# Reducing loneliness among older adults through providing free travel access: A population-based assessment of social isolation and free bus travel in older adults in England

Jackson SE\*, Yang L, Veronese N, Gorely T, Grabovac I, Johnstone J, Firth J, Firth JA, Smith L

\*Dr Sarah E Jackson. Department of Behavioural Science and Health, UCL, London, UK. [s.e.jackson@ucl.ac.uk](mailto:s.e.jackson@ucl.ac.uk)

**Abstract**

**Objective:** To investigate associations of ownership and use of concessionary bus passes (CBP) with social isolation and loneliness among older adults in England.

**Methods:** In 2012/13, participants (*n*=4,726, age ≥62y) reported whether they had a CBP and if yes, frequency of use in the past month (0/1-5/≥6 times). Social isolation and loneliness were assessed in 2012/13 and 2016/17. Logistic regression tested cross-sectional and prospective associations, adjusted for socio-demographics.

**Results:** CBP ownership was cross-sectionally associated with reduced odds of social isolation (OR=0.68, 95% CI 0.55-0.84) and loneliness (OR=0.73, 95% CI 0.58-0.91). Among CBP owners, those who had used it ≥6 times had lower odds of being isolated than those who hadn’t used it at all (OR=0.73, 95% CI 0.60-0.89). Longitudinally, CBP ownership was associated with reduced odds of loneliness (OR=0.68, 95% CI 0.49-0.94) at four-year follow-up. A similar effect size was observed for social isolation (OR=0.69, 95% CI 0.46-1.04) but this did not reach significance (*p*=0.074). Frequency of use was not significantly associated with isolation or loneliness.

**Conclusion:** The CBP scheme in England facilitates social interaction for older adults. CBPs may present a promising initiative for tackling social isolation which is currently a particularly prominent issue in this population group.

## Introduction

Almost all major societies around the globe are experiencing rapid population aging for the first time in their history, which brings a wide variety of challenges, particularly in respect to health (1). A myriad of recent research findings have shown that social relationships are a central component and play an important role in maintaining health and wellbeing in later life (2–5). Social isolation (an objective aspect of social relationships that encompasses network size, diversity and frequency of contact) and loneliness (the subjective psychological experience of social isolation) are problems often experienced at older ages (6,7), with people’s social circles narrowing due to the death of social contacts and their ability to engage with their remaining network reduced by mobility difficulties (8) and lack of disposable income (9). As such, loneliness and social isolation are one of the most important predictors of health and mortality in older individuals (10,11).

While population aging is currently a global phenomenon (1), much effort is also placed into predicting individual trajectories of each major society. For instance, in the UK, the average age of the UK’s population by 2050 is expected to have increased by 30% since 1975 (from 34 to 44 years), and the proportion of the population aged ≥65 is predicted to have increased by >75% (from 14% to 25%), resulting in an extra 11 million ≥65 year-olds. In an effort to tackle social isolation and maintain wellbeing in later life, the English National Concessionary Travel Scheme (ENCTS) was introduced in 2008 (12), providing free bus travel during off-peak hours on weekdays (09:00-16:30) and all day at weekends for all men and women in England when they reach the female State Pension age (13). In London, residents are entitled to a “freedom pass”, which extends to use of all bus, tram and underground train services within the Greater London area with no time restrictions, and rail services at off-peak times. The scheme has been widely adopted: in 2016/17, concessionary bus passes were held by 8.9 million older people in England, with each pass used for an average of 95 journeys throughout the course of the year; a total of 930 million journeys per annum (14). However, critics have argued that the ENCTS is not financially viable and offering free bus travel universally rather than means testing is a waste of resources (15). It costs approximately £1.17 billion per annum to provide the statutory free local bus travel concession in England, with an average annual cost of £120 per pass (15).

Studies evaluating the impact of the ENCTS have indicated that free bus travel may increase the use of public transport (16,17), improve access to services (18), increase physical activity and gait speed (19), reduce adiposity (16,19) and improve quality of life (20,21). However, despite these encouraging peripheral findings, there has been little investigation into the extent to which the scheme is meeting its key objective of reducing social isolation. Qualitative research with bus pass holders has indicated that free bus travel increases opportunities for older people to visit family and friends and attend community activities (22), with some people saying they use the bus specifically to meet people and alleviate loneliness and boredom (20). While these findings are suggestive of a positive impact on social relationships, quantitative evaluations of the extent the ENCTS is achieving its objective in reducing social isolation among older adults in England is lacking. This will additionally provide insight into the general benefits of improving access to travel for older individuals and the consequences this may have for their social relationships and related wellbeing.

