis of respondents' health against their propensity to use different transport modes, and the frequency with which they do so. In each case, analysis was based upon survey responses from the most recent wave of the survey in which a given question was asked.

The insights gained from the descriptive analysis were built upon through the use of multivariate models. The key advantage of such models is that they allow us to assess how one factor affects the outcome of interest (such as the frequency that someone travels by public transport), while holding all other factors constant. For example, we are able to ascertain the effect of age on the frequency of travel, given no change to underlying health.

A key characteristic of the multivariate analysis undertaken for this report is that the models utilised the longitudinal data of the two surveys considered. This, in turn, allows for changes in an individual's circumstances affecting their health and travel habits over time to be considered. Fixed effect models, specifically, were used to account for the impact a change to a given factor (such as developing arthritis) may have on an individual's travel habits. What this type of modelling in effect does is to recognise each respondent as an individual whose circumstances in the present are linked to their circumstances in the past. That is to say that an individual's circumstances are non-random; present health is informed by past health.

Two different types of models were used depending on the nature of the variable of interest. For dichotomous variables – such as whether an individual either (1) does not have difficulties with daily activities, or (2) has difficulties with more than one daily activity – logistic regression was used to infer how a change of circumstances affects the odds of falling into one category or the other. Where the variable of interest was categorical (has more than two categories) – such as the frequency of travel, e.g. (1) often, (2) not often, (3) not at all – fixed effects regressions were used to a similar effect.[9]

The range of co-variates (explanatory variables) included in each model depended on the outcome measure of interest and what was feasible given the sample size and question coverage of the particular survey being used; further details are provided at the point at which each specific set of models is discussed in the report.

Measures of income were not included in the models. Instead, other measures of socio-economic status were included, where available for most sample members,

[9] Both types of analysis were conducted using the XT family of commands in STATA (specialist statistical software).

although these should not be interpreted as proxies for income (given there is a high variance in income within each economic activity group, for example).
The decision to exclude income was motivated by two considerations:

- The extent of missing data. Across Waves 4-7 of ELSA, data was missing for 5% of survey respondents on total couple-level income. Over half of cases (52%), however, had income imputed for at least one wave. This was primarily where neither a value nor an income bracket was given by the respondent. For Understanding Society, extensive imputation of household income is also known to have taken place. Across households and waves, an (unweighted) average of 18% of household income was imputed. While missing data results in smaller sample sizes, extensive imputation has the potential to introduce bias into the analysis. Smaller effective sample sizes may, in turn, have limited the possibility of identifying significant findings. Equally, findings that may have been identified would have been subject to potential bias arising from the methods by which income had been imputed for a large number of cases.
- The specific circumstances of this analysis are known to mitigate the risk of omitted variable bias. In particular, the type of multivariate analysis – fixed effects – is primarily concerned with the effect of changes over time. Underlying fixed factors, such as household socio-economic status, are implicitly controlled for in the modelling. The inclusion of other variables which are liable to change over time, such as employment status and region, further mitigate this risk.

Nevertheless, it should be noted that travel behaviour is known to vary by income.[10] By excluding this characteristic, any impact of this characteristic on behaviour risks being assigned to other (partially correlated) characteristics.

To ensure the representativeness of the survey sample at each stage of analysis, weights were applied. These, in turn, account for the likelihoods that groups with a given set of characteristics may be more likely to respond to a survey than others, all else being equal. Where the analysis used only a single wave of responses, cross-sectional weights for that wave were applied. By contrast, where multiple waves were considered simultaneously, longitudinal weights were used to account for changes in response patterns over time.

Any differences highlighted in the report, either in charts or text, had been found to be statistically significant at the 0.1 level. This means that there is a 10% chance that they occurred randomly (by chance), rather than representing a genuine difference within the population. For descriptive charts, data are only displayed for demographic characteristics where a significant relationship between these and the variable of interest has been found. For multivariate analyses, non-significant categories of variables are sometimes displayed as a point of reference, where other categories were found to have a significant relationship with the variable of interest. These charts, however, only present confidence intervals for those categories of variables that were found to be significant. Confidence intervals, presented in the regression figures, are 90% (reflecting the overall focus of significant differences at the 0.1 level).

[10] The latest National Travel Survey (NTS) data for 2017 shows that travel behaviour in relation to private vehicles varies markedly by household income; for example, people in households in the highest income quintile have driven on average 2.5 times more miles than those in the lowest income quintile. Those in the highest income quintile have undertaken a substantially larger number of trips by car or van as a driver in the previous year, compared with those in the lowest income quintile (468 trips, compared with 241); they have also taken on average more trips by surface rail (42 trips, compared with 13 trips) and fewer trips by bus (18 trips, compared with 55 trips). These data are available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/729521/national-travel-survey-2017.pdf and https://www.gov.uk/government/statistical-data-sets/nts07-car-ownership-and-access

3.3 Data limitations

As with all secondary analysis projects, the scope and comparability of our analysis has been limited by the availability of survey data, described above. Understanding Society and ELSA were designed to answer specific research questions, and the survey questions they contain were developed primarily with these questions in mind. So, for example, the range of health conditions and travel behaviours they measure vary quite substantially in some instances. While Understanding Society asks respondents to identify which of 11 different impairments they have, ELSA only measures the respondent's ability to walk a quarter of a mile across a flat surface – which can be interpreted as a broad proxy for physical impairment. The extent to which the relationships between health conditions, travel behaviours and impairments specifically can be explored using these two survey instruments consequently differs markedly. The same is true of travel behaviour. In relation to car use, for example, both surveys ask respondents whether they have a car available for personal use and record the frequency of use (although different response categories are provided in relation to this). However, Understanding Society also asks respondents whether they have a driving licence and how far they have driven by car in the previous year. The upshot of these differences is that we can compare broad trends in relationships between health problems and travel behaviour from the two surveys (for example, are certain health problems associated with a decline in car use, however measured). However, we should not be concerned if prevalence rates for different health problems and travel behaviours differ slightly, as this may be a function of question design. In the subsequent chapters, we draw the reader's attention to discrepancies between findings from the two surveys and where the design of a particular question poses specific limitations.

4 Health conditions, impairments and travel behaviour

This chapter draws together findings from the first two sub-themes, which specifically focus on health conditions (both single and in combination) and impairments, before considering their relationships with travel behaviour. For the purposes of this report, individuals are regarded as having an impairment where a health problem or disability means that they have substantial difficulties with specific area(s) of life.

In the first part of the chapter, we identify the prevalence of different health conditions and impairments (and combinations of these characteristics) among people aged 50+ and seek to identify common patterns of co-occurrence. We then move on to examine the implications of these characteristics (and combinations of characteristics) for people's travel behaviour, focusing on the impact of individual and combinations of health conditions and of the different levels of severity of impairments. The results presented in this chapter all draw on analysis of data from Understanding Society.

4.1 What proportion of older people have multiple health conditions and impairments, and in what combinations?

There is a strong and well-established relationship between age and health; as people age they are more likely to suffer from health conditions, with multiple conditions now considered the norm for people over 65.[11] Below we consider the prevalence of different health conditions and the ways and extent to which they co-occur.

4.1.1 Types of health conditions

Respondents to Wave 7 of Understanding Society (conducted 2015-17) were asked to identify all the health conditions they have from a list of 17 conditions, listed in Figure 4.1. As depicted by this Figure, the most common health conditions are high blood pressure (28%) and arthritis (26%). There are also relatively high rates of diabetes (10%), asthma (8%) and cancer (7%). The least common conditions are epilepsy, hyperthyroidism (over-active thyroid) and congestive heart failure, each experienced by less than 1% of those aged 50+.

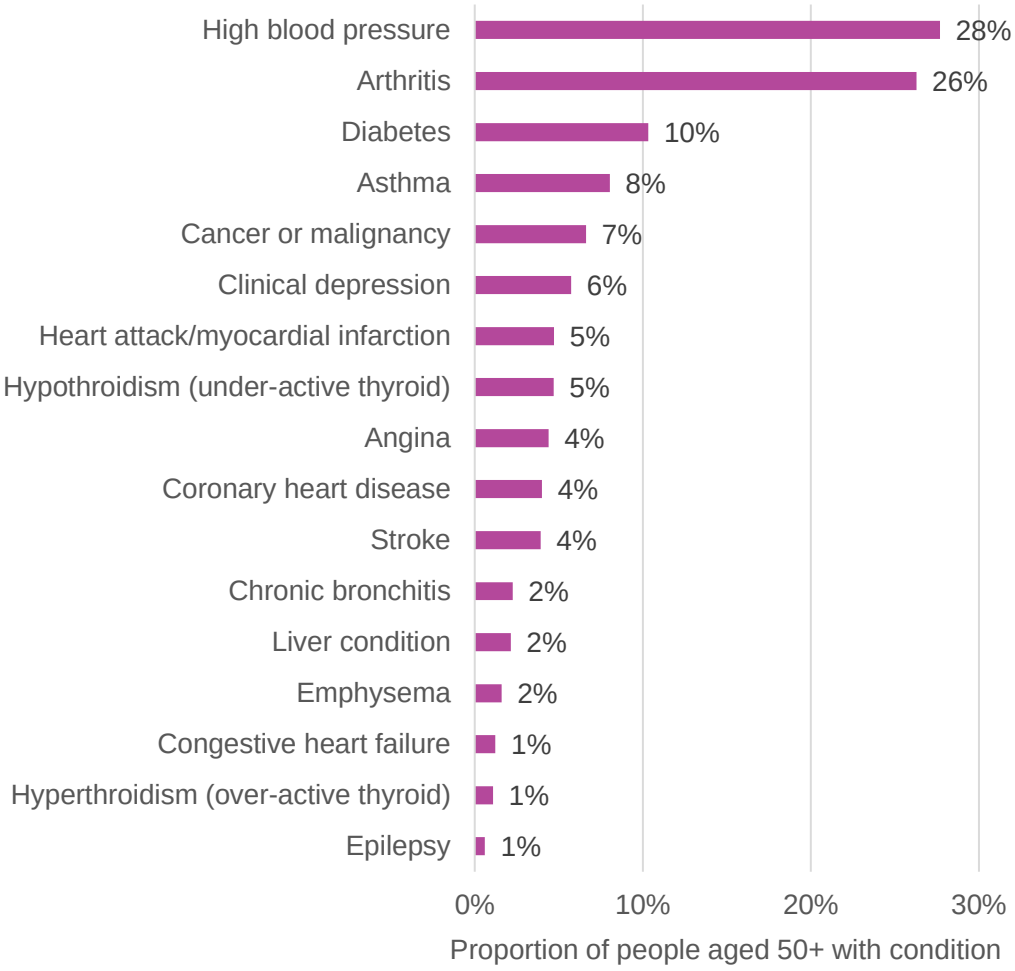
Health conditions on Understanding Society were measured in a different way to the approach used on the main health surveys; specifically, Understanding Society asks respondents to identify all the conditions they have ever been diagnosed with from a list, whereas Health Survey for England asks respondents to list the conditions they have, without prompting, in addition to identifying those they have been diagnosed with by a doctor. Despite these differences, where the same conditions were asked about, prevalence rates appear to be broadly similar.[12]

[11] Smith, S. and O'Dowd, T. (2007) Chronic diseases: what happens when they come in multiples? British Journal of General Practice 57(537), 268–270.

[12] It is not possible to make many comparisons between Health Survey for England (HSE) and Understanding Society data on the prevalence of different health conditions. HSE codes conditions into a range of broad categories, to avoid data being disclosive (which is an issue because of the comparatively smaller sample size). However, both surveys measure whether the respondent has high blood pressure or diabetes. Prevalence rates for diabetes are very similar: on Understanding Society we found 10% of the

Figure 4.1 shows the proportions of people aged 50+ with each of the listed health conditions, ordered by prevalence.

Figure 4.1 Proportion of people aged 50+ with specific health conditions



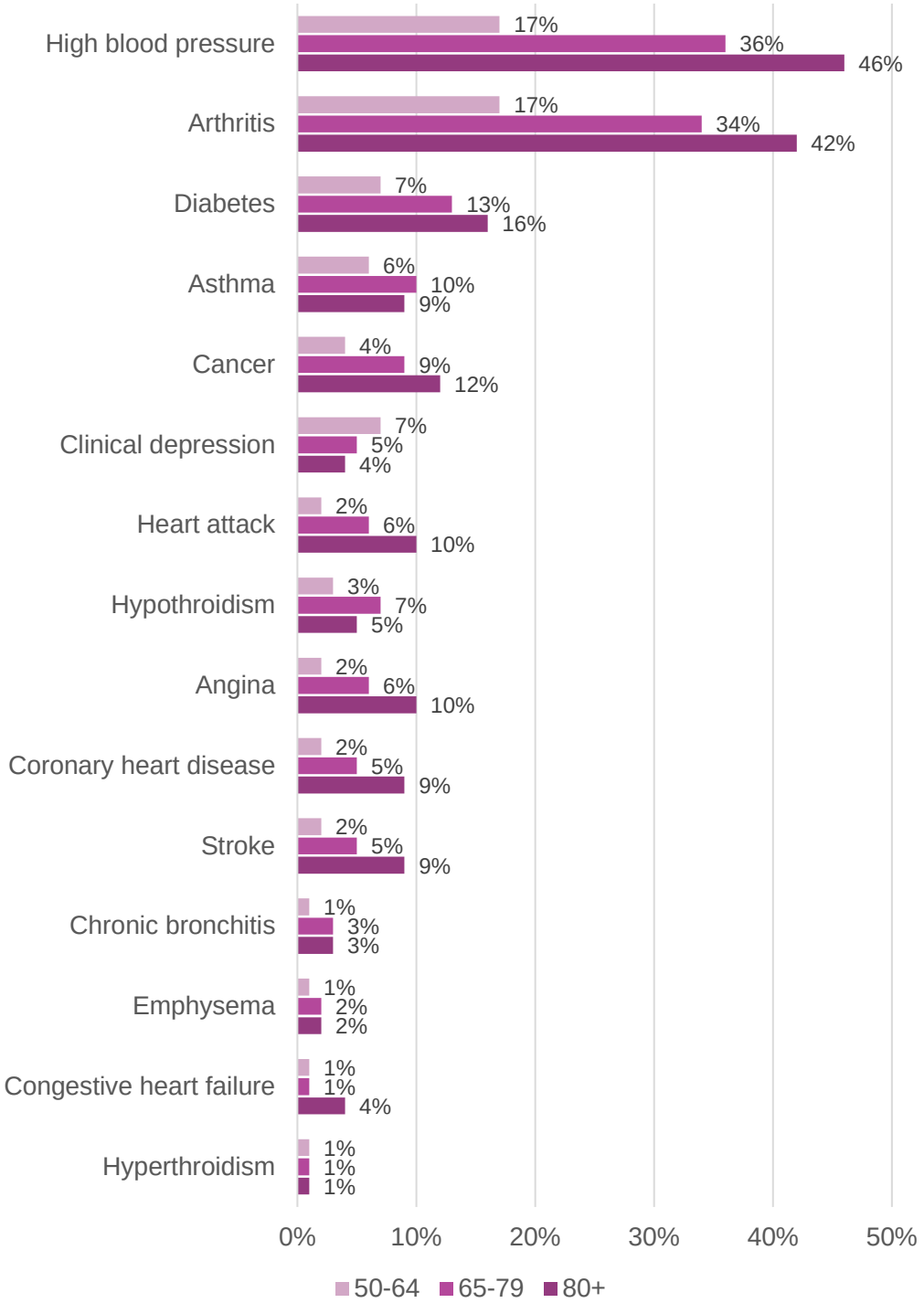
Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,746. Full table: Appendix A.1

We also analysed the age and sex profiles of individuals aged 50+ with particular health conditions. As shown in the next two Figures, there are some differences in the prevalence of health conditions by these characteristics.

The relationships with age are shown in Figure 4.2. With the exceptions of liver conditions, epilepsy and clinical depression, the prevalence of each condition increases with age. While no significant relationship with age was found for liver conditions or epilepsy, clinical depression is unique among the health conditions in that it declines with age. There is a general tendency for the most marked increase in prevalence of those health conditions that increase with age to occur between ages 50-64 and 65-79.

population aged 50+ had diabetes, compared with 10%-15% on HSE for all relevant age groups. […] HSE identified somewhat higher rates of high blood pressure (25%-64% for the range of relevant age groups, compared with 28%-46% on Understanding Society). This is perhaps not surprising, as it is a known phenomenon that health surveys elicit higher prevalence rates when health conditions are self-reported. Further details on health conditions as reported on the Health Survey for England can be found at: https://files.digital.nhs.uk/5E/BCC73B/HSE17-Adult-Health-tab.xlsx

Figure 4.2 Proportion of people aged 50+ with specific health conditions, by age group [13]



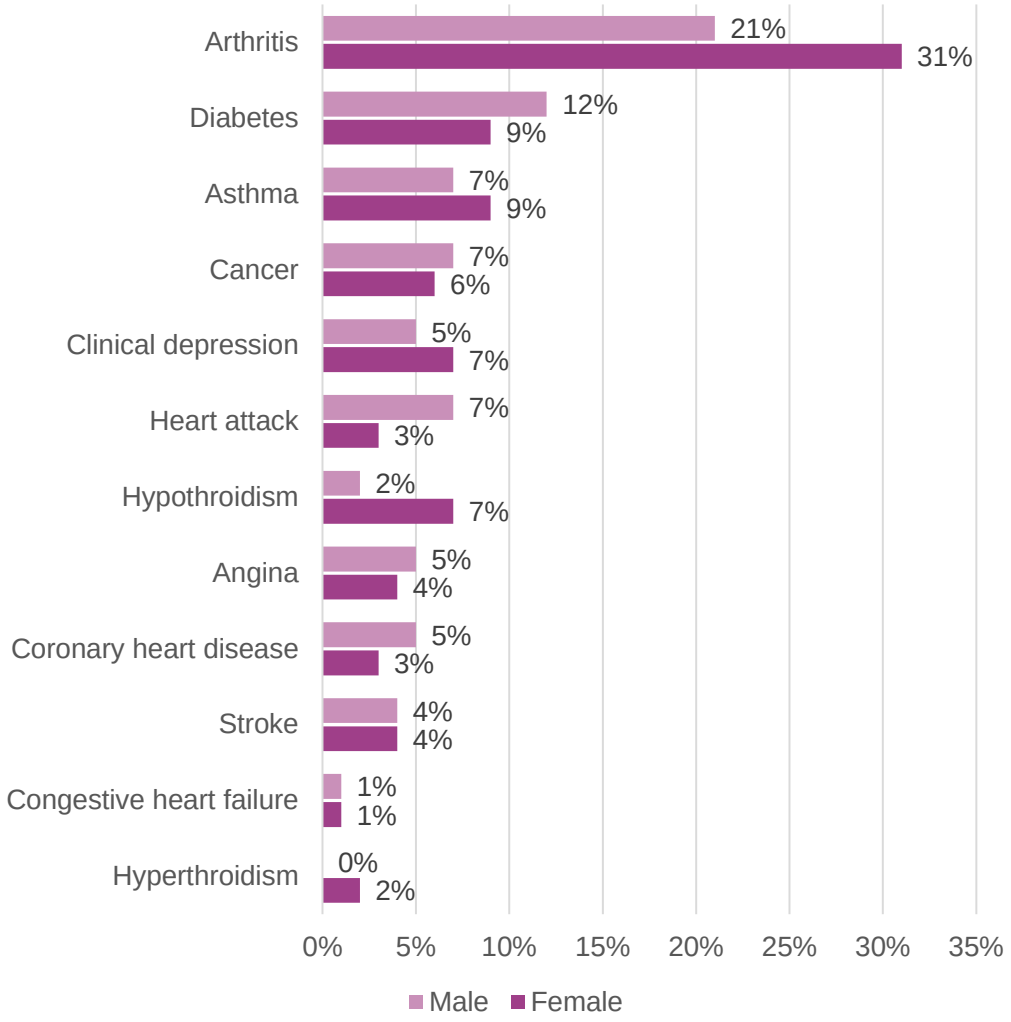
Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,746. Full table: Appendix A.1

As shown in Figure 4.3, there are also some differences by sex, with diabetes, strokes and heart conditions (heart failure, angina, congestive heart disease and myocardial infarction) generally being more prevalent amongst men, and arthritis, asthma, thyroid

[13] Data is only presented for health conditions where there was found to be a significant difference by age group.

problems (both under and over active) and clinical depression being more common amongst women. High blood pressure is equally prevalent amongst both sexes.

Figure 4.3 Proportion of people aged 50+ with specific health conditions, by sex



Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,746. Full table: Appendix A.2

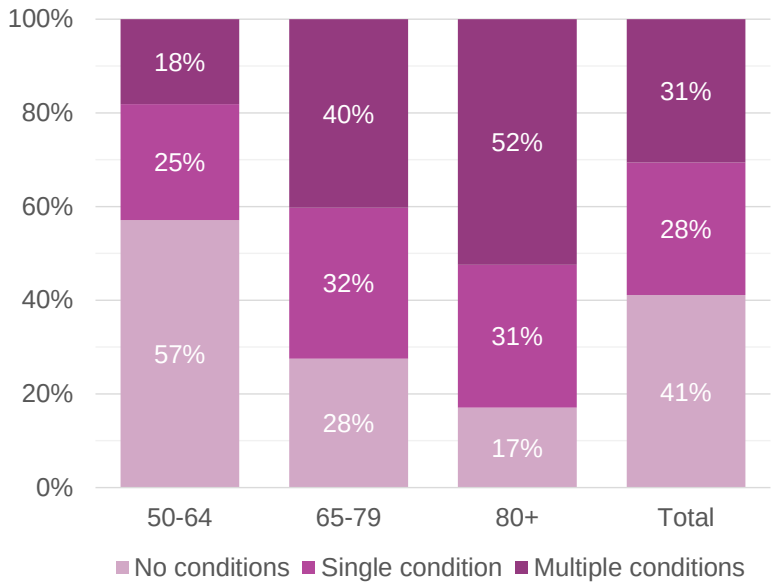
4.1.2 Number of health conditions

We next examined the extent to which the different health conditions co-occur – and in which combinations. We first consider how the number of health conditions varies by age and sex. 41% of people aged 50+ during 2015-17 had no health conditions, a further 28% had a single health condition and 31% had more than one health condition. This means that nearly 60% of those aged 50+ had one or more health conditions.

As individuals age, they are more likely to suffer from multiple health conditions. This is shown in Figure 4.4, where over half (52%) of those aged 80+ have multiple health conditions, compared with 18% of those aged 50-64. Similarly, the proportion of people with no health conditions shrinks with age; 57% of people aged 50-64 have none of the listed health conditions, compared with 17% of those aged 80+.

We also found some differences by sex, as shown in Appendix table A.4, with a larger proportion of women with multiple health conditions (32%) than men (29%). Whilst this is partially a result of the fact that women aged 50+ have a slightly older age profile, multivariate analysis, presented in the next section, indicates that this difference remains even when these profiles have been controlled for.

Figure 4.4 Number of health conditions, by age



Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,737. Full table: Appendix A.5

4.1.3 Characteristics relating to presence of health conditions

We next sought to identify which characteristics best explain the number of health conditions reported by an individual.

Whilst a large proportion of people aged 50+ have one or more health conditions, there remains a substantial proportion (41%) who do not have any health conditions. A multivariate analysis was run to gain a better understanding of the differences between those with and without at least one health condition. This cross-sectional model examines the relationships between personal and household characteristics and whether or not an individual has any health conditions at the point in time they were interviewed (2015-17). The variables included in the model were: age, sex, region, urban/rural, employment status and household composition. Given the low response rates for questions around income (and associated measures of socio-economic background), these were not included in this or subsequent longitudinal models, as they would have severely limited the number of sample members for whom analysis was possible (further information is included in Section 3.2). It may therefore be that certain associations were identified simply because they correlate with income; this may also be true for any other measures not included in the models.

