The Impact of a Free Older Persons' Bus Pass on Active Travel and Regular Walking in England

Sophie Coronini-Cronberg, MSc, MA(Oxon), Christopher Millett, PhD, Anthony A. Laverty, MSc, and Elizabeth Webb, PhD

Objectives. We assessed the potential public health benefit of the National Bus Pass, introduced in 2006, which permits free local bus travel for older adults (≥ 60 years) in England.

Methods. We performed regression analyses with annual data from the 2005–2008 National Travel Survey. Models assessed associations between being a bus pass holder and active travel (walking, cycling, and use of public transport), use of buses, and walking 3 or more times per week.

Results. Having a free pass was significantly associated with greater active travel among both disadvantaged (adjusted odds ratio [AOR] = 4.06; 95% confidence interval [CI] = 3.35, 4.86; $P < .001$) and advantaged groups (AOR = 4.72; 95% CI = 3.99, 5.59; $P < .001$); greater bus use in both disadvantaged and advantaged groups (AOR = 7.03; 95% CI = 5.53, 8.94; $P < .001$ and AOR = 7.11; 95% CI = 5.65, 8.94; $P < .001$, respectively); and greater likelihood of walking more frequently in the whole cohort (AOR = 1.15; 95% CI = 1.07, 1.12; $P < .001$).

Conclusions. Public subsidies enabling free bus travel for older persons may confer significant population health benefits through increased incidental physical activity. (*Am J Public Health.* 2012;102:2141–2148. doi:10.2105/AJPH.2012.300946)

Physical activity levels are decreasing globally.[1] In 2008, 31% of people worldwide were insufficiently active contributing to 3.2 million deaths each year related to physical inactivity.[2] Remaining physically active is as important in older as in younger adults because it reduces the risk of loss of mobility and muscle strength, falls, and fractures, and promotes social and mental well-being.[3] Responding to this evidence, the US Surgeon General recommends regular moderate physical activity for older adults,[4] and the UK Department of Health recommends at least 30 minutes of moderate exercise 5 times a week.[3] Even lower activity levels may have significant benefits: the relative risk of disability is reduced by 7% for each additional hour of relatively gentle physical activity undertaken each week,[5] and 15 minutes of moderate daily exercise is associated with a 12% decrease in all-cause mortality in persons older than 60 years.[6]

Incidental physical activity may be defined as physical activity that is a byproduct of an activity with a different primary purpose. There is increasing interest in the promotion of incidental physical activity, including greater use of active transport—walking, cycling, and use of public transport.[7–9] By swapping private vehicle travel for public transport—which may involve walking or cycling to transport access points or interchanges—physical activity levels are raised, offering significant health benefits, such as a reduced risk of obesity and cardiovascular ill health.[10–12] Research from the United States finds that those commuting on public transport walk for an average of 19 minutes each day, and that nearly one third of commuters reach recommended daily physical activity levels just through active transport.[13] In the United Kingdom, 19% of adults achieve recommended activity levels through active transport alone.[14] Although commuting may not be as relevant to retired populations,[15] incidental active travel may still have a key role to play in keeping older adults physically fit.[16,17]

FREE BUS TRAVEL FOR OLDER PERSONS IN ENGLAND

A National Bus Pass was introduced for people aged 60 years and older in England in 2006, entitling holders to free local bus travel in their area of residence after 9:30 AM on weekdays, and all day on weekends and public holidays.

Since April 2008 this has been extended to apply to travel on all local buses anywhere in England.[18] The scheme is estimated to cost £1.1 billion (US $1.7 billion) annually, with an average cost per pass of approximately £100 (US $157).[19] A key purpose of the concessionary scheme is to increase bus use as a means of reducing social exclusion among older people and, in particular, to ensure access to travel among those on limited incomes.[20] Between 2006 and 2008, average uptake of concessionary bus fare schemes was 68% nationally, ranging from 54% in the East of England to 87% in London.[21] Current pressure on public spending has lead to proposals for the UK government to cut or amend the National Bus Pass scheme as part of austerity measures,[22] including the suggestion that benefits for older people, which are currently universal, may be means-tested in the future.[23]

The purpose of this study was to assess the public health benefit of the scheme by examining whether the provision of free bus passes was associated with increased use of active transport and regular walking in older people and whether different socioeconomic status (SES) groups benefited equally from the scheme.

METHODS

We drew the data from the UK National Travel Survey (NTS). The survey methodology has been described in detail elsewhere.[24,25] In summary, since 2002, the NTS has comprised a repeated cross-sectional survey with an annual, multistage, stratified, random sample of 15 048 private households in England, Scotland, and Wales. Every member of each selected household is asked to participate in an interview, and also to complete a 1-week travel diary.[26,27] Response rates are around 60% each year.[28,29]

We extracted data for the years 2005 (the year before the legislation was implemented in England) to 2008, the most recently available data. We excluded respondents younger than 60 years (n = 67 965) because they are not eligible for an older person's pass, as well as residents of Scotland and Wales (n = 675) because the timing of the introduction of free bus passes and the benefits they offer varied across countries. We defined 3 respondents with an unusually high number of reported journeys in the week the travel diary was completed (>75) as outliers and excluded them. This resulted in a total sample size of 16 911 people over the 4-year study period. We classified participants into those with a free bus pass (n = 11 218) and those without (n = 5693).

