Preventive Medicine Reports 13 (2019) 57–61

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Exploring changes in active travel uptake and cessation across the lifespan: Longitudinal evidence from the UK Household Longitudinal Survey

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ARTICLE INFO

Keywords:
Travel
Non-communicable diseases
Social determinants of health
Environment
Health promotion
Obesity
Epidemiology

ABSTRACT

This study aims to explore changes in uptake and cessation of walking, cycling and public transport use across the lifespan in a representative sample of UK adults aged 16 and older. A longitudinal analysis of 11,559 individuals in waves two (2010–2012) and six (2014–2016) of the General Population Sample (GPS) of the UK Household Longitudinal Survey (UKHLS) was performed. The outcome variables were self-reported and categorised as changes to and from 1) walking or cycling and 2) public transport. In adjusted models compared to younger adults (aged 16–34), middle-aged adults (aged 45–55: OR 0.66, $p = 0.050$) and older adults (aged > 55: OR 0.53, $p = 0.017$) were significantly less likely to initiate walking/cycling during the study period. Middle and older aged adults were also significantly less likely to cease walking/cycling (aged 45–55: OR 0.68, $p = 0.019$; aged > 55: OR 0.46, $p < 0.001$) and public transport use (aged 45–55: OR 0.33, $p < 0.001$; aged > 55: OR 0.28, $p < 0.001$). Dose response relationships were observed where increasing age was associated with increased stability in transport mode. Developmental processes in early adulthood may contribute to self-selection and sustainability of active commuting in later life. Active travel programs and policies that target younger adults may be an efficient means to increase and sustain participation in active commuting.

1. Introduction

The promotion of active travel (i.e. commuting by walking, cycling and public transport) is increasingly being recognised as a key intervention to increase population physical activity. Public transport use frequently involves walking or cycling components across the journey and is therefore considered a form of active travel. Active travel is associated with reduced rates of obesity, type 2 diabetes, hypertension, cardiovascular disease, some cancers and all-cause mortality (Flint and Cummins, 2016) (Celis-Morales et al., 2017) (Brown et al., 2017) (Laverty et al., 2013). In addition to preventing non-communicable diseases, active travel also has potential in reducing traffic congestion, noise and air pollution and greenhouse gas emissions (Pucher et al., 2010) (Macmillan et al., 2014).

In response, countries such as the UK, Australia and New Zealand have developed national strategies to promote active commuting. Examples include the UK government Cycling and Walking Investment Strategy (UK Department for Transport, 2017), the Australian National Cycling Strategy (Australian Bicycle Council, 2010) and the New Zealand Transport Strategy (New Zealand Ministry of Transport, 2008). The UKs target aims to double cycling rates and reduce the attrition in walking trips by 2025, Australia's strategy aimed to double cycling participation by 2016, while New Zealand's Transport Strategy aims to increase walking, cycling and other active modes to 30% of total trips in urban areas by 2040. While having common goals, varying approaches to implementing these strategies reflect their local contexts and populations. For example, in addition to providing specific active travel targets, they variously promote developing supportive built environments, infrastructure, social marketing, health promotion campaigns and programs in local area governments.

Predictors of active travel behaviour are complex and reflect context-specific socio-demographic, social, cultural and environmental factors. These include gender, socioeconomic position, employment type, cultural norms, commute distance, family structure and car access (Sahlqvist and Heesch, 2012) (Panter et al., 2011a) (Jones and Ogilvie, 2012). Built environment factors such as availability and quality of walking, cycling and public transport infrastructure, and destination factors including parks and residential density also influence active travel (Sallis et al., 2016) (Smith et al., 2017). Little is known about how socio-demographic factors interact to affect active travel initiation

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https://doi.org/10.1016/j.pmedr.2018.11.008
Received 30 April 2018; Received in revised form 2 November 2018; Accepted 10 November 2018
Available online 15 November 2018

and cessation across the lifespan. A recent paper suggested two thirds of older UK adults rarely use public transport, with the authors concluding the related lack of physical activity was associated with a decline in general conditioning (Rouxel et al., 2017). If active travel uptake or cessation is more likely at different life stages, then better understanding these critical periods might offer opportunities for improved targeting of interventions. This could enable active travel policies and interventions that are more responsive to their changing populations, with the potential to increase active travel use across all, including older, age groups.

