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Active travel in London: The role of travel survey data in describing population physical activity

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ABSTRACT

National population physical activity surveys may mask the patterns of active travel in urban areas with high public transport and lower car use. Transport for London's London Travel Demand Survey (LTDS) was analysed to understand key demographic correlates of active travel among London adult residents. LTDS is a rolling household survey carried out throughout the year with residents of London. Travel information is collected for household members aged five and over for a given travel day based on an annual sample of around 8000 households. Active travel by Inner and Outer London residents was analysed using a multivariate logistic regression of indicators related to active travel, including car ownership, bicycle use, age, gender, ethnicity, household income and employment. Social correlates of active travel were similar among Inner and Outer London residents. Significant differences in the likelihood of achieving 30 min of active travel were found by household car ownership, age, income, bicycle ownership and employment. People living in non-car owning households were between two and three times (OR 2.5 and 3.3) more likely to travel actively for 30 min on a given day than people in multi-car owning households. People who own and use a bicycle were around twice as likely (OR 1.8 and 2.2) to travel actively for at least 30 min compared to those who do not own a bicycle.

1. Introduction

Physical inactivity has been identified as the fourth leading cause of mortality globally (Lee et al., 2012). It is therefore a public health priority in the United Kingdom to raise population physical activity levels (PHE, 2014). The UK Active People Survey (APS) shows that 44 per cent of adults are not meeting the minimum level of 150 min per week of moderate intensity activity and that there are lower levels of self-reported physical activity among women, certain ethnic groups and those on low incomes (CO, 2014). Similar patterns and levels of activity are shown by the Health Survey for England (HSfE) (HSCIC, 2013). In response to this, a range of policies to boost activity and address these inequalities are currently being promoted (CO, 2014).

The APS shows that in London, self-reported physical activity levels are the same as for England as a whole, where only 56 per cent of adults report achieving 150 min of activity per week (SE, 2014). This has significant impacts on population health, and health services bear the burden of treating avoidable cases of long-term conditions (Scarborough et al., 2011). If adults in London were to meet a minimum standard of 150 min of activity per week then every year over 4100 fewer people would be expected to die – an 18 per cent reduction in all deaths. We could also expect to see a 13 per cent reduction in cases of type 2 diabetes (nearly 45,000 fewer people), an 11 per cent reduction in people diagnosed with coronary heart disease (over 1500 fewer people), a 20 per cent reduction in people diagnosed with breast cancer (over 700 people) and a 20 per cent reduction in people diagnosed with colorectal cancer (nearly 500 people) (PHE, 2013). There is a policy drive to raise population physical activity and reduce inequalities in activity among London residents (London Health Commission, 2014).

While APS and HSfE both have relatively small samples at a regional level, London has an additional source of physical activity data in the London Travel Demand Survey (LTDS). This survey covers a much larger sample of the population and is run annually, it may hold useful insights into the unique characteristics of activity levels, sedentarism and inequalities in London that cannot be drawn from APS or

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HSfE. London's transport system is unusual, compared with other cities in England and Wales, as there is higher public transport use, more walking and lower car use (GLA, 2014). This has impacts on the active travel behaviour of residents as walking is a part of many public transport trips (Besser and Dannberg, 2005). This walking can be for short periods of just a few minutes, and therefore may not be picked up through traditional physical activity surveys like the APS and HSfE which both rely on a four week recall of activity (PHE, 2015). The LTDS asks in detail for recall of the previous day's travel. It is more likely to pick up short walk trips and trip stages as recall is only for one day not four weeks (Steinbach et al., 2012). Sedentarism is increasingly understood as having an impact on disease risk independent of overall physical activity levels (Proper, et al., 2011). This lends a new significance to very short walk periods that fall below the 10 min threshold required for periods to contribute to meeting the Chief Medical Officers recommendations for activity (DH, 2011). Furthermore the widespread use of public transport (and therefore walking) across the London population may also mean that demographic patterns (e.g. gender) found in the uptake of physical activities in other sectors such as sport and leisure activities do not follow through to active travel.

Analysis of children's travel using this dataset showed that a much richer picture of active travel patterns can be elicited (Steinbach et al., 2012).This study analyses data collected through the LTDS for adults to understand patterns of any activity (1 min or more) by demographic characteristics and transport choices as an indicator of the role of travel in tackling sedentarism. Multivariate logistic regression for Inner and Outer London residents using a threshold of 30 min of active travel in a given day was also conducted to assess which factors most strongly correlate with being physically active through active travel. The results show that the factors seen as the strongest determinants of overall activity in the broader national physical activity surveys (gender, ethnicity, income) are of lesser importance among London residents in terms of active travel than household car ownership, bicycle ownership and age. This shows the valuable contribution a detailed high quality travel survey can make to understanding population activity levels and how to address inequalities in active travel.

2. Methodology

2.1. London Travel Demand Survey

The LTDS is a continuous household travel survey of the London area, which has been conducted each financial year since 2005/06 (TfL, 2015). The LTDS uses data from the Census to weight the survey sample to be representative of the total population of London, and in years between Censuses, the sample is expanded on the basis of mid-year population estimates from the Greater London Authority (GLA), which are ultimately based on the latest available Census year (GLA, 2015a, 2015b).

