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RESEARCH

Associations between active commuting, body fat, and body mass index: population based, cross sectional study in the United Kingdom

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Abstract

Objective To determine if promotion of active modes of travel is an effective strategy for obesity prevention by assessing whether active commuting (walking or cycling for all or part of the journey to work) is independently associated with objectively assessed biological markers of obesity.

Design Cross sectional study of data from the wave 2 Health Assessment subsample of Understanding Society, the UK Household Longitudinal Study (UKHLS). The exposure of interest, commuting mode, was self reported and categorised as three categories: private transport, public transport, and active transport.

Participants The analytic samples (7534 for body mass index (BMI) analysis, 7424 for percentage body fat analysis) were drawn from the representative subsample of wave 2 respondents of UKHLS who provided health assessment data (n=15 777).

Main outcome measures Body mass index (weight (kg)/height (m)^2); percentage body fat (measured by electrical impedance).

Results Results from multivariate linear regression analyses suggest that, compared with using private transport, commuting by public or active transport modes was significantly and independently predictive of lower BMI for both men and women. In fully adjusted models, men who commuted via public or active modes had BMI scores 1.10 (95% CI 0.53 to 1.67) and 0.97 (0.40 to 1.55) points lower, respectively, than those who used private transport. Women who commuted via public or active modes had BMI scores 0.72 (0.06 to 1.37) and 0.87 (0.36 to 0.87) points lower, respectively, than those using private transport. Results for percentage body fat were similar in terms of magnitude, significance, and direction of effects.

Conclusions Men and women who commuted to work by active and public modes of transport had significantly lower BMI and percentage body fat than their counterparts who used private transport. These associations were not attenuated by adjustment for a range of hypothesised confounding factors.

Introduction

The beneficial effects of physical activity on obesity and related health outcomes are generally well understood.[1] In high and middle income countries however, lifestyles have become increasingly sedentary, and physical inactivity has become the fourth leading risk factor for premature mortality.[2] Declining rates of functional active travel have contributed to this population-level decrease in physical activity, and ecological evidence suggests that rising levels of obesity are more pronounced in settings with greater declines in active travel.[3 4] Active commuting to work has been strongly recommended by the UK National Institute for Health and Care Excellence (NICE) as a feasible way of incorporating greater levels of physical activity into daily life.[5] Data from the 2011 census show that in England and Wales 23.7 million individuals regularly commute to a workplace—more than half of the 41.1 million adults of working age covered by the census.[6] With 67% modal share, private motorised transport is by far the most common commuting mode reported, followed by public transport (18%), walking (11%), and cycling (3%).[6] Policies designed to effect a population-level modal shift to more active modes of work commuting therefore present major opportunities for public health improvement.

Studies consistently suggest that use of active commuting modes translates into higher levels of overall individual physical activity.[7-9] A recent UK study provided 103 commuters with accelerometers for seven days and found that total weekday physical activity was 45% higher in participants who walked to work compared with those who commuted by car, while no differences in sedentary activity or weekend physical activity were observed between the two groups.[9] However, the definition of "active commuting" should not be limited to walking and cycling. Previous research has suggested that travelling by public

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transport involves significantly more exertion than using private transport, as walking is generally required between public transport hubs and journey origins and destinations.[10] However, there is limited research on the potential population health benefits of encouraging the use of public transportation.

Systematic reviews generally suggest that active commuters have a lower risk of self reported overweight.[11 12] Recent research by Laverty et al found that active commuting was associated with a lower likelihood of self reported overweight based on data from a large, nationally representative UK study.[13] However, there is a lack of evidence linking active commuting to objectively measured markers of obesity. A recent, wide ranging, systematic review of the evidence for health benefits of active travel concluded that there is little robust evidence of the effectiveness of active transport interventions for reducing obesity.[14] The authors called for stronger study designs using objectively measured exposure and outcomes, and greater efforts to address potential confounding such as by non-travel physical activity.[14]

The aim of the present study is to investigate the relationship between active commuting and two objectively measured markers of obesity using Understanding Society, the UK Household Longitudinal Study (UKHLS), a large, nationally representative dataset.

