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Corran, P; Steinbach, R; Saunders, L; Green, J (2018) Age, disability and everyday mobility in London: An analysis of the correlates of non-travel in travel diary data. *Journal of transport & health*. ISSN 2214-1405 DOI: <https://doi.org/10.1016/j.jth.2017.12.008>

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DOI: [10.1016/j.jth.2017.12.008](https://doi.org/10.1016/j.jth.2017.12.008)

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## Journal of Transport &amp; Health

journal homepage: [www.elsevier.com/locate/jth](http://www.elsevier.com/locate/jth)

# Age, disability and everyday mobility in London: An analysis of the correlates of ‘non-travel’ in travel diary data

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## ARTICLE INFO

### Keywords:

Ageing  
Disability  
Urban  
Health  
Mobility

## ABSTRACT

Maintaining everyday mobility is important for health at older age. This paper explores one indicator of lack of mobility: not leaving the home on a particular day, which we term ‘non-travel’. We used travel diary data from London residents between 2005 and 2015 to identify the correlates of non-travel for adults. Rates of non-travel were associated with: female gender, unemployment, lack of access to a car, lack of travel concessions, increasing age, disability and being retired. In a logistic regression analysis, older age was independently associated with non-travel, with those aged 60–69, 70–79 and over 80 more likely than working age adults (odds ratios 1.76; 2.18; 3.88 respectively) to report non-travel than working age adults. London faces similar problems to other global cities, with an increasing older population, and policy obligations to shift further from private car based transport to public and active modes. This study has demonstrated that declining levels of mobility at older age in London are not due solely to leaving the labour market or to disability, and that the availability of transport helps reduce, but does not entirely mitigate, the barriers of older age and impairment. To ensure that cities are as health-promoting as possible, more attention is needed to guarantee transport systems foster mobility at older age.

## 1. Introduction

### 1.1. Ageing, mobility and health in urban environments

By 2060, people aged 60 or over will make up 22% of the global population, and will outnumber children under the age of 14 for the first time (World Health Organization, 2007). Not only will the world's population be older, it will be more urban. By 2050, two thirds of the world's population are forecasted to live in cities (United Nations, 2014). In the UK, adults aged 65 or over will account for 23% of the population by 2035 (ONS, 2012). The increase in life expectancy, however, has not been accompanied by a rise in ‘disability-free life expectancy’ (ONS, 2014). In the National Travel Survey, 12% of people in England aged 60–69 and 31% of those over 70 reported mobility difficulties (difficulty travelling by foot or bus) (Department for Transport, 2014). More people are living with long-term health conditions and disabilities which affect their ability to travel and be mobile outside of the home.

Mobility is important for health. This paper focuses on one particular aspect of mobility: everyday travel outside the house. As

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<https://doi.org/10.1016/j.jth.2017.12.008>

Received 7 June 2017; Received in revised form 17 October 2017; Accepted 20 December 2017

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Metz (2000) highlights, these ‘short distance and high frequency movements’ outside of the permanent home are the priority for older people, as opposed to larger scale mobility such as residential relocation or international migration. The health benefits of this everyday mobility have been well documented (e.g. Boniface et al., 2015; Mackett and Thoreau, 2015; Musselwhite et al., 2015). First, in terms of directly contributing to physical activity, most non-car travel entails some ‘active travel’, thus contributing to obesity reduction and other physical health benefits (Saunders et al., 2013; Webb et al., 2012). Indeed in London, like many other cities, travel is a key source of physical activity for many residents (Fairnie et al., 2016). Second, travel facilitates social inclusion. For older adults, social exclusion is a major potential determinant of health, with isolation associated with increased risk of all-cause mortality (Holt-Lunstad et al., 2010), decreased immune system efficacy (Bernard, 2013), and increased risk of cardiovascular disease (Stephoe et al., 2013). More generally, there is a large and persuasive body of evidence documenting the psychosocial benefits of mobility in later life, beyond those derived from the instrumental role of transport in facilitating accessibility (Ziegler and Schwanen, 2011). Access to the public spaces of the city can have a ‘therapeutic quality’, and be important for fostering a sense of place, belonging and wellbeing (Cattell et al., 2008). These public spaces can include the transport system itself, with buses identified as a means of tackling chronic loneliness or isolation by providing a space where opportunistic social interaction is acceptable for older adults (Green et al., 2014).