Although the survey is undertaken on a continuous basis, the LTDS is managed annually so that the sample achieved each (financial) year is representative of the population both across London and for each sub-region. The annual sample is of around 8000 households and the response rate for full interviews has been around 50 per cent each year since its inception, ranging from 54 per cent in 2008/09 to 49 per cent in 2013/14. The survey sample is drawn randomly each year from the Postcode Address File (PAF).

The LTDS comprises three components (questionnaires), which collect the following information:

- Household questionnaire – basic demographic information such as income, housing tenure and vehicle ownership, completed by a responsible adult.
- Individual questionnaire – completed by all members of the household aged 5 and over. This includes further demographic and travel-related information such as working status, frequency of use of transport modes, and details of driving licences and public transport tickets held.
- Trip sheets – completed by every household member aged 5 and over. This gathers data on all trips made on a designated travel day. The designated travel days are distributed across all seven days of the week. Details captured include trip purposes, modes used, trip start and end times, and the locations of trip origins and destinations. A trip is defined as a one-way movement from an origin to a destination to achieve a specific purpose, such as from home to the swimming pool or from work to the theatre.

The interviews are carried out by interviewers accredited by the Market Research Society (MRS) and according to standard protocols (MRS, 2014). The questionnaire forms for 2013/14 are included as supplementary file 1.

The LTDS methodology differs from that of the National Travel Survey (NTS) in some key respects. The LTDS is interviewer-led in respondents' homes, whereas NTS is based on a self-completed daily travel diary over a 7 day period. The LTDS captures all trips, including all walk stages, on a single travel day, whereas the NTS only captures short walks on the final day of the travel diary.

The challenge of capturing shorter trips in multi-day self-completion travel diaries is acknowledged in the methodology of the NTS by only recording short walks on the final day of the travel diary. For other modes of travel that are recorded over 7 days the NTS applies weighting by trip purpose to data collected via the travel diary, to correct for bias that sees a tailing off of responses during the travel week (DfT, 2015).

2.2. Sampling

Throughout the period 2005/06–2013/14, the LTDS survey area was divided into 528 Sample Control Areas (SCAs). SCAs are integral to the design of the sample, defining the stratification of the study area, into which interviewers are deployed. The number of addresses issued in each SCA (stint size) is calculated using a methodology which is designed to split the interviews amongst SCA's to achieve a mean of 15.2 interviews in each, thus spreading the desired 8000 interviews uniformly between the 528 SCAs. The calculation of stint sizes also reflects a strike rate deduced, in part, through shortfalls and surpluses against target experienced in previous survey years. This ensures an even geographical spread of sampled addresses, although non-response bias does remain an unquantified issue.

The stint size calculation uses results on response rates, ineligibles and multi-households for the current year (year n) and the preceding two years, years $(n-1)$ and $(n-2)$. These are then applied to the following year $(n+1)$. The calculations are done as late in the year

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as possible, so that they are based on up to date data for completed SCAs. The number of households interviewed in each sample area and comparison to the Census does allow the sample to be weighted to represent the whole London population, however, for this analysis the results have been analysed unweighted. Weighting the responses to the whole London population is suitable for analysing large scale trends such as the total level of car ownership in London or analysing changes in trends over time. However, given that the focus of the analysis in this case is the individual, the choices they make, and the factors that influence those decisions it is more suitable to analyse unweighted results. This avoids giving undue prominence to a relatively small subset of the population which would be necessary if trying to generalise the analysis to the whole London population.

To ensure a large enough sample size for all demographic variables, this analysis combines the survey years 2011/12, 2012/13 and 2013/14 to offer an overall sample of 24,112 households.

2.3. Characteristics of survey respondents

Between 2011/12 and 2013/14 there were a total of 40,547 respondents, who undertook a total of 119,856 active journey stages[1] on the day on which they were interviewed, which represents a mean of 3.0 active[2] stages per person per travel day. However, not all respondents travelled on the day on which their travel diary was completed – just under 30 per cent of respondents reported making no journeys at all (Table 1) – for those who did travel a mean of 4.2 active stages were completed.

Respondents included in the analysis were aged between 16 and 99, with a stable median age of 42 across all survey years. The age profiles between Inner and Outer London were slightly different with a median age of 39 in Inner London compared to 44 in Outer London.

Just over half of respondents (53.2 per cent) were female; again this was stable across the survey years. Table 2 outlines further demographic breakdowns of survey respondents.

2.4. Levels of active travel

Data were analysed from each individual's – aged 16 and over – trip sheet and the total time (minutes) spent undertaking active travel (walking, cycling, using a scooter or running) was summed across the day. However, it should be noted that journey interchanges, that is where a walk trip may be made as part of changing train within a station, are not counted as a separate active travel stage in terms of the definitions used in the survey.