The present study uses data from a large, representative sample of older adults living in England to examined cross-sectional and prospective associations of ownership and use of a concessionary bus pass with social isolation and loneliness over four years. We hypothesised that older adults who own a concessionary bus pass would be less likely to be socially isolated or to report being lonely, and that effects would be stronger among those who used their bus pass more frequently.

## Method

### Study population

Data were from the English Longitudinal Study of Ageing (ELSA), a longitudinal panel study of men and women aged 50 and older living in households in England. ELSA began in 2002 with participants recruited from a population-representative cross-sectional survey and data have since been collected in biennial waves. Baseline data for the present study were drawn from Wave 6 (2012/13; the first wave to include questions about concessionary bus passes) and follow-up data were from Wave 8 (2016/17; the latest wave available). In order to ensure eligibility for the bus pass at the time of survey, we restricted our sample to participants aged 62 years and older (eligibility is linked to the state pension age for women, which has been increasing incrementally from 60 years since April 2010) (19). Complete data on all variables of interest at baseline were available for 4,726 participants (70.9% of age-eligible participants interviewed in Wave 6), who comprised our analytic sample. Follow-up data were available for a subsample of 3,404 participants (72.0%). Ethical approval was obtained from the National Research Ethics Service and all participants gave full informed consent.

### Measures

Throughout the analysis, we took a binning approach to the considered variables in line with previous investigations of concessionary bus passes (19) and social isolation and loneliness (e.g. 23,24). In this way, we ensure that our classifications are relevant to the previous literature and thus consistent with past definitions. As such, findings from this study will be intuitive in relation to previous work, and logically incorporated to future meta research within the same framework.

Exposure: free bus travel

Bus pass ownership was assessed with the question “*Do you have a concessionary travel bus pass issued by your local authority? (yes/no)*”. Those who responded yes were asked about the frequency of bus pass use in the last month: “*In the last month, how many times have you used your concessionary travel bus pass when boarding a bus?”* Response options were none, 1-5 times, 6-10 times, 11-20 times and 21 or more times. We combined the latter three categories for analysis, creating a three-category variable (none, 1-5, ≥6 times), as has been done previously (19).

Outcomes: social isolation and loneliness

To assess social isolation, we created an index based on having less than monthly contact (including face-to-face, telephone, and written/e-mail/text messaging contact) with children, other family members, and friends (each scored as 1), and not belonging to any social organisations or clubs (scored as 1), and living alone (scored as 1) (24). Total scores ranged from 0 to 5, with higher scores indicating a greater degree of isolation. As has been done in previous studies, we dichotomised scores at ≥2 versus <2 points to indicate high versus low levels of social isolation (23).

Loneliness was assessed using a three-item short form of the Revised University of California Los Angeles Loneliness Scale (25). Participants were asked questions such as: “*How often do you feel you lack companionship?*” (hardly ever or never=1, some of the time=2, often=3). Scores ranged from 3 to 9, with higher scores indicating greater loneliness. They were dichotomised at ≥6 versus <6 to indicate high vs. low loneliness (23).

Covariates

All covariates were selected *a priori.* We included information on age, sex and marital status (married/living as married vs. unmarried). Socioeconomic status (SES) was indexed using household non-pension wealth, which has been identified as a particularly appropriate indicator of SES in this age group (26). For the purpose of analysis, wealth was categorised into quintiles measured at the benefit unit level (a benefit unit is a couple or single person along with any dependent children they might have) across all ELSA participants who took part in Wave 6.

### Statistical analysis

Analyses were performed using IBM SPSS Statistics 25. Data were weighted to correct for sampling probabilities and for differential non-response and to calibrate back to the 2011 National Census population distributions for age and sex. The weights accounted for the differential probability of being included in Wave 6 of ELSA and non-response to the self-completion questionnaire that contained the measure of loneliness. Details can be found at <http://doc.ukdataservice.ac.uk/doc/>5050[/mrdoc/pdf/](http://mrdoc/pdf/)5050[\_elsa\_w6\_technical\_report\_v1.pdf](http://_elsa_w6_technical_report_v1.pdf/).