Thus transport systems themselves have a role to play in facilitating or inhibiting the wellbeing consequences of mobility at older age, with accessible public transport having the potential (in cities) to foster physical activity and interaction, and to mitigate the loss of mobility risked by older citizens who have to give up give up driving (Mackett, 2015). Free bus travel in England for older citizens has been identified as effective in reducing risks for obesity (Webb et al., 2012) and fostering social inclusion (Green et al., 2014). The relationship between mobility and health is not, of course, unidirectional: declines in wellbeing can combine with limitations in mobility outside of the home to create a downward spiral for an individual (Ziegler and Schwanen, 2011). Ageing itself has therefore been seen as a key risk for declining mobility, with potential for contributing to reduced quality of life at older age (e.g. Metz, 2000; Musselwhite et al., 2015; Schwanen and Páez, 2010; Schwanen et al., 2012). However, this link is not inevitable: everyday mobility might be used as an explicit mechanism for structuring life after the transition from work to retirement, and thus contributing to wellbeing (Berg, 2016). Given the importance of mobility to health and wellbeing in later life it is important that we understand the different factors which may be associated with increased or decreased propensity to be mobile in urban environments.

### 1.2. The setting and policy context

London provides a useful case study for studying the impact of older age and disability on urban mobility. By 2035, there will be just over 750,000 Londoners over the age of 75, an increase of over 290,000 from 2015 (GLA Intelligence Unit, 2016). Accompanying this increase will be a rise in Londoners experiencing a long-term health condition or disability. Currently, 37% of Londoners over the age of 65 report disability, accounting for 45% of disabled London residents (Transport for London, 2014). By 2031 it is estimated that there will be an additional 150,000 people in London reporting ‘reduced mobility’ (that is, some kind of disability), bringing the total to over 1 million. (London Councils Transport Environment Committee, 2015). There have been calls for more evidence on what can improve mobility in later life, an endeavour which must scrutinize the role of transport systems (Musselwhite, 2015). Barriers to mobility at older age identified in the literature include inability to drive or access to a family member who can drive (Green and Lakey, 2013; Nordbakke, 2013), giving up driving (Davey, 2007; Mackett and Thoreau, 2015), and financial constraints (Rantakokko et al., 2012). Older citizens in London are, theoretically, less vulnerable to these constraints: car ownership and use is lower than elsewhere in the country, and there is relatively good access to frequent public transport services, which is free at the point of use for older adults. Over 90% of London’s population live within 200 m of a bus stop (Mayor of London, 2010), and public transport use is widespread and less stigmatised than elsewhere (Green et al. 2014).

Nevertheless, car use is still prevalent, with 57% of Londoners aged 65–69 and 22% of those over 80 reporting driving at least once a week (Transport for London, 2014). Further, in general, older residents of cities in both higher and lower income countries report that they do not feel their cities were designed with older people in mind (World Health Organization, 2007). Global initiatives such as the World Health Organization’s ‘Age Friendly Cities’ aim to improve conditions for urban older adults. These initiatives are underpinned by an important point – age and mobility must be considered in relation to the relevant social and built environments. The ability of older people to use different types of transportation and be more or less socially included (two important measures of age-friendliness) will differ according to their sociodemographic characteristics and will thus influence how mobile (and potentially how healthy) they are. This study aimed to contribute to our understanding of mobility in an urban context by identifying which factors might be associated with ‘non-travel’ in London.

## 2. Methods

### 2.1. Data source

We utilise the London Travel Demand Survey (LTDS), which measures respondents’ travel for one day, to model associations between non-travel and sociodemographic and transport related characteristics. The LTDS is an annual survey capturing information about the travel behaviour of Londoners. It is conducted on a rolling basis and is administered by trained interviewers. The annual sample is around 8000 households, stratified to yield 250 households for each of the 32 London boroughs and the City of London. Data is collected about the household, each individual in the household over the age of 5, and the trips they respectively made on the survey day.

## 2.2. Outcome variable; 'non-travel'

We focus here on 'non-travel', as one indicator of mobility. We created the dependent binary variable 'non-travel' by assigning a value of one to all respondents who did not leave the house (did not travel) on a particular day, even for a short walking trip. All respondents who embarked on at least one trip were assigned a value of zero. The LTDS includes respondents who were 'absent' on the travel day. These are respondents who were outside of the area covered by the survey on the recorded day, either by travelling outside of it on the day itself or remaining outside of it from a previous trip. Since these people were away from their homes for the survey day, our analysis included them as having travelled.