The aim of this study, therefore, was to explore socio-demographic changes in uptake and cessation of walking, cycling and public transport across the life-course in the United Kingdom.

2. Materials and methods

We undertook a longitudinal analysis of the UK Household Longitudinal Survey (UKHLS) General Population Sample (GPS) examining how uptake and cessation of active commuting changed between waves two and six of the survey (2010–2012 and 2014–2016).

2.1. Study population

The study population consisted of 11,559 UK adults. Participants were included in the study if they were aged 16 years or older and provided complete data on their age, sex and usual mode of commuting for waves two and six of the survey. We excluded individuals who were unemployed in either or both waves (including being retired), or worked from home or did proxy interviews because the survey did not collect commuting behaviour data on these individuals. The UKHLS is a nationally representative, longitudinal survey of approximately 40,000 British households that has been investigating changing health and socioeconomic factors since 2008. Interviews for wave two were conducted between January 2010 and March 2012. Interviews for wave six were conducted between January 2014 and May 2016. These two waves were chosen because they included all exposure, outcome and confounding variables of interest for this study. Interviewers were experienced and received training overseen by the Institute of Social and Economic Research (ISER). The full response rate of participants invited to participate in wave two was 59.4% and wave six was 64.6%. The structure and sampling of the UKHLS is described elsewhere (Institute for Social and Economic Research, 2018).

2.2. Exposures, outcomes and covariates

We recoded participant age into five categories for our exposure variable. The final categories were: 16–24 (n = 469), 25–34 (n = 1978), 35–44 (n = 3052), 45–54 (n = 3609) and 55 or older (2451). Due to the small number of 16–24 year-olds in the sample (4.1%) we combined them with the 25–34 year-olds to form a 16–34 year-old baseline comparison group in our final regression models to increase power. For the same reason we also combined males and females for the final regression models. The majority of > 55 year-olds were younger than 70 (n = 2360, 96.3%). A small tail were aged > 70 years. The maximum age was 87. Age categories were based upon standardised UK reporting (Office for National Statistics, 2018). Summary statistics stratified by sex are presented in Table 1 (please refer to Table 1).

The outcome variable was derived from the survey question: "How do you usually get to your place of work?" Participants nominated their regular mode of transport only. A sample size calculation was performed to examine the possibility of looking at the effects of age on walking and cycling initiation and cessation separately. Due to the small number of participants changing to and from cycling during the study period this approach was not feasible. We subsequently categorised commute mode into two categories: Walking/cycling and public

Table 1
Participant socio-demographic and travel characteristics at wave 2.