People making 'some' active travel were classed as those who made a total of more than one minute of active travel in a day. This set the lowest possible bar for inclusion in the active travel group; active travel is likely to be underreported, short trips are most likely to be forgotten entirely or the length of these trips underestimated (Wolf et al., 2003). By setting a low bar for inclusion it allowed analysis of the widest possible group making some active travel.

People making no active travel were composed of two distinct sub groups; one group where some travel was made in the day but no part of it was active and a second where no trips of any kind were made in a day.

2.5. Creation of variables

A combined variable for household bike ownership and use was created from the household questionnaire and individual questionnaire data with three levels: no bike available to the household; bike available but respondent had not reported cycling in the past four weeks; and bike available to the household and the respondent reported cycling in the last four weeks.

A three level car ownership variable was created: no car available to the household; one car available; two or more cars available to the household.

The income bands were collapsed into three levels: a combined household income of less than £20,000 was defined as low income; between £20,000 and £49,999 defined as middle income; and £50,000 and above as a high income household. There were a number of reasons for this decision. Firstly it reduced the number of variables in the analysis: secondly these are the bands which most closely resemble those used by the Department of Work and Pensions in their National Statistics publications (DWP, 2013): thirdly there are approximately 30 per cent of households who do not know or refuse to give their household income and these are imputed by the interviewe. While the interviewers are experienced and are trained to do this there are likely to be far fewer categorical errors when income is considered at this less granular level. The 17 ethnic groups collected in the survey were collapsed according to the standard 4+1 ethnic classification groups recommended for use in England by the Office for National Statistics[3].

Respondents to the survey were geographically split into Inner and Outer London boroughs as defined in the London Plan Consultation 2009 based on Borough boundaries where the home borough was used to classify respondents. There are 12 Inner London boroughs (plus the City of London) and generally speaking Inner London boroughs have higher population densities, and lower levels of car ownership (Table 3).

In each of the categorical variable groups the comparator category was automatically selected in the analysis apart from ethnicity where white ethnicity was manually selected as the reference category.

[1] A trip is defined as a one-way movement from an origin to a destination to achieve a specific purpose, for example, to go from home to work. Each trip may involve travel by one or more individual modes of transport. These component parts of trips are referred to as journey stages.

[2] An active stage is any part of a journey made predominantly by walking or by cycling. Running and scooting are also included.

[3] Office of National Statistics methodology and guidance: ethic group. http://www.ons.gov.uk/ons/guide-method/measuring-equality/equality/ethnic-nat-identity-religion/ethnic-group/index.html#8

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Table 1
Summary of total respondents and travel.

	Survey year		
	2011/12	2012/13	2013/14
Survey respondents	13,633	13,585	13,329
% making no travel at all	29%	30%	29%

Table 2
Demographic breakdown of survey respondents

	Survey year		
Household structure	2011/12	2012/13	2013/14
Couple with children	24%	24%	24%
Couple with no children	35%	35%	37%
Lone parent	5%	5%	4%
Single adult	10%	11%	11%
Single pensioner[a]	7%	6%	6%
Other	20%	19%	17%
Ethnic group			
White	66.3%	66.2%	66.4%
Asian	16.4%	16.1%	16.3%
Black	10.7%	11.9%	11.1%
Any mixed background	2.3%	2.2%	2.2%
Other/refused	4.3%	3.6%	4.0%
Work status			
Full or part time employment	45%	45%	45%
Full or part time self-employment	10%	10%	11%
Unemployed	8%	8%	7%
Retired	19%	19%	19%
Student	9%	9%	9%
Other non-working[b]	9%	9%	8%

[a] A single pensioner is a person aged over 65 living in a property on their own.
[b] The other not working category includes; people doing voluntary work and Looking after home or family.

Table 3
List of Inner and Outer London boroughs.

London boroughs	**Inner London**	**Outer London**
	Camden	Barking and Dagenham
	Greenwich	Barnet
	Hackney	Bexley
	Hammersmith and Fulham	Brent
	Islington	Bromley
	Kensington and Chelsea	Croydon
	Lambeth	Ealing
	Lewisham	Enfield
	Southwark	Haringey
	Tower Hamlets	Harrow
	Wandsworth	Havering
	Westminster	Hillingdon
		Hounslow
		Kingston upon Thames
		Merton
		Newham
		Redbridge
		Richmond upon Thames
		Sutton
		Waltham Forest

2.6. Day of week constraints

The survey results show that patterns of travel do vary throughout the week. Results show that over 60 per cent of people interviewed during the week reported some active travel compared to just 55 per cent of people interviewed on a Saturday and just over 40 per cent on a Sunday. Day of the week was added as an explanatory variable in the analysis.