## 2.3. Sociodemographic variables

In the LTDS respondents self-select ethnicity from UK 2001 Census categories. For this analysis, ethnicity was collated into seven categories ('White British', 'White Other', 'Mixed Heritage', 'Indian', 'Pakistani and Bangladeshi', 'Black African/Caribbean/British', and 'Other Ethnic Background'). Household income, recorded in ten categories, was recoded into quartiles for this analysis: '< £14,999', '£15,000-£24,999', '£25,000-£49,999' and '£50,000+'. Since our focus was on later life, respondents under the age of 18 were excluded from the analysis. Age was then split into five categories: 18-49, 50-59, 60-69, 70-79, and 80+ to approximate different stages in the life course, and distinguish between the 'young' and 'old' old. (Alsnih and Hensher, 2003).

Employment status was recoded into seven categories: 'full-time employed', 'part-time employed', 'self-employed', 'in education', 'unemployed/unable to work', 'retired', and 'other economically inactive'. Household composition was measured using a variable with five categories: 'couple with children', 'couple without children', 'lone parent', 'single adult' and 'other'. This was created from a six-category variable in the dataset which additionally contained a category called 'single pensioner' which was incorporated into the 'single adult' category to avoid collinearity with age variables.

We constructed a single binary variable 'Disability' (yes/no) from whether a respondent answered 'yes' to having a disability or long-term health condition affecting their daily activities or ability to travel and get about.

## 2.4. Transport related variables

This analysis included two car-related variables: whether the household owned or had access to a car, and whether the individual held a driving licence. Responses to questions on different types of driving licence (car, motorcycle, minibus etc.) were combined into one binary measure (has/does not have a driving licence). To capture access to public transport, we included receipt of travel concessions, and whether residence was in Inner or Outer London. Inner London has a population density over twice as high as Outer London (London Data Store, 2014), and (in general) higher transport connectivity (Mayor of London, 2014).

## 2.5. Analysis

To maximise sample size, LTDS waves from 2005 to 2015 were combined. Cases with missing data for any variable in the model were excluded from the analysis, along with respondents under 18, leaving a sample of 123,562. Person level survey weights were used to ensure that the sample was representative of the wider London population. These weights make the survey representative for each year by using data derived from the Census and mid-year Greater London Authority population estimates (Fairnie et al., 2016). Analyses allowed for the stratification of the sample by London borough.

We used logistic regression to model the association between 'non-travel' and socio-demographic and transport related characteristics. The dependent variable was a dichotomous measure of whether the individual travelled on the survey day or not. The model included all independent variables available in the LTDS that were, on the basis of existing literature, assumed a priori to potentially have an association with 'non-travel'. The model included individual terms for year, month and day of the week to account for fluctuations in 'non-travel' rates over time. To further explore the relationship between age and 'non-travel,' sensitivity analyses examined interaction effects between age and disability, household structure, travel concessions and location. We assessed the joint significance of the interaction effects between age and all chosen variables using Wald tests.

## 3. Results

### 3.1. The meaning of non-travel

In a free text box, survey respondents were given the opportunity to provide a reason for their non-travel. These replies suggest both the diversity of reasons for not leaving the house, and also the limitations of single day diaries for capturing limited mobility. They include some that suggest non-travel days were atypical, such as "Lazy day - playstation", and "entertaining visitors during Ramadan". Others, however, did suggest that non-travel on the survey day reflected longer term mobility issues: "Hardly ever go out", "Husband passed away not going out much" and "No driver to take [me] out".

### 3.2. Descriptive analysis: Who stays at home?

Non-travel in London is socially patterned (Table 1). On average 16% of Londoners did not leave the house on any given day.