The model identified a number of characteristics that are related to the presence of one or more health conditions:

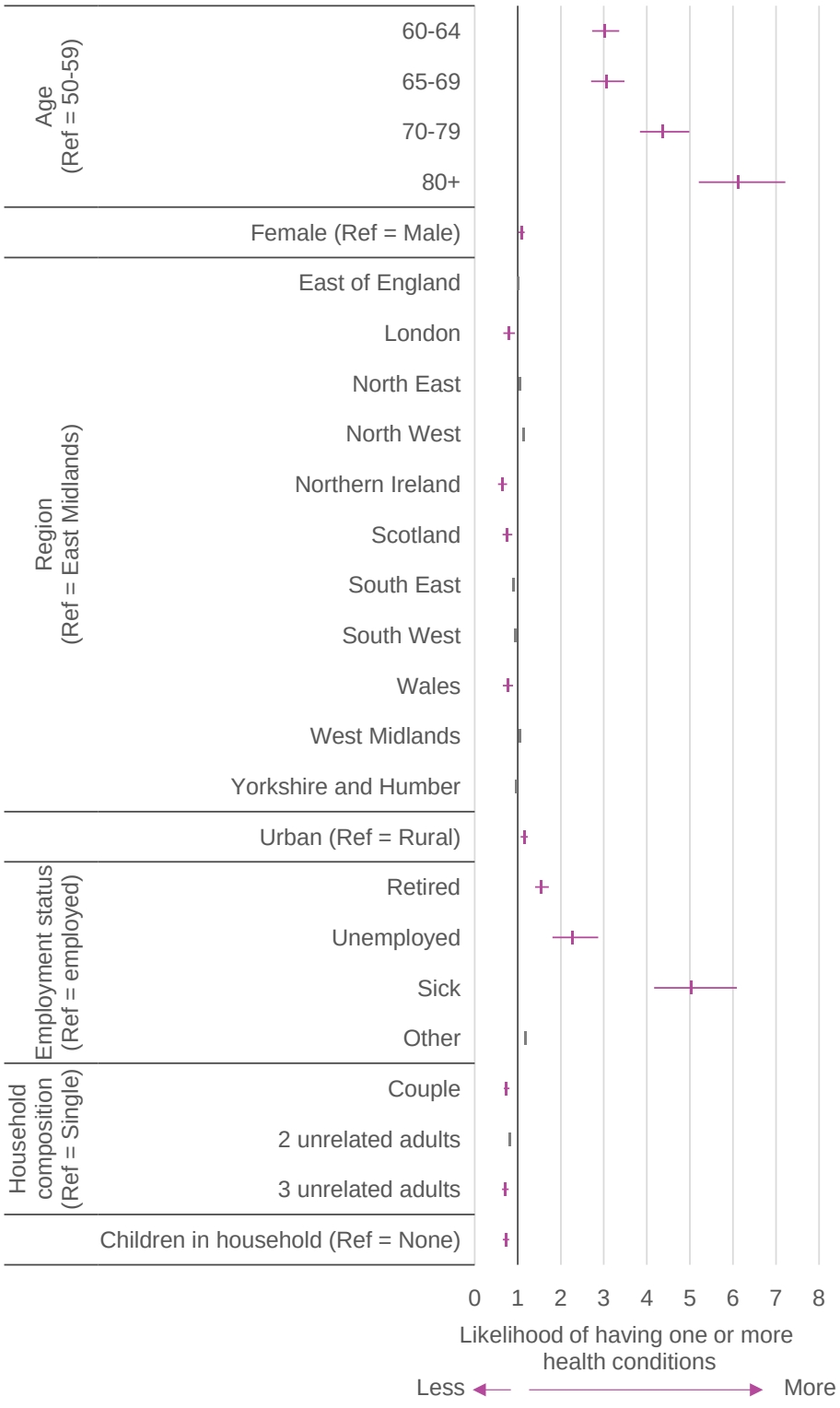
- Age is the characteristic most strongly related to having one or more health conditions. The older an individual is, the more likely they are to have one or more health conditions.
- Sex: women are more likely to have one or more health conditions than men.[14]
- Employment status: those not in employment are more likely to have health conditions than those in employment (suggesting health is a factor in continued employment and early retirement).
- Household type: those living alone are more likely to have health conditions than those living in couple households.
- Geography: individuals living outside London are more likely to have health conditions than those living in London, however, individuals in urban areas are more likely to have health conditions than those living in rural areas. This suggests urban areas are generally associated with poor health, however, Greater London is an anomaly as it is associated with better health.

Figure 4.5 summarizes the results of this model, allowing us to compare the likelihood that someone with a specific characteristic has one or more of the health conditions. Each point in Figure 4.5 shows the direction and magnitude of the relationship between each category of a particular characteristic and having one or more of the health conditions, compared with the reference category (presented in brackets). If the point is in the right-hand side of the chart, then it indicates a greater likelihood of having one or more of the health conditions for a given category, compared with the reference category. Conversely, if the point is on the left-hand side of the chart, then this suggests a lower likelihood of having one or more of the health conditions, compared with the reference category. Where a difference between the characteristic and the reference category is significant, confidence intervals are presented on the chart (as indicated by the purple lines). Where no line is present, the category of the characteristic was not associated with the presence of one or more health conditions, compared with the reference category.

Hence, for age group, the reference category is those aged 50-59 years, meaning that we compare how likely it is that someone in each of the four older age groups has one or more of the health conditions. We find that there is a higher likelihood of each of the age groups having one or more health conditions, compared with those aged 50-59 – with the highest likelihood being for those in the oldest age group (aged 80+).

[14] Note that this takes into account the fact that the women in the sample had an older age profile, in other words, the model indicates that, all else being equal, a man in this age range is less likely to have any health conditions than a woman

Figure 4.5 Characteristics associated with having one or more health conditions



Understanding Society Wave 7 (2015-17). Observations = 14,734. Full model output: Appendix B.1

4.1.4 Combinations of health conditions

Given that a sizable minority of the population aged 50+ during 2015-17 (31%) were found to have more than one health condition, we next considered the ways in which different conditions co-occur. Latent Class Analysis was undertaken to investigate common patterns of co-occurrence in health conditions, among the 31% of people who had more than one health condition.

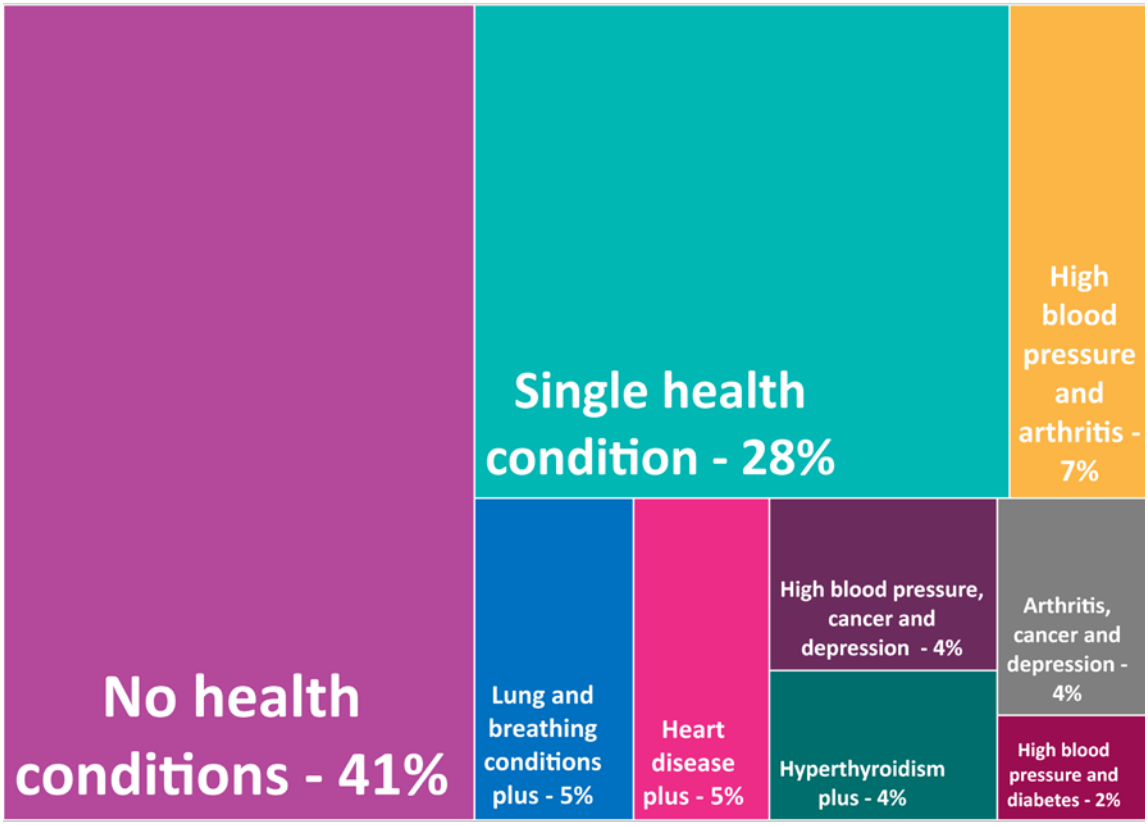
Latent Class Analysis is a method of identifying groups of individuals with similar characteristics. A statistical model was used to identify people in the data with similar combinations of health conditions. The model then allocated these people to a series of groups, called 'clusters'. The clusters therefore contain people who are similar, but different to the people in other clusters. Seven clusters were identified. Their characteristics, in terms of the combinations of health conditions experienced, are summarised below:

- Cluster 1 – **heart disease plus** (15% of those with multiple conditions, 5% of those aged 50+). This cluster contains individuals who suffer from some form of heart disease and a second condition, generally arthritis or high blood pressure. Most of the individuals with a heart condition appear in this cluster.
- Cluster 2 – **high blood pressure (HBP) and arthritis** (24% of those with multiple conditions, 7% of those aged 50+). All the individuals in this cluster have both arthritis and high blood pressure (i.e. two of the most prevalent conditions). Generally, these two conditions tend to be the only conditions that the individual suffers from, however some have additional conditions. While around a fifth of the individuals within the cluster also have diabetes, half (50%) only have arthritis and high blood pressure.
- Cluster 3 – **lung and breathing conditions plus** (18% of those with multiple conditions, 5% of those aged 50+). All the individuals within this cluster have asthma. A higher than expected proportion also have emphysema or chronic bronchitis. Half also have high blood pressure, due, in part, to the high incidence of this condition.
- Cluster 4 – **arthritis, cancer and depression** (12% of those with multiple conditions, 4% of those aged 50+). All cluster members suffer from arthritis, a high proportion also suffer from cancer or clinical depression. There is also a large number with diabetes. What distinguishes this cluster from Cluster 2 (which also contains arthritis sufferers) is that this cluster contains very few cases with high blood pressure – this cluster contains the lowest proportion of individuals with high blood pressure of all the clusters.
- Cluster 5 – **high blood pressure (HBP), cancer and depression** (14% of those with multiple conditions, 4% of those aged 50+). The majority of the cluster members have high blood pressure, but there is also a relatively high proportion with depression, along with a fairly high number with cancer and with diabetes. This cluster contains a very low proportion of respondents with arthritis (which is mainly what distinguishes it from Cluster 4).
- Cluster 6 – **hyperthyroidism plus** (12% of those with multiple health conditions, 4% of those aged 50+). All cluster members have an over-active thyroid, this is generally combined with one of the more prevalent conditions; a large number have hyperthyroidism and high blood pressure, whilst a similar proportion have hyperthyroidism and arthritis. Hyperthyroidism rarely appears in other clusters.
- Cluster 7 – **high blood pressure (HBP) and diabetes** (6% of those with multiple conditions, 2% of those aged 50+). All of the members of this cluster have both

high blood pressure and diabetes. The majority have no other conditions (hence it is the absence of other conditions that makes this cluster distinct).

Figure 4.6 shows the relative proportions of each cluster within the population of those aged 50+ as a whole.

Figure 4.6 Proportion of people aged 50+ with specific numbers and combinations of health conditions



Understanding Society Wave 7 (2015-17), Individuals aged 50+, n=14,737. Full table: Appendix A.8/9

There were some differences in the characteristics of individuals within each cluster. The 'Heart Disease Plus' cluster had the highest proportion of males (65%), while the cluster containing individuals with Hyperthyroidism had the highest proportion of females (83%). Typically, individuals in the 'HBP and Diabetes' cluster are younger than the other clusters, with 37% between the ages of 50-64. At the other end of the spectrum, only 23% of the 'Heart Disease Plus' cluster are in this age category. More details on the age and sex profiles of clusters are provided in Appendix A (Table A.8 and A.9).

4.2 Impairments

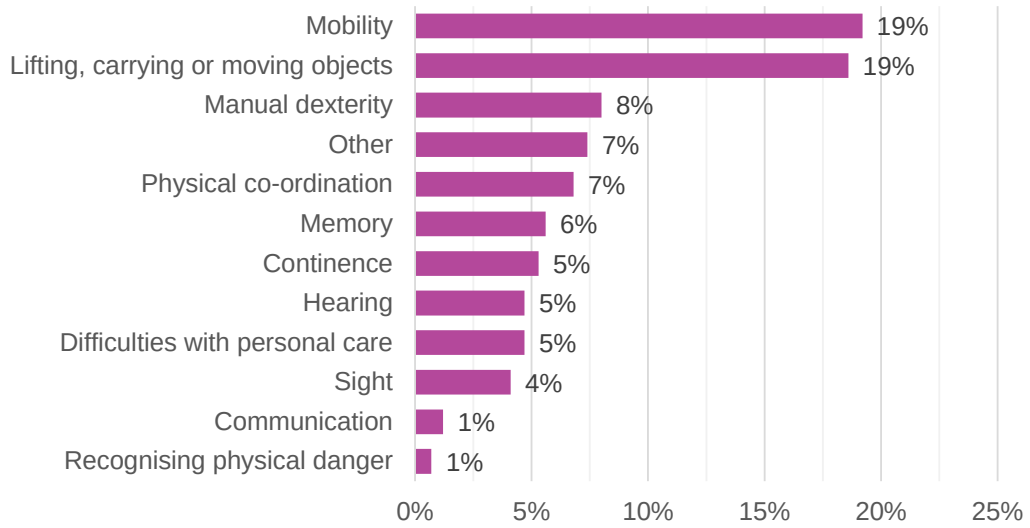
In the previous sections, we focused on specific health conditions, their prevalence and the ways in which these occur in combination. We next turn our attention to impairments (or disabilities). Impairments are slightly different from health conditions in that they encapsulate the actual difficulties that people face, as opposed to the presence of a particular health condition. Respondents to Understanding Society are asked whether they suffer from any health problems or disabilities that mean that they have substantial difficulties with any of 11 specified areas of life listed in Table 4.1 below. For the purposes of this report, these are referred to as impairments.

Table 4.1 Impairments in Understanding Society (Wave 7, 2015-17)
Mobility (moving around at home and walking)
Lifting, carrying or moving objects
Manual dexterity (using your hands to carry out everyday tasks)
Continence (bladder and bowel control)
Hearing (apart from using a standard hearing aid)
Sight (apart from wearing standard glasses)
Communication or speech problems
Memory or ability to concentrate, learn or understand (cognitive)
Recognizing when you are in physical danger
Your physical co-ordination (e.g. balance)
Difficulties with personal care

4.2.1 Prevalence of impairments

One third (33%) of people aged 50+ had one or more long-term impairments. The most commonly experienced impairments are around mobility and the ability to lift, carry or move objects, both experienced by nearly one in five (19%). The least common impairments are around communication and speech and being able to recognise physical danger, both of which are experienced by around 1% of those aged 50+ (Figure 4.7).

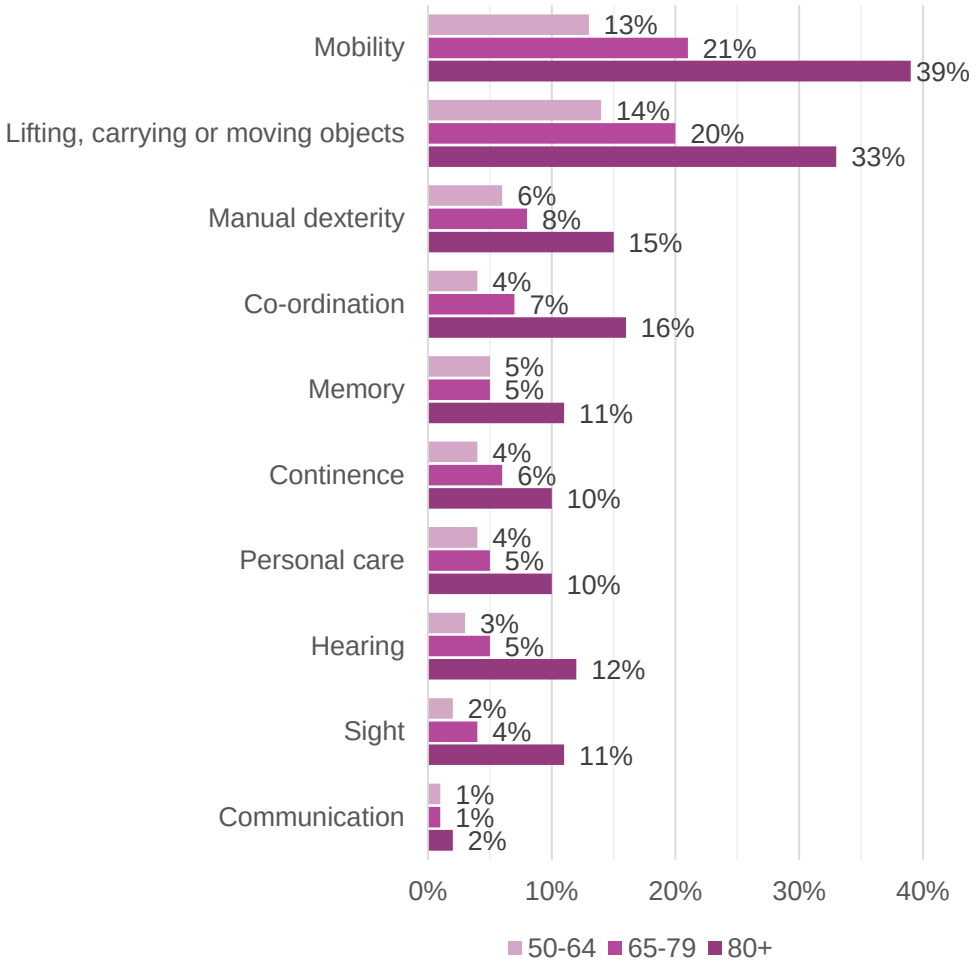
Figure 4.7 Proportion of people aged 50+ with specific impairments



Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,746. Full table: Appendix A.3

Given the close association found between age and the incidence of individual health conditions, it is little surprise that we find a similar relationship with respect to impairments. Issues with mobility were highlighted by the largest proportion of those aged 50+. Almost two in five (39%) of those aged 80+ reported issues with mobility (Figure 4.8). For each impairment type, the oldest age group (80+) had the highest incidence rate. The only exception to this was the ability to recognise physical danger, which was not found to have a statistically significant association with age.

Figure 4.8 Incidence of individual impairments by age group [15]

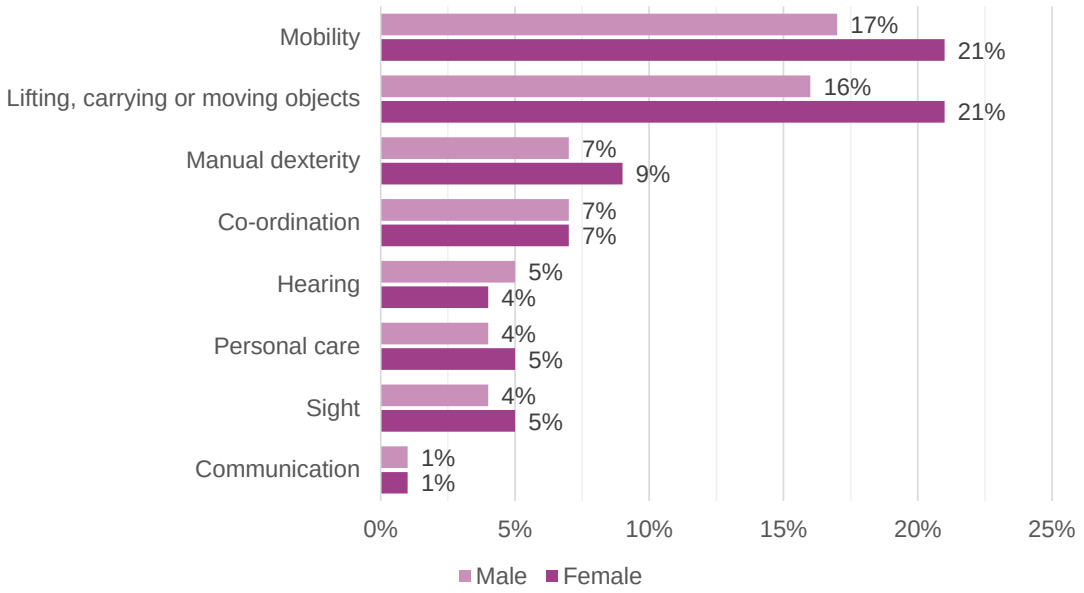


Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,746. Full table: Appendix A.3

When comparing the incidence of individual impairments by sex, the greatest level of variation was identified in relation to a similar sub-set of impairments. While significant differences between men and women were found across a range of impairment types (Figure 4.9), the largest differences were observed for more strenuous forms of physical activity. Women were more likely to report problems with mobility (+4%) and lifting, carrying or moving objects (+5%). However, men were slightly – but statistically significantly - more likely to report problems with hearing (+1%).

[15] Types of impairment are only shown in Figure 4.8 where a statistically significant association by age group was found. *Ability to recognise physical danger* and *other health problems/disability* are therefore excluded.

Figure 4.9 Incidence of individual impairments by sex [16]

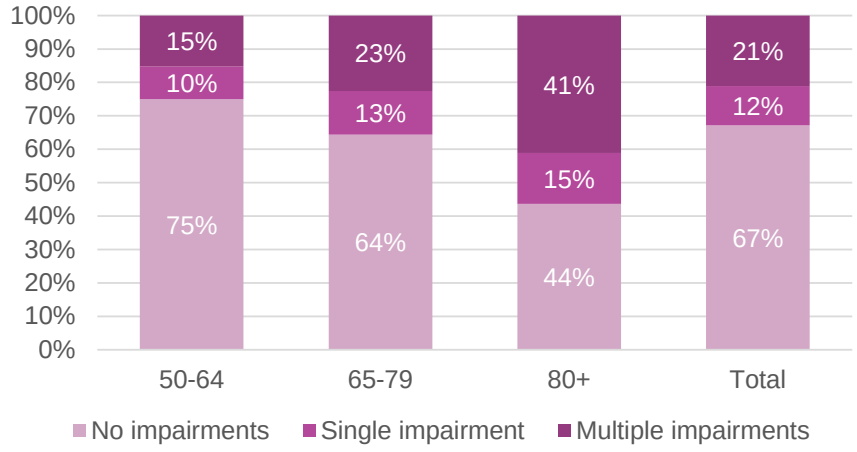


Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,747. Full table: Appendix A.4

4.2.2 Number of impairments

Two-thirds (67%) of people aged 50+ had no impairments, while 12% had a single impairment and 21% had multiple impairments (Figure 4.10). The prevalence of multiple impairments increases with age, with over two in five (41%) of people aged 80+ reporting this. Conversely, 50-64 year olds are the most likely to report no impairments, with 75% of 50-64's not reporting any impairments, compared with 44% of those aged 80+.

Figure 4.10 Number of impairments by age



Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,710. Full table: Appendix A.11

[16] Types of impairment are only shown in Figure 4.9 where a statistically significant association by sex was found. *Continence*, *cognitive ability*, *ability to recognise physical danger*, and *other health problems/disability* are all therefore excluded. Lack of differences presented in Figure 4.9 for both *co-ordination* and *communication* are due to rounding (see Appendix A.4).

4.2.3 Severity of impairments

Unlike previous waves, Wave 7 (2015-17) of Understanding Society also collected information about the severity of each impairment; for each impairment, respondents were asked if they had “some difficulty”, “a lot of difficulty” or were “unable to do this”. As with the health conditions, it should be noted that the information collected about impairments is based on self-reported data, rather than objective measures. This means there may be some under-reporting of some impairments where it is harder for individuals to self-identify, such as memory problems or the ability to recognise physical danger. There may also be under-reporting due to respondent unwillingness to admit to an impairment, due to their perceived sensitive nature, such as continence or memory problems.

More specifically:

- **Mobility:** 11% of people aged 50+ have some difficulty with mobility, compared to 8% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Lifting, carrying and moving objects:** 9% have some difficulty with this, compared with 8% who have a lot of difficulty. An additional 2% are “unable to do this”.
- **Dexterity:** 5% have some difficulty with this, compared with 3% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Continence (bladder or bowel control):** 4% of people have some difficulty with this, compared with 2% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Hearing (apart from using a standard hearing aid):** 3% of people have some difficulty with this, compared with 1% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Sight (apart from wearing standard glasses):** 3% of people have some difficulty with this, compared with 1% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Communication or speech problems:** in both cases, fewer than 1% have some difficulty or a lot of difficulty with this.
- **Memory:** 4% of people have some difficulty with this, compared with 2% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Recognising when in physical danger:** fewer than 1% in each case have some difficulty, a lot of difficulty or are “unable to do this”.
- **Balance:** 4% of people have some difficulty with this, compared with 2% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Difficulties with personal care:** 3% of people have some difficulty with this, compared with 2% who have a lot of difficulty. Fewer than 1% are “unable to do this”.
- **Other:** 5% of people have another impairment which they have some difficulty with, compared with 2% who have a lot of difficulty. Fewer than 1% are “unable to do this”[17].

[17] Understanding Society respondents were not asked to specify the nature of their “other” impairments. Given the small proportion of respondents who selected this category, we are confident that the other categories cover the impairments experienced by substantial numbers of the population aged 50+.

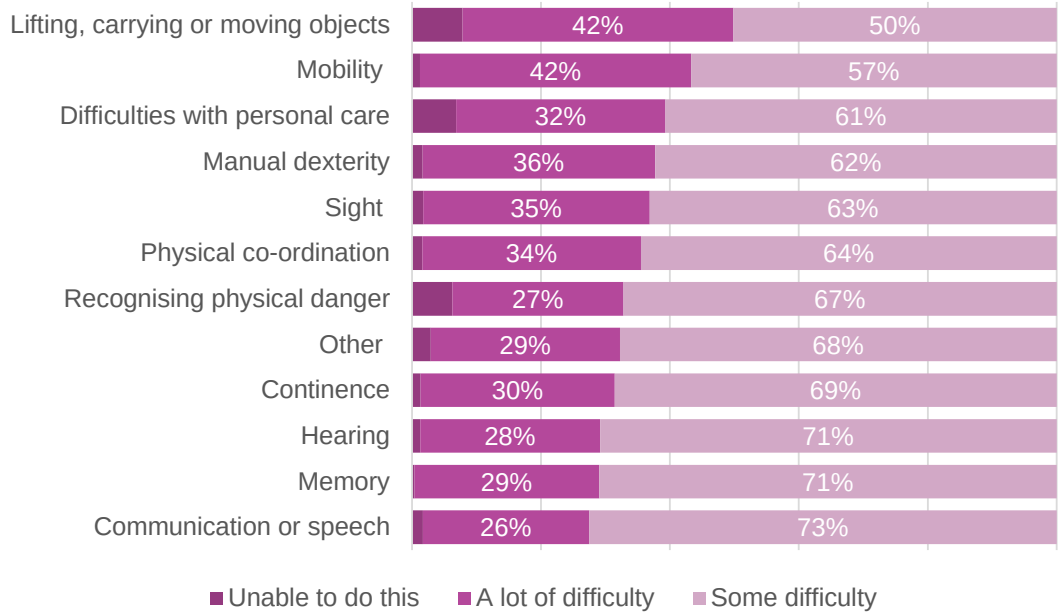
Generally, the proportion of individuals who cannot do something is very small for all impairments. This may in part reflect the fact that Understanding Society collects data from individuals living in private households, hence people who live in some forms of supported accommodation, residential care or communal establishment are excluded. This means the figures are likely to underrepresent the true proportion of the population aged 50+ who are unable to do, or have a lot of difficulty with, various tasks.