Methods

Study design and sample

Data from wave 2 of the UKHLS were used.[15] The UKHLS is a longitudinal panel survey which began in 2009 with a representative sample of 40 000 UK households.[16] Detailed information on the study and its sampling methodology is reported elsewhere.[17] Participants are surveyed annually and contribute information relating to their socioeconomic circumstances, attitudes, and behaviours via a computer assisted interview. At wave 2 (n=54 587), a representative sample of participants (n=15 777, ~30%) were also visited by a nurse to provide objective health assessment data.[18 19] For the purposes of the present study, the sample was initially restricted to participants in the health assessment who had complete data for commuting mode (n=7944). A further 337 individuals were dropped for having missing data for one or more covariate. As the study investigated two different biological markers for obesity, two separate analytic samples were then derived. These two analytic samples were restricted to those with complete data for the relevant outcome (body mass index (BMI) or percentage body fat) and all selected covariates: (i) BMI analysis sample (n=7534: 3409 men and 4125 women); (ii) percentage body fat analysis sample (n=7424: 3359 men and 4065 women). Of these, 7391 individuals appeared in both analytic samples, with a further 143 featured in the BMI sample only and 33 in the percentage body fat sample only, making a total of 7567 individuals featuring in one or both analytic samples. The two analytic datasets were found to be representative of one another, with no significant differences in the distributions of all analytic variables found. Therefore, in the interests of concision, only descriptive analysis of the BMI sample (n=7534) is presented. Ethical approval was not required for the analysis of secondary data presented here.

Data and variables

The exposure of interest was active commuting. This information was derived from responses to the following question: “How do you usually get to your place of work?” Respondents were asked to indicate which of the 10 listed transportation modes represented their main means of commuting to work. Participants were only able to select one main mode, meaning that information on multi-mode trips, such as walking to or from public transport hubs, were not captured. This variable was used to derive a three category exposure variable for use here: (i) private transport (car driver or passenger, taxi/minicab, motorcycle/moped/scooter); (ii) public transport (bus/coach, train, underground/metro/light railway); (iii) active transport (walking or cycling). These three categories are conceptualised as ordered, with private transport assumed to involve the lowest levels of physical exertion and active transport the highest. It is assumed that users of public transport generally incorporate an intermediate level of physical exertion into their journey, by walking to and from stations and stops.[10]

Two objectively measured biological markers of obesity were investigated: BMI and percentage body fat. These were measured during the health assessment visit by a registered nurse who had received specialised training. BMI was calculated using the standard equation (weight (kg)/height (m)^2) from height and weight measured with a portable stadiometer and digital floor scale placed on a hard, level surface. Weight was assessed with a single measurement and recorded to the nearest 0.1 kg. Height was assessed with a single measurement and recorded to the nearest millimetre. Percentage body fat was measured by electrical impedance analysis using a digital floor scale (Tanita BF 522) to send electrical current through the body via the feet. Percentage body fat was estimated using the assumption of “standard” body type.[19] More detailed technical information about the health assessment protocols and outcomes is available elsewhere.[19]

A range of factors hypothesised to confound the relationship between active commuting and obesity were identified: age (continuous and mean-centred); the presence of a limiting illness or disability (binary variable); monthly household income (logged, mean-centred, and equivalised using the Organisation for Economic Co-operation (OECD) modified scale[20]); occupational social class (standard three-category version of the National Statistics Socioeconomic Classification (NS-SEC), used as a categorical variable); level of physical activity in the workplace (a four-category variable of very physically active, fairly physically active, not very physically active, not at all physically active in the workplace); participation in sporting activity (self assessed level of sports participation from 0 (no sport at all) to 10 (very active through sport)); diet quality (approximated using number of days per week that vegetables were consumed: never, 1-3 days, 4-6 days, every day); and whether the respondent resided in an urban or rural area (binary variable derived from the Office for National Statistics Rural and Urban Classification of Output[21]).

