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Active commuting and the health of workers☆

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ABSTRACT

Introduction: Research has shown that commuting is related to the health of workers, and that mode choice may have a range of effects on this relationship. We analyze the relationship between active commuting (walking and cycling) and the health status reported by US workers.
Methods: We use the 2014–2016 Eating and Health (EH) Module of the American Time Use Survey (ATUS). We estimate Ordinary Least Squares models on a measure of subjective health that is the self-reported assessment of individual general health status, and on the body mass index.
Results: longer commutes by bicycle are significantly related to higher levels of subjective health and to lower body mass index, while commuting by walking is only weakly related to both health measures. We test the robustness of our results to possible measurement error in commuting times, to the exclusion of compensating factors, to the estimation method, and to the inclusion of time devoted to leisure-based physical activities.
Conclusions: Our results may help policy makers in evaluating the importance of infrastructures that facilitate the use of bicycles as a means of transport, boosting investment in these infrastructures, especially in larger cities.

1. Introduction

Commuting duration in the United States has increased over recent decades (Gimenez-Nadal, Molina and Velilla, 2018). In 2019, the average one-way commute in the US reached 27.6 min, and a record 9.8% of commuters reported daily one-way travels to work of at least 1 h. Despite recent efforts to promote more sustainable means of transport, more than three-quarters of workers commute by driving alone (Burd et al., 2021). This fact is relevant for both public health and for employers, since the literature has shown that commuting by car has negative impacts on health. Travelling to work by private transport is perceived as more stressful and boring

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compared to other means (Gatersleben and Uzzell, 2007; Wener and Evans, 2011; Rissel et al., 2014), is associated with higher body mass index (Frank et al., 2004; Lindström, 2008), and causes the most pronounced adverse effects on subjective health among passive commuters (Künn-Nelen, 2016).[1]

In contrast, commuting by active means, such as walking or cycling, is positively related to both mental and physical dimensions of individual health (Jacob et al., 2021). For instance, active commuting is perceived to be more relaxing, engaging, and less stressful than other modes of transport (Gatersleben and Uzzell, 2007; Gottholmseder et al., 2009; Scheepers et al., 2014), with cyclists being considered the happiest commuters (Wild and Woodward, 2019). Moreover, commuting by active means is associated with several objective measures of health, such as a lower likelihood of experiencing cardiovascular disease (Hamer and Chida, 2008) and a lower probability of being overweight (Lindström, 2008; Flint et al., 2014; Tajalli and Hajbabaie, 2017). However, a less explored link is that of active commuting and subjective health (Jacob et al., 2021), understood as individual self-reported evaluation of general health.

Within this framework, our objective is to analyze the relationship between commuting by active modes of transport, on the one hand, and the health status of individuals travelling to/from work. We use data from the Eating and Health (EH) Module of the American Time Use Survey (ATUS) for the years 2014, 2015, and 2016. We estimate Ordinary Least Squares (OLS) models, considering two measures of health: subjective health, captured by a self-reported assessment of the individual's general health status, and that individual's body mass index. Our main variables of interest are the duration of walking and cycling when commuting.

Our contribution to the literature is twofold. First, we contribute to the scant evidence analyzing active commuting and subjective health. Subjective health condenses several dimensions of personal health - biological, mental, social, and functional - and implicitly includes individual and cultural beliefs and behaviors (Stanojevic et al., 2017). Its use in medical research is widespread and it has been found to be a strong predictor of mortality (Idler and Benyamini, 1997; DeSalvo et al., 2006; Wuorela et al., 2020). However, and despite its potential as an integrated health measure, there is little evidence of its relationship to active commuting (Jacob et al., 2021). Second, we provide evidence for the United States, which has the fourth highest ratio of vehicles to inhabitants in the world (Myers, 2015) and the lowest prevalence of active travel among developed countries, which ultimately connects to also having among the highest rates of obesity (Bassett et al., 2008). Because active means of transport for commuting are not a common or natural choice in the US, more evidence is needed on the potential links between walking and cycling for commuting, and individual health, to better guide policies to promote active transportation.