Simple associations between bus pass ownership and frequency of use and covariates were analysed using one-way analysis of variance (ANOVA) for continuous variables and chi-square tests for categorical variables. We used binary logistic regression to analyse associations between (i) concessionary bus pass ownership and (ii) frequency of use and social isolation and loneliness. Cross-sectional models were adjusted for sociodemographic covariates and prospective models were additionally adjusted for baseline status of the outcome variables. Results are reported as odds ratios (ORs) with 95% confidence intervals (CIs). Further, to also explore socio-demographic differences in associations, we tested interactions between bus pass ownership and frequency of use and each of age, sex, marital status and wealth in turn. When the interaction effect was statistically significantly different from zero, we performed stratified analyses to explore differences in detail. A *p*-value <0.05 was considered statistically significant for all analyses.

## Results

### Sample characteristics

There were 4,726 men and women aged ≥62 years in our sample, of whom 4,054 (85.8%) reported owning a concessionary bus pass and 672 (14.2%) did not. Of those who had a bus pass, 39.8% reported not having used it at all in the past month, 28.7% had used it between 1 and 5 times, and 31.5% had used it 6 or more times. Sample characteristics in relation to bus pass ownership and frequency of use are shown in Table 1. Participants who owned a bus pass were on average slightly older than those who did not (71.6 [SD 6.9] vs. 70.4 [7.2] years), and a higher proportion were female (*p*<0.001), married (*p*=0.047) and from the middle and second-lowest quintiles of wealth (*p*<0.001). Among participants who owned a bus pass, those who used it more frequently tended to be female, unmarried and from the lowest two quintiles of wealth (*p*<0.001 for all comparisons). There was a u-shaped association between age and frequency of use (*p*<0.001), with a higher mean age among never-users (72.1 years) and frequent (≥6 times in the past month) users (71.6 years) than among moderate (1-5 times) users (70.8 years).

### Associations with social isolation and loneliness

Associations between bus pass ownership and frequency of bus pass use and social isolation and loneliness are shown in Table 2.

Cross-sectionally, participants who had a concessionary bus pass had 32% lower odds of being socially isolated (OR=0.68, 95% CI 0.55-0.84, *p*<0.001) and 27% lower odds of being lonely (OR=0.73, 95% CI 0.58-0.91, *p*=0.006) than those who did not have a bus pass, after adjustment for age, sex, marital status and wealth (Figure 1). Among those who had a concessionary bus pass, participants who had used it 1-5 times in the past month had 25% lower odds of being socially isolated (OR=0.75, 95% CI 0.61-0.93, *p*=0.007) and those who had used it 6 or more times had 27% lower odds of being socially isolated (OR=0.73, 95% CI 0.60-0.89, *p*=0.002) than those who had not used it at all. No statistically significant association was observed between frequency of bus pass use and loneliness.

Follow-up data on at least one outcome collected four years after the baseline assessment were available for 72.3% of participants. Participants lost to follow-up were significantly older (74.3 [SD 7.8] vs. 70.4 [6.5] years, *p*<0.001), less wealthy (43.0% vs. 29.8% in the two poorest quintiles, *p*<0.001) and less likely to be married (60.6% vs. 69.2%, *p*<0.001) than those who participated in the follow-up survey, although there was no significant difference by sex (*p*=0.948). They were also significantly more likely to be socially isolated (39.2% vs. 27.5%, *p*<0.001) and lonely (23.3% vs. 18.9%, *p*<0.001) at baseline.

Prospectively, baseline bus pass ownership was significantly associated with 32% lower odds of being lonely (OR=0.68, 95% CI 0.49-0.94, *p*=0.019) over four-year follow-up, after adjustment for baseline age, sex, marital status and wealth (Table 2; Figure 2). A similar effect size was observed for the association between bus pass ownership and social isolation at follow-up (OR=0.69, 95% CI 0.46-1.04, *p*=0.074), but this difference was not classed as statistically significant under these tests (likely due to the smaller sample size for this outcome meaning the confidence in this reduced likelihood of social isolation was reduced; Figure 2). As in the cross-sectional analysis, there was no significant prospective association between frequency of bus pass use and loneliness. Although factor comparison tests showed that those using their bus pass regularly at baseline had a reduced likelihood of social isolation at follow-up compared with those not using it at all (OR=0.82, 95% CI 0.55-1.21 for 1-5 times; OR=0.93, 95% CI 0.65-1.35 for ≥6 times), these differences were not classed as statistically significant.