Outcome Measures, Predictor Variable, and Covariates

Our main outcome measures were use of active transport, use of buses, and walking 3 or more times per week. When completing their travel diary, NTS respondents provided details of the mode of transport used for each stage of each journey undertaken in the week of observation. For each stage of a journey, we categorized the transport mode as "active" or "not active." Modes categorized as "active" were walking, cycling, and using public transport including buses and trains. Modes of transport classed as "not active" were cars, taxis, motorcycles, and private-hire buses. We also categorized stages of journeys into "bus" or "other." We summarized the stages of journeys undertaken during the week of observation as the proportion of stages that used active transport, and the proportion of stages that used bus travel. We further classified participants according to whether they had used active transport and whether they had undertaken a bus journey in the week of observation. Respondents were separately asked to assess their overall walking frequency, with options ranging from "3 or more times a week" to "less than once a year or never." Because significant health benefits are observed in older adults who do "normal" walking between 3 and 5 days each week,[30] a binary variable categorized participants into those who walked 3 or more times a week and those who walked fewer than 3 times a week.

Our main predictor variable was being a bus pass holder. The survey collects a range of demographic data, including age (60–69 years, ≥ 70 years), gender, access to a car, the population size of participant's geographical area of residence (London; other urban areas > 250 000 population; urban areas between > 30 000 and 250 000; urban areas between > 10 000 and 30 000; urban areas between 3000 and 10 000; areas of < 3000 population, or rural areas). We hypothesized that the population size of the area of residence would positively correlate with the amount and quality of public transport available, and that the number of journeys undertaken during the week of observation may influence the amount of active travel. In the absence of more robust data on the SES of respondents, we used housing tenure (owns or rents, including rent-free) as a proxy indicator.[31]

Statistical Analysis

For each survey year, the study population was summarized by age, gender, SES, car access, population size of the area of residence, walking frequency, and proportions of stages of journeys using active travel and the bus, according to whether they had a bus pass.

We examined associations between being a bus pass holder and active transport, and being a bus pass holder and bus travel. Many respondents used neither active transport nor bus travel in the week of observation, producing a large number of zero observations. We addressed this by applying a zero inflated negative binomial model, which can determine which variables affect the probability of being an active transport user, and separately which variables affect the levels of active transport undertaken.[32,33] The model therefore gives both an odds ratio of doing any travel in the week of observation (the logistic component) and an incidence rate ratio for journeys undertaken (the negative binomial component).

We tested for interactions between being a bus pass holder and housing tenure to determine whether there was a differential impact of the bus pass on these outcomes by SES. We made adjustments for possible confounders, including age group, gender, car access, tertiles of the number of journeys undertaken in the week of observation, and population size of the area of residence.[34–36] Because London introduced a free older person's pass in 2002—4 years before the national legislation requiring all councils to offer this came into force—and it also allows free travel on the subway network, we also undertook a sensitivity analysis by running the fully adjusted model with London residents removed.

Finally, we used a logistic regression model to investigate the relationship between being a bus pass holder and walking at least 3 times weekly. Models followed the same adjustments as those described previously. Because we sampled participants by household, we adjusted all models for clustering at the household level to account for similarities between participants living together.

We carried out all analyses with Stata version 11.0 (StataCorp LP, College Station, TX).

RESULTS

A summary of characteristics of those with free bus passes and those without in each study year shows that the groups differed significantly in almost every variable examined (Table 1). The total percentage of respondents with a free pass rose from 56.8% in 2005 to 74.7% in 2008. The percentage of pass holders increased across all categories of age, gender, SES, and area population size. The percentage of respondents with passes was higher among those aged 70 years and older, women, those living in rented property, and those living in areas of greater population size in each study year.

The increase in the percentage of respondents with a bus pass coincided with an increase in the percentage of walking 3 or more times a week. Median proportion of journey stages using a bus remained constant among those with and without bus passes, except in 2006 where there was a sharp increase among those with passes. Median proportion of journey stages using active travel decreased slightly between 2005 and 2008 among pass holders. Those with an older person's pass consistently showed a higher median proportion of journey stages using both active travel and buses, compared with those without a bus pass.

The use of active travel was positively associated with having a bus pass, an association that remained when we made full

TABLE 1—Characteristics of Bus Pass Holders and Non–Pass Holders: England, 2005–2008