Severity of individual impairments

Two-thirds (67%) of those aged 50+ did not have a longstanding physical or mental impairment. Excluding the majority with no impairments allows us to look more closely at patterns in the severity of each impairment, as differences in severity are more evident when looking solely at those who had that specific impairment. These data are presented in Figure 4.11.[18] Even when excluding individuals without impairments, the proportions of people who are "unable to do specific" things remain very small, however, the differences in distribution are more apparent.

Figure 4.11 shows that individuals who have mobility issues, problems lifting and carrying large objects or problems with personal care are more likely to say they have "a lot of difficulty" or are "unable to do this", whereas individuals who have issues around hearing, memory or speech are more likely to say their impairment is mild and causes "some difficulty". This may partly be an artefact of the survey exercise; individuals with more severe memory difficulties might be less likely to be in residential accommodation, while those with more severe hearing, memory or speech problems would experience more problems, and therefore be less likely to, participate in a social survey.

Figure 4.11 Severity of impairment, for individuals aged 50+ who suffer from that specific impairment



[18] Among those who reported each impairment, the proportions who said they were "unable to do this" were 8% (lifting carrying, or moving objects); 1% (mobility); 7% (difficulties with personal care); 2% (manual dexterity); 2% (sight); 2% (physical co-ordination); 6% (recognising physical danger); 1% (continence); 1% (hearing); 0% (memory); 1% (communication or speech); 3% (other).

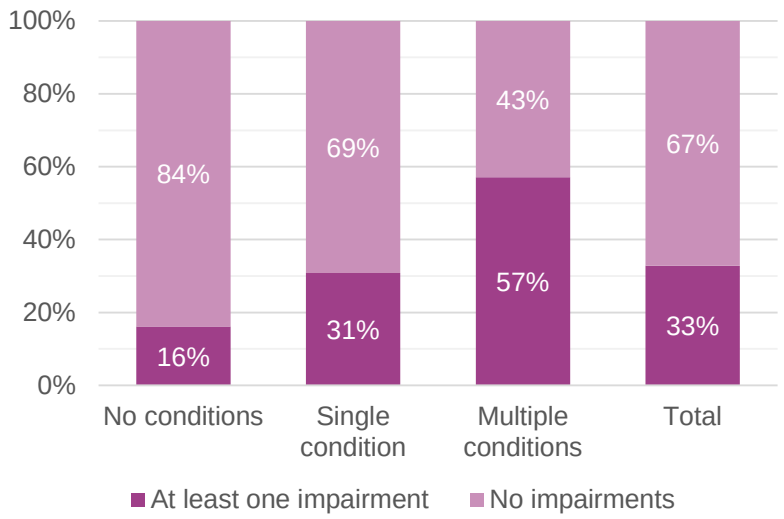
Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,746. Derived from Appendix table A.13

4.2.4 What are the relationships between different health conditions and impairments?

We considered the relationships between health conditions and impairments in two ways – by examining the proportions of individuals with each impairment who experience particular types and combinations of health conditions and, conversely, by assessing the extent to which health conditions, along with a range of other characteristics, impact on the likelihood of having particular impairments.

Analysis across the different types of impairments measured in *Understanding Society* reveals that a comparatively high proportion of individuals with multiple health conditions, aged 50+, also have at least one impairment. As presented in Figure 4.12, 57% of people with multiple conditions have at least one impairment, compared with 31% of those with a single condition, and just 16% of those with no health conditions. This suggests that while, at a top-level the diagnosis of health conditions does not exclusively determine whether someone has an impairment, the two may be closely linked.

Figure 4.12 Proportion of people aged 50+ with at least one impairment, by number of health conditions (grouped)



Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,703. Full tables: Appendix A.7

Relationships between impairments and health condition clusters

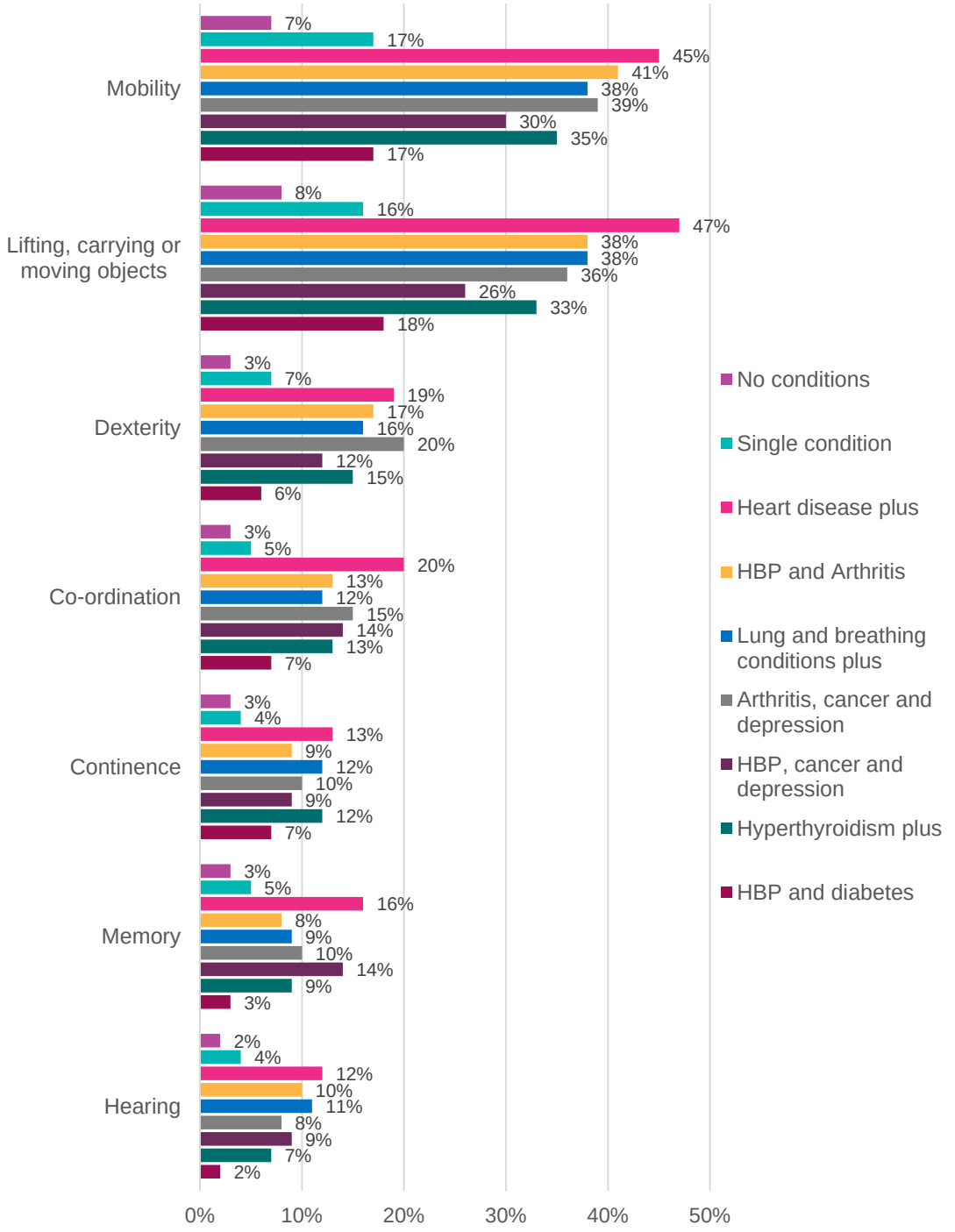
We next examined the relationships between specific impairments and having either no health conditions, a single condition, or multiple health conditions (measured in terms of membership of the seven clusters described previously). The analysis, as presented in Figure 4.13, focused on the presence of each impairment within health condition clusters, rather than on the severity of that impairment. For instance, 7% of those with no health conditions said that they had issues with mobility.[19]

[19] As the percentages for each impairment type are calculated within each health condition cluster, these do not sum to 100%. Equally, because it is possible for individuals to have more than one type of impairment (or none at all), the percentages for each health condition cluster do not sum to 100% across impairment types.

Several patterns are evident. Members of each of the seven clusters are most likely to have difficulties with carrying and moving objects or with mobility, although this relationship is less marked in relation to the 'HBP and Diabetes' cluster. Most markedly, 47% of those in the 'Heart Disease Plus' cluster have difficulties carrying or moving objects, while 45% have difficulties with mobility. The presence of impairments to memory, hearing and continence was found to be low-level across all health condition groupings. Fewer than one in five had one of these impairments across the health condition clusters.

People with no health conditions were consistently among the least likely to have a given type of impairment. This was also the case for those with either a single health condition or those in the 'HBP and Diabetes' cluster, who were both found to have a comparable incidence of impairments. This suggests that this particular combination of health conditions is comparably less likely to impact daily living than other combinations of conditions.

Figure 4.13 Prevalence of impairments, by clusters of health conditions



Understanding Society Wave 7 (2015-17). Individuals aged 50+, n=14,703. Full tables: Appendix A.7/A.10

Relationships between health conditions and impairments

We next examined the relationships between health conditions and impairments, taking into account a range of relationships with other characteristics that have been shown to exist.

A set of multivariate analyses were run. Multivariate analysis allows us to look at the relationship between health conditions and impairments while taking other characteristics, such as age and sex, into account. Longitudinal models allow us to look

at the impact of individual-level change over time; this means the models can be used to identify how changes in an individual's health, specifically whether they develop a new health condition, impacts on their impairments.

This particular analysis involved running longitudinal models using data from Understanding Society (Waves 1-7). Since data on the severity of impairments was only collected at Wave 7 (2015-17), and since the aim was to look at patterns over time (incorporating information from all waves), the analysis only looks at whether or not the individual had particular impairments.

The probability of having a specific impairment was modelled using health conditions, plus a number of demographic characteristics (age, sex, current economic activity)[20], household type, type of area), thus ensuring any relationships between health conditions and impairments were not due to underlying demographic differences. A separate model was run for each of the following impairments: mobility, carrying/lifting, manual dexterity, continence, hearing, memory, and physical coordination[21].

The figures present the relationships between health conditions, the health clusters, and a summary variable that measured the total number of health conditions an individual had, with each specific impairment. The full model output is provided in Appendix B (Table B.2).

For each impairment, we identified a consistent relationship between the likelihood of developing that impairment and the number of health conditions an individual may have. All else being equal, someone without any health conditions is less likely to have an impairment, and someone who develops an additional health condition is more likely to have an impairment. However, the relationships between specific health conditions, combinations of health conditions and impairments varied according to impairment, as described in the following sections.

4.2.5 Mobility

People aged 50+ who develop arthritis are more likely than those without arthritis to have mobility issues, whereas those who develop diabetes, high blood pressure or clinical depression are less likely than those without these conditions to have mobility issues.

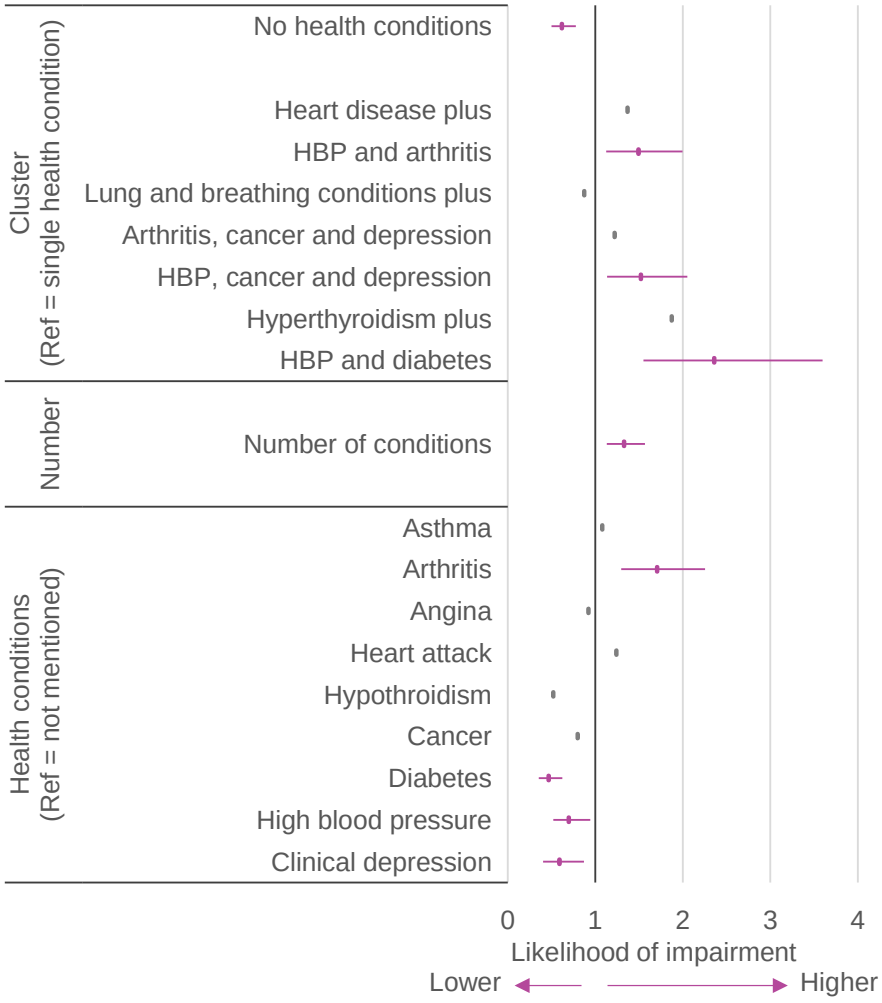
However, when looking at combinations of health conditions, those who developed a combination of high blood pressure and arthritis, or a combination of high blood pressure and cancer or depression, or a combination of high blood pressure and diabetes, are more likely than those with a single health condition to report mobility

[20] National Statistics Socio-economic Classification (NS-SEC) was not included as so many of the individuals in this age range are retired. This means for some individuals their NS-SEC would be historic, whilst for others it would be current, this meant it was not felt to be a robust control variable.
[21] Models were not run for the following impairments due to low numbers: sight (not glasses), communication, personal care, recognition of when in danger.

issues. This suggests that diabetes, high blood pressure and clinical depression may not cause mobility issues in isolation but cause problems in combination. As we would expect, people with no health conditions are less likely than those with a single health condition to report mobility issues.

More generally, the greater the number of conditions someone develops, the more likely they are to have mobility issues. *"Number of conditions"* in Figure 4.14 illustrates the effect of developing an additional health condition. The overall size of the effect gets exponentially bigger the more conditions that an individual develops.[22] Where an individual does not develop any health conditions there is no effect on the odds of mobility issues.

Figure 4.14 Associations between health conditions and mobility



Understanding Society Waves 1-7 (2009-17). Observations = 19,030. Full model output: Appendix B.2

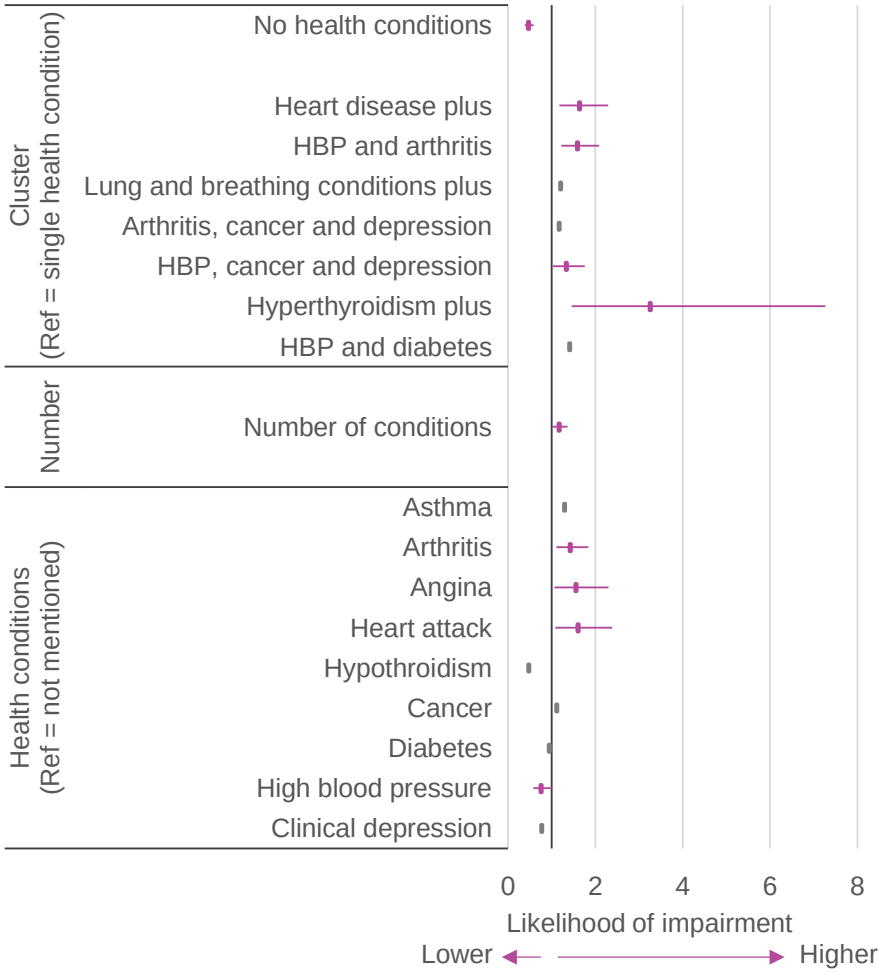
[22] The odds of having a mobility impairment for someone who has developed a single health condition are 33% higher compared to someone whose health conditions have not changed. Equally, the odds of someone having a mobility impairment who has developed two health conditions are 33% higher than someone who developed a single condition. The odds of having a mobility impairment therefore get exponentially bigger as more conditions are diagnosed, compared with there being no change in the number of health conditions.

4.2.6 Lifting, carrying and moving objects

Those aged 50+ with high blood pressure are less likely than those without high blood pressure to report problems lifting, carrying and moving objects, however, those who developed a combination of high blood pressure and cancer or depression had a higher likelihood of suffering from this impairment than those with a single health condition. As with mobility, this finding shows how some health conditions have a greater impact on impairments when they occur in combination.

Other health conditions were found to be linked with problems carrying, lifting or moving objects: developing arthritis, angina or having had a heart attack. However, developing combinations of these health conditions and heart problems more generally were also linked to reporting problems lifting. Membership of the 'Hyperthyroidism plus' cluster of health conditions led to an increase in problems lifting, carrying or moving objects, although this relationship was not found in relation to hypothyroidism in isolation.

Figure 4.15 Association between health conditions and lifting, carrying or moving objects

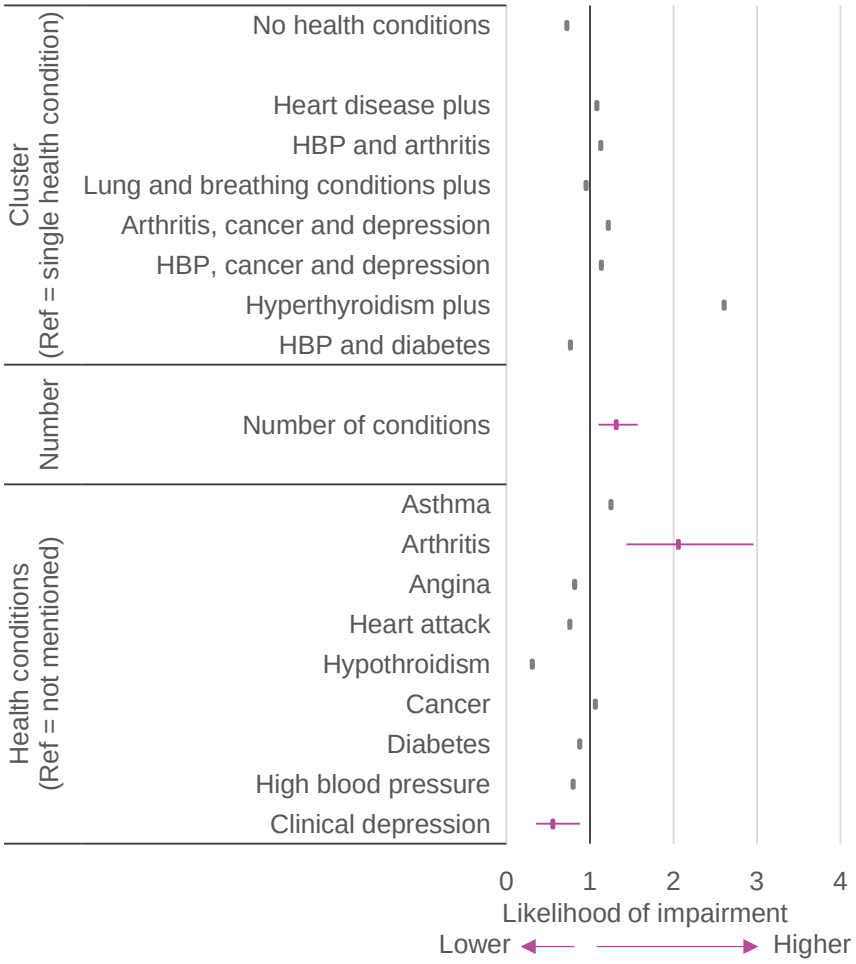


Understanding Society Waves 1-7 (2009-17). Observations = 21,427. Full model output: Appendix B.2

4.2.7 Manual dexterity

There is a strong relationship between developing arthritis and reporting issues with manual dexterity. This finding is not surprising. While it is impossible to tell from Understanding Society data where the arthritis affected the sufferer, a proportion will likely have problems with their hands, wrists and other regions which will have a particular impact on dexterity. Developing clinical depression is linked to a lower chance of reporting issues with dexterity than is the case for those who did not develop clinical depression – perhaps because, for those with depression, this was seen as a more minor health issue and was less likely to be reported.

Figure 4.16 Association between health conditions and manual dexterity

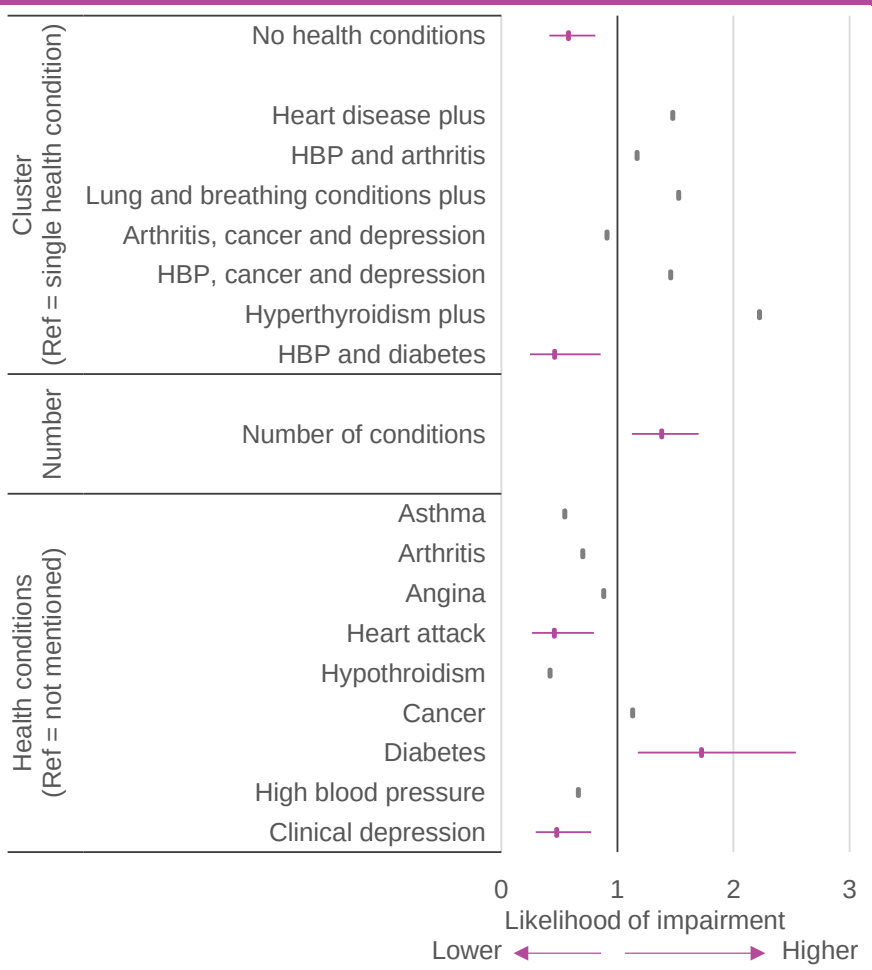


Understanding Society Waves 1-7 (2009-17). Observations = 12,202. Full model output: Appendix B.2

4.2.8 Continence (bladder or bowel control)

A strong relationship is evident between developing diabetes and having problems with continence. Again, this is unsurprising, as incontinence is a known complication of diabetes. However, developing a combination of diabetes and high blood pressure relates to a lower chance of having continence issues, suggesting there is something about this specific combination that relates to a lower chance of reporting this complication. The model also indicates that having had a heart attack and developing depression both relate to a lower chance of reporting continence issues, compared with individuals who did not develop these conditions.