### Interactions with age, sex, marital status, and wealth

There were no significant interactions between bus pass ownership or frequency of bus pass use and age, sex, marital status or wealth in associations with social isolation or loneliness (Table 3).

## Discussion

Using a large, representative sample of older adults, we show that access to free travel is associated with significantly reduced prevalence of social isolation and loneliness. Cross-sectionally, participants who had a concessionary bus pass had 32% lower odds of being socially isolated and 27% lower odds of being lonely than those who did not have a bus pass. We also found that among those who had a concessionary bus pass, more frequent use was associated with reduced prevalence of social isolation, but was not significantly associated with loneliness. Further, participants who had used their bus pass 1-5 times in the past month had 25% lower odds of being socially isolated, and those who had used it more frequently (≥6 times in the past month) had 27% lower odds, than those who had not used it at all. Interestingly, the frequency of usage was unrelated to loneliness, which may suggest a slightly different mechanism driving the objective assessment of social isolation in comparison to individuals’ self-reports of loneliness.

The cross-sectional results were also supported by longitudinal analysis over a four year follow up. In the longitudinal models, bus pass ownership was associated with 31% lower odds of being socially isolated and 32% lower odds of being lonely over four-year follow-up. Taken together, these results support our hypothesis that owning and using a concessionary bus pass can increase the capacity for social interactions for older adults and help to reduce social isolation and loneliness among the older population in England.

Findings from the present study confirm and extend previous qualitative work that has indicated that owning a concessionary bus pass may be associated with better social engagement and greater opportunity to overcome loneliness (20,22). Our results demonstrate associations between free bus travel and both objective isolation – encompassing frequency of contact with friends and family and membership of social clubs and groups – and the subjective experience of loneliness. They also provide insight into a potential causal relationship, showing a prospective association between free bus travel and future isolation. There are several mechanisms through which providing older adults with free bus travel may reduce social isolation and loneliness. First, and most obviously, enabling older adults who lack the mobility (8) or disposable income (9) to travel to meet friends or access local clubs or societies increases the opportunity for social interaction. Secondly, using the bus *per se* may increase opportunity for interaction with others, while waiting for and/or travelling on the bus. Thirdly, people who own a concessionary bus pass tend to be more physically active (19), which has been shown to be protective against social isolation and loneliness in old age (27). Therefore, physical activity generated from bus travel may be partly driving the observed associations. Further research within this area would now be useful, particularly in regards to examining these three potential drivers of this association.

By reducing social isolation and loneliness among older adults in England, the ENCTS can be expected to have a substantial impact on the health and wellbeing of the older population. People who are socially isolated have been shown to have lower levels of wellbeing (28), slower gait speed (29), higher blood pressure and inflammation (30) and poorer cognitive function (31) than those who are not isolated. Similarly, people who are lonely have been shown to be at increased risk of depression (32), functional limitations (33), cardiovascular disease (34) and dementia (35). Notably, meta-analyses have identified a 29% increased risk of death among people who are socially isolated, a 26% increased risk among those who are lonely, and a 50% reduction in risk among people with good social relationships (4,11). With the potential to considerably reduce morbidity and mortality among older adults through improving opportunity for social engagement, it is likely that the cost of providing free bus travel to all – which has attracted criticism from some (15) – will be largely, if not entirely, offset by a reduction in healthcare expenditure. Furthermore, as the reductions in social isolation in bus pass users in this study persisted across all income levels, our results suggest that previous calls for means-tested bus passes are perhaps ill-informed and unnecessary, as there is no evidence to suggest that the social and broader benefits of free bus passes are limited to only lower income groups.

Strengths of this study include the large representative sample and the prospective study design. However, findings should be interpreted in light of several limitations. All measures were self-reported, and assessment of the frequency of bus pass use relied on recall of the past month, introducing scope for bias. Although the sample was representative of the English population, and survey weights were applied to account for sampling bias and non-response, there was a significant amount of missing data which meant our sample was restricted to 71% of eligible participants. In addition, attrition and missing data at follow-up reduced our sample for prospective analyses by a further 28%, and those who were not included in the follow-up analyses tended to be older and more socioeconomically disadvantaged than the retained sample.

In conclusion, owning and using a concessionary bus pass is associated with reduced social isolation and loneliness among older adults in England, indicating that the scheme is successful in encouraging and facilitating sociality in the vulnerable section of the population. Therefore, these findings add weight to the growing body of evidence on the positive impact of the concessionary travel scheme in England, suggesting that the scheme is achieving its key objective of reducing social isolation in old age, which is likely to have wide-ranging benefits for health and wellbeing in later life. More generally, the findings also support that access to free travel may generally be a useful initiative to aid with social isolation of older adults in aging populations across the globe.