Statistical analysis

Descriptive analysis was undertaken in order to assess the prevalence of the different commuting modes in the study population, the distributions of BMI and percentage body fat in the sample, and the patterning of the hypothesised confounding factors. Each outcome was operationalised as a continuous variable so multivariate linear regression analysis was used to investigate the relationship between active commuting and each of the two outcome variables, adjusting for the effects of hypothesised confounding factors. We found significant differences in commuting mode prevalence by sex (χ^2 test, P<0.001), and significant sex differences in the outcome variables BMI (*t* test, P=0.002) and percentage body fat (*t* test, P<0.001). Linear regression analysis was therefore stratified by sex. All analyses were undertaken with Stata 12 software[22] using the appropriate sampling probability weights provided with the UKHLS health assessment data.[19 23]

Results

Descriptive analysis of the BMI analytic sample is presented in table 1⇓. Mean (SD) age was 44 (12.9) years for men and 43 (12.4) years for women. In the BMI analytic sample (3409 men, 4125 women), 76% of men and 72% of women commuted by private transport modes (predominantly car), 10% of men and 11% of women reported public transport as their main commuting mode, and 14% of men and 17% of women walked or cycled to work. Overall mean (SD) BMI was 28 (5.1) for men and 27 (5.7) for women. Mean (SD) percentage body fat was 23% (9.4%) for men and 36% (8.4%) for women. Among both men and women, 27% reported a longstanding illness or disability. Sixty three per cent of men and 60% of women described themselves as very or fairly physically active at work. Men reported a mean sporting and recreational physical activity level of 4.3 (SD 3.0) on a scale of 0–10, compared with a mean score of 3.6 (2.7) for women. Seventy eight per cent of the sample resided in an urban area. As noted above, the percentage body fat analytic sample was representative of the BMI sample on all analytic variables.

Body mass index

Table 2⇓ shows the results of sex stratified multivariate linear regression modelling to investigate the relationship between active commuting and BMI. Compared with using private transport, commuting via public and active modes was significantly predictive of lower BMI in unadjusted, age adjusted, and fully adjusted models for both men and women. Overall, effect sizes were similar for public and active modes of transport. In both cases, adjustment for hypothesised confounders did not substantially attenuate the relationship when compared with unadjusted or age adjusted models.

Effect sizes were generally greater for men than for women. In unadjusted models, men who commuted via public transport had BMI scores 1.43 (95% confidence interval 0.84 to 2.01) points lower than those who used private transport, while men who used active transport had scores 1.41 (0.85 to 1.97) points lower. Adjustment for age reduced these differences to 1.05 (0.49 to 1.61) and 1.01 (0.45 to 1.57) points lower respectively. Further adjustment for the full range of hypothesised confounding factors did not greatly affect the magnitude or significance of these effects.

For women, a similar picture emerges from regression modelling, albeit with smaller effect sizes. In unadjusted analysis, women who commuted via public or active modes had BMI scores 0.94 (0.26 to 1.62) and 0.86 (0.36 to 1.35) points lower respectively than women using private transport. These coefficients were attenuated to some degree in age adjusted models, but further adjustment for hypothesised confounding factors in the fully adjusted model did not reduce effect sizes further.

Percentage body fat

The results of sex stratified, multivariate linear regression modelling presented in table 3⇓ indicate that commuting via active or public transport is significantly associated with lower percentage body fat compared with commuting via private transport. This significant association was found for both men and women, and was not greatly attenuated by adjustment for age and a range of hypothesised confounding factors. These results corroborate our similar findings for BMI.

Effect sizes in unadjusted and age adjusted models were greater for men than for women, but adjustment for the full range of hypothesised confounding covariates attenuated the central associations to a greater degree for men than for women, resulting in effect sizes which were similar in the fully adjusted models. In unadjusted analysis, men who commuted via public or active modes had body fat 2.42 (1.23 to 3.60) and 2.22 (1.14 to 3.30) percentage points lower respectively than men who used private transport. After adjustment for the full range of hypothesised confounding factors, men who used public transport for their commute to work had body fat 1.48 (0.32 to 2.65) percentage points lower than men who used private transport, while men who used active transport had body fat 1.35 (0.29 to 2.41) percentage points lower. In unadjusted analysis, women who commuted via public or active modes had body fat 1.97 (0.87 to 3.08) and 1.39 (0.56 to 2.22) percentage points lower respectively than women using private transport. These coefficients were attenuated to some degree in age adjusted models, but further adjustment for hypothesised confounding factors in the fully adjusted model did not reduce effect sizes further.