Figure 4.17 Association between health conditions and continence



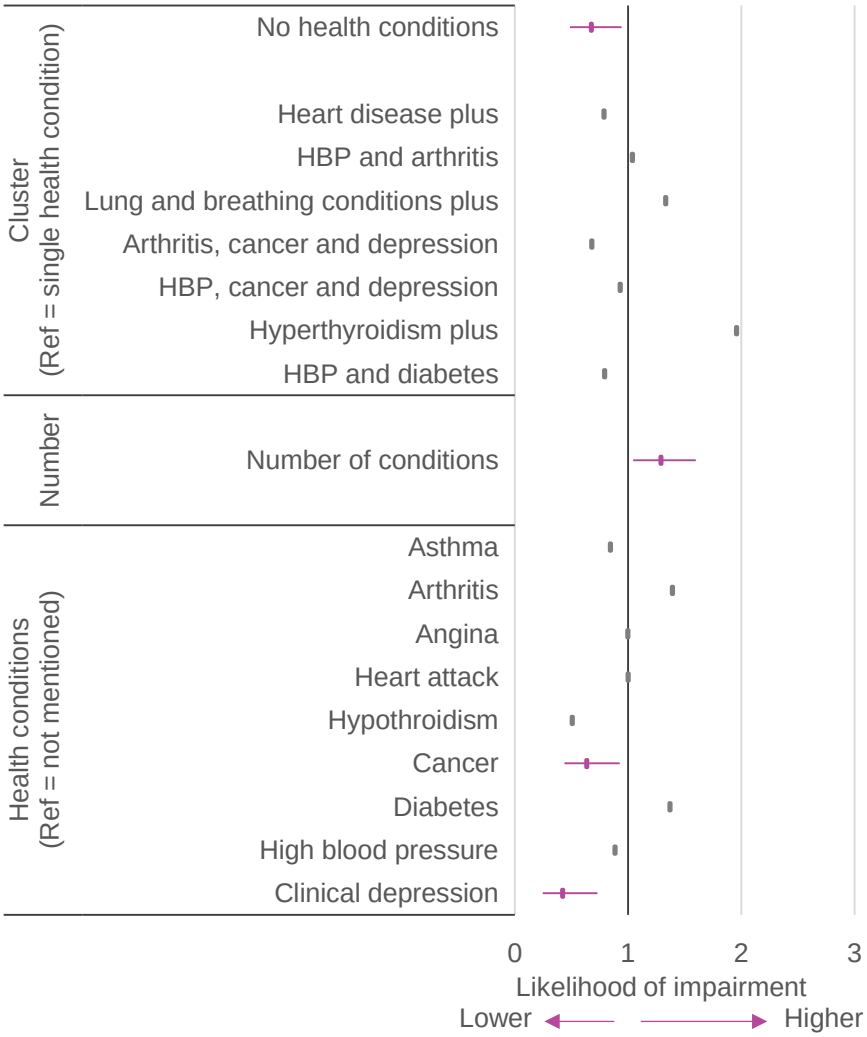
Understanding Society Waves 1-7 (2009-17). Observations = 8,826. Full model output: Appendix B.2

4.2.9 Hearing (apart from using a standard hearing aid)

Individuals who develop cancer and individuals who develop clinical depression are less likely to say they have hearing issues, compared with individuals who do not develop these conditions. As noted previously, this may be because those with more significant and life-changing health conditions are less likely to remember and report more minor impairments.

None of the specific combinations of heath conditions relate to having an increased chance of reporting this impairment, suggesting specific combinations of conditions, or increased numbers of health conditions, do not affect the likelihood of experiencing hearing problems. However, an increase in the absolute number of health conditions does relate to an increased chance of having problems with hearing – suggesting this is a health problem that is more likely to co-occur with or be impacted by the development of additional health conditions. The size of this effect is greatest where multiple health conditions are diagnosed.

Figure 4.18 Association between health conditions and hearing

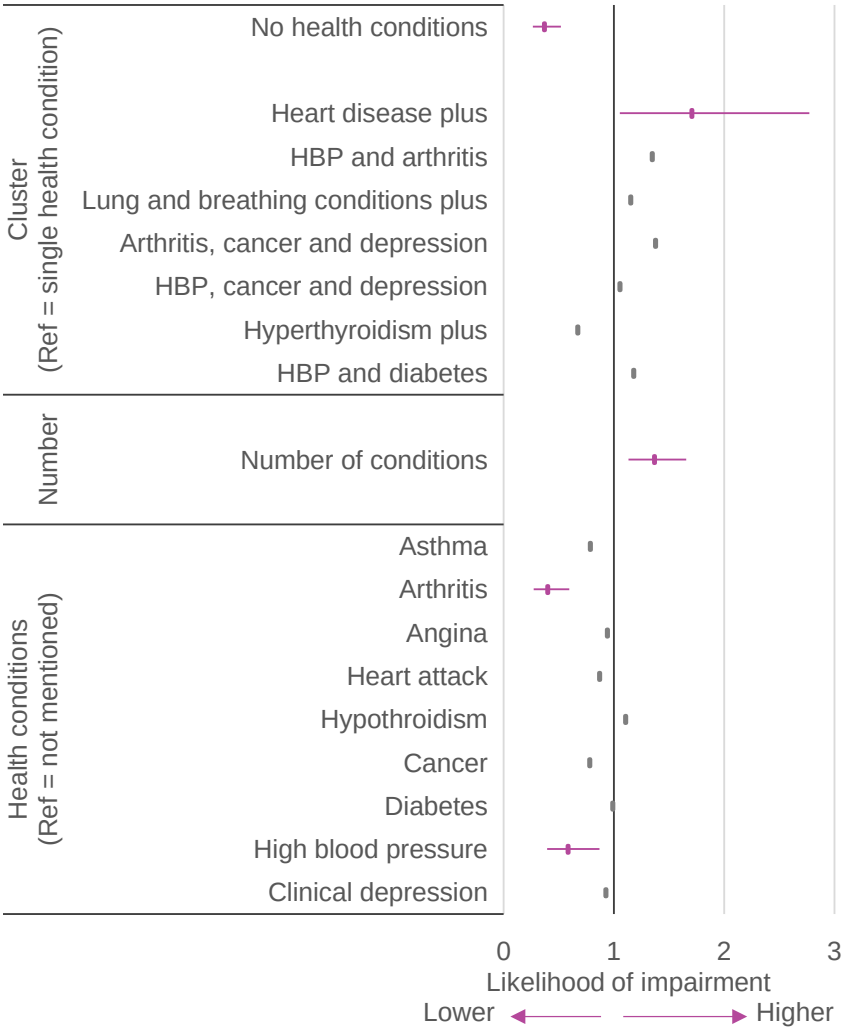


Understanding Society Waves 1-7 (2009-17). Observations = 8,866. Full model output: Appendix B.2

4.2.10 Memory

Developing arthritis or high blood pressure means individuals are less likely to report issues with their memory, compared to individuals who did not develop these conditions. However, those who develop a combination of heart problems and other conditions are more likely to say they have memory issues than those with a single health condition. It should be noted that Understanding Society asks about problems with 'memory' in general, rather than dementia, and related conditions specifically – meaning this analysis is likely to incorporate a much wider range of problems with 'memory' than these two conditions. In addition, it should be noted that people with memory problems may not recall their other impairments as accurately as others without these difficulties.

Figure 4.19 Association between health conditions and memory

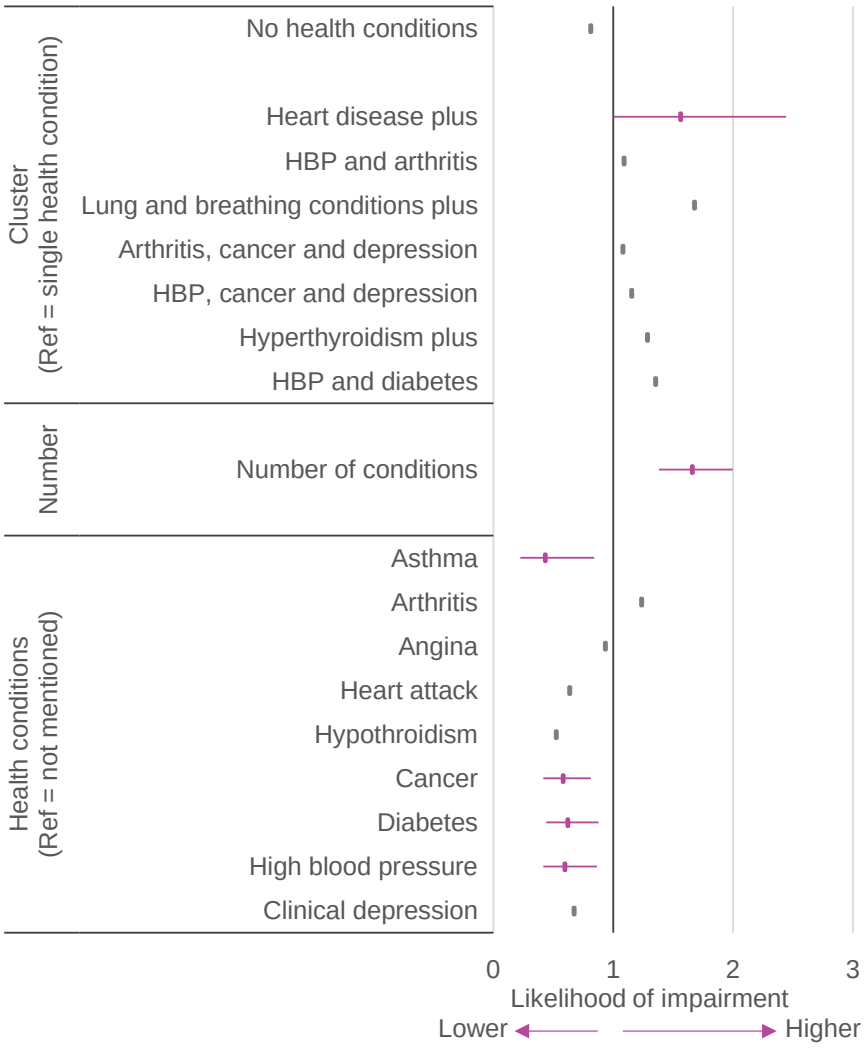


Understanding Society Waves 1-7 (2009-17). Observations = 8,972. Full model output: Appendix B.2

4.2.11 Balance and coordination

Individuals who develop asthma, cancer, high blood pressure or diabetes are less likely to report issues with balance and coordination, than those who do not develop these conditions. However, individuals who have developed combinations of heart problems with other health conditions are more likely to report problems with balance and coordination. This suggests that developing additional multiple issues, rather than developing specific health conditions, leads to experiences of this impairment being more prevalent.

Figure 4.20 Association between health conditions and balance/coordination



Understanding Society Waves 1-7 (2009-17). Observations = 10,847. Full model output: Appendix B.2

4.2.12 Summary of findings from models

When examining the results by health condition, rather than impairment, we can identify a number of themes that run across the models presented in Figures 4.14-4.20.

Some health conditions, such as asthma, are associated with only a single impairment. Developing asthma is associated with an increased chance of having issues with balance and coordination. Similarly, developing angina is related only to a high risk of issues with lifting or moving objects.

However, more commonly, each health condition relates to a number of different impairments. Developing arthritis is associated with a range of impairments; specifically, with an increased chance of having issues related to mobility, lifting and dexterity, but a decreased chance of having memory issues. Arthritis is known to cause issues with movement, mobility and lifting, whereas memory issues are not a known complication. Likewise, developing diabetes is associated with an increased risk of continence issues, a known complication of diabetes, but a decreased risk of issues with mobility or balance and coordination.

High blood pressure and cancer, when not in combination with other health conditions, both relate to a lower risk of a number of impairments. High blood pressure relates to a lower risk of impairments relating to mobility, lifting, memory, and balance and coordination, whereas developing cancer relates to a lower risk of impairments related to hearing or balance and coordination. However, these health conditions cause issues when in combination with other health conditions. A combination of high blood pressure and arthritis, or a combination of high blood pressure, cancer and depression, relate to an increased risk of both mobility and lifting impairments. Similarly, a combination of high blood pressure and diabetes relates to an increased risk of mobility issues and issues with continence.

Other combinations of health conditions also cause issues. A combination of heart disease and other conditions relates to a high chance of issues with mobility, memory, and balance and coordination. However, most of the heart conditions in isolation only impact on the odds of having one or two of the different types of impairment.

4.3 What are the relationships between health conditions and travel behaviour?

Having gained a better understanding of the relationships between health conditions and impairments, the next step is to look at the relationship between health conditions, combinations of health conditions, and travel behaviour – before repeating the same process for impairments.

Data on people aged 50+ from Understanding Society was used to run a series of multivariate analyses[23], each one measuring a different aspect of travel behaviour, specifically:

[23] As before, fixed effects regression models were used to model the longitudinal data. This time OLS models were used, rather than logistic regression models, as the outcomes were frequencies (or total mileage) and therefore non-binary. The rotating nature of the modules in Understanding Society mean the information required for the outcome variables was not asked in every wave, hence different combinations of waves were used for different outcomes. Frequency of travel by mode was asked in Waves 4 (2012-14) and 6 (2014-16) only, car mileage and walking/cycling for short journeys was only asked in Waves 1 (2009-11) and 4 (2012-14).

- Frequency of travel by bus
- Frequency of travel by train
- Frequency of travel by bicycle
- Frequency of travel by car or van (as a driver or passenger)
- Annual car mileage (for those holding a driver's licence)

In each model, travel behaviour was charted against a range of explanatory variables. These included: health conditions and a number of demographic characteristics (age, sex, employment status, household type, region and type of area). Patterns over time were explored using longitudinal modelling. This enabled us to identify changes in travel behaviour associated with a change in characteristics – developing a new health condition, for example.

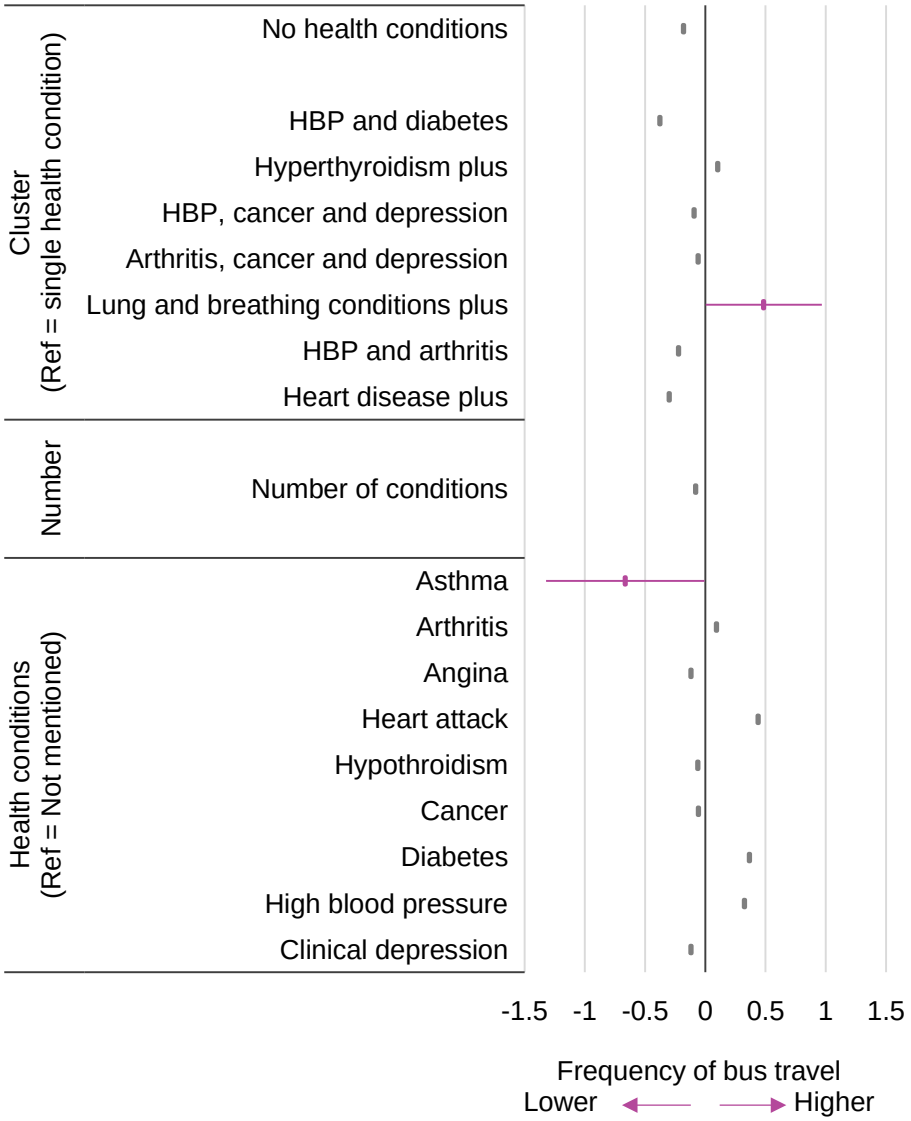
The resulting findings are described and depicted below for each travel behaviour. In each instance, the size of the effect on frequency of travel is presented in the figure. A value equal to or greater than 1 indicates that travel by a given mode of transport would be expected to increase by one category on the frequency scale.[24] Someone who previously travelled by bus *"once or twice a week"*, would then be expected to travel that way at least *"three times a week"*. The opposite would be true for a value equal to or less than -1. Travel would be anticipated to decrease from *"once or twice a week"* to *"less than that, but more than twice a month"*, for example. Where the effects are smaller than in either of these examples, there is still scope for a statistically significant change in travel behaviour to exist, even if the size of the effect cannot be generalised in terms of the frequency scale used in the Understanding Society questionnaire.

4.3.1 Relationships between health conditions and frequency of bus travel

Developing asthma relates to less frequent bus travel, compared with individuals who do not develop this condition. While developing asthma reduces bus travel, being part of the 'Lung and breathing conditions plus' cluster (which means that, in addition to asthma, people in this group could have other health conditions like high blood pressure, emphysema or chronic bronchitis) has the opposite effect, leading to an increase in bus travel. It therefore appears that developing asthma is related to a change in travel mode, but the direction of this change is dependent on the presence or absence of multiple health conditions including other conditions associated with breathing difficulties such as emphysema or chronic bronchitis.

[24] In each case, respondents were asked how frequently they used each mode of transport. For bus, train, bicycle and car travel they could answer either: (1) At least once a day, (2) Less than once a day but at least 3 times a week, (3) Once or twice a week, (4) Less than that but more than twice a month, (5) Once or twice a month, (6) Less than that but more than twice a year, (7) Once or twice a year, (8) Less than that or never. For the model which relates to the number of miles driven in a year, responses were grouped as follows: (1) no driving license, (2) 0 miles, (3) 1-999 miles, (4) 1,000-4,999 miles, (5) 10,000-19,999 miles, (6) 20,000+ miles.

Figure 4.21 The associations between health conditions and frequency of travel by bus



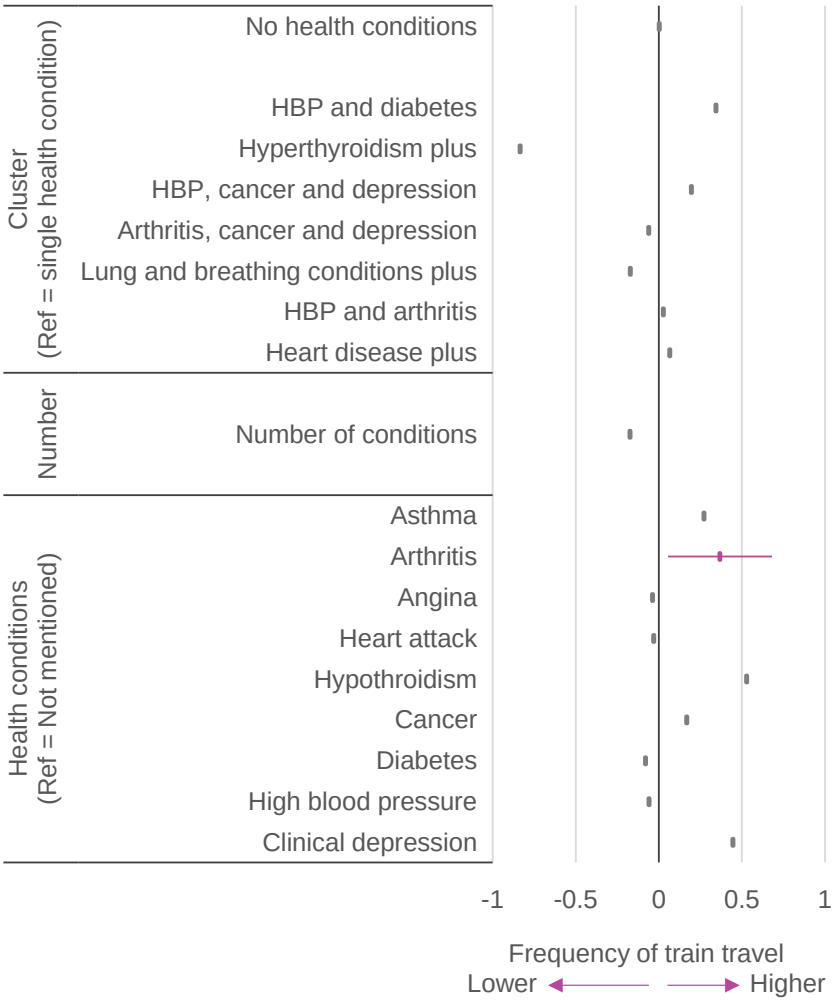
Understanding Society Waves 1-7 (2009-17). Observations = 16,497. Full model output: Appendix B.3

4.3.2 Relationships between health conditions and frequency of train travel

Older people generally travel less frequently by train, particularly when past retirement age, as the main reason for train travel is commuting.[25] For this reason, we should treat these findings with more caution than those associated with more popular modes (such as buses and cars). Changes in the frequency of train travel tend to be broadly unrelated to health. When modelled, the only health condition which was found to be an exception to this was arthritis – the development of which is associated with an increase in the use of trains.

[25] The sharp decline in the number of train trips after age 60 is shown in the National Travel Survey NTS0601: Average number of trips (trip rates) by age, gender and main mode: England (ODS, 176KB): https://www.gov.uk/government/statistical-data-sets/nts03-modal-comparisons)

Figure 4.22 The associations between health conditions and frequency of travel by train



Understanding Society Waves 1-7 (2009-17). Observations = 16,502. Full model output: Appendix B.3

4.3.3 Relationships between health conditions and frequency of travel by bicycle

Only a small proportion of respondents aged 50+ reported travelling by bicycle, meaning, as is the case with train travel, we should treat these findings with a greater degree of caution.

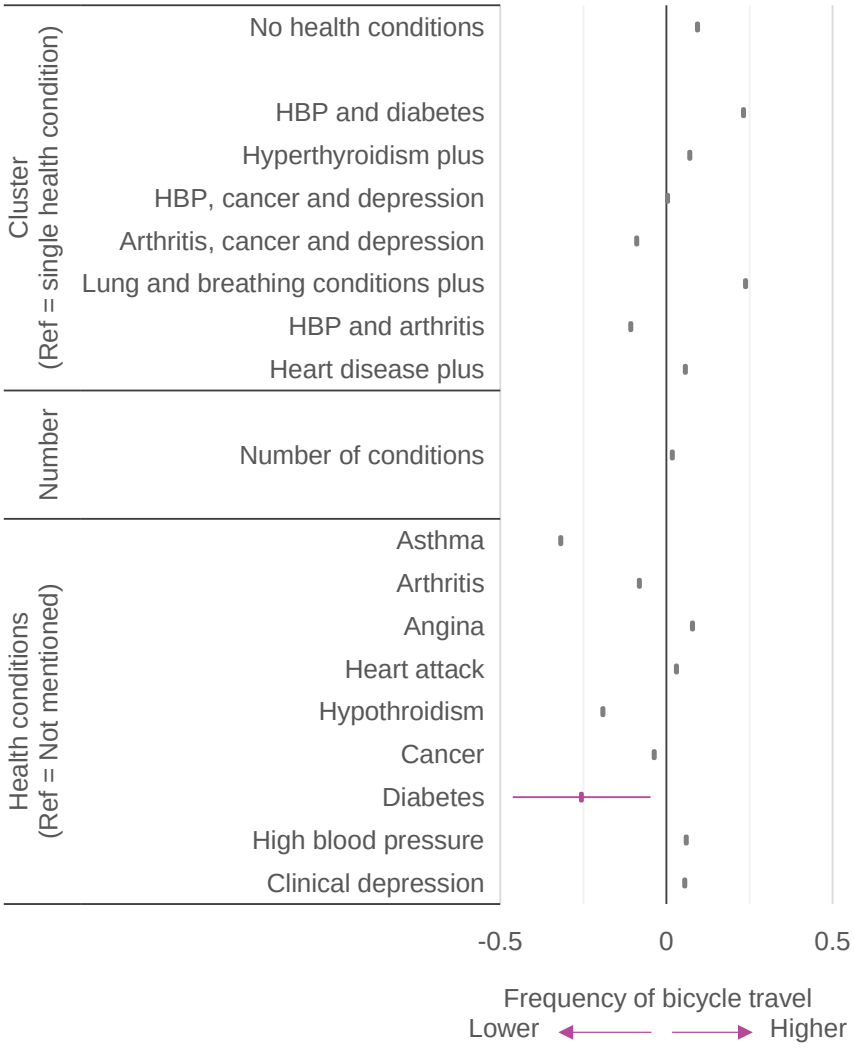
Developing diabetes was found to be associated with travelling less frequently by bicycle. However, it is unclear whether it is the development of diabetes which causes less frequent bicycle use or vice versa.

This analysis only focuses on individuals aged 50+, the vast majority of whom, due to developing diabetes at this point in life, will be diagnosed with Type 2 diabetes.[26] This is a result of its association with obesity and getting older. According to advice from

[26] Advice from NHS Scotland suggests that Type 1 diabetes is unlikely to develop after the age of 40 and is typically first observed in childhood (https://www.nhsinform.scot/illnesses-and-conditions/diabetes/type-1-diabetes).

Diabetes UK, one means to successfully manage the condition is through lifestyle changes, including becoming more active.[27] Therefore, if the development of diabetes is leading to less frequent travel by bicycle among those aged 50+, this may lead to sub-optimal health outcomes.