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Table 4
People making at least one minute of active travel per day by demographic characteristics

	Survey year			
	2011/12	2012/13	2013/14	All years
Percentage of all respondents making some active travel	58.0%	58.3%	58.4%	58.2%
Percentage of all respondents making some active travel by gender				
Male	57.0%	58.5%	57.9%	57.8%
Female	58.9%	58.2%	58.8%	58.7%
Percentage of all respondents making some active travel by ethnic group				
White	57.7%	58.9%	59.0%	58.5%
Asian	53.9%	52.5%	52.7%	53.1%
Black	63.4%	61.5%	62.3%	62.4%
Any mixed background	69.1%	65.9%	67.2%	67.4%
Other/refused	58.1%	59.3%	54.9%	57.4%
Percentage of all respondents making some active travel by household income				
Low household income	59.3%	58.1%	57.5%	58.3%
Middle household income	57.1%	58.5%	58.7%	58.1%
High household income	57.3%	58.4%	59.0%	58.3%
Percentage of all respondents making some active travel by household car availability				
No car	73.2%	70.8%	70.5%	71.5%
One car	54.0%	55.3%	55.9%	55.1%
Two or more cars	43.4%	43.9%	44.7%	44.0%
Percentage of people who made no active travel who made no trips at all	68.4%	71.3%	69.1%	69.6%

2.7. Socio-demographic predictors of active travel

Due to the over-dispersed and zero-heavy nature of the distribution of active travel minutes among the population few of the conditions of a standard regression were fulfilled. Therefore, in order to determine the factors that influence active travel a multivariate logistic regression was carried out. As the travel diary was collected only for a single day and there is little information on the day to day variation that may exist in an individual's travel it was not possible to directly measure against the recommended 150 min of activity per adult per week (DH, 2011). Thirty minutes of activity five days per week is commonly recommended for achieving the recommended activity levels, therefore 'active travel' has been defined as a binary condition achieved by any respondent who had reported at least 30 min of travel by walking, cycling or a combination of these two activities in their travel diary, reflecting the current recommendation that adults should accumulate at least 30 min of moderate-intensity physical activity on most days of the week (Ogilvie et al., 2008). The independent variables included in the model were the socio-demographic variables. All terms were entered in the initial model and this was tested against a null model with no predictors.

In order to test the impact of living in different parts of London two separate models were fitted for Inner and Outer London to test the impact of the socio-demographic variables in each.

3. Results

Table 4 outlines active travel behaviour by demographic characteristics. It shows that a majority of respondents (around 58 per cent) make some active travel[4] as part of their daily travel, at.

3.1. Gender

There is no statistically significant effect of gender on the likelihood of making some active travel although females are slightly more likely to make some active travel than males.

3.2. Age

For all ages from 16 up to around late-30s the percentage of people making some active travel is fairly consistent (65 per cent), it is also consistent across the survey years. From ages of around 40 to late-70s there is a near linear decline in the percentage making some active travel and by age 80 fewer than half are making some active travel. This trend accelerates through ages 80–90 and by age 90 fewer than 3 in 10 people are making any active travel at all (Chart 1).

[4] Some active travel is defined as at least one stage made by walking or cycling on the travel day, regardless of length

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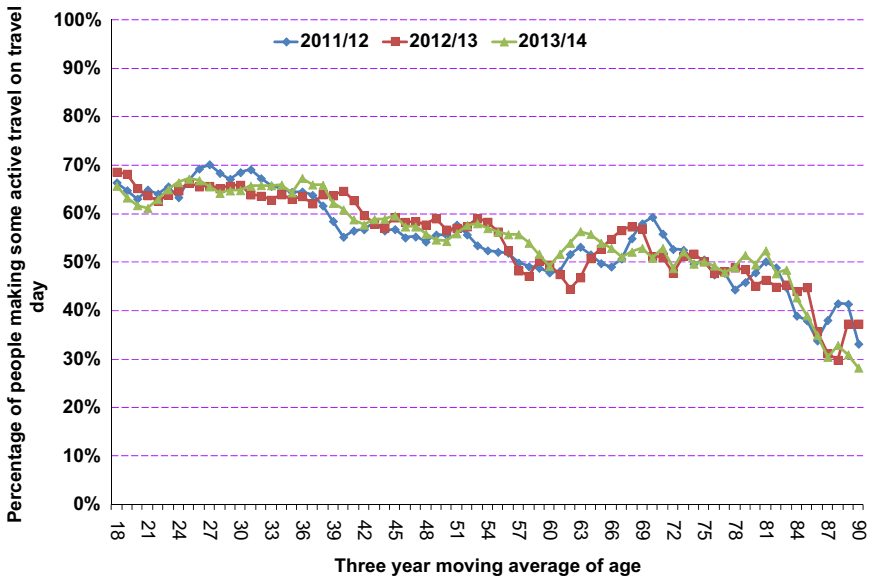

Chart 1. Percentage of people making some active travel by age (3 year moving average), 2011/12–2013/14.