Variables	2005,[a] No. (%) With a Bus Pass, or Median (IQR)	P[b]	2006,[a] No. (%) With a Bus Pass, or Median (IQR)	P[b]	2007,[a] No. (%) With a Bus Pass, or Median (IQR)	P[b]	2008,[a] No. (%) With a Bus Pass, or Median (IQR)	P[b]
All respondents	3886 (56.8)		4086 (63.6)		4426 (68.7)		4513 (74.7)	
Age, y		< .001		< .001		< .001		< .001
60–69	1865 (50.7)		1996 (56.8)		2295 (63.7)		2280 (69.8)	
≥ 70	2021 (61.8)		2090 (69.5)		2131 (72.9)		2233 (78.9)	
Gender		< .001		< .001		< .001		< .001
Male	1758 (49.8)		1908 (58.0)		2022 (63.9)		2099 (70.2)	
Female	2128 (63.3)		2178 (68.8)		2404 (73.9)		2414 (79.2)	
Housing tenure		< .001		< .001		< .001		< .001
Rented	760 (68.9)		799 (68.8)		826 (75.4)		890 (77.2)	
Owned	3126 (53.9)		3287 (62.3)		3600 (67.2)		3623 (74.7)	
Geographical area		< .001		< .001		< .001		< .001
London	315 (85.4)		350 (87.4)		401 (86.0)		367 (92.3)	
Urban > 250 000	1124 (63.6)		1124 (72.0)		1212 (77.3)		1312 (80.0)	
Urban > 25 000–250 000	1053 (57.8)		1101 (61.0)		1139 (69.7)		1213 (76.3)	
Urban > 10 000–25 000	419 (54.7)		373 (59.2)		422 (69.0)		392 (74.4)	
Urban > 3000–10 000 or rural	975 (39.7)		1138 (51.7)		1252 (53.8)		1229 (62.0)	
Walking frequency		.107		.943		< .001		.105
< 3 times/wk	2491 (57.5)		2609 (64.8)		2757 (67.8)		2909 (75.6)	
≥ 3 times/wk	1170 (60.3)		1259 (64.8)		1430 (74.3)		1335 (77.9)	
Access to a car		< .001		< .001		< .001		< .001
No	2859 (49.8)		3021 (57.0)		3306 (63.4)		3398 (71.4)	
Yes	1032 (76.4)		1065 (82.1)		1120 (84.4)		1115 (84.7)	
Proportion of journey stages by active transport		< .001		< .001		< .001		< .001
Pass holder[a]	0.25 (0.00–0.67)		0.24 (0.00–0.67)		0.20 (0.00–0.60)		0.19 (0.00–0.56)	
Non–pass holder[a]	0.00 (0.00–0.179)		0.00 (0.00–0.143)		0.00 (0.00–0.125)		0.00 (0.00–0.125)	
Proportion of journey stages by bus		< .001		< .001		< .001		< .001
Pass holder[a]	0.00 (0.00–0.30)		0.00 (0.00–0.29)		0.00 (0.00–0.25)		0.00 (0.00–0.235)	
Non–pass holder[a]	0.00 (0.00–0.00)		0.00 (0.00–0.00)		0.00 (0.00–0.00)		0.00 (0.00–0.00)	

Note. IQR = interquartile range.
[a]Before 2006, local councils only had to offer local bus travel concessions for residents aged ≥ 60 years, not necessarily free bus travel; from 2006, local councils were required to offer free local bus travel to residents aged ≥ 60 years; in 2008 older person's passes became valid on all local bus services throughout England.
[b]Differences between pass holders and non–pass holders reported using χ^2 test for categorical variables; independent 2-tailed *t* test for difference between means; Mann=Whitney test for difference between medians.

adjustments (Table 2). In the simple logistic model, respondents with a bus pass were significantly more likely to undertake any active travel in the week of observation (adjusted odds ratio [AOR] = 3.76; 95% confidence interval [CI] = 3.45, 4.06; $P < .001$). In the fully adjusted models, having a bus pass was associated with a greater rate of active travel among those who rented their homes (incidence rate ratio [IRR] = 1.14; 95% CI = 1.04, 1.24; $P < .001$), but not among those who owned their home (IRR = 1.08; 95% CI = 1.00, 1.17; $P < .068$). The odds of doing any active travel were similar among pass holders who owned their homes (AOR = 4.72; 95% CI = 3.99, 5.59; $P < .001$) and those who rented their homes (AOR = 4.06; 95% CI = 3.35, 4.86; $P < .001$). Participants who were older than 70 years, female, living in London, or in small to medium urban areas, and those without access to a car, were significantly more likely to use active transport. Associations remained substantively unchanged following the exclusion of London residents (results not shown).

The use of bus travel was positively associated with having a bus pass, an association that remained when we made full adjustments (Table 3). In the simple model 1, respondents with a bus pass were significantly more likely to use buses than those without a pass (AOR = 12.38; 95% CI = 10.85, 14.01; $P < .001$). In the fully adjusted model, the odds of doing any bus travel were similar among pass holders who owned their homes (AOR = 7.11; 95% CI = 5.65, 8.94; $P < .001$) and those who rented their homes (AOR = 7.03; 95% CI = 5.53, 8.94; $P < .001$). Those who were younger than 70 years, female, living in large urban areas, or with high levels of overall travel were significantly more likely to use buses. Again, associations remained substantively

TABLE 2—Associations Between Holding a Bus Pass and Active Travel Among Residents Aged 60 Years and Older: England, 2005–2008