**Table 1**  
Percentage of non-travelling respondents by demographic factors.

Variable	Characteristic	Did not travel (%)	p Value
<b>All respondents</b>		16%	
<b>Income</b>	£0-£14,999	24%	< 0.001
	£15,000-£24,999	17%	
	£25,000-£49,999	13%	
	£50,000 +	22%	
<b>Gender</b>	Male	14%	< 0.001
	Female	18%	
<b>Employment Status</b>	FT Employment	9%	< 0.001
	PT Employment	12%	
	Self-Employed	12%	
	In education	17%	
	Unemployed/Unable to work	29%	
	Retired	29%	
	Other economically inactive	23%	
<b>Location</b>	Inner London Residents	16%	0.170
	Outer London Residents	16%	
<b>Age</b>	18–49	13%	< 0.001
	50–59	15%	
	60–69	19%	
	70–79	26%	
	80 +	44%	
<b>Ethnicity</b>	White British	15%	< 0.001
	White Other	14%	
	Mixed Heritage	15%	
	Indian	18%	
	Pakistani and Bangladeshi	22%	
	Black African/Caribbean/British	19%	
	Other Ethnic Background	18%	
<b>Driving licence</b>	None	24%	< 0.001
	Holds one or more	12%	
<b>Has a disability</b>	No	14%	< 0.001
	Yes	37%	
<b>Receives travel concessions</b>	No	14%	< 0.001
	Yes	24%	
<b>Owns or has access to a car</b>	No	20%	< 0.001
	Yes	14%	
<b>Household structure</b>	Couple with children	13%	< 0.001
	Couple without children	17%	
	Lone parent	14%	
	Single adult	18%	
	Other	18%	

Propensity to non-travel increases with age (13% of 18–49 year olds, 19% of 60–69 year olds and 40% of those over 80 did not travel) and retirement (with 29% of retirees non-travelling compared with 9% in full-time employment). Disability was associated with increased propensity to non-travel (37% of respondents reporting a disability or impairment did not travel, compared with 14% of those who reported no disability) as well as gender (18% of women did not travel compared to 14% of men). Household structure was also associated with tendency to non-travel: 13% of people living in households consisting of a couple with children did not travel compared to 17% of people living in a couple without children, and 18% of single adults. Owning or having access to a car was associated with a reduced propensity to non-travel compared with having one (14%, 20%). To provide more detail on the demographics of the sample, [Table A2](#) in the appendix provides a breakdown of the sample by age.

### 3.3. Logistic regression model

[Table 2](#) outlines propensity to non-travel by social and demographic characteristics, giving the odds ratio, 95% confidence interval and p-value for each characteristic in the model. Year and day of the week were also included in the analysis (not shown: full results from the model are available as online appendices, see [Tables A1 and A2](#)). A Hosmer-Lemeshow test suggested that the model is an acceptable fit for the data ( $p = 0.590$ ). There was good evidence that increasing age was associated with non-travel. Londoners over the age of 80 were 3.88 times (95% CI 3.42–4.40) more likely to stay at home than 18–49 year olds; 70–79 year olds were 2.18 times (95% CI 1.93–2.46) more likely to non-travel than 18–49 year olds and 60–69 year olds were 1.76 times (95% CI 1.59–1.95) more likely to non-travel than 18–49 year olds.

There was also good evidence from the model of an association between employment status and non-travel. Retired persons were 2.42 (95% CI 2.20–2.66) times more likely to non-travel than those in full-time employment; those who were unemployed or unable to work were 2.83 (95% CI 2.63–3.04) times more likely to non-travel than the full-time employed; and those economically inactive