	Male (n = 5081)	Female (n = 6478)	Missing data (n, %)
Age category (years), n (% of total)			–
16–24	190 (3.7)	279 (4.3)	
25–34	895 (17.6)	1083 (16.7)	
35–44	1374 (27.0)	1678 (25.9)	
45–54	1526 (30.0)	2083 (32.2)	
55 and older	1096 (21.6)	1355 (20.9)	
Commuting mode prevalence by age group in years			–
Walking or cycling, n (% of age group)			
16–24	37 (19.5)	47 (16.9)	
25–34	145 (16.2)	126 (11.6)	
35–44	178 (13.0)	204 (12.2)	
45–55	184 (12.1)	302 (14.5)	
> 55	111 (10.1)	220 (16.2)	
Public transport, n (% of age group)			
16–24	30 (15.8)	44 (15.8)	
25–34	124 (13.9)	168 (15.5)	
35–44	204 (14.9)	204 (12.2)	
45–55	195 (12.8)	248 (11.9)	
> 55	109 (10.0)	163 (12.0)	
Initiated active transport during study period by age group in years			–
Walking or cycling, n (% of age group)			
16–24	15 (7.9)	26 (9.3)	
25–34	65 (7.3)	43 (4.0)	
35–44	76 (5.5)	69 (4.1)	
45–55	57 (3.7)	75 (3.6)	
> 55	27 (2.5)	49 (3.6)	
Public transport, n (% of age group)			
16–24	20 (10.5)	26 (9.6)	
25–34	37 (4.1)	61 (5.6)	
35–44	64 (4.7)	60 (3.6)	
45–55	71 (4.7)	86 (4.1)	
> 55	37 (3.4)	48 (3.5)	
Ceased active transport during study period by age group in years			–
Walking or cycling, n (% of age group)			
16–24	34 (17.8)	43 (15.9)	
25–34	73 (8.2)	96 (8.9)	
35–44	86 (6.3)	87 (5.2)	
45–55	92 (6.0)	111(5.3)	
> 55	43 (3.9)	65 (4.8)	
Public transport, n (% of age group)			
16–24	18 (9.4)	34 (12.2)	
25–34	63 (7.0)	77 (7.1)	
35–44	57 (4.2)	67 (4.0)	
45–55	44 (2.9)	53 (2.5)	
> 55	31 (2.8)	35 (2.6)	
Ethnicity, n (%)			79 (0.6)
White British, Irish, other white	4408 (86.8)	5714 (88.2)	
Black/African/Caribbean/ Black British	115 (2.3)	238 (3.7)	
Asian/Asian British	422 (8.3)	348 (5.4)	
Other ethnic groups	95 (1.9)	140 (2.2)	
Highest qualification, n (%):			1650 (14.3)
Degree or higher	1353 (26.6)	1840 (28.4)	
Diploma or other equivalent	389 (7.7)	815 (12.6)	
A levels	390 (7.7)	387 (6.0)	
GCSE	1318 (25.9)	1596 (24.6)	
No formal qualifications	906 (17.8)	911 (14.1)	
Type of occupation, n (%)			180 (1.6)
Professional	381 (7.5)	316 (4.9)	
Managerial & technical	1977 (38.9)	2614 (40.4)	

(continued on next page)

Table 1 (*continued*)

	Male (n = 5081)	Female (n = 6478)	Missing data (n, %)
Skilled non-manual	739 (14.5)	1915 (29.6)	
Skilled manual	1051 (20.7)	347 (5.4)	
Partly skilled occupation	611 (12.0)	1034 (16.0)	
Un-skilled occupation	299 (5.9)	165 (2.6)	
Net equivalised monthly household income (GBP), mean (SD)	1760.4 (979.4)	1760.4 (979.4)	–
Has dependent children in the household, n (%)			–
Yes	2169 (42.7)	2765 (42.7)	
No	2908 (57.2)	3712 (57.3)	
Change in distance to work (miles), n (%)			307 (2.7)
< 3 miles no change	695 (13.7)	1352 (20.9)	
> 3 miles no change	3447 (67.8)	3739 (57.7)	
Change < 3 miles to > 3 miles	451 (8.9)	624 (9.6)	
Change > 3 miles to < 3 miles	367 (7.2)	577 (8.9)	
Regular access to car, n (%)			1183 (10.2)
Yes	4496 (88.5)	5322 (82.2)	
No	248 (4.9)	310 (4.8)	

transport. We created change variables to identify individuals who initiated or ceased walking/cycling or public transport between the two waves.

Based upon the existing literature we hypothesised a number of covariates that could confound the relationship between age and active travel and controlled for these in the analyses. These included sex, ethnicity, level of education, type of occupation, household income, whether participants had dependents, change in commute distance and access to a car. Many of these variables were derived and appendix 1 provides more information on their construction.

2.3. Statistical methods

All statistical analyses were performed using STATA version 14.1 (StataCorp). Data from waves two and six of the UKHLS were matched and converted into long format. Change variables were created for commute modes and change in distance from work. Frequency distributions and percentages were used to summarise categorical variables stratified by sex. All variables used in final models were categorical except for net equivalised monthly household income (GBP). This variable was summarised by mean and standard deviation and was approximately normally distributed. We developed unadjusted and adjusted logistic regression models to estimate the odds of initiation and cessation of walking/cycling and public transport in each age group compared to the combined reference group. Analyses were adjusted to account for confounders and the sampling strategy of the UKHLS using the recommended set of commands. Here the SVYSET command was specified with individual interview level as the primary sampling unit. Standard errors were estimated using the strata option with singleunit (scaled). Missing data was not imputed.