Variables	Simple Model 1		Simple Model 2		Fully Adjusted Model	
	Logistic Model, AOR (95% CI)	Negative Binomial Model, IRR (95% CI)	Logistic Model, AOR (95% CI)	Negative Binomial Model, IRR (95% CI)	Logistic Model, AOR (95% CI)	Negative Binomial Model, IRR (95% CI)
Older person's bus pass holder						
No (Ref)	1.00	1.00	. . .	. . .	. . .	. . .
Yes	3.76*** (3.45, 4.06)	1.41*** (1.34, 1.49)	. . .	. . .	. . .	. . .
Year						
2005 (Ref)	1.00	1.00	1.00	1.00	1.00	1.00
2006	0.87* (0.77, 0.98)	1.04 (0.99, 1.11)	0.87* (0.78, 0.97)	1.05 (1.00, 1.11)	0.90 (0.81, 1.00)	1.05* (1.00, 1.09)
2007	0.81*** (0.72, 0.91)	1.02 (0.96, 1.08)	0.82*** (0.73, 0.91)	1.02 (0.97, 1.08)	0.85** (0.76, 0.95)	1.00 (0.96, 1.04)
2008	0.80*** (0.70, 0.90)	0.96 (0.91, 1.02)	0.80*** (0.72, 0.89)	0.96 (0.91, 1.01)	0.84** (0.76, 0.94)	0.99 (0.96, 1.04)
Housing tenure and pass ownership						
Rent, no bus pass (Ref)	. . .	. . .	1.00	1.00	1.00	1.00
Own, no bus pass	. . .	. . .	1.17 (1.00, 1.36)	0.68*** (0.61, 0.75)	1.61*** (1.36, 1.90)	0.84*** (0.77, 0.92)
Rent, bus pass	. . .	. . .	5.40*** (4.50, 6.42)	1.19*** (1.07, 1.32)	4.06*** (3.35, 4.86)	1.14*** (1.04, 1.24)
Own, bus pass	. . .	. . .	4.00*** (3.43, 4.67)	0.98 (0.89, 1.08)	4.72*** (3.99, 5.59)	1.08 (1.00, 1.18)
Age, y						
60–69 (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
≥ 70	. . .	. . .	. . .	. . .	0.68*** (0.63, 0.73)	0.93*** (0.90, 0.95)
Gender						
Male (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
Female	. . .	. . .	. . .	. . .	1.09* (0.99, 1.17)	0.95** (0.93, 0.98)
Geographical area						
London	. . .	. . .	. . .	. . .	1.29*** (1.11, 1.51)	1.34*** (1.27, 1.40)
Urban > 250 000	. . .	. . .	. . .	. . .	0.90* (0.82, 1.00)	1.07*** (1.03, 1.11)
Urban > 30 000–250 000 (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
Urban > 10 000–30 000	. . .	. . .	. . .	. . .	0.92*** (0.80, 1.06)	0.96 (0.91, 1.01)
Urban > 3000–10 000 or rural	. . .	. . .	. . .	. . .	0.79 (0.71, 0.87)	0.95* (0.91, 1.00)
Access to car						
Yes (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
No	. . .	. . .	. . .	. . .	5.28*** (4.70, 5.87)	2.03*** (1.96, 2.11)
Amount of travel						
Low	. . .	. . .	. . .	. . .	0.45*** (0.41, 0.50)	0.50*** (0.48, 0.52)
Medium (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
High	. . .	. . .	. . .	. . .	1.46*** (1.33, 1.60)	1.46*** (1.41, 1.52)

Note. AOR = adjusted odds ratio; CI = confidence interval; IRR = incidence rate ratio.
*$P < .05$; **$P < .01$; ***$P < .001$.

unchanged following the exclusion of London residents (results not shown).

We observed a significant positive association (AOR = 1.15; 95% CI = 1.07, 1.12; $P < .001$) between having a bus pass and walking 3 or more times a week (Table 4). This association was similar across pass holders who both did and did not own their own homes. Respondents younger than 70 years, men, respondents without car access, and those who lived in an area with population of less than 30 000 were significantly more likely to walk 3 or more times per week. Again, associations remained substantively unchanged following the exclusion of London residents (results not shown).

DISCUSSION

With increasing evidence that even small increases in moderate physical activity reduce the risk of ill health in older adults,[3,5,6,16,30] initiatives that promote incidental exercise are likely to be beneficial to population health. Our main findings suggest that older persons in England with a National Bus Pass are significantly more likely to report active transport use and frequent walking. This builds on existing literature, which shows that active transport use is associated with raised physical activity levels.[12–14] Active travel may provide additional social well-being benefits in older adults,[16,17] something we have not been able

TABLE 3—Associations Between Being a Bus Pass Holder and Bus Use Among Residents Aged 60 Years and Older: England, 2005–2008