**Table 2**  
Logistic Regression Model of Propensity to Non-Travel.

Variable	Characteristic	Odds Ratio	95% C.I	p value
<b>Income</b>	£50,000+ (ref cat)			
	£25,000-£49,999	1.09	(1.03–1.15)	0.004
	£15,000-£24,999	1.13	(1.06–1.20)	0.000
	> £14,999	1.20	(1.13–1.28)	0.000
<b>Age</b>	18–49 (ref cat)			
	50–59	1.03	(0.97–1.10)	0.259
	60–69	1.76	(1.59–1.95)	0.000
	70–79	2.18	(1.93–2.46)	0.000
	80+	3.88	(3.42–4.40)	0.000
<b>Gender</b>	Male (ref cat)			
	Female	1.15	(1.11–1.20)	0.000
<b>Employment Status</b>	FT Employment (ref cat)			
	PT Employment	1.25	(1.15–1.35)	0.000
	Self-Employed	1.54	(1.43–1.65)	0.000
	In education	1.74	(1.60–1.89)	0.000
	Unemployed/Unable to work	2.83	(2.63–3.04)	0.000
	Retired	2.42	(2.20–2.66)	0.000
<b>Location</b>	Other economically inactive	2.49	(2.32–2.67)	0.000
	Inner London (ref cat)			
<b>Ethnicity</b>	Outer London	1.09	(1.05–1.14)	0.000
	White British (ref cat)			
<b>Driving licence</b>	White Other	1.06	(1.00–1.13)	0.034
	Mixed Heritage	1.09	(0.95–1.25)	0.218
	Indian	1.29	(1.21–1.39)	0.000
	Pakistani and Bangladeshi	1.47	(1.35–1.60)	0.000
	Black African/Caribbean/British	1.35	(1.27–1.44)	0.000
	Other Ethnic background	1.29	(1.21–1.38)	0.000
<b>Has a disability</b>	None			
	Holds one or more	0.64	(0.61–0.67)	0.000
<b>Receives concessionary travel</b>	No (ref cat)			
	Yes	1.79	(1.70–1.88)	0.000
<b>Owns or has access to a car</b>	No (ref cat)			
	Yes	0.51	(0.47–0.56)	0.000
<b>Household Structure</b>	No (ref cat)			
	Yes	0.95	(0.91–1.00)	0.064
	Couple with children (ref cat)			
	Couple without children	1.14	(1.08–1.21)	0.000
	Lone parent	0.67	(0.60–0.75)	0.000
<b>Household Structure</b>	Single adult	0.82	(0.77–0.88)	0.000
	Other	1.14	(1.08–1.21)	0.000

for some other reason were 2.49 times (95% CI 2.32–2.67) more likely to non-travel than those who were full-time employed. Respondents who reported having a disability or impairment limiting travel were 1.79 (95% CI 1.70–1.88) times more likely to non-travel than those who did not.

Women were 1.15 times (95% CI 1.11–1.20) more likely to non-travel than men. Londoners of Pakistani and Bangladeshi ethnic backgrounds were 1.47 times (95% CI 1.35–1.60) more likely to non-travel than White British Londoners, and Black African/Caribbean/British Londoners were 1.35 times (95% CI 1.27–1.44) more likely to non-travel than White British Londoners. There was good evidence that propensity to non-travel is inversely related to income. Those who earned £14,999 or less were 1.20 times (95% CI 1.13–1.28) more likely to non-travel than those earning £50,000 or more. Earning between £15,000 and £24,999 per year was associated with a propensity to non-travel of 1.13 times greater (95% CI 1.06–1.20) than those earning £50,000 or more. Londoners with a yearly income of between £25,000 and £49,999 were only marginally (1.09 times; 95% CI 1.03–1.15) more likely to non-travel than those in the reference category.

There was good evidence that receiving travel concessions is inversely related to non-travel, with those who receive the benefit half (0.51; 95% CI 0.47–0.56) as likely to non-travel as those who do not despite the fact that those receiving travel concessions are overall more likely to non-travel than the general population. This is perhaps because travel concessions are aimed at Londoners who may find mobility more difficult – those who are unemployed, over 65 or disabled. Possessing a driving licence was associated with a decreased propensity to non-travel compared to those without a driving licence (0.64; 95% CI 0.61–0.67). However, there was only weak evidence that owning or having access to a car was associated with non-travel (0.95; 95% CI 0.91–1.00). Those living in households consisting of couples without children were 1.14 times (95% CI 1.08–1.21) more likely to non-travel than those in households consisting of couples with children. Lone parents were a third less likely (0.67; 95% CI 0.60–0.75) to non-travel as those in households consisting of couples with children. Single adults living alone were 0.82 times (95% CI 0.77–0.88) as likely to non-travel as people living in households consisting of couples with children. Those living in other types of household were 1.14 times (95% CI 1.08–1.21) more likely to non-travel than those living as a couple with children in the house.

### 3.4. Sensitivity analyses

To further unpick the relationship between age and non-travel, sensitivity analyses examined interactions between age and: household structure, travel concessions, disability, gender, and whether the person lived in Inner or Outer London in five separate models (included as web appendices, [Tables B1 to B5](#)). Wald tests indicate that age interaction terms were jointly significant (at the 5% level) in each of the five models suggesting that the relationship between age and non-travel differs by gender, disability, location, whether the person receives travel concessions or not, and the structure of their household.