Figure 4.23 The associations between health conditions and frequency of bicycle travel



Understanding Society Waves 1-7 (2009-17). Observations = 16,502. Full model output: Appendix B.3

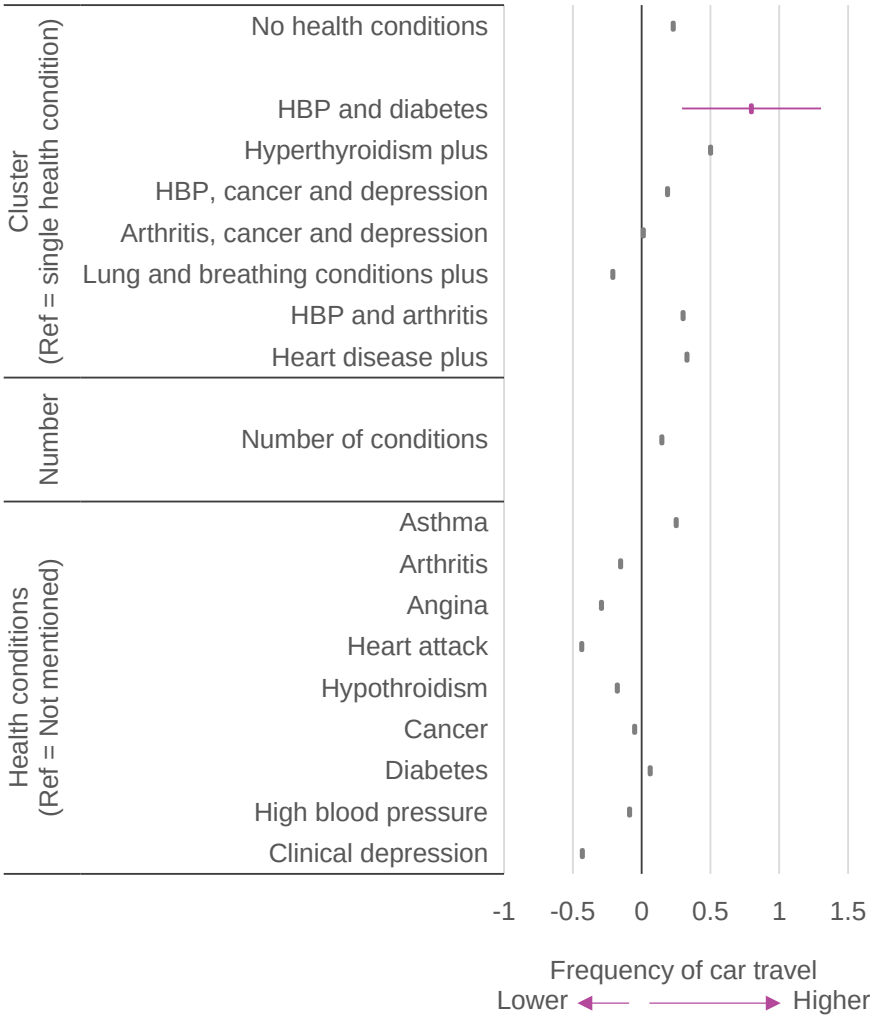
4.3.4 Relationship between health conditions and frequency of travel by car [28]

Developing a specific combination of high blood pressure and diabetes, as is the case for those in the 'HBP and Diabetes' cluster is associated with more frequent car travel (either as a driver or passenger), compared with those who did not develop this combination of health conditions. This finding contextualises the association between developing diabetes and reduced bicycle use, reported above. It may suggest that individuals substitute active modes of travel, such as travel by bicycle, with travel by

[27] https://www.diabetes.org.uk/Guide-to-diabetes/Managing-your-diabetes/Exercise
[28] This is the frequency of travelling by private car, either as a car driver or as a car passenger.

car when developing diabetes in combination with associated conditions (in this case, high blood pressure). However, there is no explicit evidence that this is indeed the case.

Figure 4.24 The associations between health conditions and frequency of car travel



Understanding Society Waves 1-7 (2009-17). Observations = 16,499. Full model output: Appendix B.3

4.3.5 Relationship between health conditions and distance driven (for those with a driving licence)

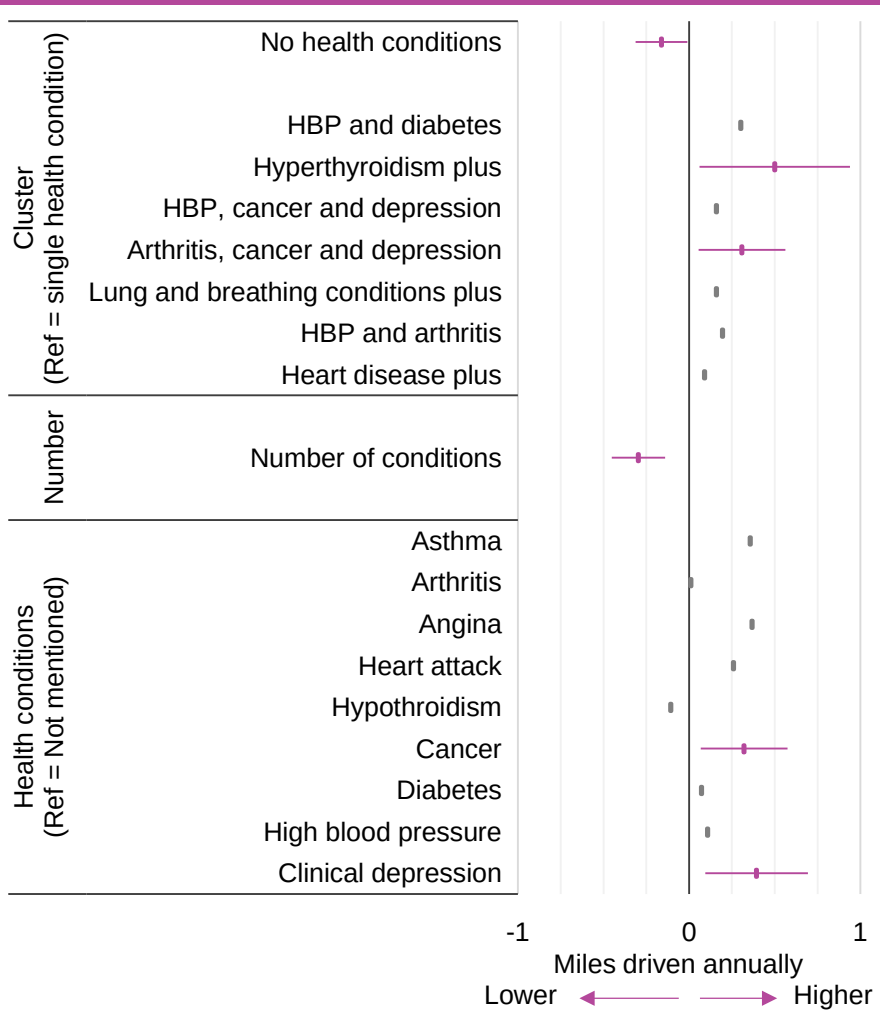
Developing cancer or developing clinical depression in isolation both relate to driving greater distances by car, when compared with individuals who did not develop either condition. It is possible that this is a result of the need to travel for treatment, although we are unable to confirm this using Understanding Society data – and it is also theoretically possible that treatment could have the opposite effect – making individuals too unwell to drive.

In addition, membership of the 'arthritis, cancer and clinical depression' cluster relates to driving greater distances, compared with individuals who do not develop this specific combination of health conditions. Similarly, membership of the 'hyperthyroidism plus'

cluster also relates to driving greater distances, compared to those who do not develop this set of conditions.

Developing additional health conditions relates to driving shorter distances, compared with individuals who maintain the same number of health conditions over time. However, an absence of health conditions also relates to driving shorter distances. This suggests that the largest distances are being driven by individuals with specific single, stable health conditions, or combinations of conditions. It also suggests that the effect of developing a health condition on the number of miles driven annually may be counter-balanced by the condition type (such as is the case for cancer or depression). This may reflect the fact that an individual with the specified conditions or combinations of conditions might find it easier to travel by car than by public transport, but that travel in general may become more difficult with the development of additional health conditions.

Figure 4.25 The associations between health conditions and distance driven by car



Understanding Society Waves 1-7 (2009-17). Observations = 13,210. Full model output: Appendix B.3

4.3.6 Summary of findings from models

Few cross-cutting themes are evident when looking across the models in Figures 4.21-4.25. In general, very few individual, combinations or patterns of health conditions impact on specific travel behaviours, with distance driven by car being an exception (where we identify a considerable number of impacts). Moreover, the health conditions, combinations and patterns of conditions that impact on travel behaviour vary for each of the modes asked about; there is no evidence of those with particular health conditions (or combinations) reducing their use of one mode and replacing it with another or reducing their travel overall (for each mode) for example.

There is a tendency for the development of health conditions to be associated with an increase in mode use. Being part of the 'lung and breathing plus' cluster is associated with an increase in bus travel; developing arthritis relates to an increase in train travel and developing a combination of 'HBP and diabetes' leads to an increase in car travel. In terms of distance driven by car, developing cancer or clinical depression in isolation, 'arthritis, cancer and clinical depression' in combination or 'hyperthyroidism plus' are all associated with an increase in the distance driven. However, the development of health conditions is not universally associated with increased mode use; the development of asthma is associated with a decrease in bus travel; this is the case for diabetes in relation to bicycle travel and the development of additional heath conditions for the distance driven by car.

4.4 What are the relationships between the severity of different impairments and travel behaviour?

Having explored the relationships between health conditions and travel behaviour, we next performed a similar exercise in relation to impairments and travel behaviour. A further series of multivariate analyses were used to explore the relationships between severity of impairment and different travel behaviours; namely frequency of travel by car (either as a driver or a passenger), bus, train and bicycle (with a separate model per travel mode). The aim was to gain a better understanding of how the severity of impairment affects each travel behaviour. These analyses were based on travel behaviours measured at Wave 6 (2014-16) and severity of impairment measured at Wave 7 (2015-17).[29] The analysis was not longitudinal in nature; the models indicate whether a relationship between severity of impairments and travel behaviour exists but cannot be used to comment on whether changes over time in the severity of an impairment affects travel behaviour.

As with other multivariate analyses in this chapter, the models included a number of demographic characteristics (age, sex, employment status, household type, region and type of area) as well as controlling for health conditions. This therefore ensures that any relationships between severity of impairment and travel behaviour identified are not caused by underlying differences on these measures.

[29] As noted in Section 3.1.2, the questions about severity of impairment were only asked in Wave 7 (2015-17) of Understanding Society, whereas questions on travel behavior were included in Waves 4 (2012-14) and 6 (2014-16). An adjustment was made to the Wave 7 impairment measure in order to bring it closer to what we would expect the impairment status to be, given the measure at Wave 6. Specifically, the Wave 7 measure was set to 'no impairment' for those individuals who did not have an impairment in Wave 6. Whilst it is acknowledged that this assumption will not hold in all cases, the relationships identified from the data are felt to be sufficiently robust and representative. It does however mean that the results should be treated as indicative.

The relationships identified are described below for each travel behaviour and summarised in Figure 4.26.

- **Frequency of car travel:** There is no evidence that having a mild version of an impairment associated with mobility, lifting, or dexterity impacts on frequency of car travel. However, the models suggest that a severe version of these impairments will decrease it. For hearing, sight, memory, recognition of physical danger, balance, and personal care, an incremental negative effect is evident: as the severity of the impairment increases, the frequency of travelling by car decreases. Hence, the milder versions of each impairment are associated with a small decrease, whereas the more severe versions are associated with a larger decrease.
- **Frequency of travel by bus:** As some impairments become progressively more severe, the frequency of travelling by bus decreases. This is specifically the case for impairments with mobility, lifting, dexterity, communication, memory, balance, and personal care (although the relationship is not evident for all degrees of each impairment). Conversely, having the most severe degree of hearing impairment is associated with greater frequency of bus use (perhaps as travel by car reduces for this group).
- **Frequency of travel by train:** Similar patterns are observed when looking at the frequency of travel by train, although the relationships are weaker in many instances. However, these is no evidence of impairments relating to hearing having a positive impact on train use, while we find that those with the milder forms of sight impairment are less likely to travel by train than those without this impairment. The lack of non-visual cues to passengers may be negatively impacting on the ability of those with a sight impairment to use this mode of transport. As noted previously, this analysis should be treated with a greater degree of caution given the low number of people aged 50+ who travel by train.
- **Frequency of travel by bicycle:** The results indicate that even mild forms of impairments (e.g. mobility or hearing) decrease the frequency of using a bicycle, albeit the negative relationships are weak in each instance. The physical requirements for using a bicycle, and the exposed nature of being on a bicycle in traffic, are likely to reduce the appeal and accessibility of bicycle transportation to individuals with even mild forms of some impairments. As noted previously, analysis related to travel by bicycle should be treated with a greater degree of caution given the low number of people aged 50+ who travel by bicycle.

4.4.1 Summary of findings from models

Considering the impact of different types of impairments on travel behaviour, some impairments were found to have more widespread effects than others. Across the different levels of impairment, impairments associated with mobility, lifting, dexterity, memory, personal care and physical co-ordination have impacts for all four travel modes examined. Meanwhile, having problems associated with continence, hearing, sight, communication and recognition of physical danger affected the use of some modes of transport, but not all of them.

Figure 4.26 summarises the statistically significant relationships between the severity of impairments and subsequent changes to individuals' travel behaviour. Green shading indicates a positive relationship (more frequent travel); while red indicates a negative association (less frequent travel). The number of plus (+) or minus (-) symbols reflects the size of the effect, with (++) indicating a strong positive effect and (- -)

indicating a strong negative relationship.[30] Blank spaces indicate that no statistically significant relationship was found – any differences in travel behaviour associated with a given level of impairment may have occurred by chance.

The strength of a given relationship indicates the degree to which we expect travel behaviour to change with a given set of underlying circumstances. In this analysis, a strong relationship (++ or - -) refers to a change in travel frequency of at least one interval along the frequency scale, which can move from 1 (highest frequency) to 8 (lowest frequency).[31] Other factors (such as age or sex) may, equally, contribute to changes in the frequency of travel. The multi-variate analysis allows us to control for such factors,[32] and to understand the unique effect of having an impairment of a given severity on travel behaviour.

When we compare two individuals with otherwise identical characteristics, we would expect the frequency of bus travel for someone with no mobility (responding 'unable to move') to be *at least* [33] one interval lower on the frequency scale, compared with someone who has no mobility issues (responding 'no mobility impairment').[34] Using this example, the analysis suggests that:

- a typical person aged 50+ with no mobility issues, on average, may travel by bus *more than twice a month*
- and someone else with similar characteristics but with a lot of mobility difficulties or with no mobility at all, would travel by bus *less than once a month*.

Only one type and level of impairment was identified as being associated with an increase in frequency of travel. A typical person aged 50+, who became unable to hear, would typically be expected to increase their travel by bus from *more than twice a month* to *at least three times a week*.

With the exception of hearing (where those people with a severe hearing impairment appear to reduce travel by car in favour of travel by bus), there is no explicit evidence of mode replacement. As impairments become more severe, the trend for car use to reduce is at odds with the finding identified in relation to health conditions in the previous section.[35] However, it should be emphasized that these relationships were identified only in relation to a minority of specific individual or combinations of health conditions, for which the level of severity was unknown. The number of impacts

[30] The number of plus or minus signs reflects the size of the predicted change to travel behaviour caused by the development of a given level of impairment. Where the effect is statistically significant and is in the range between -1 and 1, a single -/+ sign is used. Where the coefficient is either less than -1 or more than 1, this is indicated by (- -) or (+ +).
[31] In each case, respondents were asked how frequently they used each mode of transport. They could answer either: (1) At least once a day, (2) Less than once a day but at least 3 times a week, (3) Once or twice a week, (4) Less than that but more than twice a month, (5) Once or twice a month, (6) Less than that but more than twice a year, (7) Once or twice a year, (8) Less than that or never. This scale was inverted when running the regression, i.e. positive coefficients indicate increased transport mode use; negative coefficients indicate decreased mode use.
[32] Other factors controlled for in the modelling were: health conditions, age group, gender, region, urban/rural and employment status.
[33] In some cases where a strong effect is indicated (- - or + +), the regression coefficients presented in Appendix Table B.4 suggest there may be an effect greater than one interval on the frequency scale (subject to confidence intervals). This applies to the following: (1) the effect of being unable to remember on car use, (2) the effect of being unable to move on bus use, (3) the effect of having no manual dexterity (unable to do this) on bus use, (4) the effect of being unable to hear on bus use, and (5) the effect of being unable to perform personal care on bus use.
[34] For the predicted size of effect for each severity of impairment refer to Appendix Table B.4.
[35] In Section 4.3.4 we found that, in the single instance where the development of health conditions affected the frequency of travel by car, this led to an increase in travel.

identified in Figure 4.26 below, and the variation by level of severity, suggests that it is the presence of impairments, rather than health conditions, that affects travel behaviour (and that the effect almost entirely relates to a reduction).

Figure 4.26 Association between severity of impairments and travel behaviour

Severity (vs. no impairment)	Mobility			Lifting, carrying or moving objects			Manual dexterity			Physical coordination /balance		
	Some difficulty	A lot of difficulty	Unable to do this	Some difficulty	A lot of difficulty	Unable to do this	Some difficulty	A lot of difficulty	Unable to do this	Some difficulty	A lot of difficulty	Unable to do this
		-	--			-			--	-	-	--
	-	--	--	-	-	--		-	--	-	-	--
	-	-		-	-	-		-			-	
	-	-		-	-	-	-	-		-	-	

Severity (vs. no impairment)	Personal care			Memory or understanding			Sight			Hearing		
	Some difficulty	A lot of difficulty	Unable to do this	Some difficulty	A lot of difficulty	Unable to do this	Some difficulty	A lot of difficulty	Unable to do this	Some difficulty	A lot of difficulty	Unable to do this
	-	--	--	-	-	--	-	--	--	-		--
	--	--	--	-	--							+ +
	-	-	-	-	-		-	-				
		-		-								

	Communication			Continence			Recognition of physical danger			Other		
Severity (vs. no impairment)	**Some difficulty**	**A lot of difficulty**	**Unable to do this**	**Some difficulty**	**A lot of difficulty**	**Unable to do this**	**Some difficulty**	**A lot of difficulty**	**Unable to do this**	**Some difficulty**	**A lot of difficulty**	**Unable to do this**
				-			-	--			-	
	-	--										
												
										-		

Understanding Society Waves 6-7 (2014-17). Minimum observations = 5,977 (frequency of car travel; recognition of physical danger). Consolidated model output: Appendix B.4

+ + strong positive relationship; + weaker positive relationship;

- - strong negative relationship; - weaker negative relationship

5 Ageing, daily tasks and travel behaviour

In this chapter we consider difficulties with undertaking 'daily tasks' as a potential indicator of health problems, that might affect travel. Adopting a similar approach to Chapter 4, we explore the prevalence of difficulties with daily tasks among the population aged 50+, the extent to which these co-occur with health conditions and the nature and extent of their impact on travel behaviours. The results presented in this chapter are based on analysis of ELSA data.

5.1 How many older people have difficulties undertaking tasks required for daily living, independent daily living, and using transport?

ELSA collects information on key tasks required for daily living, defined as activities for daily living (ADLs), instrumental activities for daily living (IADLs), and other difficulties. The ADLs and IADLs are a set of fundamental skills for basic living that are widely recognised by the social care community. In addition to these skills, ELSA collects information on a number of additional health-related difficulties. We report on these separately later in this Chapter, since they do not belong to the same, recognised set of basic skills. A list of tasks measured in each of these categories is given in Table 5.1. Respondents are asked to identify, from a list, each of the difficulties that applies to them.

Table 5.1 Activities for Daily Living (ADL), Instrumental Activities for Daily Living (IADL), and other difficulties

Activities for Daily Living (ADL)	Instrumental Activities for Daily Living (IADL)	Other difficulties
Dressing, including putting on shoes and socks	Using a map to figure out how to get around a strange place	Reaching or extending arms above shoulder level (either arm)
Walking across a room	Shopping for groceries	Sitting for about two hours
Using the toilet, including getting up or down	Recognizing when you are in physical danger	Getting up from a chair after sitting for long periods
Eating, such as cutting up food	Taking medications	Climbing several flights of stairs without resting
	Managing money, such as paying bills and keeping track of expenses	Lifting or carrying weights over 10lbs, like a heavy bag of groceries
		Climbing one flight of stairs without resting
		Pulling or pushing large objects
		Walking 100 yards
		Picking up a 5p coin from the table

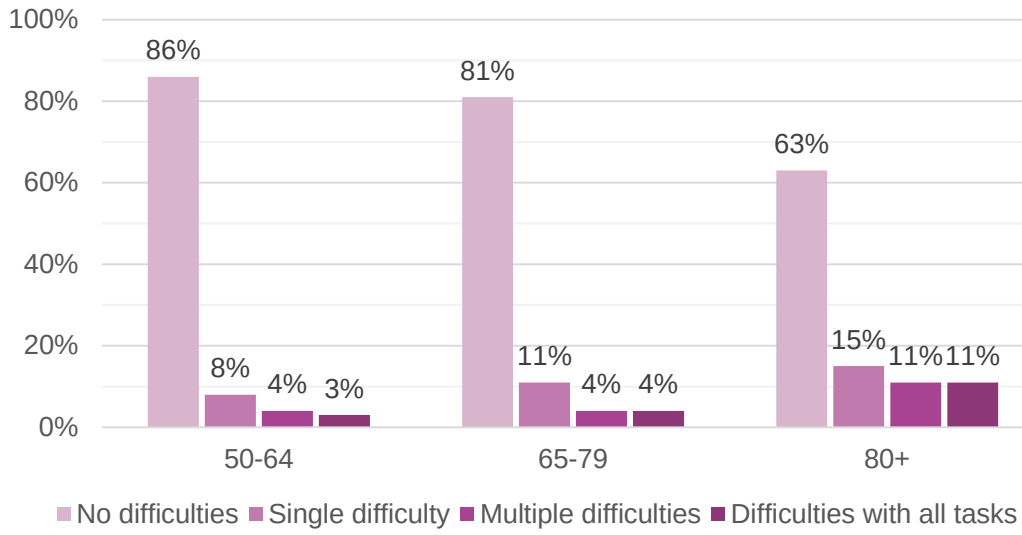
Each of the measures considered tests the capacity of respondents to complete different types of tasks and activities. ADL tasks provide an indication of whether the individual has the core functionality required to complete tasks needed for a basic standard of living, while IADL tasks differ in that they relate to independence. Other difficulties, meanwhile, measure physical ability – be this fitness, strength or dexterity. When considered together, difficulties with such activities provide us with some useful insights. If an individual finds a given task challenging, then this may have significant implications for their travel patterns, since these or similar capabilities may be required to use some modes of transport, to undertake activities outside the home, or to make journeys.

5.1.1 How difficulties with daily tasks (ADL/IADL) vary by age group and sex

Analysis reveals that age is closely linked to whether an individual has difficulties with the nine ADL and IADL tasks.[36] We examined how the number of tasks individuals had difficulties with varied by age, as well as the prevalence of individual difficulties by this characteristic.

As shown in Figure 5.1, over one in ten (11%) respondents aged 80+ had difficulties with all the activities listed, compared with just 3% aged 50-64. Similarly, there are large differences between different age groups of respondents who report difficulty with either one or several activities. The biggest shift in prevalence occurs between the 65-79 and 80+ age groups, where the proportion reporting no difficulties drops from 81% to 63%.

Figure 5.1 Difficulty with ADL/IADL tasks by age group



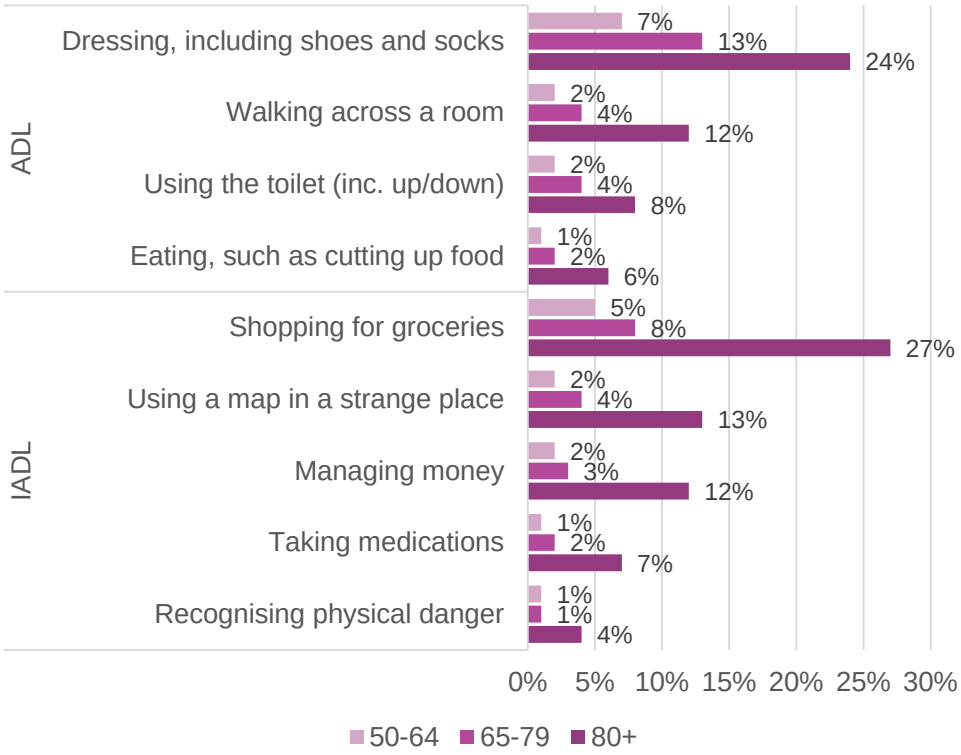
English Longitudinal Study of Ageing, Wave 7 (2014-15). Individuals aged 50+, n=5,614. Full table: Appendix A.15

There are also some differences by sex (detailed in Appendix table A.16). Women are more likely to identify difficulties with ADL and IADL tasks than men. Over four in five (83%) men have no issues with these activities, while just 78% of women report this. This reflects the findings in Chapter 4 which showed that women are more likely to have multiple health conditions than men.