Variables	Simple Model 1		Simple Model 2		Fully Adjusted Model	
	Logistic Model, AOR (95% CI)	Negative Binomial Model, IRR (95% CI)	Logistic Model, AOR (95% CI)	Negative Binomial Model, IRR (95% CI)	Logistic Model, AOR (95% CI)	Negative Binomial Model, IRR (95% CI)
Older person's bus pass holder						
No (Ref)	1.00	1.00	. . .	. . .	. . .	. . .
Yes	12.38*** (10.85, 14.01)	1.22*** (1.07, 1.40)	. . .	. . .	. . .	. . .
Year						
2005 (Ref)	1.00	1.00	1.00	1.00	1.00	1.00
2006	1.00 (0.87, 1.14)	1.02 (0.94, 1.12)	1.00 (0.89, 1.13)	1.04 (0.97, 1.12)	1.06 (0.93, 1.20)	1.04 (0.98, 1.10)
2007	0.97 (0.85, 1.11)	1.00 (0.91, 1.08)	0.99 (0.88, 1.10)	1.00 (0.94, 1.09)	1.08 (0.95, 1.21)	1.00 (0.95, 1.07)
2008	0.92 (0.81, 1.04)	0.95 (0.88, 1.04)	0.93 (0.83, 1.04)	0.97 (0.91, 1.04)	1.07 (0.95, 1.21)	1.00 (0.94, 1.06)
Housing tenure and pass ownership						
Rent, no bus pass (Ref)	. . .	. . .	1.00	1.00	1.00	1.00
Own, no bus pass	. . .	. . .	0.40*** (0.31, 0.51)	0.47*** (0.38, 0.58)	0.71*** (0.54, 0.92)	0.72*** (0.61, 0.85)
Rent, bus pass	. . .	. . .	9.98*** (8.00, 12.43)	0.96 (0.82, 1.13)	7.03*** (5.53, 8.94)	1.01 (0.89, 1.16)
Own, bus pass	. . .	. . .	5.02*** (4.07, 6.17)	0.72*** (0.61, 0.85)	7.11*** (5.65, 8.94)	0.92 (0.81, 1.06)
Age, y						
60–69 (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
≥ 70	. . .	. . .	. . .	. . .	0.84*** (0.77, 0.92)	0.95* (0.91, 0.99)
Gender						
Male (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
Female	. . .	. . .	. . .	. . .	1.51*** (1.38, 1.63)	0.97 (0.93, 1.00)
Geographical area						
London	. . .	. . .	. . .	. . .	1.72*** (1.47, 1.99)	1.24*** (1.16, 1.32)
Urban > 250 000	. . .	. . .	. . .	. . .	1.26*** (1.13, 1.39)	1.11*** (1.05, 1.16)
Urban > 30 000–250 000 (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
Urban > 10 000–30 000	. . .	. . .	. . .	. . .	0.67*** (0.57, 0.79)	0.85*** (0.78, 1.08)
Urban > 3000–10 000 or rural	. . .	. . .	. . .	. . .	0.65*** (0.57, 0.73)	0.84 (0.79, 0.90)
Access to car						
Yes (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
No	. . .	. . .	. . .	. . .	7.00*** (6.25, 7.85)	2.04*** (1.94, 2.14)
Amount of travel						
Low	. . .	. . .	. . .	. . .	0.47*** (0.42, 0.53)	0.56*** (0.54, 0.59)
Medium (Ref)	. . .	. . .	. . .	. . .	1.00	1.00
High	. . .	. . .	. . .	. . .	0.88* (0.79, 0.98)	1.13*** (1.07, 1.19)

Note. AOR = adjusted odds ratio; CI = confidence interval; IRR = incidence rate ratio.
*$P < .05$; **$P < .01$; ***$P < .001$.

to investigate in our research. Our findings also indicate that the public health benefit of the bus pass appears to be similar in different SES groups.

Previous research has suggested that price makes a difference to transportation choice and frequency of use,[37] particularly among those of lower SES groups. Free bus pass eligibility is associated with a 50% higher likelihood of using public transport in England,[38] and 40% of trips on public transport by pensioners in the West Midlands would not have been undertaken without the concessionary pass, with the majority of travel for shopping trips by those on low incomes.[39] By contrast, a study from Scotland found that homeowners are more likely to use active travel than nonhomeowners.[35] We found that older people with a free bus pass have a similarly increased likelihood of using active travel no matter whether they rent or own their home. These findings suggest that the public health benefit to older people associated with holding a free bus pass may be equitable across SES groups.

In addition to whether one is a bus pass holder, the factor that consistently determines transport choices is having access to a car. This is the factor that most reduces the likelihood of bus travel, walking, and use of active transport in general, a finding that is consistent with other research.[35,40] Respondents living in areas with larger populations are significantly more likely to use active transport and bus

TABLE 4—Associations Between Being a Bus Pass Holder and Walking 3 or More Times a Week Among Residents Aged 60 Years and Older: England, 2005–2008