## References

1. Harper S. Economic and social implications of aging societies. Science. 2014 Oct 31;346(6209):587–91.

2. House JS, Landis KR, Umberson D. Social relationships and health. Science. 1988 Jul 29;241(4865):540–5.

3. Umberson D, Karas Montez J. Social Relationships and Health: A Flashpoint for Health Policy. J Health Soc Behav. 2010 Mar 1;51(1\_suppl):S54–66.

4. Holt-Lunstad J, Smith TB, Layton JB. Social relationships and mortality risk: a meta-analytic review. PLoS Med. 2010 Jul 27;7(7):e1000316.

5. Cohen S. Social relationships and health. Am Psychol. 2004;59(8):676.

6. Cacioppo JT, Hawkley LC, Norman GJ, Berntson GG. Social isolation. Ann N Y Acad Sci. 2011 Aug;1231(1):17–22.

7. Hawkley LC, Cacioppo JT. Aging and Loneliness: Downhill Quickly? Curr Dir Psychol Sci. 2007 Aug 1;16(4):187–91.

8. Mollenkopf H, Marcellini F, Ruoppila I, Flaschenträger P, Gagliardi C, Spazzafumo L. Outdoor mobility and social relationships of elderly people. Arch Gerontol Geriatr. 1997;24(3):295–310.

9. Mullins LC, Sheppard HL, Andersson L. Loneliness and Social Isolation in Sweden: Differences in Age, Sex, Labor Force Status, Self-Rated Health, and Income Adequacy. J Appl Gerontol. 1991 Dec 1;10(4):455–68.

10. Cornwell EY, Waite LJ. Social disconnectedness, perceived isolation, and health among older adults. J Health Soc Behav. 2009;50(1):31–48.

11. Holt-Lunstad J, Smith TB, Baker M, Harris T, Stephenson D. Loneliness and social isolation as risk factors for mortality: a meta-analytic review. Perspect Psychol Sci. 2015;10(2):227–237.

12. H M Treasury. Budget 2006 [Internet]. 2006 Mar [cited 2018 Oct 19]. Report No.: HC 968. Available from: http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/d/bud06\_ch5\_180.pdf

13. Apply for an older person’s bus pass [Internet]. GOV.UK. [cited 2018 Oct 19]. Available from: https://www.gov.uk/apply-for-elderly-person-bus-pass

14. Department for Transport. Concessionary travel statistics: year ending, March 2017 [Internet]. GOV.UK. 2017 [cited 2018 Oct 19]. Available from: https://www.gov.uk/government/statistics/concessionary-travel-statistics-year-ending-march-2017

15. Butcher L. Concessionary bus fares. House of Commons Library; 2015 Jul. Report No.: Briefing paper SN01499.

16. Webb E, Netuveli G, Millett C. Free bus passes, use of public transport and obesity among older people in England. J Epidemiol Community Health. 2012 Feb 1;66(2):176–80.

17. Mackett R. Has the policy of concessionary bus travel for older people in Britain been successful? Case Stud Transp Policy. 2014 Sep 1;2(2):81–8.

18. Kelly E. Ticket to Ride: does free bus travel promote Active Ageing. UK Univ Lond Univ Coll Lond. 2011;

19. Webb E, Laverty A, Mindell J, Millett C. Free Bus Travel and Physical Activity, Gait Speed, and Adiposity in the English Longitudinal Study of Ageing. Am J Public Health. 2015 Nov 12;106(1):136–42.

20. Andrews G. JUST THE TICKET? EXPLORING THE CONTRIBUTION OF FREE BUS FARES POLICY TO QUALITY OF LATER LIFE. [PhD Thesis]. PhD dissertation. University of the West of England, Bristol, 2011. Google Scholar; 2012.

21. Rye T, Mykura W. Concessionary bus fares for older people in Scotland-are they achieving their objectives? J Transp Geogr. 2009;17(6).

22. Whitley R, Prince M. Fear of crime, mobility and mental health in inner-city London, UK. Soc Sci Med 1982. 2005 Oct;61(8):1678–88.

23. Steptoe A, Shankar A, Demakakos P, Wardle J. Social isolation, loneliness, and all-cause mortality in older men and women. Proc Natl Acad Sci U S A. 2013 Apr 9;110(15):5797–801.

