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Public transport use and mortality among older adults in England: A cohort study

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ABSTRACT

Background: Most evidence on transport use and mortality has focused on the commute to work. This study aims to fill a gap by assessing relationships between public transport use and mortality among older adults. *Methods*: Data come from a cohort of 10,186 individuals aged 50 or older who participated in the English Longitudinal Study of Ageing (ELSA), with survey data linked to mortality records over 16 years (2002–2018). We assessed a binary measure of public transport use and frequency of use from 'every day or nearly every day' to 'never'. Cox proportional-hazards regression models were used to estimate hazard ratios (HRs) with 95% confidence intervals (CIs) for associations between public transport use and mortality. Analyses were adjusted for a range of covariates including socio-demographic factors, chronic disease, and self-reported problems with daily living activities. *Results*: Overall, 3371 participants (33.1%) died within the study period. Mortality was lower among public transport users (21.3%) compared with non-users (64.2%). Adjusted analyses found that users had 34% lower mortality than non-users (HR 0.66 (95% CI 0.61;0.71)). Adjusted analyses showed similar association sizes across frequencies of public transport use, with those using public transport every day or nearly every day having 41% lower mortality than never users (HR 0.59 (0.49;0.71)). Associations were similar among those with and without a longstanding illness. *Conclusion*: The use of public transport among older adults is linked to lower levels of mortality. Reductions in provision of public transport services could be detrimental to both transportation and population health.

1. Introduction

The impacts of transport systems on health are increasingly well recognised. Pathways through which impacts can occur include through exposure to air pollution, road traffic incidents and physical activity as part of journeys (active travel) (van Schalkwyk and Mindell, 2018). Most of the research attention has focused on the commute as the reason for travel. This research has identified substantial benefits of changing travel modes, for example research on walking and cycling has found it to be linked to reductions in cardiometabolic risks, (Hamer and Chida, 2008) adiposity (Martin et al., 2015; Laverty et al., 2013) and mortality (Panter et al., 2018). Public transport use also provides an opportunity for large numbers of people to build physical activity into their daily lives, walking to and/or from public transport services, as well as providing access to services and social participation (Mackett, 2015). There is comparatively less research on public transport, but a study of travel data in England found that public transport users accumulated 21 min of physical activity per day on average through their use of public transport (Patterson et al., 2019a). A 2019 systematic review of the impacts of public transport on health identified only 10 studies, with nine of these focused on adiposity (Patterson et al., 2019b).

Older people in England are a large and growing segment of the population and are an informative group to study the health impacts of public transport use due to a national policy introduced in 2006 which provides free travel on local buses to people over 60 years of age (Department for Transport, 2016). The age of eligibility has risen over

Abbreviations: ELSA, English longitudinal study of ageing; CES-D, Center for Epidemiologic Studies Depression Scale; ADL, Activities of daily living; IADL, Instrumental activities of daily living; HR, Hazard ratio; CI, Confidence interval.

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time and from 2020, people over 66 years are eligible. Levels of uptake are high with an estimated 76% of eligible people having a bus pass (Department for Transport, 2016). Uptake of the scheme is higher among ethnic minorities and similar across categories of wealth (Patterson et al., 2018; Laverty et al., 2018a). Evaluations of the policy have identified increases in the use of buses and physical activity as well as reductions in loneliness and depressive symptoms linked to the scheme (Whitley et al., 2020; Reinhard et al., 2018; Laverty et al., 2018b). In April 2021, the UK Government launched a national bus strategy (*Bus Back Better),* which outlined ambitions to improve services nationally and to standardise levels of service provision across the country (Department for Transport, 2021). These plans however, have been criticised as some commentators have claimed that funding levels have been reduced and that services are deteriorating (Campaign for Better Transport, 2024). The potential for bus use and public transport more generally to improve health is seldom considered in these debates, which would benefit from data on this issue.