Variables	Simple Model 1, AOR (95% CI)	Simple Model 2, AOR (95% CI)	Fully Adjusted Model, AOR (95% CI)
Older person's bus pass holder			
No (Ref)	1.00	. . .	. . .
Yes	1.15*** (1.07, 1.12)	. . .	. . .
Year			
2005 (Ref)	1.00	1.00	1.00
2006	1.02 (0.92, 1.12)	1.02 (0.92, 1.12)	1.00 (0.91, 1.11)
2007	1.09 (0.99, 1.19)	1.08 (0.98, 1.19)	1.05 (0.96, 1.16)
2008	0.95 (0.87, 1.05)	0.95 (0.86, 1.04)	0.92 (0.83, 1.01)
Housing tenure and pass ownership			
Rent, no bus pass (Ref)	. . .	1.00	1.00
Own, no bus pass	. . .	1.15*** (1.24, 1.78)	1.37*** (1.14, 1.65)
Rent, bus pass	. . .	1.23* (1.02, 1.49)	1.43*** (1.17, 1.75)
Own, bus pass	. . .	1.74*** (1.46, 2.07)	1.78*** (1.49, 2.13)
Age, y			
60–69 (Ref)	. . .	. . .	1.00
≥ 70	. . .	. . .	0.69*** (0.64, 0.74)
Gender			
Male (Ref)	. . .	. . .	1.00
Female	. . .	. . .	0.86*** (0.80, 0.92)
Geographical area			
London	. . .	. . .	1.07 (0.94, 1.22)
Urban > 250 000	. . .	. . .	0.91* (0.83, 1.00)
Urban > 30 000–250 000 (Ref)	. . .	. . .	1.00
Urban > 10 000–30 000	. . .	. . .	1.15* (1.02, 1.31)
Urban > 3000–10 000 or rural	. . .	. . .	1.23*** (1.12, 1.35)
Access to car			
Yes (Ref)	. . .	. . .	1.00
No	. . .	. . .	1.21*** (1.10, 1.33)
Amount of travel			
Low	. . .	. . .	0.59*** (0.54, 0.64)
Medium (Ref)	. . .	. . .	1.00
High	. . .	. . .	1.45*** (1.34, 1.58)

Note. AOR = adjusted odds ratio; CI = confidence interval.
*$P < .05$; **$P < .01$; ***$P < .001$.

transport, but not more likely to walk frequently. This may be associated with better public transport infrastructure and reduced convenience of driving and parking in cities, leading to reduced dependency on cars.[34,41] By contrast, rural areas may provide fewer opportunities for incidental physical activity through active transport, but more opportunity to go for recreational walks,[42] which could explain the increased likelihood of walking frequently among people living in areas with smaller populations.

In line with other research, we found increasing age resulted in reduced active transport, bus travel, and likelihood of frequent walking,[35] presumably as a result of increased frailty and comorbidities and associated lack of access to transport.[40] However, as no data on the health or physical functioning of participants are available in the NTS, we were not able to investigate this hypothesis.

The National Bus Pass was introduced nationally in 2006, and a corresponding increase in the number of persons with passes has been seen since this time, though there is also a reduction in overall use in all active transport and bus use. This may suggest that increasing the number of people with passes is not sufficient to compensate for the overall downward trend in active travel in both groups separately. Nevertheless, we demonstrated that those with passes undertake more activity than those without a pass, thereby underscoring the policy's health benefit.

Strengths and Limitations

The strengths and weaknesses of the NTS have been described in detail elsewhere.[24,28,29] For the purposes of this study, the strengths of the NTS are that it provides a large, representative, and weighted sample with detailed information about travel patterns in adults aged 60 years and older and is the most comprehensive data set of this type available in the United Kingdom. However, a number of important limitations should be considered when one is interpreting our findings.

First, the NTS does not currently employ a weighting scheme for nonresponse, which may limit the generalizability of our findings.[24,25] Previous research has shown that men, those with health problems, and more disadvantaged groups are all less likely to participate in surveys,[43] As all these groups are also less likely to use active transport, we may have overestimated the proportion of the population using active transport. However, the response rate (60%) is comparable to that in other population surveys, and these data are the most comprehensive data of this type available in the United Kingdom. Although we have no reason to hypothesize that response to the NTS was associated with holding a bus pass, there remains a possibility that nonresponse in this survey may have biased our results.

Second, the NTS travel data are self-reported, so active transport use may not be accurately captured. However, the use of travel diaries should minimize recording bias. The walking data from which we derived our binary variable were not collected as part of the travel diary but as a separate survey question, and respondents may have underestimated incidental walking associated with active or bus travel modes. If this is the case, the association described here could be an underestimation.

Third, we were not able to robustly investigate whether the use and health benefits derived from the free bus pass were equitably distributed among older people. The measures of SES available in the NTS were either not relevant to this population (e.g., employment status in a predominantly retired cohort) or subject to large proportions of missing data (e.g., annual income). We instead used housing tenure as a proxy for SES, which can be appropriate because it gives an indication of wealth and life course social advantage.[31] However, it is a crude measure and precludes us from investigating in detail the effect of SES on the relationship between holding a bus pass and active transport use.

Finally, because the NTS samples new participants each year with no follow-up, a longitudinal analysis investigating how individuals' transport habits may change in response to receiving a bus pass was not possible. We cannot therefore exclude the possibility of reverse causality (i.e., respondents with higher levels of active travel being more likely to obtain a bus pass).

Policy Implications and Conclusions

Physical inactivity is estimated to cost the UK economy £10.7 billion (US $16.8 billion) annually.[3] In response to this, the UK government, like many other governments and agencies, is seeking to increase physical activity across all population groups.[44] Despite pensioners having more free time than working adults, most fall short of achieving nationally recommended levels of physical activity and may gain weight during retirement.[3,45] The positive benefits of the National Bus Pass on use of active transport and regular walking among older people in England is therefore encouraging.