[36] In this Chapter, the descriptive analysis is based on Wave 7 (2015-17) of ELSA.

Figure 5.2 shows how the proportions who have difficulties with specific daily tasks vary by age. In each instance, a greater proportion of those in the oldest age group find each of the daily activities difficult, although the magnitude of the differences between the oldest and youngest age groups vary markedly. Most strikingly, 27% of those aged 80+ have difficulties shopping for groceries, compared with just 5% of those aged 50-64. At the other end of the spectrum, difficulties with recognising physical danger do not increase much by age – 4% of those aged 80+ report difficulties with this, compared with 1% of the two younger age groups.

Figure 5.2 Difficulty with ADL/IADL tasks by age group



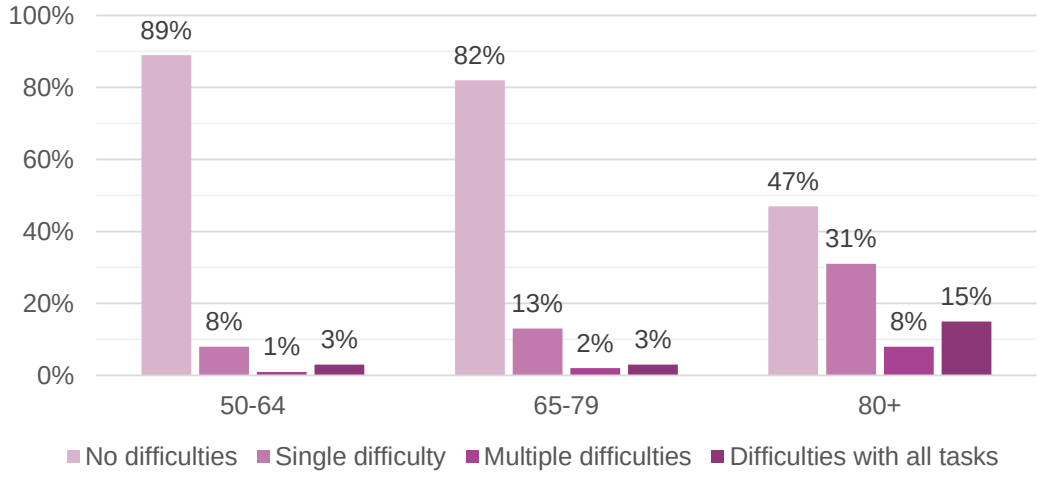
English Longitudinal Study of Ageing, Wave 7 (2014-15). Individuals aged 50+, n=8,152. Full table: Appendix A.17

As depicted in Figure 5.3, the number of other difficulties experienced also increases with age. Five times as many people aged 80+ have difficulties with all tasks (15%), compared with those aged 50-64 and those aged 65-79 (3% for both). More markedly, less than half of the oldest age group do not have difficulties with any tasks (47%), compared with almost nine in ten of the youngest age group (89%). As before, women are more likely to report other difficulties than men, as shown in Appendix Table A.20. Just under one quarter (24%) of women report at least one difficulty, compared with fewer than one in five (18%) men.

Figure 5.4 presents a comparable analysis to that presented for age group above, for each of the other difficulties asked about on ELSA. Again, we see that difficulties become substantially more prevalent with age. The most prevalent difficulty among those aged 80+ is with stooping, crouching and kneeling, identified as problematic by almost two-thirds (63%). A similar proportion of the oldest age group find climbing more than one flight of stairs with no rest difficult (62%). Along with getting up from a chair (18%), these two difficulties are also the most prevalent among the youngest age group aged 50-64; 26% view stooping, kneeling or crouching as difficult, whereas 18% say this for climbing multiple flights of stairs. Given that a number of these activities could

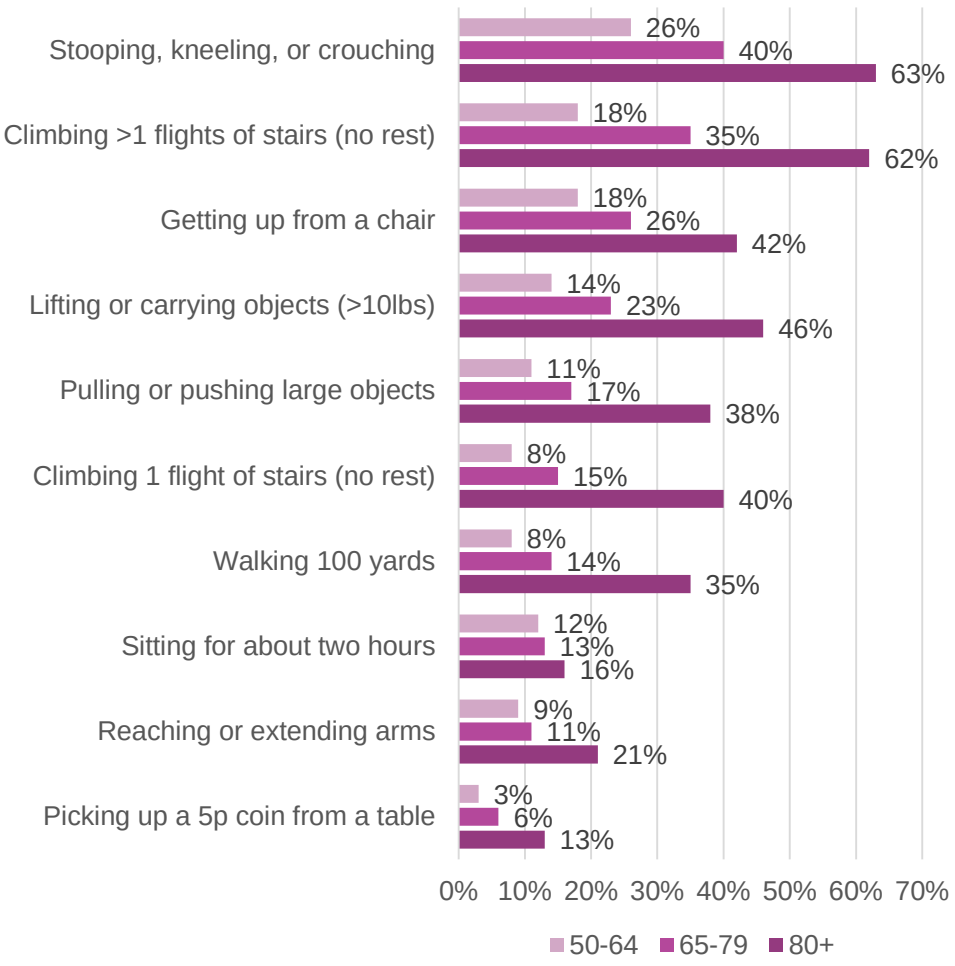
potentially be required in travel, this data provides a clear indication of why activities associated with travel are likely to become more problematic as people age.

Figure 5.3 Other difficulties by age group



English Longitudinal Study of Ageing, Wave 7 (2014-15). Individuals aged 50+, n=5,614. Full table: Appendix A.19

Figure 5.4 Other difficulties by age group



English Longitudinal Study of Ageing, Wave 7 (2014-15). Individuals aged 50+, n=8,152. Full table: Appendix A.21

5.1.2 Relationships between health conditions and difficulties with key tasks

As in Chapter 4, where we investigated the relationships between health conditions and impairments, here we consider how the difficulties with daily activities reported in Figures 5.1 and 5.2 relate to different health conditions. Multivariate analysis was used to investigate the relationship between health conditions and difficulties with the nine ADL/IADL tasks whilst taking other characteristics, such as age and sex, into account. As in Chapter 4, longitudinal models were used to look at the impact of individual-level change over time. The models were used to identify how changes in an individual's health had an impact on their ability to perform various tasks.

A series of models were run to estimate the probability of having difficulties with one or more ADL/IADL tasks, considering each respondent's characteristics (e.g. age, sex, current economic activity,[37] household type, region and type of area).[38] This was done to ensure any associations that were identified between health conditions and difficulties were not due to underlying demographic differences. Once the demographic characteristics are controlled for, we could identify which health conditions are significantly related to having difficulties with key tasks.

The model output is presented in Figure 5.5 (the full output is presented in Appendix B, Table B.5). It suggests the relationship between health conditions and difficulties depends on whether the condition is chronic or degenerative. For instance, developing degenerative conditions such as Alzheimer's disease and Parkinson's disease relates to an increase in difficulties with key tasks. In addition, having cancer or arthritis were also found to relate to having difficulties with key tasks, although the impact is smaller.

The size of effect may depend on individual circumstances. At onset, conditions such as Alzheimer's may have a modest impact on everyday life, typically causing issues with the IADL tasks (such as using a map or shopping for groceries). Once the condition progresses, it can manifest itself in difficulties completing physical tasks such as dressing, walking across a room, using the toilet and eating. As such, we see greater variation among how respondents experience conditions such as this or Parkinson's disease, compared to say arthritis.

Having a stroke and fracturing a hip also relate to having difficulties with everyday tasks, compared with individuals who did not experience these conditions. It is clear how these conditions impact on an individual's ability to complete tasks, although in some instances the individual will be expected to make some recovery (this may not be picked up by the model if the recovery is long-term). In addition, fracturing a hip has been shown to reduce people's confidence in the long-term in managing certain tasks such as walking outside or managing the stairs. It should be remembered that the

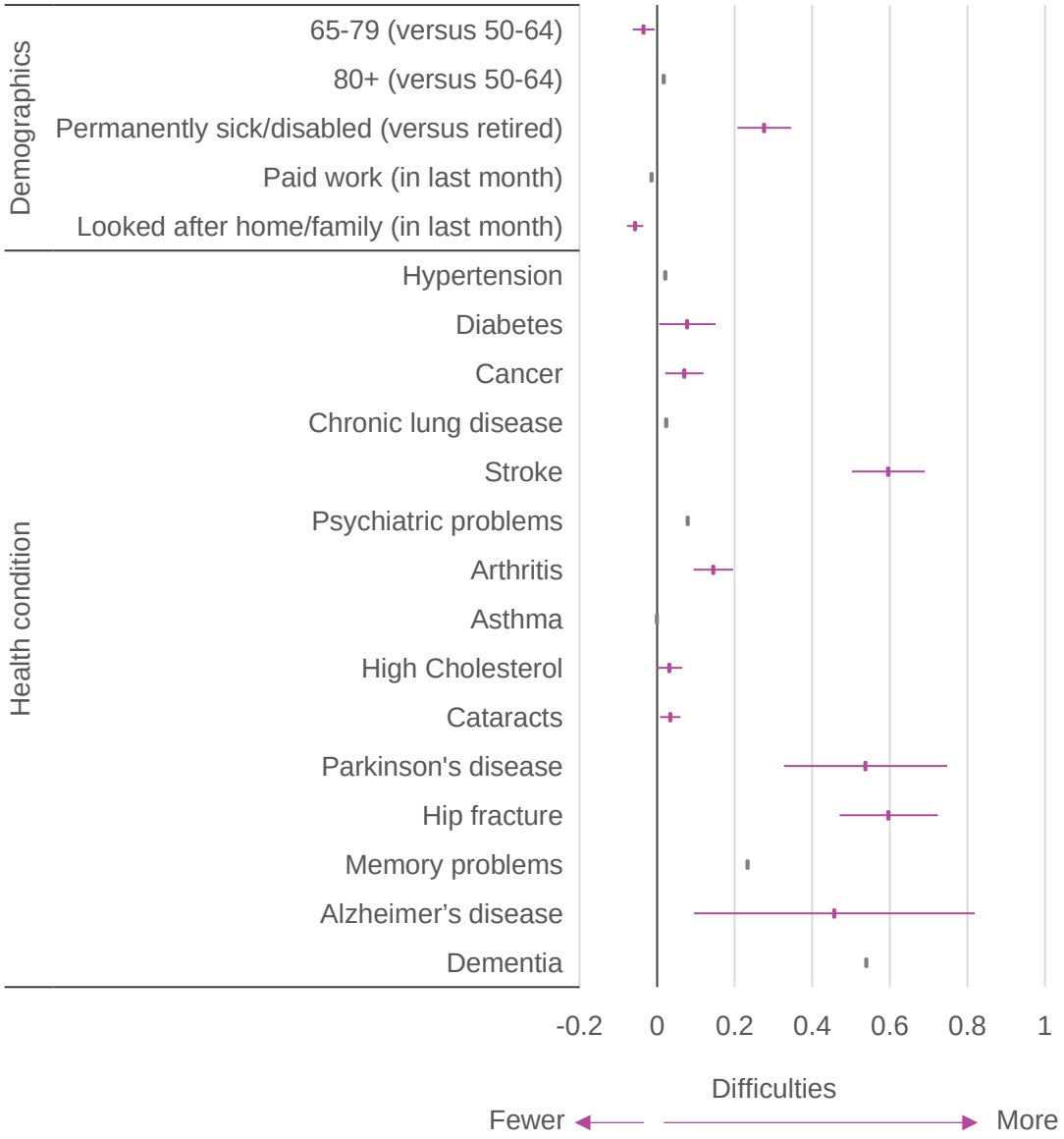
[37] National Statistics Socio-economic Classification (NS-SEC) was not included as so many of the individuals in this age range are retired. This means for some individuals their NS-SEC would be historic, whilst for others it would be current, this meant it was not felt to be a robust control variable. The 'current economic activity' variable which was instead specified was comprised of the following categories: (1) retired, (2) employed, (3) self-employed, (4) unemployed, (5) permanently sick/disabled, (6) looking after home/family, (7) spontaneous: semi-retired.

[38] Fixed effects logistic regression models were used. These are longitudinal models that identify the impact of change on an outcome. One model was run for each travel behaviour.

model may be picking up on such an impact, as the measures of difficulties with daily tasks relate to individual perception, rather than being measured objectively.

In addition to the health conditions reported above, having a working status of being "permanently sick or disabled" is also associated with finding IADL/ADL tasks more difficult. This contrasts with the other categories of employment, for which no relationships were found.

Figure 5.5 Association between health conditions and difficulties with ADL/IADL tasks [39]



English Longitudinal Study of Ageing, Waves 4-7 (2008-15). Observations = 17,897. Full model output: Appendix B.5

[39] Demographic variables were specified in the modeling to control for an individual's underlying characteristics, which, if excluded, may confound the analysis (a selection of which – where significant in at least one model – are included in Figures 5.5 and 5.7). All categories of employment status were compared against becoming retired. An additional set of variables which address activities carried out in the past month are also included and compare carrying out that activity to not carrying out that activity.

It is also notable that, once health conditions and demographic factors have been controlled for, the relationship between age, sex and the ability to complete everyday activities becomes weaker; in other words, age and sex become less effective than they were previously at predicting levels of difficulty with daily tasks, once their relationships with other variables have been accounted for. This is particularly the case when looking at changes in an individual's age, those who move to the 65-79 age group from the 50-64 age group tend to be more able when it comes to ADL and IADL tasks, than those who remain in the 50-64 age group. This highlights the importance of health conditions, rather than age in isolation, in determining individual abilities and difficulties.

There are a few possible explanations for why those who move from the 50-64 age group to the 65-79 age group experience fewer difficulties with daily activities than those who are younger[40]. Firstly, the margin could be explained by variation between cohorts. If there are systematic differences between different aged respondents, not captured by the health condition variables, then these could manifest themselves in the age variable. Equally, those aged 50-64 with serious health conditions may be more likely to stop responding to the survey, either because they become less able to respond or because of severe illness or death (meaning that those who remain, who move to the 65-79 age group, are necessarily healthier). In other words, there may be other confounding factors at play here. Similar patterns were observed when repeating the analysis with the other measures of 'other difficulties', as specified in the ELSA survey. These are presented in Appendix B (Table B.5).

5.2 What are the relationships between difficulties undertaking key tasks and travel behaviour?

In this section we investigate the relationship between difficulties with key tasks and travel behaviour – focusing on frequency of public transport use, getting lifts from family and friends, driving a car, using taxis, using door-to-door community transport and using transport provided by hospitals, day centres or lunch clubs

5.2.1 Frequency of using public transport

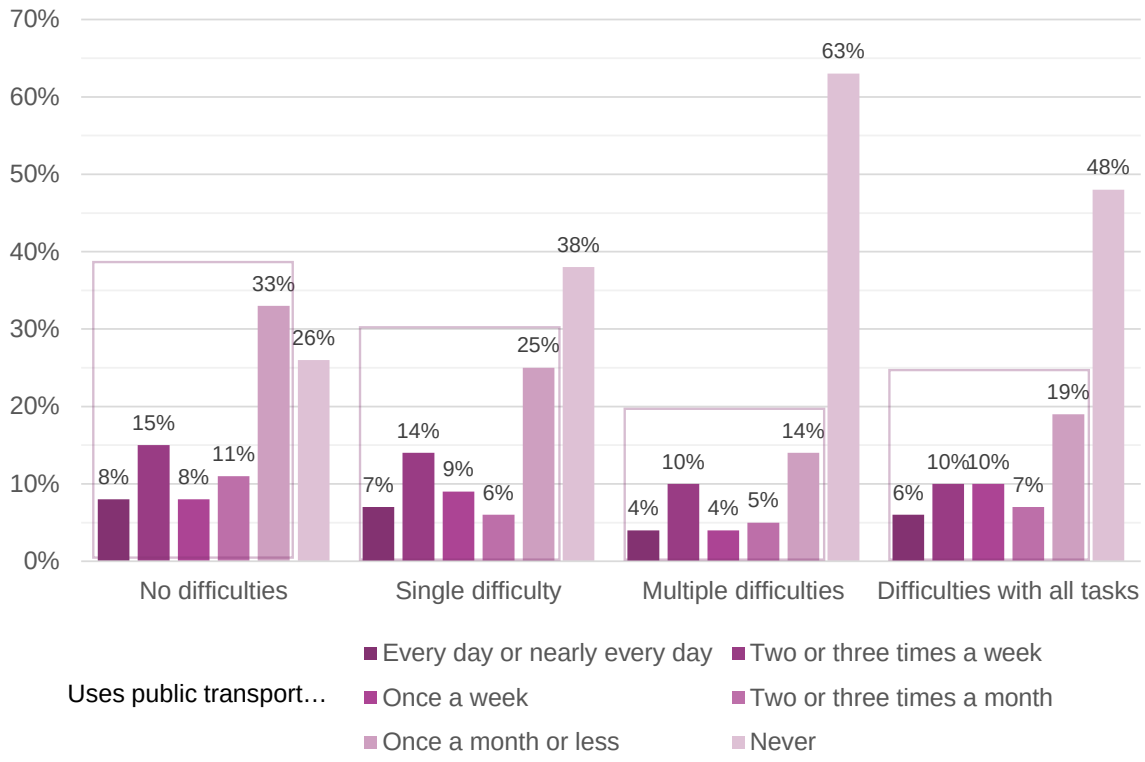
As shown in Figure 5.6, an individual will generally use public transport less frequently if they experience a greater number of difficulties completing daily tasks. Just under three-quarters (74%) of individuals that have no difficulties with ADL and IADL tasks use public transport, compared with under half (37%) of those who have "multiple difficulties".

However, within this broad theme there are some more subtle differences. We find a non-linear relationship between the number of difficulties experienced and the frequency with which someone uses public transport. 26% of those without any difficulties never use public transport; this proportion rises to 38% of those with a single difficulty and 63% of those with multiple difficulties, before dropping again to 48% of those with all the named difficulties. This could be due to the specific type or combinations of difficulties that an individual is experiencing – or to the impact of other demographic factors or health conditions. This was investigated further using

[40] Ability was defined as a categorical variable in the statistical modelling, where individuals had either (1) no difficulty with ADL/IADL tasks, (2) difficulty with a single task, (3) difficulty with more than one task but not every task, or (4) difficulty with every ADL/IADL tasks.

multivariate analysis techniques, allowing us to look at the impact of different ADL/IADL difficulties in parallel to use of public transport. This meant that other factors (such as demographic characteristics) could be considered when looking at the relationship between all the difficulties and travel behaviour. A longitudinal model[41] was used to understand how changes in an individual's difficulties with daily tasks impacts on their use of public transport. The findings of this model are presented in Figure 5.7.

Figure 5.6 Public transport use by difficulty with ADL/IADL tasks



English Longitudinal Study of Ageing, Wave 7 (2014-15). Individuals aged 50+, n=5,614. Full table: Appendix A.23

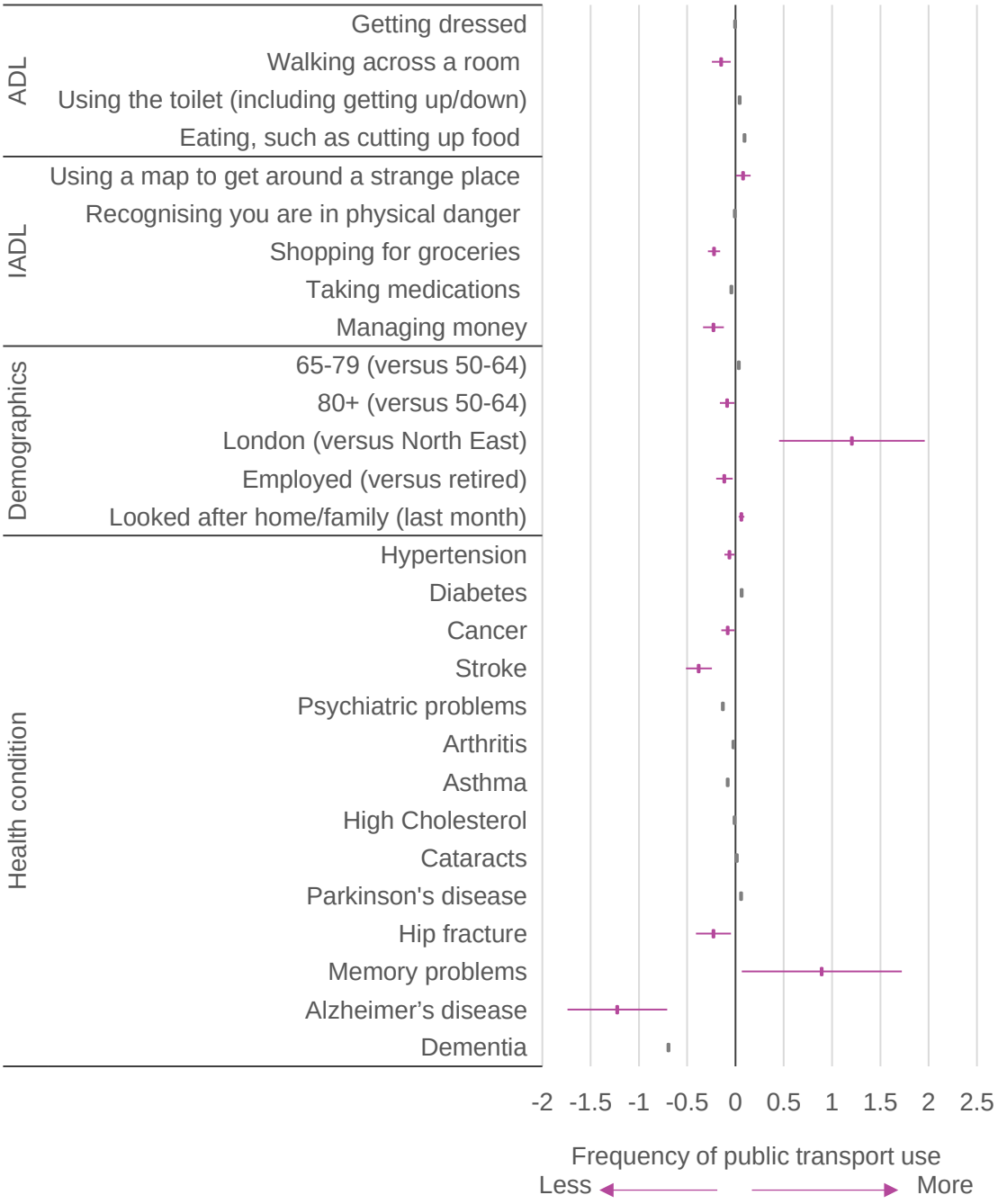
As the prior analysis suggests, there is a close association between an individual's age and the incidence of health conditions. Therefore, by controlling for age and whether individuals have a given health condition, we can discern the effect of different difficulties on capability and usage of different transport modes. Developing a difficulty walking across a room, for instance, has an association with public transport being used less frequently. The IADL tasks also appear to be especially important in this regard.

However, rather than difficulties with daily tasks, it was the development of either memory problems or Alzheimer's that appeared to have the greatest impact (in different directions) on the frequency of public transport use. Given issues with recall associated with these two health conditions (and the fact that the pattern for memory problems contradicts that identified when impairments were considered in Chapter 4), we may wish to treat this finding with caution.[42]

[41] Fixed effect regression models allow us to look at the impact of change over time.
[42] The "memory problems" health condition was derived from responses to questions regarding the diagnosis of either Alzheimer's Disease or dementia. In cases where respondents mentioned that they had been diagnosed with *either* Alzheimer's or dementia, they were also coded as having memory problems.

Similar patterns were observed when repeating the analysis with the measures of 'other difficulties', specified in the ELSA survey. These are presented in Appendix B (Table B.5).

Figure 5.7 Association between frequency of public transport use [43] and difficulties with ADL/IADL



The advantage of including this variable is that it captures the effect of memory problems on transport outcomes in general. Meanwhile, the inclusion of Alzheimer's and dementia helps to capture effects specific to these conditions.

[43] Frequency of public transport use was defined here as an ordinal categorical variable. The categories used were: 'Never', 'Once a month or less', '2/3 times a month', 'once a week', '2/3 times a week', 'every day/nearly every day'.

English Longitudinal Study of Ageing, Waves 4-7 (2008-15). Observations = 17,896. Full model output: Appendix B.6

5.2.2 Getting lifts from family and friends

None of the ADL/IADL measures have unique effects on the frequency of getting lifts form family and friends,

5.2.3 Driving a car

None of the ADL/IADL measures have unique impacts on whether a person drives a car or not.