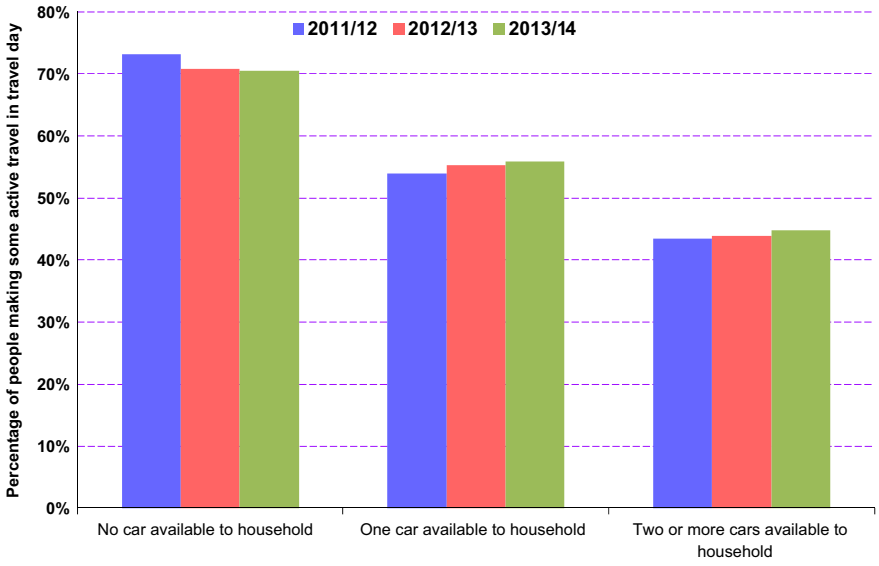

Chart 2. Percentage of people making some active travel by household car availability, 2011/12–2013/14.

3.3. Ethnicity

There are some differences between ethnic group with over half (58.5 per cent) of white people, a higher proportion of black people (62.4 per cent), and over two thirds (67.4 per cent) of people from mixed backgrounds making some active travel in a day (Table 2). Those of Asian ethnicity are least likely to make some active travel – just over half (53.1 per cent) – 14 percentage points lower than the equivalent figure for those from a mixed background across the three survey years. This does not take into account any other demographic differences between the ethnic groups. Other differences between them, such as income levels, age or car ownership may also affect the levels of active travel.

3.4. Access to a car

People living in a household with access to a car are more likely to report that they have made no active travel in a day. Just over 70 per cent of those in non-car owning households report some active travel compared to 55 per cent of those living in one car households and 44 per cent of those in households with access to two or more cars (Chart 2).

3.5. Association of active travel with public transport use

Not making any active travel in a day is strongly associated with not making any travel of any type in a day. Just under 70 per cent of people who made no active travel made no trips of any sort in that day (Table 4). Of those who make some travel in a day yet no active travel nearly 95 per cent of trips are made by private transport (car, van or motorbike, as driver or passenger). By contrast 98 per cent of

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Table 5
Distribution of active travel stages with alternative main mode[a].

Main mode for Trip	Percentage of all active travel that is part of a trip using this main mode (%)	Average length of active travel stage associated with this main mode
Bus	17	4 m 38 s
National Rail/ overground	10	6 m 34 s
Private transport	4	49 s
Taxi/other	0	51 s
Underground/DLR	14	6 m 15 s
Walk	49	13 m 04 s
Cycle	6	20 m 10 s

[a] The main mode is the one which was used to cover the greatest distance for the end to end trip.

bus trips involve an active travel stage, of any length, as do over 99 per cent of underground, DLR and National Rail stages. The equivalent figure for all car driver trips is just 80 per cent.

For trips made by private motorised transport – where an active travel stage was involved – the average length of active stage was 49 s. In comparisontrips made by bus involved an average active travel stage of just under five minutes; for rail based main modes it was over six minutes.

Nearly half of all of the time spent travelling actively by London residents (42 per cent) is undertaken as part of a journey that involves a public transport main mode (Table 5), 17 per cent of all active travel is made as part of a bus trip, 24 per cent as part of a rail based main mode, and four per cent as part of a private transport trip. Fifty-six per cent of all the active travel made by London residents is made where an active mode (walking or cycling) is the main mode with 49 per cent of all active travel time made as part of trips where the main mode is walking.

3.6. Predicting 30 min of active travel in Inner London

In Inner London the model of socio-demographics provided reasonable improvement on the null model (a model with no explanatory variables) (Hosmer and Lemeshow test: $X^2=13.247$, df=8, $p=0.104$). The model explained just over 10 per cent of the variance in active travel (Nagelkerke's $R^2=12.0$ per cent).

Active travel was significantly and positively associated with having fewer than two cars available to the household, owning and having used a bicycle recently, being in full time employment, being of white ethnicity (compared to all ethnicities except for those of mixed ethnicity), not having a disability, having a household income above £50,000, not being unemployed or retired, being younger, and being female. People were half as likely to travel actively at the weekend as on weekdays (Table 6 and Chart 3).

3.7. Predicting 30 min of active travel in Outer London

In Outer London the model provided better goodness-of-fit over the null model than in Inner London (Hosmer and Lemeshow test: $X^2=8.042$, df=8, $p=0.429$) but explained less of the observed variance (Nagelkerke's $R^2=10.0$ per cent).