24. Kobayashi LC, Steptoe A. Social Isolation, Loneliness, and Health Behaviors at Older Ages: Longitudinal Cohort Study. Ann Behav Med. 2018 May 31;52(7):582–93.

25. Russell DW. UCLA Loneliness Scale (Version 3): reliability, validity, and factor structure. J Pers Assess. 1996 Feb;66(1):20–40.

26. Banks J, Karlsen S, Oldfield Z. Socio-economic position. 2003 [cited 2014 Mar 4]; Available from: http://discovery.ucl.ac.uk/15366/1/15366.pdf

27. Cattan M, White M, Bond J, Learmouth A. Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions. Ageing Soc. 2005 Jan;25(1):41–67.

28. Shankar A, Rafnsson SB, Steptoe A. Longitudinal associations between social connections and subjective wellbeing in the English Longitudinal Study of Ageing. Psychol Health. 2015 Jun 3;30(6):686–98.

29. Shankar A, McMunn A, Demakakos P, Hamer M, Steptoe A. Social isolation and loneliness: Prospective associations with functional status in older adults. Health Psychol. 2017;36(2):179.

30. Shankar A, McMunn A, Banks J, Steptoe A. Loneliness, social isolation, and behavioral and biological health indicators in older adults. Health Psychol Off J Div Health Psychol Am Psychol Assoc. 2011 Jul;30(4):377–85.

31. Shankar A, Hamer M, McMunn A, Steptoe A. Social Isolation and Loneliness: Relationships With Cognitive Function During 4 Years of Follow-up in the English Longitudinal Study of Ageing. Psychosom Med. 2013 Mar;75(2):161.

32. Cacioppo JT, Hughes ME, Waite LJ, Hawkley LC, Thisted RA. Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses. Psychol Aging. 2006;21(1):140–51.

33. Luo Y, Hawkley LC, Waite LJ, Cacioppo JT. Loneliness, health, and mortality in old age: A national longitudinal study. Soc Sci Med. 2012 Mar 1;74(6):907–14.

34. Valtorta NK, Kanaan M, Gilbody S, Ronzi S, Hanratty B. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. Heart. 2016 Jul 1;102(13):1009–16.

35. Holwerda TJ, Deeg DJ, Beekman AT, van Tilburg TG, Stek ML, Jonker C, et al. Feelings of loneliness, but not social isolation, predict dementia onset: results from the Amsterdam Study of the Elderly (AMS℡). J Neurol Neurosurg Psychiatry. 2014;85(2):135–142.