5.2.4 Using taxis

Developing difficulty with eating, such as cutting up food, is associated with a decrease in the likelihood of using taxis. It might be that the development of a physical difficulty such as this, would make the physical aspects of getting in and out of taxis, paying the driver and so on, more challenging.

5.2.5 Using door-to-door community transport

Developing a difficulty with dressing, including putting on shoes and socks, increases the likelihood of using door-to-door community transport. Similarly, those who develop difficulty dressing (including putting on shoes and socks) are more likely to use door-to-door community transport than those that do not experience this issue. This result says something about the types of services that individuals are likely to be exposed to, given their general health and mobility.

5.2.6 Using transport provided by hospital / day centre / lunch club

Developing a difficulty in dressing, including putting on shoes and socks increases the likelihood of using transport provided by a hospital, day centre or lunch club. Again, developing difficulties dressing, including putting on shoes and socks, is related to an increase in the use of transport provided by one of these facilities, compared with those who do not experience this difficulty. This finding, and the reasons behind it, are similar to those for community transport.

Someone who requires daily assistance to complete daily tasks, such as getting dressed, is more likely to have regular visits from a carer and have greater access to adult social care services more generally. Once such services have been introduced, they are likely to form a gateway to other provisions, such as door-to-door community transport. This, in turn, is supported by the observation that use of this mode of transport is uniform among those who have difficulties with either ‘several’ or ‘all of’ the ADL/IADL tasks (93% in both cases).

5.2.7 Summary of findings from models

Overall, the models reported above indicate that difficulties with daily tasks have little explanatory power in predicting various travel behaviours, once the presence of health conditions and various demographic characteristics have been controlled for. It should be noted that this is the case when the impact of each difficulty is considered in

isolation; these models did not assess the combined impact of multiple difficulties. This finding contrasts with what we found from the comparable analyses presented in Chapter 4, which found that impairments - more broadly - have a significant bearing on travel behaviour. Furthermore, where significant effects on the use of public transport were found with respect to specific activities of daily living or other difficulties, these were relatively small. This therefore suggests that the wider measures of health and impairment previously explored have a larger role to play, than those derived in relation to specific difficulties, in impacting on the travel behaviour of the population aged 50+.

6 Mobility aids and travel behaviour

This chapter seeks to understand the prevalence of the use of mobility aids and the relationship between their use and travel behaviour. While the previous chapters have analysed direct measures of individual health (health conditions, impairments, and difficulties with daily tasks), this chapter focuses on what might be a potential solution to some of these problems, when travelling or moving around. It is therefore interesting to know how far use of mobility aids might remain problematic – that is, be associated with a decrease in travel behaviour.

The findings presented in this chapter are based on ELSA data. Specifically, this chapter examines whether the prevalence of the use of different mobility aids changes with age, and whether this is affected by the relationship between impairments and age. It explores whether the use of mobility aids has an impact on how frequently an individual may travel and the mode of transport they use.

6.1 How does the use of different mobility aids change with age?

Respondents to ELSA are asked to state which mobility aids they use. Table 6.1 presents a list of the mobility aids covered by the survey.[44]

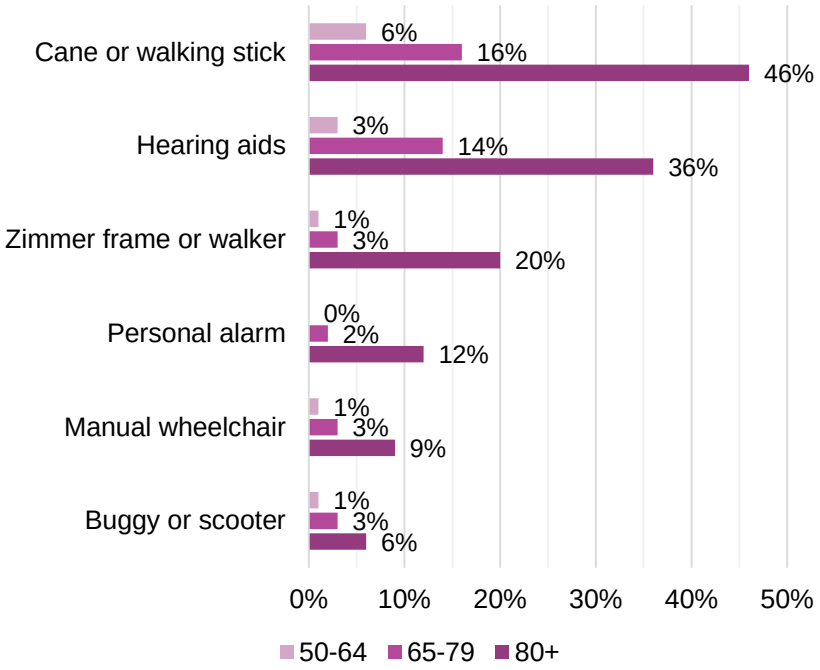
Table 6.1 Mobility aids covered by ELSA
A cane or walking stick
A Zimmer frame or walker
A manual wheelchair
An electric wheelchair
A buggy or scooter
A personal alarm
Elbow crutches
Hearing aids

In investigating the use of mobility aids amongst those aged 50+, the relationship between age and health – a key thread in the analysis presented so far – is once again apparent. As shown in Figure 6.1 below, the rate of uptake for each type of mobility aid increases by age group. Those aged 80+ are more likely to use mobility aids. This is perhaps unsurprising as previous chapters have shown how older members of the population are the most likely to have multiple health conditions and multiple impairments, and therefore are more likely to require the support that mobility aids may provide. For each mobility aid, the most marked change in prevalence of use occurs between the 65-79 and 80+ age groups. This is reflected in the fact that, in terms of the absolute number of mobility aids used, 93% of those aged 50-64 reported using no

[44] In the same bank of questions, ELSA also asks about the use of specialised eating utensils, however, these were not included as they were felt to be unrelated to transport use. It was felt any relationships between mobility aids and travel behaviour would be better picked up by the other aids in the list.

mobility aids, compared with 83% of those aged 65-79 and 41% of those aged 80+. Further details on the number of mobility aids used by age and sex are presented in Appendix A (Tables A.26 and A.27).

Figure 6.1 Use of mobility aids by age group [45]



English Longitudinal Study of Ageing, Wave 7 (2014-15). Individuals aged 50+, n = 8,152. Full Table: Appendix A.24

On a similar basis, women are more likely than men to use mobility aids. Almost one in five (17%) women aged 50+ use a cane or walking stick, compared with under one in seven (13%) men. Similar differences by sex were seen for the other types of mobility aids. These proportions are shown in Appendix A (Table A.25).

While it is possible to draw some basic conclusions from these findings, they do not tell the whole story. To do this, a multivariate analysis[46] was run to investigate the relationships between the type of mobility aid used and a set of wider factors including a range of health conditions, whether the individual is able to walk a quarter of a mile on a flat surface unaided (in the absence of a more standard measure of physical impairment) and a set of demographic characteristics including age, sex, work status, caring responsibilities, and location. The only types of aid for which this was not done were hearing aids, electric wheelchairs and elbow crutches. In the case of hearing aids, this was because use of this particular type of aid was only asked about in Wave 7 of ELSA. This meant that longitudinal analysis was not possible. Meanwhile, electric wheelchairs and elbow crutches were excluded due to the risk of bias resulting from the small proportion of people who use these types of aid. For all the other types of mobility aids, the results of the multivariate analyses are presented in Section 6.1.1 below. The specification of these models allows for relationships between health and mobility aids to be explored whilst controlling for different demographic characteristics.

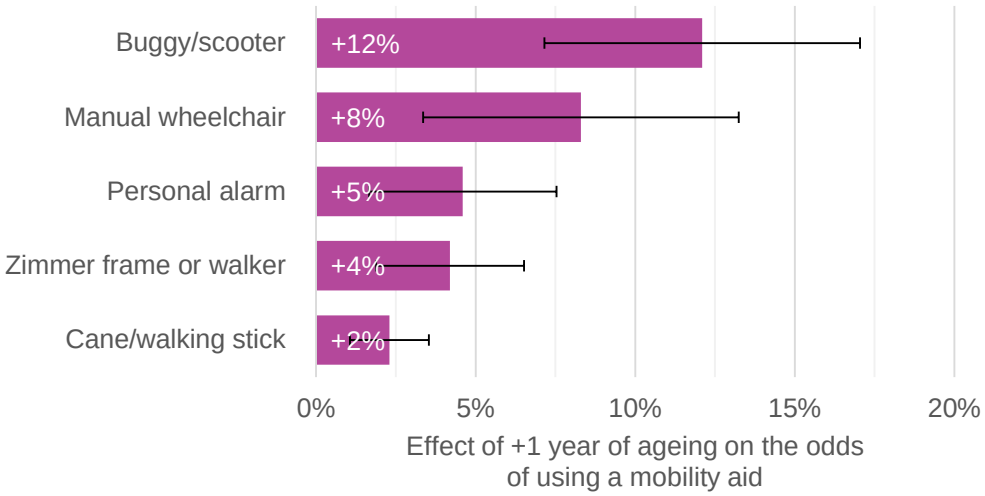
[45] Use of either electric wheelchairs or elbow crutches have been excluded due to small sample sizes.
[46] As before fixed effects regression models were used

6.1.1 Relationships between age, health and use of mobility aids

A separate multivariate analysis was run for each mobility aid listed in Table 6.1, except for hearing aids, electric wheelchairs and elbow crutches. The models suggest that age has an impact on the use of mobility aids, even after controlling for differences in health conditions and individual ability to walk a quarter of a mile on a flat surface. The impact of age is consistently the largest, when looking across all types of mobility aid. The likelihood of using mobility aids increases with each additional year of age, for all mobility aids. However, the effect is especially marked for the motorised aids such as buggies/scooters.

This is demonstrated in Figure 6.2, which shows the relationship between age and use of the different mobility aids. The full outputs of each model are provided in Appendix B (Table B.8). The figure shows the increased likelihood in mobility aid use that is associated with a respondent ageing by a year. The odds of using every type of aid were found to increase with each year of ageing. Someone aged 50+ ageing by a year is estimated as increasing the odds of using a buggy or scooter by 12%. The effect is significantly larger than for using a cane or walking stick, where becoming a year older increases the likelihood of someone using this type of aid by only 2%.

Figure 6.2 Effect of one year of ageing on the increased odds of mobility aid use [47]



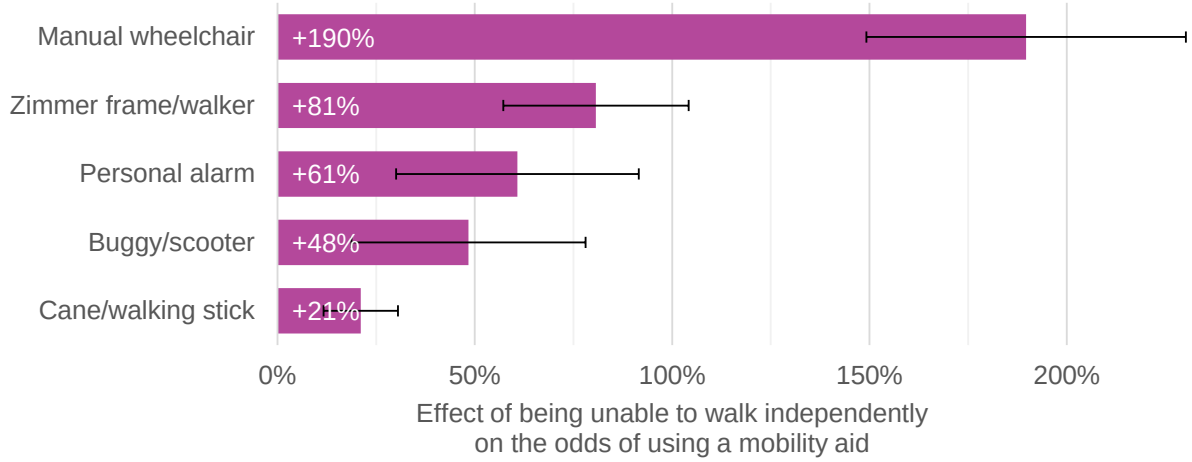
English Longitudinal Study of Ageing, Waves 4-7 (2008-15). Observations = 14,566. Full model output: Appendix B.8

As expected, being unable to walk a quarter of a mile on a flat surface also links to use of mobility aids. However, it is important to understand the relative impact that this measure has on the use of different mobility aids. Using the same approach as above, the impact of such reduced ability to walk independently on mobility aid use has been extracted from the models and presented in a single chart in order to show its relative impact on the use of mobility aids (Figure 6.3). The inability to walk a quarter of a mile on a flat surface is associated with an increase in the likelihood of using five of the

[47] The model underlying Figure 6.2 does not use 'age groups' as defined in other parts of the analysis. By using an individual's absolute age (e.g. 50, 51, 52) we are better able to quantify that effect of ageing by a year.

seven mobility aids asked about, and a particularly large increase in the likelihood of using a manual wheelchair (+190%), as we would expect.

Figure 6.3 Effect of being unable to walk independently on the increased odds of mobility aid use



English Longitudinal Study of Ageing, Waves 4-7 (2008-15). Observations = 14,566. Full model output: Appendix B.8

It should be noted that the measure of an individual's ability to walk a set distance over a flat surface provides no assessment of the other facets of impairment. Other impairments, such as sensory impairments, may have different impacts on the uptake of mobility aids, which will not have been accounted for in this analysis.

The analysis underlying Figures 6.2 and 6.3 also took account of any changes to an individual's demographic profile and whether they had developed any health conditions (full results in Appendix B.8). This found that a handful of health conditions are significantly associated with increased use of mobility aids. A diagnosis of arthritis, for example, is associated with an increased likelihood of using a stick or cane. The odds of someone who had been diagnosed with this condition using a stick or cane were found to be 73% higher compared with not having arthritis. Even considering the variation with which arthritis might present, this finding indicates the specific transport needs that an individual with this specific health condition has; they are more likely to have difficulty walking, standing, and are likely to find standing on moving transport difficult.

Similar conclusions can be drawn when considering those who have suffered from a hip fracture. The likelihood of someone in this group using a walking stick or cane are far higher (+121% increase in odds) compared with those without this condition. Equally, the likelihood of someone with this condition using a Zimmer frame or walker are far higher (+207% increase in odds), than for someone without this condition. Those who have experienced a stroke, meanwhile, are far more likely to use a manual wheelchair (+511% increase in odds), again, this indicates they will have specific transport needs, as they will require additional space for car use, ramps for public transport, and access for carers.

Interestingly, the onset of the health conditions identified above each had very specific impacts in terms of the specific types of mobility aids for which use increased (there was no impact on the use of other mobility aids). Therefore, when thinking about the additional access and space requirements which mobility aids might necessitate, it is

clear that this will need to be focused on an analysis by individual health conditions, given their impacts on mobility aid use are fairly distinct.

6.2 What are the relationships between use of mobility aids and travel behaviour?

The analysis presented so far in this chapter suggests that there are several key factors which influence whether an individual uses mobility aids. Chief among these are: an individual's age, their ability to walk independently, and whether they suffer from particular health conditions. The need to use a given mobility aid may make using some modes of travel more challenging than others; in this section we therefore examine the impact of mobility aid use on travel behaviour.

Multivariate analysis was undertaken to explore this issue further. Longitudinal models were used as these allow us to investigate the impact of change over time, in particular, they can be used to identify whether travel behaviour is associated with an individual starting to use a mobility aid. In addition to the explanatory variables incorporated in the models, use of a given mobility aid and the onset of individual health conditions, age, sex, region, employment status, and activities in the last month were also controlled for.

The models did not identify any association between beginning to use any of the seven mobility aids listed in Table 6.1 and the likelihood of driving a car, getting lifts from friends or family, using a taxi, taking door-to-door community transport, or using transport provided by a hospital/day-centre/lunch club. Only in the case of public transport is the use of a mobility aid found to be associated with how frequently an individual used that mode of travel. As shown in Figure 6.4, where individuals began to use any of the mobility aids listed, frequency of travel by public transport decreases. The only exception to this was elbow crutches, which had no impact.

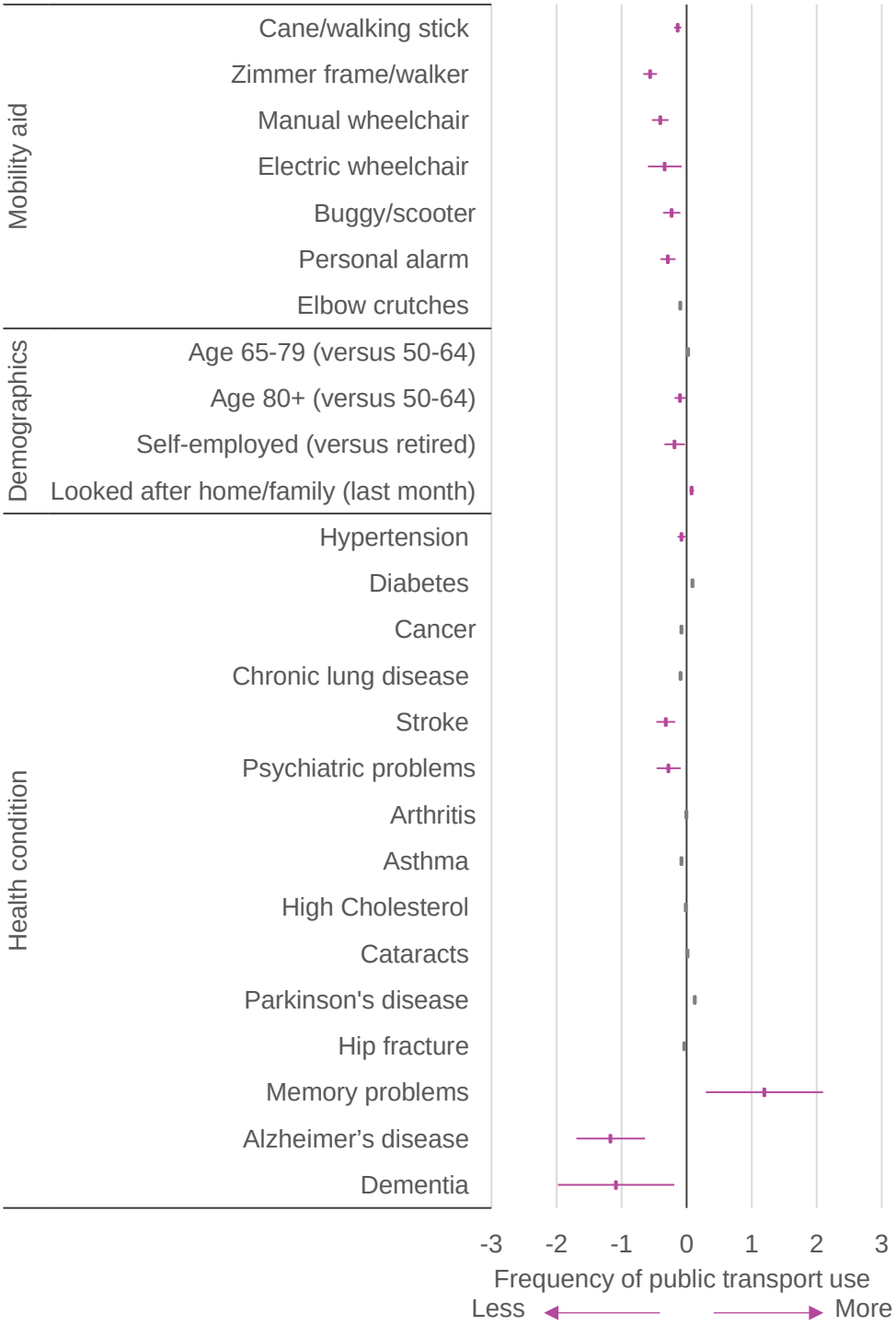
The mobility aid which has the largest effect on decreasing the use of public transport is a Zimmer-frame or walker, followed by a manual wheelchair, an electric wheelchair, a personal alarm, a buggy or scooter, and, finally, a cane or walking stick, which had only a minor impact. Each of these mobility aids is associated with a decreased frequency in public transport use.

The different sizes of the effects of using different mobility aids on public transport use outlined above can potentially be explained by the different impacts on accessibility of using different types of mobility aids. A walking stick, in and of itself, does not prevent an individual from using public transport. A bulkier mobility aid, such as a wheelchair or a Zimmer-frame, may present a wider range of issues. Not only does it suggest a higher level of impairment, it may also require special provisions to be made on public transport. Just as staff assistance, or a ramp, may be required to provide access, so too designated space may have to be provided to store the mobility aid while in transit.

Whilst newer forms of public transport, such as low floor buses and kneeling buses, can improve access, wheelchair users still face wider access issues. It may not be straightforward for a wheelchair user to reach the bus stop in the first place, or there may be issues with accessibility of ongoing modes of transport required to complete the trip. There may also be factors around convenience; train travel may be possible with a wheelchair, but help is required from platform staff, which often needs to be arranged in advance. In addition, the movement of train companies away from

providing on board supervisors may be viewed as a barrier. These factors may not in themselves prevent travel, but they make it more difficult.

Figure 6.4 Effect of starting to use mobility aids on frequency of public transport use [48]



[48] In a similar vein to the other multivariate analyses conducted, the full model controls for a range of demographic and health factors. All types of mobility aid, all age groups and all diagnosed health conditions are shown, in addition to significant categories of the employment status and recent activities variables.

English Longitudinal Study of Ageing, Waves 4-7 (2008-15). Observations = 14,566. Full model output: Appendix B.10

The government's Inclusive Transport Strategy sets out an ambition for disabled people to have equal access to transport with everyone else, with assistance if physical infrastructure remains a barrier, by 2030[49]. It encompasses a range of strategies around five main themes: awareness and enforcement of passenger rights; staff training; improving information; improving physical infrastructure; and ensuring that disabled people are taken account of in the design of future inclusive transport. It therefore recognises that a multi-faceted approach is needed to reduce such negative impacts, as those reported in relation to mobility aid use above.

Otherwise, the picture conveyed by evidence concerning the patterns of use of public transport is very similar to that found in the previous chapter of the report, focusing on the impact of difficulties with daily activities on travel behaviour. Where an individual develops a specific condition which impairs cognition, such as Alzheimer's disease or dementia, they tend to use public transport less frequently. Suffering a stroke, meanwhile, has a similar impact.

6.2.1 Summary of findings from the models

Those requiring mobility aids are theoretically more likely to have additional travel needs, in terms of requiring greater assistance or infrastructure when travelling. People who begin to use a mobility aid are less likely to use public transport than previously. This is evident for most mobility aids, but the impact is greatest for wheelchair users, both manual and electric, which are both more likely to be associated with greater access issues than a stick or personal alarm, for instance. There is no evidence that the use of mobility aids has an impact on the use of private transport modes, however.

[49] Department for Transport, Policy paper: The Inclusive Transport Strategy: achieving equal access for disabled people (updated October 2018), available at https://www.gov.uk/government/publications/inclusive-transport-strategy/the-inclusive-transport-strategy-achieving-equal-access-for-disabled-people

7 Self-reported health and travel behaviour

Previous chapters have focused on specific objective measures of health and potential difficulties with travel, (be they self-reported conditions, impairments or difficulties), and have sought to disentangle their relationships with travel behaviour. This chapter considers the more general cross-cutting measure of self-reported health. This more subjective measure captures people's overall assessment of their health or well-being, irrespective of the presence or otherwise of specific conditions or impairments. It explores the relationship between self-reported general health and travel behaviour for older people, considering interactions with having difficulty walking a quarter of a mile unaided and health conditions, using data from ELSA. It may be that this, more subjective, measure of health is a strong predictor of travel behaviour – in which case it could potentially be used to identify the sections of the population aged 50+ where particular changes in behaviour are likely to occur.

Respondents to each wave of ELSA are asked whether they would say their health is excellent, very good, good, fair or poor. 13% regard their health as excellent and 29% as very good. Individual health is perceived to be good, fair or poor by 32%, 18% and 8% respectively. The perception that one's health is excellent or very good declines with age; this view is held by 48% of people aged 50-64, compared with 38% and 25% of those aged 65-79 and 80+ respectively.

7.1 What is the relationship between self-reported health and travel behaviour?

A series of multivariate analyses were used to investigate the relationship between self-reported health and different aspects of travel behaviour that cover a range of different transport options; whether the individual uses public transport, whether they drive, the frequency by which they receive lifts from (non-resident) family or friends, whether they use door-to-door community transport and the frequency with which they use taxis. As in previous chapters, longitudinal models were used to understand how changes in an individual's self-reported health impact on their travel behaviour. These models are used to identify patterns in change over time. The models indicate whether a decline in self-reported health is associated with increased or decreased use of different travel modes.