Ethical approval was not required for the secondary analysis of public data presented here, however the University of Essex ethics committee has approved the Understanding Society study. Approval from the National Research Ethics Service was obtained for the collection of biosocial data by trained nurses in waves two and six of the main Understanding Society survey.

3. Results

The analysis included data from 11,559 participants (5081 males and 6478 females). The average age of males at follow-up was 45 (range 20 to 82 years) and females 45 (range 19 to 87 years). Walking and cycling was more common among younger males adults (19.5% among 16–24 year-olds dropping down to 10.1% among > 55 year-olds). Walking and cycling prevalence had less of a gradient among females (16.9% for 16–24 year-olds and 16.2% of > 55 year-olds). Public transport use was highest among the youngest age group for both males and females (15.8% for both sexes), dropping down to 10.0% for > 55 year-old males and 12% for > 55-year old females.

Summary statistics show walking and cycling initiation was most common among the youngest group of males (7.9%) and females (9.3%) dropping to 2.5% and 3.6% for > 55-year-old males and females respectively. The direction and magnitude of reduction was similar for both sexes. Public transport initiation was also more common among the youngest males (10.5%) and females (9.6%) dropping to 3.4% and 3.5% in > 55 year-old males and females respectively. A similar direction and magnitude of change was observed in both sexes.

Descriptive statistics also show walking and cycling cessation was more common among the youngest age group of males (17.8%) and females (15.9%), dropping to 3.9% and 4.8% among > 55 year-old males and females respectively. Public transport cessation was also more common among the youngest age group of males (9.4%) and females (12.2%), dropping to 2.8% and 2.6% in the oldest age group for males and females respectively. The gradients and direction of change were similar for males and females in relation to walking/cycling and public transport cessation.

In adjusted models, compared to baseline (16–34 age group), 45–55-year-olds were significantly less likely to initiate regular walking or cycling during the study period (OR 0.66, p = 0.050), as were > 55-year-olds (OR 0.53, p = 0.017) (see Table 2). The reduction in walking and cycling initiation with age approximated a dose response relationship.

In multivariable models, 35–44 year-olds were significantly less likely to cease walking or cycling (OR 0.64, p = 0.016) compared to the 16–34-year-old group, as were 45–55 year-olds (OR 0.68, p = 0.019) and > 55-year-olds (OR 0.46, p < 0.001) (see Table 3). Finally,

Table 2
Associations between age and odds of initiating walking/cycling and public transport over a four-year period.

	Walking and cycling				Public transport			
	OR unadjusted		OR adjusted		OR unadjusted		OR adjusted	
	Odds of initiating (95% CI)	p-Value	Odds of initiating (95% CI)	p-Value	Odds of initiating (95% CI)	p-Value	Odds of initiating (95% CI)	p-Value
Age category (at wave 2)								
16–34 (reference group)	0	–	0	–	0	–	0	–
35–44	0.82 (0.59, 1.14)	0.236	0.99 (0.64, 1.55)	0.978	0.76 (0.55, 1.04)	0.085	1.19 (0.78, 1.80)	0.416
45–55	0.59 (0.43, 0.82)	0.001	0.66 (0.44, 1.00)	0.050	0.68 (0.49, 0.92)	0.014	1.21 (0.80, 1.82)	0.363
> 55	0.50 (0.35, 0.72)	< 0.001	0.53 (0.31, 0.89)	0.017	0.55 (0.38, 0.81)	0.003	0.97 (0.59, 1.59)	0.891

Adjusted = adjusted for sex, ethnicity, highest qualification, type of occupation, net equivalised household income (monthly), whether dependent children in the household, regular access to a car and change in distance to work (miles).

Table 3
Associations between age and odds of ceasing walking/cycling and public transport over a four-year period.