Active travel was significantly associated with being younger, having fewer than two cars available to the household, not being self-employed or unemployed, having a household income above £50,000, not having a disability, and owning a bicycle regardless of whether it has been used recently. People were half as likely to travel actively at the weekend as on weekdays (Table 7 and Chart 4).

4. Discussion

4.1. The role of public transport

Active travel is a primary source of activity for Londoners. A majority (58 per cent) of Londoners make some active travel on a given day. There is a strong link with public transport as nearly half (42 per cent) of all active travel undertaken by the sample is made as part of a public transport trip with nearly a fifth (17 per cent) of all active travel being made as part of bus trip, and a quarter (24 per cent) as part of a rail based trip – including Underground, DLR, London Overground or National Rail. By contrast less than five per cent (four per cent) of active travel is made as part of a car trip. This demonstrates the importance of public transport to population physical activity levels in London. As the literature on sedentarism grows, further analysis of the role of public transport in breaking up prolonged periods of sitting in the daily routine would be useful (Owen et al., 2011).

4.2. Factors influencing active travel – Car ownership

The analysis of active travel and the factors that influence achieving 30 min of active travel show that car ownership has the strongest association with active travel levels. The impact of not owning a car is significantly higher in Outer London. A non-car owning household member in Inner London is 2.49 times more likely to make over 30 min of active travel in their travel day than a car owning household member. In Outer London, someone from a non-car owning household is 3.33 times more likely to make over 30 min of active travel in their travel day than a car-owning equivalent. The difference in physical activity between Inner and Outer London car owners may reflect

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Table 6
Multivariate logistic regression model of predictors of achieving 30 mins of active travel in Inner London.

Inner London		95% Confidence intervals		
	Odds ratio	**Lower bound**	**Upper bound**	***p*-Value**
Variable				
Age	0.99	0.991	0.997	0.00
Work status (reference other non-working*)				
Full part time employment	1.16	1.018	1.331	0.03
Full or part time self-employment	0.96	0.812	1.123	0.58
Unemployed	0.72	0.608	0.863	0.00
Retired	0.70	0.583	0.846	0.00
Student	0.98	0.833	1.162	0.85
Gender (reference female)				
Male	0.92	0.856	0.987	0.02
Ethnicity (reference white)				
Other/refused	0.72	0.614	0.842	0.00
Any mixed background	0.91	0.735	1.123	0.37
Black	0.69	0.620	0.763	0.00
Asian	0.59	0.530	0.663	0.00
Day of the week (reference weekday)				
Weekend	0.51	0.470	0.551	0.00
Car ownership (reference two or more cars in household)				
No car in household	2.49	2.180	2.841	0.00
One car in household	1.54	1.355	1.754	0.00
Houshold income (reference income above £50,000)				
Household income below £20,000	0.79	0.716	0.875	0.00
Household income between £20,000 and £49,999	0.86	0.784	0.936	0.00
Disability (reference no reported disability)				
Self-reported disability	0.55	0.480	0.626	0.00
Household has access to a bike (reference no bikes available to household)				
Bike available and cycled recently	1.80	1.626	1.993	0.00
Bike available but not cycled recently	1.06	0.971	1.154	0.20

*The 'other non-working' category includes: people doing voluntary work and Looking after home or family

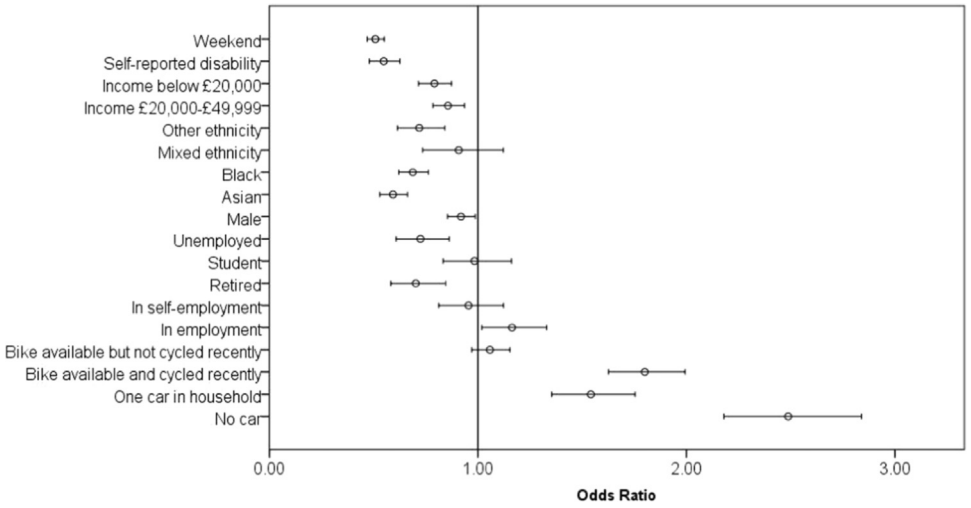

Chart 3. Predictors of achieving 30 min of active travel for Inner London, odds ratio compared to reference category with 95 per cent confidence limits.

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Table 7
Multivariate logistic regression model of predictors of achieving 30 min of active travel in Outer London.