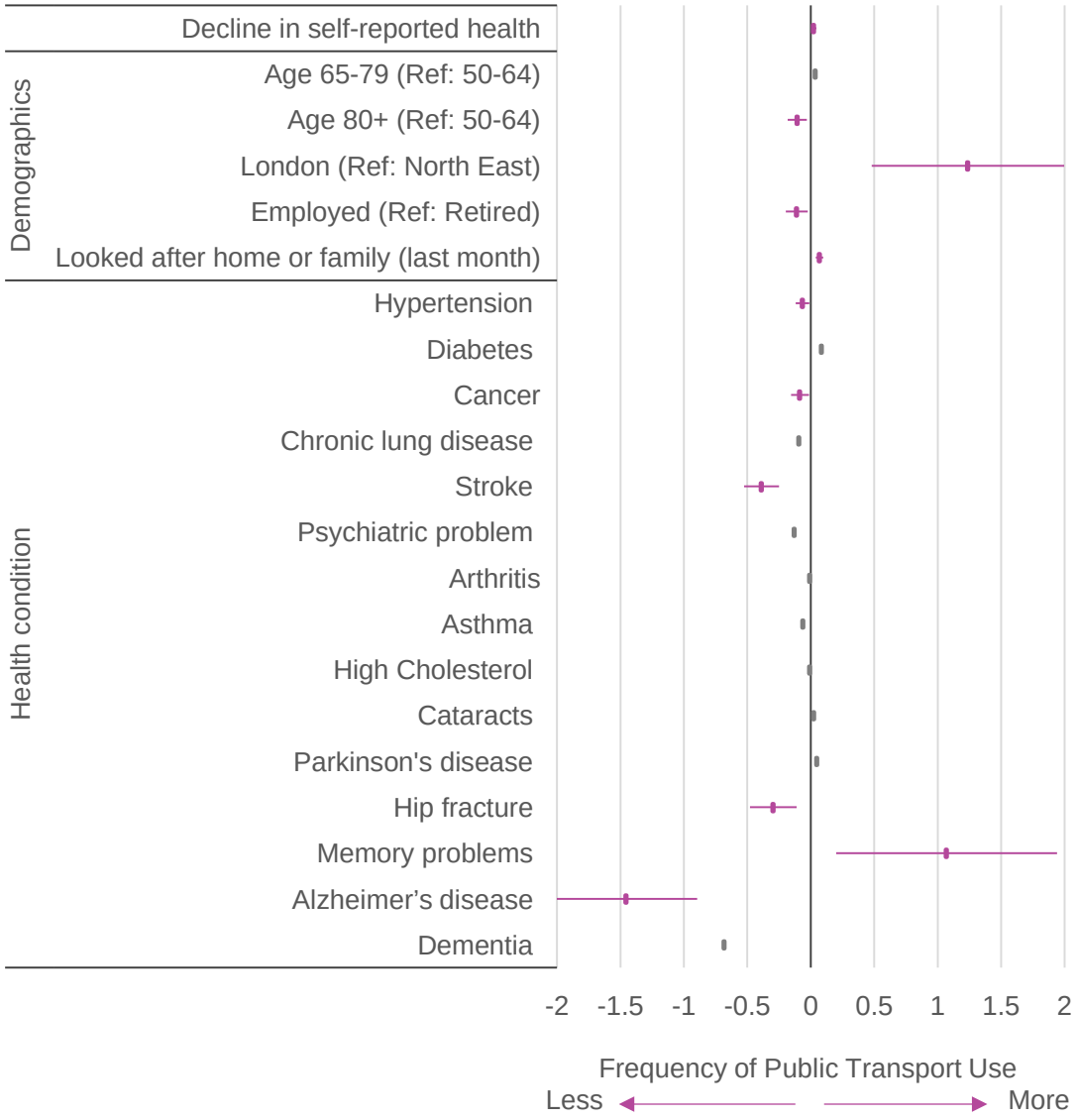
7.1.1 Use of public transport

The results of the analysis suggest that a unit decline in self-reported health is associated with greater use of public transport.[50] This being said, it should be noted that it is not possible to conclude from this analysis that the increased use of public transport is offset by an associated decrease in use of other forms of transport, specifically by a decrease in driving. As shown in Figure 7.1, the relationship between self-reported health and the use of public transport is also influenced by the different health conditions an individual is diagnosed with. This is because the effect of a decline

[50] A *unit decline* in self-reported health refers to a one unit decrease in the scale provided to each survey respondent to describe their health. The options in all but Wave 3 (where a modified scale was used) were as follows: 1. Excellent, 2. Very good, 3. Good, 4. Fair, 5. Poor. In Figure 7.1, the effect of a single unit decline in self-reported health is indicated. A two-unit decline would have twice the effect (and so on, to a maximum four unit decline in self-reported health).

in self-reported health is relatively small (albeit statistically significant). This means that the change in travel behaviour associated with a decline in self-reported health for someone with hypertension, will be different to the change in travel behaviour associated with the same change in self-reported health for someone with memory problems.

Figure 7.1 Effect of a decline in self-reported health on frequency of public transport use [51]



English Longitudinal Study of Ageing, Waves 4-7 (2008-15). Observations = 17,650. Full model output: Appendix B.11

The amount of change, and direction of change, in travel behaviour differs based on which health conditions the individual is diagnosed with. For people diagnosed with one of hypertension, cancer, a stroke, hip fracture or Alzheimer's Disease, these were

[51] Self-reported health was specified in the model as a continuous rather than a categorical variable. A decline in self-reported health from "best" to "worst", represents a four-point change (0 to 4 on the scale). The size of this effect would, therefore, be four times the magnitude of that indicated in Figure 7.1 for this variable.

found to be associated with a negative effect on the frequency of public transport use (compared with individuals who have not been diagnosed with one of these conditions). Conversely, the diagnosis of memory problems is associated with an increase in reported public transport use. However, due to the nature of this health condition (making it less likely that respondents will recall the frequency of their public transport use accurately), we may wish to apply some caution to this finding.

Ageing (in terms of the relative effect of moving from the 50-64 to 80+ age groups) was also found to have a negative effect on public transport use. This effect tends to offset any increase in public transport use associated with a decline in self-reported health. This finding contrasts with those made in *Disabled People's Travel Behaviour and Attitudes to Travel (2017)*,[52] which found that ageing among those without a disability was associated with an increase in the odds of using public transport more than once a month.

There a number of explanations as to why this could be the case. The most likely explanation is that it is due to the analysis here considering the frequency of public transport use, while the *Disabled People's Travel Behaviour* study only considers the odds of using public transport once a month or less. It is entirely feasible for the odds of using public transport less than once a month to decrease (i.e. use of public transport once a month or more increases), but for the average frequency of travel by public transport to decrease overall when all levels of use are considered. An alternative explanation would be that it is due to the different factors considered in each analysis. The inclusion of self-reported health in this analysis may, for instance, explain some of the effect on public transport use previously attributed to age.

Additional analysis presented in the Appendix (Table B.12)[53] indicates that there is a significant interaction effect between an individual's self-reported health and the number of conditions they suffer from. This suggests that the effect of a decline in self-reported health may be exacerbated by the number of health conditions a person is diagnosed with. As the number of health conditions increases, having an incrementally poorer perception of one's health was found to correspond to an increase in use of public transport. The relationship between a decline in self-reported health and increased use of public transport is therefore stronger for people with a large number of health conditions than it is for people with fewer conditions. The weakest relationship is seen for those without any health conditions.

7.1.2 Getting lifts from family and friends who do not live with the respondent

In Section 7.1 we saw that there is no relationship between self-reported health and the frequency of getting lifts from non-resident family or friends. While that appears to be the case in general, there is some evidence to suggest that the nature of the relationship between self-reported health and use of lifts from friends and family varies according to the specific health condition under consideration. People diagnosed with psychiatric problems tend to experience an increase in the frequency of receiving lifts as their self-reported health becomes more negative (see Appendix Table B.11). However, for people diagnosed with Alzheimer's disease, an increasingly negative assessment of one's health appears to induce a substantial decrease in receiving lifts

[52] Full report available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647703/disabled-peoples-travel-behaviour-and-attitudes-to-travel.pdf

[53] The additional analyses also considered the number of health conditions a person was diagnosed with. This was then included in the model alongside an interaction term between this variable and self-reported health. This indicates the simultaneous effect of declining self-reported health as the number of diagnosed conditions increases.

from non-resident friends or family.

7.1.3 Using transport provided by a hospital, day centre or lunch club

In addition, the models suggest a relationship between the diagnosis of specific health conditions and using transport provided by a hospital, day centre or lunch club. This indicates that people with cancer tend to increase their use of this transport provision (Appendix Table B.11). No statistically significant association between self-reported health and use of this mode of transport was found, however.

7.1.4 Other transport modes

The models did not identify any relationships between self-reported health and either driving a car, using taxis, or using door-to-door community transport.

7.1.5 Summary of findings from models

The measure of health used in this section is based on the respondent's own perception of their health. Changes in perception of health can therefore reflect genuine changes in health or be due to relative changes or changes in circumstances (for example, a partner's ill health may lead a respondent to reassess their own health).

The analysis indicated that people who perceive their general health to be in decline use public transport more frequently than previously. The analysis also suggested that this relationship is stronger for older age groups, hence a perceived decline in general health is more likely to be accompanied by more frequent travel using public transport if the individual is older (80+).

The relationship between self-reported health and use of public transport is modified by the respondent's health conditions. As the number of health conditions increases, having a poorer perception of one's health results in even greater use of public transport (the survey did not ask about specific types of public transport). This pattern was not seen for the other transport modes; for getting lifts and using transport provided by a hospital, day centre or lunch club we saw an increase in mode use with worsening self-reported health for only a minority of specific health conditions, while no relationship was identified with the frequency of driving a car, using taxis or door-to-door community transport.

There were also some patterns observed by health condition, where specific conditions (psychiatric problems) strengthened the relationship between a poor perception of general health and receiving lifts from family and friends, possibly as a result of greater dependency, whereas others (Alzheimer's) weakened the relationship, resulting in receiving fewer lifts.

8 Discussion

Previous research commissioned by the Department[54] identified a number of ways in which the travel behaviour of those with disabilities aged 50+ is distinct from the older population in general and warrants further investigation. Ageing in general is associated with more frequent public transport use, yet people with disabilities grow less likely to use public transport as they age. Older people with disabilities are also much less likely to report using various transport modes, particularly cars, as much as they would like. Across the board, people with disabilities in older age groups are more distinct from the non-disabled population than those in younger age groups. On the other hand, people with disabilities, including those in the older age groups, are clearly a diverse population – emphasizing the need to look beyond the broad category of 'disability' to focus on more narrowly defined health conditions and problems.

Arising from these findings, the overarching aim of this research was to generate a better understanding of the health problems of people aged 50+ and their impacts on the travel needs and behaviours of this population. Coupled with projections about the future age and health profile of the UK population, it was envisaged that this information would assist the Department in developing policy and strategies to improve access to and experiences of travel for older people in general, and those with health problems in particular.

Before discussing the key findings to emerge from this exercise, there are two cross-cutting themes that will inevitably influence future policy and infrastructure development. First of all, the population aged 50+ is highly heterogeneous in terms of its health - indicating that any strategy to improve the uptake and experiences of travel for this group would need to be highly nuanced and to focus on particular typologies or segments of need. Second, despite this diversity, on each of the five measures of health examined in this report, we found that the prevalence of 'poor' health increases markedly with age – meaning that policy is likely to need to focus in particular on the older segments of the population aged 50+ at any given point in time. In particular, the prevalence of health problems appears to increase most markedly between the groups aged 65-79 and 80+; this is the case for impairments, difficulties with daily activities and mobility aid use, while the prevalence of health conditions changes most markedly between the 50-64 and 65-79 age groups (and self-reported health declines steadily across these age groups). This supports the findings of the previous research, which concluded that older people with disabilities are more distinct from their non-disabled counterparts, than is the case for younger populations. Accepting these over-arching trends, we next consider cross-cutting themes to emerge in terms of the impacts of the health of this population on their travel behaviours.

8.1 Which aspects of health have the greatest impacts on travel behaviour?

Of the five dimensions of health examined, we found that the development of impairments or disabilities has the most substantial and wide-ranging impacts on travel behaviour. We considered the impacts of 11 discrete impairments[55] on four different travel behaviours - the frequency of travel by car, bus, train and bicycle. Of a possible 44 impacts, we found that individual impairments impacted on travel behaviour in 33

[54] Full report available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647703/disabled-peoples-travel-behaviour-and-attitudes-to-travel.pdf

[55] The 11 impairments measured were: mobility; lifting carrying or moving objects; manual dexterity; continence; hearing; sight; communication or speech problems; memory or ability to concentrate learn or

instances. In particular, impairments associated with mobility, lifting, dexterity, memory, physical co-ordination, and difficulties with personal care impacted on all four travel behaviours.

This finding suggests that it is the physical ability of an individual to move, balance, hear, and so on, that affects their access to and use of transport, rather than underlying health conditions that might comprise these elements. However, the severity of an impairment was also found to be important. With the exception of a hearing impairment (where the most severe level was found to have a positive impact on bus use with other levels having no impact), some more severe impairments were associated with reductions in travel (for example having a severe impairment relating to personal care was associated with reductions in car, bus and train use, while a severe impairment relating to communication had no discernible impacts).

Underlying health conditions and combinations of health conditions were found to have fewer impacts on travel behaviour than impairments across the board, with impacts only observed in a small minority of instances. Nevertheless, developing cancer or clinical depression in isolation, 'arthritis, cancer and clinical depression' in combination or 'hyperthyroidism plus' are associated with an increase in the distance driven by car, while the development of asthma and diabetes are associated with a decrease in bus travel and an increase in bicycle travel respectively.

The development of difficulties with daily tasks had more limited impacts on travel behaviour, which were less pronounced than those discussed above. With the exception of public transport use, the experience of using a mobility aid or having a declining perception of one's own health were not found to have any unique impacts on travel behaviour.

These findings suggest that the development of future transport policy for the population aged 50+ should focus on the likely future prevalence and severity of various impairments, to identify where policy and infrastructure change is needed – concentrating on impairments associated with mobility, lifting, dexterity, memory, physical co-ordination and difficulties with personal care, where travel impacts were observed across the board.

8.2 What is the nature of the impact of health on travel behaviour?

We can consider the nature of the impact of health problems on travel behaviour in a number of different ways: firstly, whether health problems impact on all forms of transport or only on particular modes, secondly whether they tend to produce an increase or decrease in travel (or simply the abandoning of one mode in favour of another – termed 'mode replacement').

8.2.1 Impact on different transport modes

Public transport

Health problems are most likely to impact on the use of public transport – and, in general though not universally, to relate to a decline in its use.

Such impacts were identified in relation to all five measures of health considered. We found that, with the exception of a severe hearing impairment leading to an increase in bus travel, where impacts were found in relation to bus or train travel for all other levels of impairments, these were associated with a reduction in mode use. In terms of health conditions, while most conditions or combinations of conditions had no impact, developing asthma led to a decrease in bus use, while developing asthma in conjunction with another breathing condition and/or high blood pressure conversely led to an increase in bus use. Developing arthritis led to an increase in train travel. While there is an apparent contradiction here (with some health conditions being more likely to be associated with an increase in public transport use and impairments almost universally with a decrease), it is important to remember that the impact of health conditions in this area was very limited, with impairments having more wide-ranging impacts.

Where difficulties with daily tasks were found to impact on public transport use, they were associated with less frequent use: this was the case for a number of difficulties with daily tasks that were primarily physical in nature – for instance, difficulty walking across a room is associated with public transport being used less frequently.

When individuals begin to use any mobility aid (with the exception of crutches), the frequency of travel by public transport decreases. This decrease is most marked for the use of a Zimmer-frame or walker. A decline in self-reported health is associated with greater public transport use; however, when the development of health conditions is considered, these appear to mediate this relationship. For people diagnosed with one of hypertension, cancer, a stroke, hip fracture or Alzheimer's Disease, a decline in self-reported health appears to reduce public transport use.

These findings suggest that, when seeking to address travel difficulties for those with health problems aged 50+, public transport in general, and buses in particular, need to be a primary area of focus. Addressing difficulties with these modes of transport would have the most wide-ranging impacts on the travel experiences of this population.

Car use

Health problems had fewer and more diverse impacts on car use – whether measured in terms of distance driven by the respondent or frequency of car travel as a driver or passenger

For the frequency of travelling by car (as a driver or passenger), most levels of different impairments appeared to exert a negative effect or, at best, no influence on the frequency of use of this mode. It appears the development of impairments is limiting individuals' ability or desire to travel by car. For health conditions, on the other hand, the greatest number of impacts were found in relation to the distance driven by car; developing cancer or clinical depression in isolation, 'arthritis, cancer and clinical depression' in combination or 'hyperthyroidism plus' are associated with an increase in the distance driven by car. Clearly, there is some contradiction between this finding and those relating to impairment; it may be that individuals with these health conditions travel by car for a smaller number of longer journeys, perhaps required by treatment. Indeed, the absence of any impacts of health conditions (with the exception of the increase associated with the 'HBP and diabetes' cluster) on the frequency of car travel, imply that the impacts of health problems primarily relate to the distance driven by the individual rather than their frequency of travel (albeit as a driver or passenger).

It is interesting to note, however, that as the number of health conditions experienced by an individual increases, car travel becomes less frequent – reflecting our finding in

relation to more severe impairments being associated with a decline in the use of this mode. In a similar vein, developing additional health conditions relates to driving shorter distances, compared with individuals who maintain the same number of health conditions over time. However, having no health conditions at all also relates to driving shorter distances. This suggests that the largest distances are being driven by individuals with a single, stable health condition, rather than individuals with no health conditions, or who have developed additional health conditions. Taken together, these findings imply that car use may be problematic primarily for those with more severe impairments or a greater number of health conditions – and that this population should be targeted in any work undertaken to address issues with travel in this area. The characteristics of this population might suggest that the development of autonomous vehicles is an avenue worth exploring – given they are likely to have multiple difficulties in accessing standard vehicles.

Other transport modes

Impacts relating to other transport modes, such as bicycles, taxis or community transport, were isolated, rather than occurring across the board – and were only associated with specific health conditions, combinations of health conditions, impairments or difficulties with daily tasks. Diabetes is the only health condition which was found to have an impact on bicycle use, being associated with a decline in use. On the other hand, a number of mild forms of impairments were also associated with a decline in bicycle use, although these relationships were fairly weak in most instances. In the small number of instances where the development of difficulties with daily activities impacted on taxi use, they are associated with less frequent use. However, developing difficulties with dressing increased the likelihood of using door-to-door community transport and hospital transport – reflecting the population segment at which these services are targeted.

Fundamentally, then, reducing barriers to the use of these transport modes are unlikely to have widespread impacts on the travel behaviour of those aged 50+ with health problems – especially given that the numbers of older people using these modes of transport are small.

8.2.2 An increase or decrease in travel or mode replacement?

As noted above, with the exception of travel behaviours associated with car use or forms of transport targeted at the elderly (such as community transport), the development of health problems tended to lead to a reduction in the use of different transport modes. Importantly, however, there is little evidence of individuals reducing the use of one mode and replacing it with another. The one instance where such ‘mode replacement’ is evident is in relation to those with a severe hearing impairment, who appear to replace car use with bus use. For most groups, however, it appears that the development of health problems may lead them to reduce the frequency of their travel overall, although there is some evidence that certain groups make longer car journeys. It should be noted, however, that data was not collected in relation to walking – so potentially individuals may now be walking where previously they had used other forms of transport – although this is obviously more likely for certain health conditions than others.

There is some evidence to suggest that the development of certain health problems necessitates a greater quantity of travel; we found that developing cancer or clinical depression relates to a greater distance being travelled by car (although not to more

frequent car journeys), compared with those who do not develop each condition (possibly as a result of the requirement to travel for treatment).

The changing nature of travel behaviour as a result of health problems (both in terms of the quantity of travel and the range of transport modes used) is therefore highly complex and condition or impairment-specific. Linking to previous research conducted by the Department which found that older people with disabilities tend to travel less than they would like, it is also important to consider, for those with specific health problems, how far travel behaviours reflect individual preferences (and to what extent they are inhibited by barriers to access and so on). For instance, the onset of certain health problems are likely to make individuals less inclined or willing to travel, due to greater tiredness for example. Where individuals reduce their use of a particular transport mode (but wish to maintain their current levels of travel), further work is needed to discern whether adaptations can be made to that transport mode, or whether their preference would be to travel by an alternative (adapted) mode. Such evidence is needed to establish where policy and infrastructure development should best be focused (e.g. in response to individual preferences for travel and mode use following the onset of health problems).

8.2.3 Summary

The picture painted by this report of the relationships between health problems and travel behaviours among the population aged 50+ is highly complex and nuanced. Nevertheless, it yields a number of indications as to where policy and infrastructure development could have the greatest impact on the future abilities of this population to engage with travel – namely development that focuses on sub-populations defined by impairment type, that is geared in particular towards the oldest population segment (aged 80+) and which concentrates on public transport use in general (and bus use in particular).

Health problems, and consequently their impacts on travel behaviour, increase markedly with age, suggesting that the older segments of this population should be a particular focus. This supports the findings of previous research, which found that older people with disabilities were much more distinct from the general population than their younger counterparts. Clearly then, more ‘bespoke’ strategies are needed to address the travel needs of those aged 80+ in particular.

When seeking to predict how health problems will affect travel behaviour in the future, it is clear that the most effective analysis will be around the future prevalence of different impairments (and their severity) – as these characteristics are associated with the greatest number and range of impacts on travel behaviour, even once their relationships with a range of other health-related and demographic characteristics have been controlled for. Clearly, the most diverse, consistent and potentially problematic (in terms of being associated with a decline in use) impacts are occurring in relation to public transport in general (and buses specifically), suggesting that future developments should be targeted at this mode in particular. Finally, it should be considered why individuals are changing their travel behaviour and the extent to which it reflects their preferences – in order to establish which experienced impacts are directly at odds with the wishes of individuals – and should therefore be the target of future policy development.

9 Research gaps

In common with all secondary analysis projects, our ability to answer the research questions set out in Section 2.1 has been inhibited to some degree by the design of the two social surveys selected for analysis for this purpose – in terms of both sampling and question coverage. The general limitations of each of the survey instruments analysed have been set out in Section 3.1. Specific to the research aims of this project, in terms of sampling, these include:

- The fact that both surveys cover private households only, meaning our findings cannot be applied to those in residential care settings (the proportion within these settings is higher for older age groups, particularly those with health problems[56]); and
- The fact that our topic of interest (health) is related to individuals' propensity to participate in social surveys. Individuals with better health might be more likely to wish to, or have the cognitive abilities, to participate in social surveys – meaning that our findings are likely to relate to samples that are 'healthier' than the average population aged 50+ (although weighting will have addressed such sample bias to some extent). This is particularly an issue for ELSA, as the longitudinal nature of the study and the provision of data on health measures to respondents, is likely to make the sample atypical in terms of its level of awareness regarding health.

In terms of question coverage, limitations include:

- The fact that survey response requires recall, which may be more or less accurate for different respondents. This is a problem inherent in survey research – but which will have a greater impact on an older population including a larger proportion of respondents with memory difficulties. Further, it means that we have to apply a degree of caution to those findings relating to those respondents who report having problems with memory – as their recall (of the frequency of their travel, for example) will necessarily be less accurate.
- The fact that income data wasn't consistently and continuously collected across both surveys, and the lack of variation over time on this characteristic, led to the decision to not include this measure in the analysis of the relationship between health problems and travel behaviours, as detailed in Section 3.2.
- The fact that the two surveys asked questions about the same topics in slightly different ways (in terms of the range of health conditions experienced and the frequency of mode use for example) makes it difficult to precisely compare results for health conditions and impairments (obtained from Understanding Society), with those for difficulties with daily activities, mobility aid use and self-reported health (obtained from ELSA). Specifically, Understanding Society does not include dementia or Alzheimer's disease in the list of health conditions that respondents are asked about, although memory problems are included in its list of impairments. This means that we could not analyse the impact of these two conditions on travel behaviour for the Understanding Society analyses, in the same way as we could for the ELSA analysis, as ELSA asks about the two conditions specifically, as well as memory problems more generally. Consequently, we are less able to draw a coherent picture of the impacts of these two conditions from across the two

[56] Official statistics based on the 2011 Census show that, in 2011, 3.2% of the usual resident population in England and Wales aged 65+ were resident in care homes. This proportion rises from 0.6% of those aged 65-74, to 13.7% of people aged 85+ although, for all groups, it has declined since 2001. These data are available at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/articles/changesintheolderresidentcarehomepopulationbetween2001and2011/2014-08-01 (Table 1).

surveys, than we were for other health conditions such as arthritis for example. Conversely, Understanding Society includes more detailed questions on travel behaviour than ELSA, for example differentiating between bus and train travel, while ELSA asks about public transport use in general, and also asks about more specific aspects of car ownership and use. This enabled a more detailed analysis of travel behaviours for Understanding Society data than was possible for ELSA, and consequently limited comparisons between the findings of the two surveys. While the coverage of specific issues by different surveys will tend to diverge, because of the distinct research questions they are trying to answer, any attempts to standardize survey questions around health, for example, would inevitably be of benefit to analyses involved multiple surveys.

- Furthermore, these two surveys did not collect data on a range of measures that would have allowed us to further contextualize and interpret our findings. Neither of the surveys measures the frequency of journeys undertaken on foot, specifically, making it impossible to analyse whether a reduction in mode use resulted from 'mode replacement' (with more journeys being undertaken by foot) or led to less travel overall. While respondents to Understanding Society and ELSA were asked how often they travelled using various transport modes, they were not asked how often they wished to do so using each mode. We cannot therefore be certain that the observed increases and decreases in the use of particular modes were a consequence of them having to reduce or change mode use due to accessibility difficulties resulting from their health problems. It may be that certain health problems made respondents less inclined to travel – or conversely to require further travel (such as that required for medical treatment). We cannot therefore be clear to what extent changes in mode use reflected respondents' underlying preferences – and so to what extent changes in behaviour might be regarded as 'problematic'.

There are two potential ways in which we would recommend addressing this research gap in the future:

- Qualitative research with individuals with specific health problems who had increased or decreased their use of particular modes would enable us to explore the mechanisms and decision-making processes associated with changes in mode use and the extent to which individuals regard these changes as problematic. It is likely that a range of factors and considerations underpin behaviour change, and in-depth qualitative research would extend our understanding of their range and links, as well as indicating how me might frame and measure these in a social survey context in the future.

Given the relatively strong and consistent relationships between impairments and travel behaviour identified, we would recommend including a question, ideally to be standardized across different survey instruments, recording respondent impairments on other surveys which explore the topic of travel behaviour in greater detail than do Understanding Society and ELSA (which both have a wide-ranging topic coverage). For example, a question included on the Life Opportunities Survey (and analysed as part of the previous DPTAC research) asked respondents whether they travelled by particular modes as much as they would like; analysis of responses by impairments would have yielded useful contextual information regarding the extent to which changes in mode use identified by this project were problematic and could potentially be addressed. Alternatively, we would recommend considering including a question measuring respondent impairments on the National Travel Survey, given the wealth of data collected around travel behaviour; this would enable us to undertake analysis regarding a much wider scope of travel behaviours and attitudes than those covered in this report (for example, on the extent to which those with different impairments encounter specific travel difficulties and how these might link to the number of trips taken).