There is thus a gap in the literature on the impacts of public transport use on mortality among older people and more generally a paucity of evidence on health impacts of non-commute travel choices. Considering the high levels of bus pass ownership among older adults in England, and the potential health impacts of public transport use, this study examined the relationship between public transport use and all-cause mortality.

2. Methods

2.1. Study population

Data come from the English Longitudinal Study of Ageing (ELSA), with this data linked to mortality records from the Office for National Statistics. ELSA is a cohort study of people aged 50 years and over living in private households in England. It commenced in 2002 and was designed to be nationally representative. Participants are interviewed every two years, with proxy interviews if this is not possible, and health examinations, involving nurses collecting blood samples and anthropometric data, every four years. A more detailed description of the study can be found elsewhere (Steptoe et al., 2013). Response rates across the eight waves varied from 65% to 82%. All ELSA participants gave written informed consent. The National Research and Ethics service granted ethical approval for all the ELSA waves (MREC/01/2/91). We used eight biennial waves from 2002 to 2016, with linkage to all-cause mortality data complete up to 2018.

2.2. Variables

Public transport use was measured at each wave, with participants selecting from a list of possible frequencies of use. As the question on public transport use changed over time, we created two measures of transport use: (1) A binary measure of public transport use (use versus no use), with data available for all waves, and (2) a categorical measure of frequency of public transport use, using data from wave 3 onwards. The categorical variable enabled an exploration of the impact of frequency of public transport use, but the inconsistency of the question meant this was not possible using all waves of data. The public transport question in waves 1 and 2, asked participants whether they used public transport a lot, quite often, sometimes, rarely, or never. From wave 3, participants selected a frequency from: every day or nearly every day; two or three times a week; once a week, two or three times a month; once a month or less; and never.

Potential confounding factors included were: sex (male/female), age (in 10-year age groups), total household non-pension wealth (in quintiles), smoking status (never/former/current), self-reported doctor-diagnosed cardiovascular disease (yes/no), self-reported longstanding illness (yes/no) and other self-reported chronic health conditions (none/1 or more from lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease, nervous or psychiatric problems, Alzheimer's disease and dementia). The presence of depressive symptoms was recorded when a score on the shortened version of the Center for Epidemiologic Studies Depression Scale (CES—D) was greater than or equal to four (Radloff, 1977). Problems with Activities of Daily Living (ADL) were assessed using the modified Katz Index, which measured difficulty with any of the six basic activities of daily living assessed by self-reported difficulty in: dressing; walking across a room; bathing, or showering; eating; getting in or out of bed; or using the toilet (Katz et al., 1963). Instrumental Activities of Daily Living (IADL) were assessed using an adapted Lawton scale which measured self-reported difficulty with any of: preparing meals; managing money; using transportation; shopping; using the telephone; house cleaning; washing clothes; or taking medications (Lawton, 1971). Finally, we derived a measure of physical activity from three questions on the frequency of mild, moderate and vigorous activities, with questions covering both recreational and work-based activities. As with previous work, physical activity was categorised as high (vigorous activity at least once a week), moderate (moderate activity at least once a week but not in the high physical activity group), low (mild activity at least once a week but not in a more active group) and inactive (Smith et al., 2015).

2.3. Analyses

The characteristics of the sample were examined on all the factors listed above. In descriptive analyses we show the characteristics of participants at the first wave for which they contributed data.

We followed up participants from each contribution to ELSA until either their death or until the next wave where they contributed data. Cox proportional-hazards regression models were used to estimate hazard ratios (HRs) with 95% confidence intervals (CIs) for the association between public transport use and mortality. The study period was 2002–2018 for the binary measure of public transport use and from 2006 to 2018 for the measure of public transport frequency. We evaluated the proportional hazards assumption by regressing the scaled Schoenfeld residuals on functions of time to test for a non-zero slope.