Discussion

This study investigated associations between active commuting and objectively assessed biological markers of obesity, using a large, nationally representative dataset. Our findings show a robust, independent association between active commuting and two objective markers of obesity, BMI and percentage body fat. Those who used active and public transport modes had a lower BMI and percentage body fat compared with those who used private transport. These associations were not attenuated after adjustment for confounding variables in multivariate analyses. The results corroborate findings from other observational studies which show that walking or cycling to work is associated with lower body weight[14 24-27] and contribute novel findings for objectively assessed BMI and percentage body fat.

A key finding from this study is that the effects observed for public transport were very similar in size and significance to those for walking or cycling to work. This finding may have important implications for transport and health policy, as over the past decade the proportion of commuters who walk or cycle to work has remained stubbornly low outside major cities in the UK.[28] Greater emphasis on encouraging a shift from private to public transport modes may plausibly have significant population health benefits and may be more acceptable to commuters. Such a strategy could also yield large environmental benefits, and could be an important structural intervention to combat obesity.

The magnitude of effects observed in this study were clinically meaningful. The observed effect size for men of around 1 (0.97 to 1.1) BMI point suggests that, for the average man in the sample (43 years old, 176 cm tall, weight 86 kg, and BMI 27.8), this would equate to a difference in weight of 3 kg (almost half a stone). For the average woman in the sample (43 years old, 163 cm tall, weight 72.8 kg, BMI 27.4), an effect size of around 0.7 (0.66 to 0.72) BMI points would correspond to a difference in weight of approximately 2.5 kg (5.5 lb). These differences are larger than the effect sizes seen in most individually focused interventions based on diet and physical activity to prevent overweight and obesity.[29]

Sports participation was adjusted for in the models, as the extent to which an individual may undertake sporting activities may confound the association between active travel and BMI or percentage body fat. Sports participation was found to be a significant covariate in the fully adjusted BMI model for women, but not for men. However this sex difference was not found in the percentage body fat model. A possible interpretation for these results could be that BMI better represents muscle mass in men compared with women, and that confirmatory analysis using percentage body fat is particularly important in this case.

Occupational physical activity was not associated with BMI in men or women. This superficially counterintuitive finding is supported by previous studies which have examined the relationship between occupational physical activity and BMI. Gutiérrez-Fisac et al (2012) found no association between work related physical activity and BMI in a sample of Spanish workers.[30] Haglund et al found no association between occupational physical activity and BMI in a Swedish sample,[31] and the Healthy Worker Project actually found a positive association between occupational activity level and the presence of obesity.[32] Gutiérrez-Fisac et al suggest that a socioeconomic interpretation may not be plausible, as most studies adjust for socioeconomic position.[30] Instead, the authors suggest that differences in diet and energy intake, factors that are less commonly measured or adjusted for in social epidemiological studies, may explain why greater levels of occupational activity do not appear to translate into lower BMI.[30] In addition, evidence from the MONICA study suggested that individuals with higher levels of occupational physical activity had a higher BMI and a greater risk of fatal myocardial infarction than inactive individuals, even after controlling for cardiovascular risk factors and socioeconomic position.[33] The authors hypothesised that work related physical activity might have different effects on basal metabolic rate than other forms of physical activity, especially when combined with shift working.