	Walking and cycling				Public transport			
	OR unadjusted		OR adjusted		OR unadjusted		OR adjusted	
	Odds of cessation (95% CI)	p-Value	Odds of cessation (95% CI)	p-Value	Odds of cessation (95% CI)	p-Value	Odds of cessation (95% CI)	p-Value
Age category (at wave 2)								
16–34 (reference group)	0	–	0	–	0	–	0	–
35–44	0.54 (0.42, 0.71)	< 0.001	0.64 (0.45, 0.92)	0.016	0.50 (0.36, 0.70)	< 0.001	0.49 (0.32, 0.76)	0.001
45–55	0.50 (0.39, 0.64)	< 0.001	0.68 (0.49, 0.94)	0.019	0.35 (0.25, 0.49)	< 0.001	0.33 (0.21, 0.50)	< 0.001
> 55	0.37 (0.27, 0.49)	< 0.001	0.46 (0.31, 0.69)	< 0.001	0.32 (0.22, 0.46)	< 0.001	0.28 (0.17, 0.48)	< 0.001

Adjusted = adjusted for sex, ethnicity, highest qualification, type of occupation, net equivalised household income (monthly), whether dependent children in the household, regular access to a car and change in distance to work (miles).

35–44-year-olds were significantly less likely to cease commuting by public transport (OR 0.49, $p = 0.001$) compared to the baseline, as were 45–55 year-olds (OR 0.33, $p < 0.001$) and > 55 year-olds (OR 0.28, $p < 0.001$). These relationships also approximated a dose response curve.

4. Discussion

To our knowledge this is the first study to specifically examine the relationship between life stages and uptake/cessation of active travel. We found that in adjusted models, middle and older age adults were significantly less likely to take up walking and cycling compared to younger adults. Surprisingly, middle and older age adults were also significantly less likely to cease walking, cycling and using public transport during the study period. Our summary statistics further suggest the above relationships are similar for both males and females although regression analysis stratified by sex was not possible. This suggests young adulthood is a critical period where long-term transport behaviours are shaped and that behaviours developed in this period could be maintained into middle age and older adult life.

4.1. Interpretation and generalisability

In their 2016 analysis of the UKHLS, Clark et al. suggest major life events, including changing commute distance and employment are key predictors for initiating and ceasing active travel (Clark et al., 2016). Our work builds on Clark et al.'s by holding these life events stable and stratifying results by age group. We found when accounting for the above factors a strong relationship exists between life stages and the initiation and cessation of active travel. Our finding that young adults in the UK are more likely to both initiate and cease active travel than their middle and older age peers could be interpreted through a developmental lens. Young adulthood is a time of experimentation characterised by increasing independence, exploration of personal values and developing a sense of how life should be structured and lived (Fuller, 2011) (Murtagh, 2017). It is possible that this exploration extends to transport behaviour. Younger adults may be more likely to try different forms of transport, including active travel, and if experiences are positive and the transport mode fits with their lifestyle and values to persist with it. This is plausible given in our analysis the relationship between age and commuting mode persisted despite controlling for a range of confounders including change in commute distance, car access, dependents and a host of socio-demographic factors. This self-selection may also help to explain the stability in commuting modes observed in middle and older aged adults. In their 2011 study, Panter et al. reported that older adults who regularly actively commuted were more likely to have developed long-term habits and positive psychological associations with active travel (Panter et al., 2011b), a finding that supports our developmental hypothesis. Qualitative evidence has suggested mechanisms around how social values and cultural norms can shape ideas around transport mode choice (Steinbach et al., 2011), although there is little evidence exploring how these values change across the lifespan. Further research interviewing younger and older active commuters regarding their ideas, values and experiences trialling different forms of commuting may help to shed further light on key transition points in this area.

Through linked datasets, Clark et al. also reported individuals who moved house and into areas with higher quality built environments were themselves more likely to initiate walking/cycling and public transport (Clark et al., 2016). Using the same dataset Hutchinson's et al. also reported differences in active travel commute mode prevalence between metropolitan and regional areas (Hutchinson et al., 2014). While the impact of the built environment on active travel was outside of the scope of this paper, it does raise interesting questions going forward. It is possible that some of the observed differences in active travel initiation and cessation in this study were due to differential effects of specific built environment features on different age groups. For example, younger participants may be more responsive to changing travel behaviours in the presence of particular types or densities of cycling infrastructure compared with older adults and vice versa. These types of relationships have been reported in the literature with respect to cycling infrastructure and gender (Garrard et al., 2008). It is possible that age related gradients exist for a broad range of built environment interventions. Future studies linking the UKHLS or other large sociodemographic datasets to high quality geospatial data could explore these hypothesised relationships.