We estimated both unadjusted models and models adjusted for sex, age, non-pension household wealth, smoking status, depressive symptoms (CES—D), self-report cardiovascular disease, self-reported longstanding illness, self-reported other chronic disease, problems with at least one ADL, problems with at least one IADL, and physical activity. Public transport use was included in models as a time-varying exposure, allowing participants who contributed different public transport use in different waves to contribute the public transport use associated with each period of follow-up separately. All confounding variables were also considered to be time-varying.

We present analyses both for our binary measure of public transport use and for the frequency of public transport use exposure to examine potential dose response in any associations with mortality. Data on frequency of public transport use are restricted to those with data from wave 3 onwards, for which these data were consistent. Multiplicative interactions were used to test whether the association between public transport and mortality differed by levels of the hypothesized effect modifiers. Sex was identified as a potential effect modifier due to the established differences in travel patterns between men and women. Longstanding illness was identified as a potential modifier due to its impact of behaviour more broadly and how it might change the way in which public transport is used. These interaction tests were significant ($p < 0.001$) and so we also present analyses stratified by these. Complete case analyses were conducted, with missingness of 1.5–3% across waves for public transport use and 3%–8% for other covariates combined. Participants were included if they had at least two waves with complete data. We also conducted sensitivity analyses controlled for retirement status (yes/no). Analyses were performed in Stata.

3. Results

Sample characteristics by public transport use are given in Table 1. There were 10,186 participants, 54% female, with a mean age of 64 years. 7390 participants (73%) reported using public transport at least once per month, and users and non-users were found to be statistically significantly different on all included covariates, although the magnitude of these differences was not always substantial. 77% of women were public transport users, and 67% of men. Public transport use ranged from 73% among 50–59 year olds to 65% among 80–89 year olds. Public transport use was similar in those with and without self-reported cardiovascular disease (71% vs. 74%). There were differences between those with problems with ADL and those without (60% vs. 76%) as well as between those with and without problems with IADL (58% vs. 76%).

Frequencies of public transport use and mortality are shown in Table 2, reflecting the greater sample for the binary measure of public transport (using all waves) than frequency of public transport use (wave 3 onwards). Among all participants, 2796 (27.5% of sample) never used public transport. Use ranged from 1959 (27.6%) participants who used public transport once a month or less to 526 (7.4%) who used it every day or nearly every day.

Overall, 3371 participants (33.1%) died within the total study period (2002–2018), during which participants contributed a mean of 9.1 years of follow-up for the binary measure of public transport. Among public transport non-users, 1796 (64.2%) participants died within the study period, compared with 1575 (21.3%) among users. Using a more granular breakdown of public transport use frequency over a shorter period (2006–2018; mean follow-up of 6.2 years) showed that, among users, mortality was highest among those using public transport two or three times a week (29.1%) and lowest among those using public transport one a month of less (17.2%).

Analyses of Cox models on the association between public transport use and mortality are presented in Table 3. In unadjusted models, public transport users had lower mortality than non-users (HR 0.60 (95% CI 0.55;0.64)). Adjustment for a wide range of potential covariates including age, sex and wealth resulted in some attenuation but public transport users still had lower mortality than non-users (HR 0.66 (95% CI 0.61;0.71)).

Analyses using the more granular breakdown of public transport use identified lower risk of mortality among public transport users (Table 3). In unadjusted models, all frequencies of use were associated with a lower rate of mortality, for example using public transport every day or nearly every day was associated with a 43% reduced risk of mortality (HR 0.57 (0.47;0.68)). In fully adjusted models there was some attenuation but all frequencies of use were still associated with a lower rate of mortality. For example, those using public transport every day or nearly every day had a 41% lower rate than non-users (HR 0.59 (0.49;0.71)). Overlapping confidence intervals indicated little variation in associations by frequency of use among users, despite some differences in point estimates.

Analyses stratified by sex indicated public transport use was more strongly associated with lower mortality in women (adjusted HR 0.59 (0.53;0.66) than men (adjusted HR 0.73 (0.66;0.81)) (Table 4). Analyses

Table 1
Descriptive characteristics of a sample of older adults in England (2002–2018) by public transport use.