Strengths and limitations of the study

The UKHLS is a nationally representative study, involving individuals from across the UK and therefore allowing a high level of generalisability. The main strength of this research is the use of objectively measured outcomes obtained from the UKHLS Health assessments. Most previous studies have used participants' self reported heights and weights, which are commonly over and under reported (respectively), leading to systematic underestimation of BMI.[34] The inclusion of percentage body fat, measured by electrical impedance, therefore corroborates the theory that the promotion of active commuting may be one way to help individuals to maintain a healthy weight and body composition. While residual confounding may be in operation, a wide range of potential confounding covariates were adjusted for in the models presented. High levels of occupational and recreational physical activity were controlled for, as were socioeconomic and physical health factors. However, the dietary quality variables available in the UKHLS do not allow potential confounding by energy intake to be fully adjusted for. Two of the diet variables available in the UKHLS—type of milk usually consumed and type of bread usually consumed—were found to have no overall significant association with BMI or percentage body fat, although some categories of milk type were significantly associated with BMI. Using skimmed milk actually predicted a higher BMI than using whole milk, despite the former being considerably less energy dense than the latter. Because these variables are poor proxies for energy intake, they were not included in the models. Instead, number of days per week on which vegetables were consumed was included as an indicator of diet quality, as a significant association was found with both outcome variables, and vegetable consumption may be a better proxy for dietary quality and energy intake than bread or milk choices.[35] However, vegetable intake frequency was not significant in the fully adjusted regression model for either BMI or percentage body fat.

A further key limitation of this study, in common with much of the literature on active commuting and health, is the somewhat crudely quantified exposure. UKHLS participants were asked to give their main commuting mode, meaning mixed-mode journeys were not captured. It is therefore likely that the people who reported using a form of public transport as their main mode were highly heterogeneous in terms of the levels of physical activity their commutes entailed. For example, it is possible that some "public transport users" walked a greater distance from home to the train station than "active commuters" who walked from home to a local workplace. This quantification of active commuting may explain why the protective effects of active and public transport modes for BMI and percentage body fat were so similar in magnitude when compared with private transport users. However, sensitivity analyses—in which walkers were split into <1 mile versus >1 mile commute distance categories, and cyclists were split into <2 miles versus >2 miles categories—did not change the pattern of the results. It is therefore likely that heterogeneity of physical activity levels within the public transport group may be a factor, and overall journey distance or duration data cannot illuminate this further. A high degree of heterogeneity in the three commuting mode categories is likely to result in weaker associations and an underestimation of the true effects.

UKHLS health assessment data are currently available for only one time point, and direction of causality can therefore not be inferred from these findings. Longitudinal or quasi-experimental study designs should be used for future research in this area in order to define and explore causal processes.[36,37]

Conclusions

This study suggests that the incorporation of greater levels of physical activity into the daily commute independently predicts lower bodyweight and healthier body composition for both men and women. Effect sizes and significance levels were similar for both active modes (walking and cycling) and public transport. The promotion and facilitation of greater use of public transportation, in addition to walking and cycling, should therefore be considered. Given that most commuters in the UK use private transport as their main mode, there are potentially large population-level health gains to be made by shifting to more active modes of travel. The use of public transport and walking and cycling in the journey to and from work should be considered as part of strategies to reduce the burden of obesity and related health conditions. Further research using longitudinal data with high quality exposure and outcome measures is required in order to confirm the direction of causality in the association between active commuting and body weight.

Understanding Society (UKHLS) is an initiative by the Economic and Social Research Council, with scientific leadership by the Institute for Social and Economic Research, University of Essex, survey delivery by the National Centre for Social Research, and survey management by the UK Data Archive.

Contributors: The study was conceived of and planned by all authors. EF undertook the data analysis and interpretation, assisted by AS. EF drafted the manuscript. All authors edited the manuscript and approved the final version. Professor Paul Clarke, University of Essex, is thanked for his methodological advice.

What is already known on this topic

The health benefits of physical activity are well known, and an emerging literature consistently suggests that use of active commuting modes translates into higher levels of overall individual physical activity

Previous studies have generally suggested that active commuters have a lower risk of self reported overweight, but self-reported measures of weight are prone to bias, especially in adults

There is limited amount of robust evidence linking active commuting to objectively measured markers of obesity, with systematic reviews calling for research using more robust data and study designs

What this study adds

For both men and women, commuting by public or active transport modes was independently associated with significantly lower objective measures of overweight (body mass index and percentage body fat) compared with commuting by private motorised transport

Further research using longitudinal data is required to confirm the direction of causality

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Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethical approval: Not required for this secondary data analysis project. The Understanding Society study has been approved by the University of Essex ethics committee. Approval from the National Research Ethics Service was obtained for the collection of biosocial data by trained nurses in wave 2 and of the main Understanding Society survey.