Although the costs of the scheme are considerable,[19] it may offer value for money as it seems to promote physical activity among older people, thereby helping to reduce inactivity-related mortality and morbidity.[5,6] To maximize the population health benefits of this policy, other barriers to public transport use in older persons, such as poor access and inconvenience, ease of car use, and poor pedestrian access of neighborhoods, should be addressed.[46,47]

In conclusion, older people in England with a free bus pass seem more likely to use active transport and buses, and to undertake regular walking than those without, regardless of their SES. These findings suggest that public subsidies enabling free bus travel for older persons may confer significant population health benefits through increasing incidental physical activity levels. ■

About the Authors

All authors are with the Department of Primary Care and Public Health, Faculty of Medicine, Imperial College, London, UK. Sophie Coronini-Cronberg is also with Interventional Public Health, Imperial College Healthcare NHS Trust, London. Elizabeth Webb is also with the Economic and Social Research Council, International Centre for Lifecourse Studies in Society and Health, University College London, Department of Epidemiology and Public Health, London.

Correspondence should be sent to Sophie Coronini-Cronberg, Department of Primary Care and Public Health, Imperial College London, Reynolds Building, St Dunstan's Rd, London W6 8RP, UK (e-mail: s.coronini-cronberg@imperial.ac.uk). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

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Contributors

S. Coronini-Cronberg, E. Webb, and C. Millett designed the study. E. Webb supervised S. Coronini-Cronberg and A. A. Laverty in carrying out the statistical analyses. S. Coronini-Cronberg drafted the article, and all authors provided editorial comment to, and approved, the final version.

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Human Participant Protection

Ethical approval for this study was not required as a secondary data analysis was undertaken.

References

1. Lindström M, Isacsson S-O, Merlo J. Increasing prevalence of overweight, obesity and physical inactivity: two population-based studies 1986 and 1994. *Eur J Public Health.* 2003;13(4):306–312.

2. World Health Organization. Physical inactivity: a global public health problem. Available at: http://www.who.int/dietphysicalactivity/factsheet_inactivity/en/index.html. Accessed March 27, 2011.

3. *At Least Five Days a Week: Evidence on the Impact of Physical Activity and Its Relationship to Health.* London, England: Department of Health; 2004: 10. Available at: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4080981.pdf. Accessed June 16, 2011.

4. US Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.

5. Boyle PA, Buchman AS, Wilson RS, Bienias JL, Bennett DA. Physical activity is associated with incident disability in community-based older persons. *J Am Geriatr Soc.* 2007;55(2):195–201.

6. Wen CP, Wai JPM, Tsai MK, Yi Chen Yang MS, Cheng TYD, Lee M-C. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *Lancet.* 2011;378(9798):1244–1253.

7. United Nations. Draft Resolution Submitted by the President of the General Assembly: Political Declaration of the High-Level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases. September 16, 2011. A66/l.1. Available at: http://www.un.org/ga/search/view_doc.asp?symbol=A/66/L.1. Accessed September 26, 2011.

8. *Physical Activity and the Environment: Costing Report. Public Health Guidance 8.* London, England: The National Institute of Health and Clinical Excellence; 2008.

9. Wilkinson R, Marmot M, eds. *Social Determinants of Health: The Solid Facts.* Copenhagen, Denmark: World Health Organization Regional Office Europe; 2004.

10. World Health Organization Regional Office Europe. *Charter on Transport, Environment and Health.* 1999 EUR/ICP/EHCO 02 02 05/9 Rev.4. Available at: http://www.euro.who.int/__data/assets/pdf_file/0006/88575/E69044.pdf. Accessed May 3, 2011.

11. Bassett DR Jr, Pucher J, Buehler R, Thompson DL, Crouter SE. Walking, cycling, and obesity rates in Europe, North America, and Australia. *J Phys Act Health.* 2008;5(6):795–814.

12. Hamer M, Chida Y. Active commuting and cardiovascular risk: a meta-analytic review. *Prev Med.* 2008;46(1):9–13.

13. Besser LM, Dannenberg AL. Walking to public transit: steps to help meet physical activity recommendations. *Am J Prev Med.* 2005;29(4):273–280.

14. Adams J. Prevalence and socio-demographic correlates of "active transport" in the UK: analysis of the UK time use survey 2005. *Prev Med.* 2010;50(4):199–203.

15. Slingerland AS, van Lenthe FJ, Jukema JW, et al. Aging, retirement and changes in physical activity: prospective cohort findings from the GLOBE study. *Am J Epidemiol.* 2007;165(12):1356–1363.

16. Dahan-Oliel N, Mazer B, Gélinas I, Dobbs B, Lefebvre H. Transportation use in community-dwelling older adults: association with participation and leisure activities. *Can J Aging.* 2010;29(4):491–502.

17. Titheridge H, Achuthan K, Mackett R, Solomon J. Assessing the extent of transport exclusion among the elderly. *J Transport Land Use.* 2009;2:31–48.

18. Direct Gov [Web site]. Available at: http://www.direct.gov.uk/en/TravelAndTransport/Publictransport/BusAndCoachTravel/DG_10036264. Accessed April 14, 2011.

19. Butcher L. Buses: concessionary fares. House of Commons. February 28, 2011. SN/BT/1499.

Available at: http://www.parliament.uk/briefing-papers/SN01499. Accessed July 20, 2012.