Variable	Category	Public transport users		Public transport non-users		p-value[*]
		n	%[a]	n	%[a]	
All	N	7390	73	2796	27	
Sex						<0.001
	Male	3098	67	1537	33	
	Female	4292	77	1259	23	
Age						<0.001
	50–59 years	2867	73	1040	27	
	60–69 years	2293	73	841	27	
	70–79 years	1649	73	607	27	
	80–89 years	581	65	308	35	
Wealth						<0.001
	Lowest quintile	1319	71	530	29	
	Second quintile	1422	71	588	29	
	Third quintile	1466	71	607	29	
	Fourth quintile	1536	73	567	27	
	Highest quintile	1647	77	504	23	
Smoker status						<0.001
	Never smoker	2716	75	913	25	
	Former smoker	3401	72	1325	28	
	Current smoker	1273	70	558	30	
CESD-8						<0.001
	≤3 symptoms	6306	73	2277	27	
	4+ symptoms	1084	68	519	32	
CVD conditions						0.001
	None	3783	74	1331	26	
	One or more	3607	71	1465	29	
Other chronic conditions						0.005
	None	3731	74	1325	26	
	One or more	3659	71	1471	29	
ADL[b]						<0.001
	No difficulty	6211	76	2002	24	
	One or more difficulties	1179	60	794	40	
IADL[c]						<0.001
	No difficulty	6343	76	2031	24	
	One or more difficulties	1047	58	765	42	
Physical activity						<0.001
	High	22	59	15	41	
	Moderate	196	67	97	33	
	Low	6811	74	2333	25	
	Sedentary	361	51	351	49	
Long-standing illness						<0.001
	Yes	3969	70	1705	30	
	No	3421	75	1091	24	

[a] Percentages have been rounded to integers so may not sum to 100.
[b] ADL – Difficulties with activities of daily living; CESD-8 - Center for Epidemiologic Studies Depression Scale.
[c] IADL – Difficulties with instrumental activities of daily living.
[*] From Pearson chi-squared test.

Table 2
Mortality in a sample of older adults in England (2002–2018) by public transport use.

		N in sample	% of sample	Deaths	
				N	%
Current public transport use (binary variable)	Non-user	2796	27.5	1796	*64.2*
	User	7390	72.6	1575	21.3
	Total	*10,186*	*100*	*3371*	*33.1*
Frequency of current public transport use	Never	2716	38.2	1377	50.7
	Once a month or less	1959	27.6	336	17.2
	Two or three times a month	538	7.6	107	19.9
	Once a week	556	7.8	137	24.6
	Two or three times a week	811	11.4	236	29.1
	Every day or nearly every day	526	7.4	124	23.6
	Total	*7105*	*100*	*2.317*	*32.6*

Percentages have been rounded to integers so may not sum to 100.
N in sample comes from wave 1 (binary measure of public transport use) and wave 3 (frequency of public transport use).
Deaths come from waves 1–8 (binary measure of public transport use) and waves 3–8 (frequency of public transport use).

Table 3
Associations between public transport use and mortality in a sample of older adults living in England from Cox regression models.

Public transportation use	Model 1	Model 2
	HR (95% CI)	HR (95% CI)
Binary exposure		
Non-user	1	1
User	0.60 (0.55; 0.64)	0.66 (0.61; 0.71)
Frequency of public transport use [a]		
Never	1	1
Once a month or less	0.51 (0.45; 0.57)	0.59 (0.52; 0.67)
Two or three times a month	0.48 (0.39; 0.58)	0.55 (0.46; 0.67)
Once a week	0.56 (0.47; 0.67)	0.65 (0.55; 0.77)
Two or three times a week	0.54 (0.47; 0.62)	0.60 (0.52; 0.69)
Every day or nearly every day	0.57 (0.47; 0.68)	0.59 (0.49; 0.71)