Transparency: The lead author, EF, affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. All authors had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Data sharing: The UK Household Longitudinal Study dataset is available under End User License from the UK Data Archive (http://discover.ukdataservice.ac.uk/series/?sn=2000053.)

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Tables

Table 1| Distribution of outcome variables (body mass index and percentage body fat), exposure variable (commuting mode), and hypothesised confounding covariates in the BMI analytic sample. Values are number (percentage) of respondents unless stated otherwise

Variable and category	Men (n=3409)	Women (n=4125)
Mean (SD) body mass index	27.8 (5.1)	27.4 (5.7)
Mean (SD) percentage body fat	22.9 (9.4)*	35.5 (8.4)*
Mean (SD) age (years)	43.6 (12.9)	42.7 (12.4)
Mean (SD) sporting activity scale (0 (none) to10 (very active))	4.3 (3.0)	3.6 (2.7)
Mean (SD) equivalised monthly household income (£)	2474.6 (1589.6)	2373.2 (1503.7)
Commuting mode:		
Private transport	2577 (75.6)	2973 (72.1)
Public transport	347 (10.2)	442 (10.7)
Active transport	485 (14.2)	710 (17.2)
Longstanding illness or disability:		
No	2501 (73.4)	3033 (73.5)
Yes	908 (26.7)	1092 (26.5)
Occupational physical activity level:		
Very active	854 (25.1)	842 (20.4)
Fairly active	1297 (38.1)	1639 (39.7)
Not very active	834 (24.5)	1074 (26.0)
Not at all active	424 (12.4)	570 (13.8)
No of days per week vegetables are consumed:		
Never	57 (1.7)	39 (1.0)
1–3	707 (20.7)	691 (16.8)
4–6	1084 (31.9)	1117 (27.1)
7	1561 (45.8)	2278 (55.2)
Residential area:		
Rural	752 (22.1)	918 (22.3)
Urban	2657 (77.9)	3207 (77.8)
Occupational social class†:		
Management or professional	1448 (42.5)	1708 (41.4)
Intermediate occupation	669 (19.6)	939 (22.8)
Routine occupation	1292 (37.9)	1478 (35.8)

*n=3344 for men, n=4047 for women.

†Standard three-category version of the National Statistics Socioeconomic Classification.

Table 2| **Results of sex stratified series of linear regression models investigating the association between commuting mode and body mass index (BMI). Values are difference (95% confidence interval) in BMI score**

Variables	Men (n=3409)			Women (n=4125)		
	Unadjusted difference	Age adjusted difference	Fully adjusted difference	Unadjusted difference	Age adjusted difference	Fully adjusted difference
Commuting mode:						
Private transport	0	0	0	0	0	0
Public transport	−1.43 (−2.01 to −0.84)**	−1.05 (−1.61 to −0.49)**	−1.10 (−1.67 to −0.53)**	−0.94 (−1.62 to −0.26)*	−0.66 (−1.31 to −0.01)*	−0.72 (−1.37 to −0.06)*
Active transport	−1.41 (−1.97 to −0.85)**	−1.01 (−1.57 to −0.45)**	−0.97 (−1.55 to −0.40)*	−0.86 (−1.35 to −0.36)*	−0.72 (−1.21 to −0.24)*	−0.87 (−1.37 to −0.36)*
Age (mean centred)	—	0.08 (0.06 to 1.00)**	0.08 (0.06 to 0.09)**	—	0.09 (0.07 to 0.10)**	0.07 (0.06 to 0.09)**
Limiting illness or disability	—	—	0.67 (0.27 to 1.07)*	—	—	1.40 (0.90 to 1.89)**
Sports participation scale (mean centred)	—	—	−0.10 (−0.21 to 0.05)	—	—	−0.26 (−0.33 to −0.19)*
Physical activity level at work:						
Very active	—	—	0	—	—	0
Fairly active	—	—	0.25 (−0.43 to 0.94)	—	—	0.36 (−0.18 to 0.89)
Not very active	—	—	0.59 (−0.18 to 1.37)	—	—	0.23 (−0.34 to 0.80)
Not at all active	—	—	0.68 (−0.20 to 1.54)	—	—	−0.07 (−0.75 to 0.61)
Days per week vegetables consumed	—	—	−0.26 (−0.52 to 0.04)	—	—	−0.27 (−0.54 to 0.00)
Residential area:						
Rural	—	—	0	—	—	0
Urban	—	—	0.34 (−0.13 to 0.81)	—	—	0.04 (−0.43 to 0.51)
Occupational social class:						
Management or professional	—	—	0	—	—	0
Intermediate occupation	—	—	0.39 (−0.40 to 1.20)	—	—	0.20 (−0.40 to 0.60)
Routine occupation	—	—	−0.15 (−0.57 to 0.29)	—	—	0.12 (−0.40 to 0.63)
Log equivalised household income (units of £1000, mean centred)	—	—	−0.31 (−0.68 to 0.07)	—	—	−0.27 (−0.64 to 0.10)