Outer London		95% Confidence intervals		
	Odds ratio	**Lower bound**	**Upper bound**	***p*-Value**
Variable				
Age	0.99	0.986	0.991	0.00
Work status (reference other non-working*)				
Full or part time employment	1.06	0.950	1.192	0.28
Full or part time self-employment	0.76	0.653	0.878	0.00
Unemployed	0.78	0.665	0.918	0.00
Retired	1.02	0.876	1.193	0.78
Student	0.98	0.838	1.136	0.75
Gender (reference female)				
Male	0.99	0.927	1.052	0.70
Ethnicity (reference white)				
Other/refused	0.90	0.762	1.074	0.25
Any mixed background	0.88	0.715	1.080	0.22
Black	0.93	0.840	1.034	0.19
Asian	0.81	0.741	0.877	0.00
Day of the week (reference weekday)				
Weekend	0.50	0.470	0.542	0.00
Car ownership (reference two or more cars in household)				
No car in household	3.33	3.028	3.663	0.00
One car in household	1.66	1.533	1.792	0.00
Houshold income (reference income above £50,000)				
Household income below £20,000	0.81	0.743	0.889	0.00
Household income between £20,000 and £49,999	0.86	0.796	0.927	0.00
Disability (reference no reported disability)				
Self-reported disability	0.55	0.492	0.623	0.00
Household has access to a bike (reference no bikes available to household)				
Bike available and cycled recently	2.15	1.957	2.367	0.00
Bike available but not cycled recently	1.25	1.167	1.345	0.00

*The 'other non-working' category includes: people doing voluntary work and looking after home or family.

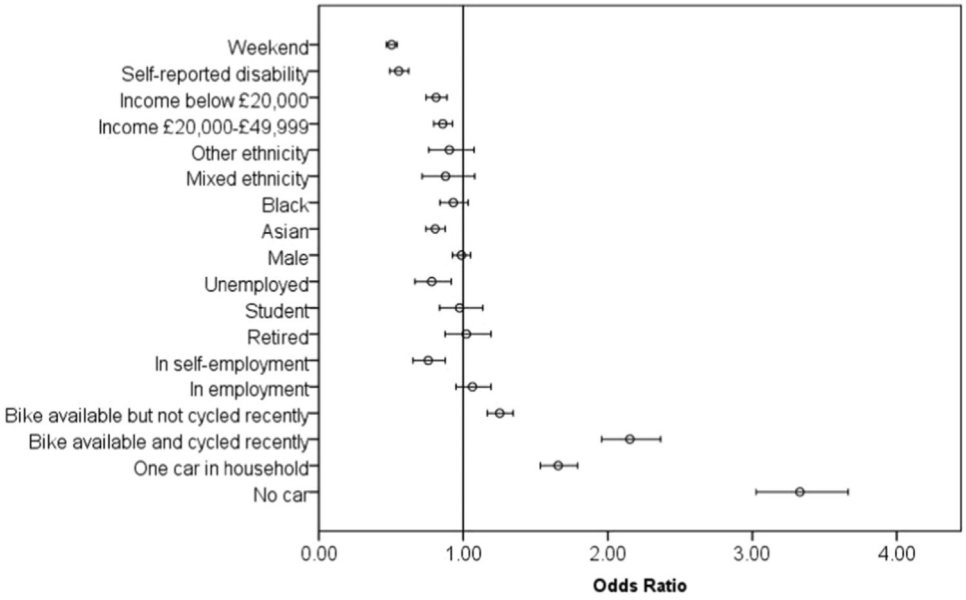

Chart 4. Predictors of achieving 30 min of active travel for Outer London, odds ratio compared to reference category with 95 per cent confidence limits.

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the necessity of using a car in areas with poorer public transport access or perceived norms around car use in high car-use areas compared to Inner London where car use may be more discretionary.

4.3. Factors influencing active travel – Bicycle use

Cycling only makes up 6 per cent of overall active travel. However owning a bicycle had the second strongest association with active travel (not necessarily by actually cycling). For Outer London those who owned a bicycle and had cycled recently were 2.15 times more likely to achieve 30 min of active travel than those who did not. Those who owned a bicycle but who had not cycled recently still were 125 per cent more likely to have made over 30 min of active travel. For Inner London, those who had a bicycle available to them and who had cycled recently were 1.8 times more likely to achieve 30 min of active travel in a day compared with those who did not. However, those who owned a bicycle but had not cycled recently were not more likely to have made over 30 min of active travel than those without a bicycle.

4.4. Factors influencing active travel – Age

Although the age profiles for Inner and Outer London are different with the median age of respondents in Outer London five years older than those from Inner London the impact of a single year increment in age is the same in both. For each year older a respondent was, the odds of them completing 30 min of active travel on their travel day reduce by a factor of 0.99. Future analysis may look at the differing impact of age within different age segments of the population. It is likely that the influence of age on the likelihood of achieving certain levels of active travel is not strictly linear and an adaptive or segmented regression technique may be more appropriate at determining the effect of increasing age.