Model 1: unadjusted.
Model 2: adjusted by sex, age, wealth, smoking status, depression, cardiovascular disease, longstanding illness, other chronic condition, difficulties with Activities of Daily Living, difficulties with Instrumental Activities of Daily Living, physical activity.
[a] Frequency of public transport use analyses include data from wave 3 onwards.

by frequency of public transport use were consistent with these findings. Analyses stratified by presence of a longstanding illness provided little evidence for a difference between the two groups, based on overlapping confidence intervals. The point estimates suggested a larger association among those with a longstanding illness (adjusted HR 0.63 (0.57; 0.69)) than those without (adjusted HR 0.73 (0.64; 0.83)) (Table 4).

Sensitivity analyses additionally controlling for retirement status had very similar results to main analyses (Supplemental Table A.1).

4. Discussion

This analysis of data from ELSA identified lower rates of mortality among older people using public transport. This was true after adjusting for a wide range of potential covariates, with similar association sizes across frequencies of public transport use. These findings contribute to a growing evidence base for health benefits associated with public transport use. Public transport use is associated with increased physical activity, with authors suggesting that walking to access public transport leads to a potentially important contribution to overall physical activity levels (Patterson et al., 2019a; Laverty et al., 2018b; Rissel et al., 2012). Systematic review evidence also suggests that public transport use is associated with a modest reduction in adiposity (Patterson et al., 2019b). Among older adults, public transport use has also been associated with cognitive health as well as wellbeing, although among working aged people lengthy commutes have been suggested to be detrimental to wellbeing (Reinhard et al., 2019; Martin et al., 2014; Chatterjee et al., 2020). The precise mechanisms between public transport use and health are unclear. Physical activity has been proposed and has been linked to a wide range of physical and mental health and wellbeing outcomes. Despite some differences in descriptive data, adjusted analyses showed that the association between public transport use and mortality did not systematically differ by frequency of use. This suggests that physical activity was not the only mechanism at play as this would be expected to deliver increased benefits with increases in travel and the associated increases in physical activity. It should be noted that while our analyses controlled for physical activity, this was a general measure and not specific to activity related to transport use.

The larger associations seen in women than men are consistent with evidence that men and women have different travel behaviours. It might reflect differences in the destinations of travel and the activities that occur related to public transport journeys. We did not have data on participant's detailed itinerary and therefore this could not be examined with ELSA. The lack of a clear pattern of differences between those with and without long-standing illnesses suggest that both groups might

Table 4
Associations between public transport use and mortality from Cox regression models in a sample of older adults in England (2002–2018) stratified by sex and baseline self-reported longstanding illness.

Public transportation use	Model 1	Model 2
	HR (95% CI)	HR (95% CI)
	Male	
Binary exposure		
Non-user	1	1
User	0.66 (0.59; 0.73)	0.73 (0.66; 0.81)
Frequency of public transport use [a]		
Never	1	1
Once a month or less	0.57 (0.48; 0.67)	0.67 (0.57; 0.79)
Two or three times a month	0.51 (0.39; 0.67)	0.59 (0.46; 0.77)
Once a week	0.64 (0.50; 0.83)	0.74 (0.58; 0.95)
Two or three times a week	0.60 (0.49; 0.74)	0.63 (0.52; 0.77)
Every day or nearly every day	0.86 (0.67; 1.10)	0.84 (0.66; 1.07)
	Female	
Binary exposure		
Non-user	1	1
User	0.55 (0.50; 0.61)	0.59 (0.53; 0.66)
Frequency of public transport use [a]		
Never	1	1
Once a month or less	0.43 (0.36; 0.52)	0.50 (0.41; 0.61)
Two or three times a month	0.45 (0.33; 0.60)	0.52 (0.39; 0.69)
Once a week	0.53 (0.42; 0.68)	0.57 (0.45; 0.72)
Two or three times a week	0.53 (0.43; 0.64)	0.55 (0.46; 0.67)
Every day or nearly every day	0.40 (0.30; 0.53)	0.41 (0.30; 0.55)
	Longstanding illness	
Binary exposure		
Non-user	1	1
User	0.59 (0.54; 0.64)	0.63 (0.57; 0.69)
Frequency of public transport use [a]		
Never	1	1
Once a month or less	0.60 (0.53; 0.68)	0.53 (0.46; 0.62)
Two or three times a month	0.54 (0.46; 0.64)	0.53 (0.41; 0.68)
Once a week	0.53 (0.45; 0.63)	0.64 (0.52; 0.79)
Two or three times a week	0.59 (0.51; 0.68)	0.58 (0.49; 0.69)
Every day or nearly every day	0.78 (0.62; 0.98)	0.59 (0.47; 0.75)
	No longstanding illness	
Binary exposure		
Non-user	1	1
User	0.67 (0.59; 0.76)	0.73 (0.64; 0.83)
Frequency of public transport use [a]		
Never	1	1
Once a month or less	0.76 (0.65; 0.90)	0.71 (0.58; 0.86)
Two or three times a month	0.62 (0.50; 0.77)	0.62 (0.46; 0.85)
Once a week	0.55 (0.43; 0.70)	0.67 (0.50; 0.90)
Two or three times a week	0.63 (0.52; 0.77)	0.62 (0.49; 0.79)
Every day or nearly every day	0.69 (0.51; 0.94)	0.59 (0.43; 0.81)