## Tables

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1** Sample characteristics at baseline in relation to free bus travel | | | | | | | | | | | | |
|  |  | **Has a concessionary bus pass** | | | |  | | **How often has used concessionary bus pass1** | | | | |
|  |  | **No**  **(*n*=672)**2 | **Yes**  **(*n*=4054)** | ***p*** |  | | **Never**  **(*n*=1613)** | | **1-5 times**  **(*n*=1164)** | **≥6 times**  **(*n*=1277)** | ***p*** |
| Age (mean [SD] years) | | 70.44 (7.21) | 71.57 (6.85) | <0.001 |  | | 72.05 (7.19) | | 70.84 (6.51) | 71.62 (6.65) | <0.001 |
| Sex | |  |  |  |  | |  | |  |  |  |
|  | Men | 56.4 | 45.7 | <0.001 |  | | 50.5 | | 45.4 | 40.2 | <0.001 |
|  | Women | 43.6 | 54.3 | - |  | | 49.5 | | 54.6 | 59.8 | - |
| Marital status | |  |  |  |  | |  | |  |  |  |
|  | Married | 62.8 | 67.2 | 0.047 |  | | 71.1 | | 72.5 | 57.8 | <0.001 |
|  | Unmarried | 37.2 | 32.8 | - |  | | 28.9 | | 27.5 | 42.2 | - |
| Wealth quintile | |  |  |  |  | |  | |  |  |  |
|  | 1 (poorest) | 16.3 | 16.1 | <0.001 |  | | 15.8 | | 10.7 | 21.0 | <0.001 |
|  | 2 | 14.4 | 18.4 | - |  | | 15.9 | | 17.6 | 22.0 | - |
|  | 3 | 16.5 | 23.4 | - |  | | 24.4 | | 22.5 | 23.0 | - |
|  | 4 | 22.6 | 21.9 | - |  | | 20.5 | | 27.7 | 18.5 | - |
|  | 5 (richest) | 30.3 | 20.3 | - |  | | 23.3 | | 21.5 | 15.5 | - |
| 1 Usage in the past month among participants who had a concessionary bus pass.  2 Unweighted sample sizes.  Values are percentages unless otherwise stated.  All figures are weighted for sampling probabilities and differential non-response.  SD = standard deviation. | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2** Cross-sectional and prospective associations between free bus travel and social isolation and loneliness | | | | | | | | | | | | | | |
|  | |  | **Cross-sectional** | | | | |  | **Prospective** | | | | |
|  | |  | **High social isolation** | |  | **High loneliness** | |  | **High social isolation** | |  | **High loneliness** | |
|  | |  | **% (SE)** | **OR [95% CI]** |  | **% (SE)** | **OR [95% CI]** |  | **% (SE)** | **OR [95% CI]** |  | **% (SE)** | **OR [95% CI]** |
| Has a concessionary bus pass | | |  |  |  |  |  |  |  |  |  |  |  |
|  | No | | 36.1 (1.7) | 1.00 (ref) |  | 24.6 (1.5) | 1.00 (ref) |  | 20.5 (1.9) | 1.00 (ref) |  | 21.2 (1.6) | 1.00 (ref) |
|  | Yes | | 29.0 (0.7) | 0.68 [0.55-0.84]\*\*\* |  | 19.2 (0.6) | 0.73 [0.58-0.91]\*\* |  | 16.3 (0.7) | 0.69 [0.46-1.04] |  | 17.1 (0.6) | 0.68 [0.49-0.94]\* |
| How often has used concessionary bus pass1 | | |  |  |  |  |  |  |  |  |  |  |  |
|  | Never | | 31.7 (1.1) | 1.00 (ref) |  | 19.3 (1.0) | 1.00 (ref) |  | 16.9 (1.2) | 1.00 (ref) |  | 16.7 (1.0) | 1.00 (ref) |
|  | 1-5 times | | 27.6 (1.3) | 0.75 [0.61-0.93]\*\* |  | 18.7 (1.2) | 0.97 [0.77-1.23] |  | 15.5 (1.3) | 0.82 [0.55-1.21] |  | 17.7 (1.2) | 1.06 [0.77-1.48] |
|  | ≥6 times | | 26.4 (1.2) | 0.73 [0.60-0.89]\*\* |  | 19.8 (1.1) | 1.07 [0.86-1.32] |  | 15.4 (1.3) | 0.93 [0.65-1.35] |  | 16.5 (1.1) | 0.99 [0.73-1.35] |
| 1 Usage in the past month among participants who had a concessionary bus pass.  All figures are weighted for sampling probabilities and differential non-response and adjusted for age, sex, marital status and wealth. Prospective results are additionally adjusted for baseline status on the outcome variable.  OR = odds ratio, CI = confidence interval.  \**p*<0.05, \*\**p*<0.01, \*\*\**p*<0.001. | | | | | | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 3** *p*-values for interactions between free bus travel and baseline socio-demographic characteristics | | | | | | | | |
|  | |  | **Cross-sectional** | |  | **Prospective** | |
|  | |  | **High social isolation** | **High loneliness** |  | **High social isolation** | **High loneliness** |
| Bus pass ownership | | |  |  |  |  |  |
|  | Age | | 0.870 | 0.873 |  | 0.337 | 0.574 |
|  | Sex | | 0.854 | 0.938 |  | 0.640 | 0.774 |
|  | Marital status | | 0.169 | 0.494 |  | 0.341 | 0.547 |
|  | Wealth | | 0.397 | 0.598 |  | 0.131 | 0.847 |
| Frequency of bus pass use | | |  |  |  |  |  |
|  | Age | | 0.158 | 0.899 |  | 0.577 | 0.753 |
|  | Sex | | 0.908 | 0.431 |  | 0.517 | 0.510 |
|  | Marital status | | 0.161 | 0.282 |  | 0.220 | 0.313 |
|  | Wealth | | 0.562 | 0.056 |  | 0.484 | 0.070 |
| 1 Among participants who had a concessionary bus pass.  Figures shown are *p*-values.  All models were weighted for sampling probabilities and differential non-response and adjusted for age, sex, marital status and wealth. Prospective models were additionally adjusted for baseline status on the outcome variable.  \**p*<0.05. | | | | | | | | |