The odds of non-travel appear to increase more rapidly with age among men compared to women ([Table B1](#)). Men aged 80+ were 2.14 times (95% CI 1.64–2.78) more likely to ‘non-travel’ than men 18–24, while women 80+ were 1.46 times (95% CI 1.27–1.68) more likely to ‘non-travel’ than women 18–49. Although the relationship between age and non-travel was more pronounced in non-disabled Londoners than disabled Londoners, the general trend appeared consistent ([Table B2](#)). The interaction between age and the built environment ([Table B3](#)) suggests that the built environment does in fact play a role in the mobility of older adults. Those living in Inner London were 2.41 times (95% CI 2.07–2.80) more likely to non-travel than 18–49 year olds when aged 70–79, and 3.86 times (95% CI 3.27–4.54) when aged 80+. However, there was little evidence of a relationship between age and ‘non-travel’ in Outer London.

The odds of non-travel appear to increase particularly steeply amongst those who do not receive travel concessions ([Table B4](#)), with 80+ year olds 5.24 times (95% CI 4.33–6.34) more likely to non-travel than 18–49 year olds. A sensitivity analysis of the interaction between age and household structure suggests that the most pronounced relationship between age and non-travel is present in households consisting of a couple with children ([Table B5](#)). Individuals living in a couple with children aged 70–79 are 2.51 (95% CI 1.56–4.06) times more likely to non-travel than 18–49 year olds living in a couple with children, and individuals living in a couple with children over the age of 80 are 4.59 times (95% CI 0.97–21.71) more likely to non-travel than 18–49 year olds living in a couple with children.

## 4. Discussion

Our findings suggest some sociodemographic and transport related associations of one indicator of everyday mobility in London, non-travel on a given day. That is, increasing age, having a disability and not being in paid employment all made it more likely that a person would not leave the house. Even for London, with relatively good public transport access, which makes car use less essential, and universal access to free bus travel at older age, increasing age was associated with non-travel. Crucially, we have shown that disability and long-term health problems did not explain decreasing mobility at older age, which remained an independent association in the regression model. We do not suggest that not leaving the house is necessarily a risk for health and wellbeing: there are good reasons why some benefits of travel outside the house can be provided without leaving it (through virtual technologies, for instance). Neither do we claim that having to engage with the rigours of urban life is necessarily good for health; relaxing at home might well confer more benefit, at least some of the time. However, given the accumulating evidence of the wellbeing benefits of everyday mobility at older age, our findings do suggest some continuing structural barriers to the determinants of health for older adults.

There are three potential pathways through which increasing age might put people at risk of declining opportunities for mobility. First, retirement is a powerful predictor of decreased mobility. This is not inevitable: research from a smaller and less dense urban area in Sweden suggests that after retirement, everyday mobility can (in contrast) become a means of structuring the day by “getting out of the house, either just for a walk or to do errands” ([Berg, 2016](#), p. 53). Second, ageing, even when controlling for factors such as disability and retirement, appears to be associated with reduced mobility in its own right, although this may reflect some unmeasured confounding, if those with long-term health problems that affect mobility do not reporting having a disability. Third, disability itself has been widely reported as a barrier to mobility ([Green and Lakey, 2013](#); e.g. [Imrie, 2012](#); [Nordbakke, 2013](#); [Trailblazers, 2016](#)).

Travel can provide an important bulwark against loneliness and social isolation. In the UK, 20% of people over the age of 52 living alone reported feeling lonely often, and 39% reported feeling lonely some of the time ([Beaumont, 2013](#)). We found living alone to be associated with a lower propensity to non-travel than living with other adults or children, at all ages. This was the case for both single adults and pensioners (the latter of whom are proportionally more likely to be non-travellers), as well as lone parents. Single people may be more likely to travel to seek out social contact unavailable within the home, as well as to do shopping for the households.