Model 1: unadjusted.
Model 2: adjusted by age, sex[b], wealth, smoking status, depression, cardiovascular disease, longstanding illness[b], other chronic condition, difficulties with Activities of Daily Living, difficulties with Instrumental Activities of Daily Living, physical activity.
[a] Frequency of public transport use analyses include data from wave 3 onwards.
[b] Stratified analyses not adjusted for the stratifying variable.

benefit from public transport use, despite the interaction being statistically significant. Whatever mechanisms drove the associations we found appear to operate irrespective of long-standing illness.

The association we found between public transport use and mortality is relatively large, even when compared with studies of walking and cycling. We estimated 34% lower mortality for public transport users compared with non-users, and a 41% lower mortality for those with the highest levels of use. In comparison, a 2019 systematic review and meta-analysis of commuting to work estimated that mortality was 8% (95%CI -18% to +3%) lower for walking and 24% (95%CI 37% to 8%) lower for cycling (Dinu et al., 2019). Mortality and public transport is less well studied, although some studies among working aged people have assessed this. A study of linked Census data from England and Wales found a 7% (95%CI 11% to 3%) lower rate of mortality among those commuting by public transport compared with those using motorised transport. This reduction was largely found among train users (Patterson et al., 2020). A study using UK Biobank to compare car users with those using any other travel modes, including public transport, walking and cycling, found an 8% (95%CI 14% to 1%) lower rate of mortality among those not making regular commutes (Panter et al., 2018). These two studies employed different exposure categorisations; the Biobank study was able to adjust for several important confounders including total physical activity, smoking status and baseline cardiovascular disease. The Census study followed participants over 25 years, although there were 10 years between data collection times, and it was unable to adjust for some key health behaviours. Our study among older adults here used 2 year follow up between waves and assessed associations over 16 years. These differences in study design, and perhaps most prominently age, are likely to explain some of the differences between estimates. Another potential explanation might be reverse causality; discussed below.

4.1. Strengths and limitations

ELSA is a large dataset of older adults in England, a group that have relatively high levels of both public transport use and mortality. We followed participants for up to 16 years with detailed data collected every two years, including on their health and socio-economic positions. Such measures are likely to be important confounding factors. Detailed data on the health of participants reduces the potential for reverse causality, where individuals travel less by public transport because they are unwell rather than becoming unwell because they travel by public transport less. We were able to adjust for ill-health, including cardiovascular and other chronic disease, and also for both ADL and IADL, which might indicate reduced mobility and therefore propensity to travel. Nonetheless, it is possible that some of the factors we have adjusted for were mediators, which would likely make our findings an underestimate. The adjusted models found similar, though attenuated, results. Likewise, the analyses stratified by the presence or absence of longstanding illness revealed similar results. We also adjusted for non-pension wealth, and most of the older people were likely to be using their free bus pass: these reduce the likelihood of findings being due to socio-economic differences (Department for Transport, 2016). English National Concessionary Travel Scheme passes, under which free bus travel is provided to those of state pension age, also entitles holders to free rail travel in some local areas, subject to certain restrictions (Transport for Greater Manchester, 2024; Rail, n.d.).