Our findings also suggest critical age periods for policy interventions in active travel. Where age related gradients in active travel initiation and cessation exist, policies and programs could be tailored to maximally leverage these. For example, targeted tax relief or health promotion campaigns could be pitched at specific age groups to synergise or counterbalance these phenomena. Examples of the former could include modifying the UKs Cycle Mileage or Cycle to Work schemes through tax relief gradients that encourage greater behaviour change in specific age groups (Cycling, 2016). This strategy could hold significant appeal for policy makers particularly in contexts of limited fiscal resources, by allowing a more efficient allocation of funding for projects. Replication of these findings in other low-active transport countries would help with generalisability and informing future policy developments.

4.2. Strengths and limitations

This study benefited from the quality of the data in the UKHLS. The response rate was satisfactory, the data set nationally representative and we controlled for a wide range of predictors identified in the literature. Unfortunately, due to the relatively small number of cycle commuters in the dataset we were unable to look at the impacts of age on walking and cycling separately. A compromise was to combine cycling with walking as an outcome in our models. Walking and cycling commuting have some different predictors that may have affected the outcomes and conclusions drawn here. This is a recurrent problem in the active commuting literature due in part to cycle commuting being relatively uncommon in many datasets. Similar analyses of large datasets including Clark et al.'s 2016 analysis of the UKHLS and Flint & Cummins 2016 analysis of the health effects of active commuting in the UK (Flint and Cummins, 2016) have taken a similar approach in combining walking and cycling in their models.

Due to fewer younger adults in the dataset we needed to combine the 16–24 and 25–34-year-old age bands into a single group for regression analyses. This produced a sufficiently large baseline group to compare middle-aged and older-aged adult commuting behaviour to. It is likely that combining these groups led to an underestimation in odds ratios between age groups for both initiation and cessation of active travel. Future studies with larger proportions of younger adults could overcome this limitation. Similarly, due to sample size factors we were unable to stratify regression models by sex, however we note that in summary statistics the magnitude and direction of change in active travel initiation and cessation with age was similar for males and females.

Final limitations were our inability, due to sample size and available variables, to control for changes in all behavioural or health factors. For example, while it is likely that much of the behaviour change associated with moving to a new house, job or employer is captured by the change in commute distance variable it is possible that changes in commuting routes occurred during the study period that may have facilitated or inhibited active travel but escaped measurement. Furthermore, it is possible that older individuals were less likely to initiate active travel due to chronic diseases such as musculoskeletal conditions, chronic heart disease and respiratory problems. While this is possible, all participants in the study were sufficiently healthy to maintain employment. However, if health factors are a predictor for age related initiation of active travel, then our observation that older aged participants are also less likely to cease active travel could equally be explained by them having better physical health in part due to sustained use of active travel. This position is supported by Rouxel et al.'s 2017 observation that elderly UK public transport users have slower rates of decline in physical capabilities (Rouxel et al., 2017). Future linkage studies that take account of potential health confounders could address this limitation.

5. Conclusion

In the UK, middle and older age adults are less likely to initiate active travel compared to their younger counterparts. Middle and older aged adults are also less likely to cease using active travel, and commute modes become increasingly stable with age. The experiences of younger adults engaging with transport modes in formative years may help to reinforce self-selection for particular transport related behaviours in middle-aged and older age. A developmental perspective could help inform a clearer understanding of these processes. Active travel interventions may have differential impacts depending on the age groups targeted, a factor that could allow a more efficient and effective allocation of resources when developing future active travel policies.

Acknowledgments

This research was funded by The Shepherd Foundation, Victoria, Australia. The Shepherd Foundation had no input in the design, analysis or writing up of this research. The authors would also like to acknowledge the UK Data Service and Understanding Society for facilitating access to the data used in this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2018.11.008.

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