Receipt of travel concessions is strongly negatively associated with non-travel. For the older adults in our sample, this is largely the Freedom Pass, providing free travel on the public transport system for those over State Retirement Age. Although those receiving travel concessions are more likely to non-travel overall, once the factors likely to predict receipt of non-travel are accounted for, receipt protects against non-travel. Although there may be selection bias here, with those taking the time to apply for travel passes more likely to be the more mobile, this may have a role in mitigating the effects of household income, which is negatively associated with non-travel. That there was little evidence that car ownership or accessibility was associated with reduced propensity to non-travel may relate to the mix and density of London's built environment and relatively good public transport network. Holding a driving licence was negatively associated with non-travel; which may reflect some selection bias, in that those who are more mobile more likely to obtain a driving licence.

### 4.1. Sensitivity analyses

That men over the age of 80 are over twice as likely to non-travel as women over the age of 80 is not surprising given their

reported lower propensity to draw on social support, relative reluctance to seek health care (Davidson, 2012; Gleibs et al., 2011) and lesser likelihood to attend community support groups compared with older women (Beach and Bamford, 2014). These factors may result in increased propensity to non-travel.

It is more surprising that Outer Londoners over the age of 80 have a much lower propensity to non-travel – we would have expected any relationship to go in the opposite direction since Outer London is more car dependent and thus older people who gave up driving would be left without convenient options for travel. One possible explanation is that rates of deprivation amongst older people are much higher in Inner London (Hanna and Bosetti, 2015). Although we have tried to control for income and car ownership or access, these measures will not be able capture the many dimensions of deprivation which may influence propensity to leave the house.

Travel concessions have been successfully used to increase the mobility and inclusion of older people across the UK (Mackett, 2014), so it is no surprise that those receiving travel concessions are less likely to non-travel. Although uptake is generally high (92% of 70–79 year olds and 84% of those over 80 in our sample reported receiving travel concessions – see Table A2) more research is needed to understand the minority of people who do not apply. Apart from the initial cost of the concessionary travel pass (i.e. deposit) and a preference for car use over public transport, few relevant factors have been identified to date (Rye and Carreno, 2008). As we have suggested, this finding may reflect selection bias.

Further research is also required to examine the potential relationship between household structure and non-travel. We can speculate that Londoners over the age of 70 and 80 are less likely to travel when they live with their children if they co-reside because of needs for care. It is also possible that living alone is a push factor to seek social contact outside of the home. Nevertheless, these suggestive results should be treated with caution as the plethora of categories required to test this interaction resulted in wide confidence intervals.

#### 4.2. Strengths and limitations

Our indicator of ‘non-travel’ does not capture isolation or physical activity levels directly, but does provide some clues at a population level of the effect of socio-demographic and transport related circumstances on propensity to ‘non-travel’. The response rates of the LTDS, at between 50% and 55%, are generally in line with other large surveys. Although there is evidence to suggest that short walking trips are underreported in travel surveys, this is minimised in the LTDS as participants only have to recall their journeys from the previous day. This is important as older adults tend to travel shorter distances in their daily lives (Mercado and Páez, 2009). The focus on one day additionally avoids the drop off in trip recording seen towards the end of weekly travel diary surveys (Lepanjuuri et al., 2016). However, this record of only one day captures non-travel at the aggregate level (in terms of which groups are most likely to do so), and cannot provide a more finely-tuned analysis of who might never leave the house. Nevertheless, the LTDS is a large sample, representative of London’s resident population, and this analysis provides useful baseline findings for future comparisons as policies for age-friendly cities are implemented.

### 5. Conclusion

This study has highlighted that, even for a city with relatively good public transport and free travel for older citizens, ageing is independently associated with reduced mobility, beyond the impact of retirement and disability. Given the evidence that everyday mobility has benefits for health at older age, this is a major determinant of health. In the context of aging populations, and cities which will contain larger populations with disability, policies to foster health and health equity must consider age-friendly environments. Transport system continue to favour those who are physically agile, can move quickly and have the cognitive skills necessary to navigate sometimes unpredictable transport provision (Freund, 2001). We have demonstrated that, even in London, where older citizens benefit from free public transport and relatively good public transport, age independently predicts ‘non-travel’. One important indicator of the success of policies for more age-friendly cities will be reductions in inequalities in mobility for those at older age and those with disabilities.

#### Acknowledgements

This work was funded by the ESRC as part of a PhD CASE studentship. Grant number: ES/J500057/1.

We would like to thank the policy analysis team at Transport for London for providing us with the data and responding to enquiries about the dataset so promptly.

#### Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jth.2017.12.008>.

#### Appendix B. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jth.2017.12.008>.



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