We examined the impacts of public transport for any purpose, rather than focusing on commute mode, which has been the case in many studies of transport and health. Commuting to work is only a subset of travel and does not necessarily reflect travel among older adults, those that do not work, and travel for other purposes. Analyses stratified by sex indicated larger associations in women compared with men, which is consistent with point estimates in meta-analyses of walk and cycling commuting (Dinu et al., 2019).

However, there were some limitations to these analyses, including the absence of data on the specific type of public transport used (e.g. train or bus). We do not have sufficient data to explore the specific pathways through which public transport might impact health. Physical activity is one possible mechanism, but there are other differences in both detrimental (e.g. air pollution) and positive (e.g. social contacts and reduced isolation) exposures across different modes of transport. Finally, we were unable to conduct analyses on specific reasons for mortality and it may be that different patterns of associations may be found across e.g. cancer, cardiovascular and other common forms of death.

4.2. Implications

In some ways public transport is well supported in England, especially travel for older adults. All those aged 66 years and above (current state pension age) are eligible for free local bus travel and reduced-price train travel. However, the provision of bus services has reduced substantially in recent years meaning that in some areas it is not possible to travel by public transport (BBC, 2024). This trend has been accentuated by the recent Covid-19 pandemic; public transport use has yet to return to pre-pandemic levels. The Government has set out a strategy to *'Bus Back Better'* to deliver a low congestion economic recovery through increased bus use (Department for Transport, 2021). Older people benefit society economically; improving accessibility would enable increased economic contributions to society (Mackett, 2015). Our study suggests that if bus use can be substantially increased then this may also bring with it health benefits. It is important that this is achieved, as successive government have repeatedly reformed bus regulation in England but with little success.

5. Conclusions

This study adds to evidence on the health benefits of public transport, particularly among older people. We found that public transport users were at lower risk of mortality than non-users with similar association sizes across frequencies of public transport use. While the mechanisms behind the associations seen here remain unclear, these findings highlight the potential for transport policies to influence population health.

Data statement

The English Longitudinal Study of Ageing data are available to the scientific community from the UK Data Service for researchers who meet the criteria for access to confidential data, under conditions of the End User License http://ukdataservice.ac.uk/media/455131/cd137-enduserlicence.pdf. The data can be accessed from: https://beta.ukdataservice.ac.uk/datacatalogue/series/series?id=200011#!/access-data. Contact with the UK Data Service regarding access to the English Longitudinal Study of Ageing can be made through the website https://www.ukdataservice.ac.uk/about-us/contact, by phone +44 (0)1206 872,143 or by email at help@ukdataservice.ac.uk.

Mortality data are not available. Death registrations from the date of the interview up to April 2018 were obtained from the Office for National Statistics for all consenting participants.

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Author contributions

All authors contributed to the conceptualisation and planning of the analyses. IJCS and CdO conducted analyses. AAL and RP wrote the first draft of the manuscript. All authors revised the manuscript for important intellectual content.

CRediT authorship contribution statement

Richard Patterson: Writing – original draft, Methodology. **Cesar de Oliveira:** Writing – review & editing, Methodology, Data curation. **Ione Jayce Ceola Schneider:** Writing – review & editing, Formal analysis, Data curation. **Jennifer S. Mindell:** Writing – review & editing, Investigation. **Jenna Panter:** Writing – review & editing, Investigation. **Anthony A. Laverty:** Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2024.108064.

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