4.5. Factors influencing active travel – Ethnicity

Ethnicity has a differing impact in Inner and Outer London. In Outer London only the comparison between White and Asian ethnicity was statistically significant. There were no statistically significant differences between white and black, mixed or other ethnicities. People of Asian ethnicity were 19 per cent less likely to travel actively than people of white ethnicity. In Inner London comparisons between White and other ethnicities, except those of mixed backgrounds, were statistically significant. People of Asian ethnicity were 41 per cent less likely to achieve 30 min of active travel in a day, people of black ethnicity 31 per cent less likely and people of 'other' ethnicity 28 per cent less likely to be active. There is not a clear picture on the relationship between ethnicity and active travel. Different patterns appear depending on what threshold of 'activity' is used. For example, those of black ethnicity were more likely to make some active travel (at least one minute of active travel per day) than those from the white ethnic group (62.4 per cent compared to 58.5 per cent); however, Outer London residents of black ethnicity were equally likely to achieve 30 min of active travel per day as people of white ethnicity, but less likely to achieve it in Inner London.

4.6. Factors influencing active travel – Gender

Gender differences in overall physical activity and in uptake of sporting activity are widely reported (Stamatakis and Chaudhury, 2008). However the data describing active travel in London shows no statistically significant difference in doing doing 30 min of active travel in Outer London. In Inner London men were slightly less likely to achieve 30 min of activity (OR 0.92 (CI: 0.86–0.99).

4.7. Factors influencing active travel – Income

Income is another factor that is often associated with differences in overall activity (PHE, 2014). Our analysis showed that people who were not from higher income households (below than £50,000) were statistically significantly less likely to travel actively. In Inner London unemployed people and retired people were less likely to travel actively compared to those in the 'other non working' category. People in full or part-time employment were more likely to travel actively: this may be a reflection of whether individuals had a reason to travel on a given day for work which could generate some active travel. In Outer London there was a different picture with only those who were self-employed or unemployed being significantly less likely to travel actively than 'other non working' and no groups being more likely to travel actively. This may reflect higher levels of car use for commuting in outer London compared with inner London.

4.8. Strengths and weaknesses and future research

Such detailed analysis of a transport survey for understanding adult population physical activity levels across all types of travel has not previously been done in the UK to our knowledge. The National Travel Survey (NTS) does not have a large enough sample size to allow this type of analysis for a city population. The NTS does collect data of travel activities over a week, rather than just one day which could build a better picture of an individual's general activity patterns than the LTDS.

A cut-off of 30 min active travel accumulated throughout the day was used for this analysis. This was considered a reasonable and practical means of setting an indicator for activity but does not reflect the distribution of the survey sample in relation to each variable. More detailed analysis, for example examining the data by active travel periods of ten minutes or more, to align with the Chief Medical Officers' physical activity recommendations may produce a richer picture.

Reviews of correlates of physical activity show that some personal factors such as self-efficacy and health status are related to activity levels. These individual factors and factors such as social norms which could be pertinent predictors of active travel (Bauman et al., 2012) are not routinely collected in transport surveys (which are not designed primarily for understanding population physical activity patterns).

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The differences between people living in households in Inner and Outer London suggest that ecological model factors such as land use density and access to public transport may be as, or even more, influential than individual level factors (Bauman et al., 2012). Further analysis of this data controlling for variables such as age may help to identify the strongest determinants of active travel.

Recent studies in the Netherlands and the UK (Fishman et al., 2015, Belanger et al, 2011) showed the strong predictive value of performing any active travel in achieving the recommended physical activity levels per week. Given the known cost-effectiveness of active travel in promoting physical activity (NICE, 2012) this adds further value to ensuring that policy makers can access data on the active travel patterns in their population and determine the strongest influencers on active travel.

5. Conclusion

This study suggests that active travel, particularly walking, is a key source of physical activity and may have a role in tackling sedentarism through using public transport instead of private cars.

Demographic patterns seen in broader physical activity surveys do not appear to follow through to active travel in London. The strongest associations lie with car ownership, age and bicycle ownership. There are not clear patterns associated with ethnicity or gender and there is not a strong relationship with household income. This has implications for policy makers when considering which groups to 'target' with active travel interventions. This analysis of the London Travel Demand Survey also raises the issue of validity in national population physical activity and travel surveys. National surveys which record behaviour over longer periods may be prey to recall bias that results in some shorter active travel periods being excluded. The growing interest in the independent effects of sedentarism on disease risks raises the importance of capturing very short periods of activity in surveys. Likewise the urgency to fully understand the local determinants of physical activity to identify effective policies to tackle sedentarism is rising as our understanding of the breadth of the health impacts of inactivity grows.

This new analysis of transport survey data from a public health perspective shows there are valuable insights to be gained by bringing together transport and public health sectors. Given the imperatives for both sectors to understand how to increase active travel there could be benefits to more detailed population surveys of travel patterns with additional analysis of the determinants of time spent travelling actively.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jth.2016.02.003.

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