*P≤0.05, **P<0.001.

Table 3| **Results of sex stratified series of linear regression models investigating the association between commuting mode and body mass index (BMI). Values are difference (95% confidence interval) in percentage body fat**

Variables	Men (n=3359)			Women (n=4065)		
	Unadjusted difference	Age adjusted difference	Fully adjusted difference	Unadjusted difference	Age adjusted difference	Fully adjusted difference
Commuting mode:						
Private transport	0	0	0	0	0	0
Public transport	−2.42 (−3.60 to −1.23)**	−1.68 (−2.82 to −0.53)*	−1.48 (−2.65 to −0.32)*	−1.97 (−3.08 to −0.87)**	−1.41 (−2.43 to −0.38)*	−1.46 (−2.48 to −0.43)*
Active transport	−2.22 (−3.30 to −1.14)**	−1.43 (2.50 to −0.35)*	−1.35 (−2.41 to −0.29)*	−1.39 (−2.22 to −0.56)*	−1.15 (−1.94 to −0.37)*	−1.37 (−2.17 to −0.57)*
Age (mean centred)	—	0.17 (0.14 to 0.20)**	0.16 (0.13 to 0.19)**	—	0.18 (0.16 to 0.21)**	0.16 (0.14 to 0.19)**
Limiting illness or disability	—	—	1.38 (0.48 to 2.28)*	—	—	1.76 (1.06 to 2.47)**
Sports participation scale (mean centred)	—	—	−0.19 (−0.32 to −0.06)*	—	—	−0.34 (−0.45 to −0.23)**
Physical activity level at work:						
Very active	—	—	0	—	—	0
Fairly active	—	—	0.87 (−0.11 to 1.85)	—	—	−0.98 (0.15 to 1.81)*
Not very active	—	—	1.15 (0.06 to 2.25)*	—	—	0.71 (−0.17 to 1.58)
Not at all active	—	—	0.14 (−1.07 to 1.34)	—	—	−0.16 (−1.21 to 0.88)
Days per week vegetables consumed	—	—	−0.65 (−1.13 to −0.17)*	—	—	−0.32 (−0.73 to 0.10)
Residential area:						
Rural	—	—	0	—	—	0
Urban	—	—	0.24 (−0.65 to 1.13)	—	—	0.02 (−0.65 to 0.68)
Occupational social class:						
Management or professional	—	—	0	—	—	0
Intermediate occupation	—	—	0.06 (−1.04 to 1.16)	—	—	0.04 (−0.72 to 0.81)
Routine occupation	—	—	−0.08 (−0.95 to 0.78)	—	—	0.06 (−0.68 to 0.80)
Log equivalised household income (units of £1000, mean centred)	—	—	−0.84 (−1.71 to 0.03)	—	—	−0.45 (−1.00 to −0.11)

*P≤0.05, **P<0.001.