20. Department for Transport. Concessionary bus travel. Available at: http://www.dft.gov.uk/topics/public-transport/buses/concessionary-bus-travel. Accessed November 2, 2011.

21. Bayliss J, Sly F. *Ageing Across the UK*. London, England: Office for National Statistics; 2010.

22. Free bus pass age rise may be sped up amid budget cuts. *BBC News;* July 16, 2010. Available at: http://www.bbc.co.uk/news/uk-10657515?print=true. Accessed November 22, 2011.

23. Kirkup J. Nick Clegg: pensioners' benefits should be means tested. *The Telegraph*. December 4, 2011. Available at: http://www.telegraph.co.uk/news/politics/nick-clegg/8934674/Nick-Clegg-pensioners-benefits-should-be-means-tested.html. Accessed December 6, 2011.

24. Anderson T, Rofique J, Pickering K, Tipping S. *National Travel Survey: Technical Report*. London, England: National Centre for Social Research for the Department of Transport; 2010.

25. Freeth S. *Using a Range of Methods to Collect Travel Data: The Experience of the British National Travel Survey. TRB Transportation Research Circular E-C008: Transport Surveys: Raising the Standard*. London, England: Office of National Statistics; 2000.

26. Economic and Social Data Service. SN 5340—National Travel Survey, 2002–2010. Available at: http://www.esds.ac.uk/findingData/snDescription.asp?sn=5340. Accessed April 26, 2011.

27. National Centre for Social Research. National Travel Survey. Available at: http://www.natcen.ac.uk/study/national-travel-survey. Accessed April 21, 2011.

28. Anderson T, Christopherson O, Pickering K, Southwood H, Tipping S. *National Travel Survey 2008: Technical Report*. London, England: National Centre for Social Research for the Department of Transport; 2009.

29. Cronberg A, Christopherson O, Pickering K, Tipping S. *National Travel Survey 2006: Technical Report*. London, England: National Centre for Social Research for the Department of Transport; 2009.

30. Paterson DH, Warburton DER. Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. *Int J Behav Nutr Phys Act*. 2010;7:38.

31. Grundy E, Holt G. The socioeconomic status of older adults: how should we measure it in studies of health inequalities? *J Epidemiol Community Health*. 2001;55(12):895–904.

32. Alain F, Zuur AF, Ieno EN, Walker NJ, Saveliev AA, Smith GM. *Mixed Effects Models and Extensions in Ecology with R*. New York, NY: Springer; 2009.

33. Sheu M-L, Hu T-W, Keeler TE, Ong M, Sung H-Y. The effect of a major cigarette price change on smoking behavior in California: a zero-inflated negative binomial model. *Health Econ*. 2004;13(8):781–791.

34. Saelens BE, Sallis JF, Frank LD. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Ann Behav Med*. 2003;25(2):80–91.

35. Ogilvie D, Mitchell R, Mutrie N, Petticrew M, Platt S. Personal and environmental correlates of active travel and physical activity in a deprived urban population. *Int J Behav Nutr Phys Act*. 2008;5:43.

36. Wen LM, Rissel C. Inverse associations between cycling to work, public transport, and overweight and obesity: findings from a population based study in Australia. *Prev Med*. 2008;46(1):29–32.

37. Avinieri E, Goodwin P, eds. *Individual Behaviour Change: Evidence in Transport and Public Health*. Bristol, UK: University of West of England; 2009. Available at: http://www.dft.gov.uk/pgr/scienceresearch/social/behaviour-changes/pdf/transport-and-health.pdf. Accessed April 27, 2011.

38. Webb E, Netuveli G, Millett C. Free bus passes, use of public transport and obesity among older people in England. *J Epidemiol Community Health*. 2011. Available at: http://jech.bmj.com/content/early/2011/08/31/jech.2011.133165.short. Accessed September 26, 2011.

39. Metz D. Transport policy for an ageing population. *Transport Rev*. 2003;23:375–386.

40. Acheson D. *Independent Inquiry Into Inequalities in Health Report*. London, England: Department of Health; 1998.

41. Fuller D, Sahlqvist S, Cummins S, Ogilvie D. The impact of public transportation strikes on use of a bicycle share program in London: interrupted time series design. *Prev Med*. 2012;54(1):74–76.

42. Brownson RC, Baker EA, Housemann RA, Brennan LK, Bacak SJ. Environmental and policy determinants of physical activity in the United States. *Am J Public Health*. 2001;91(12):1995–2003.

43. Korkeila K, Suominen S, Ahvenainen J, et al. Non-response and related factors in a nation-wide health survey. *Eur J Epidemiol*. 2001;17(11):991–999.

44. *Be Active, Be Healthy: A Plan for Getting the Nation Moving*. London, England: Department of Health; 2009. Available at: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_094359.pdf. Accessed December 12, 2011.

45. *Health Survey for England 2008. Physical Activity and Fitness*. London, England: The Information Centre for Health and Social Care; 2009.

46. *Promoting and Creating Built or Natural Environments that Encourage and Support Physical Activity*. London, England: National Institute for Health and Clinical Excellence; 2008.

47. *Prevention of Cardiovascular Disease at Population Level*. London, England: National Institute of Health and Clinical Excellence; 2010.