The remainder of the paper is as follows. Section 2 presents a review of the literature. Section 3 presents the data and variables, Section 4 describes the empirical strategy, and Section 5 shows the results. Section 6 presents the discussion and Section 7 sets out our main conclusions.

2. Background

The study of how commuting affects workers has grown in recent years. Longer commutes are associated with increased sickness absence (van Ommeren and Gutiérrez-i Puigarnau, 2011; Gimenez-Nadal et al., 2022), which may lead to increased labor costs (Allen, 1983; Goodman et al., 2012) and losses of productivity (Grinza and Rycx, 2018), as well as to lower levels of well-being and life satisfaction (Stutzer and Frey, 2008; Dolan et al., 2008; Fordham et al., 2018; Friman et al., 2018; Gimenez-Nadal and Molina, 2019; Chatterjee et al., 2020).

The literature analyzing the effects of commuting on health outcomes has examined a range of health dimensions. For instance, evidence suggests that commuting is adversely related to psychological health (Roberts et al., 2011). Commuting may affect mental health through a variety of channels such as lower social participation (Putnam, 2000), depression from long traffic delays (Wang et al., 2019), and stress from unpredictability (Evans et al., 2002; Gottholmseder et al., 2009) and from traffic congestion (Hennessy and Wiesenthal, 1999). Moreover, commuting is associated with more fatigue (Lyons and Chatterjee, 2008; Gimenez-Nadal and Molina, 2019), possibly because of less nocturnal sleep (Walsleben et al., 1999; Costal et al., 1988) and lower sleep quality (Hansson et al., 2011). In turn, given that both fatigue and stress may induce cardiovascular abnormalities and heart dysfunction, commuting has also been linked to these health outcomes (Koslowsky et al. 1995; White and Rotton, 1998). Additionally, commuting is negatively related to subjective health, understood as self-reported evaluation of general health or as satisfaction with health (Stutzer and Frey, 2008; Hansson et al., 2011; Künn-Nelen, 2016).

However, the majority of prior analyses focus on commuting irrespectively of mode of transport, or on commuting by car, given that some of the negative consequences of commuting may be exacerbated when travelling by private transport. Commuting by car is perceived as being more stressful and boring compared to other means of transportation (Gatersleben and Uzzell, 2007; Wener and Evans, 2011; Rissel et al., 2014), and causes the most pronounced adverse effects on self-rated health among passive commuters (Künn-Nelen, 2016). Further, commuting by car is related to a higher body mass index (Frank et al., 2004; Lindström, 2008). Another group of studies has shown that active modes of transport, such as commuting by bicycle or walking, may have beneficial effects on health.

[1] The recent COVID-19 outbreak may have changed commuting patterns regarding the use of alternative modes of transport, such as walking and cycling. Recent research has found that the subway and bike sharing systems (BSS) suffered a drastic ridership reduction with the COVID-19 pandemic, although the COVID-19 impacts were less severe on the BSS than on the subway, pointing to a possible modal transfer from the subway to the BSS. Furthermore, given the increase of remote work associated with the pandemic, many more workers are able to work from home, leading to a reduction of the average commuting duration of workers.

Regarding active commuting, prior evidence has found that it is positively related to both mental and physical dimensions of individual health (Jacob et al., 2021). On the one hand, commuting by active means is perceived to be more relaxing, exciting, and less stressful than other modes of transport (Gatersleben and Uzzell, 2007; Gottholmseder et al., 2009; Scheepers et al., 2014). In turn, cyclists are usually considered the happiest commuters because they have a higher degree of control and arrival-time reliability, while feeling the positive effects of exercise and having more opportunities for social interaction (Wild and Woodward, 2019). Moreover, active commuting is positively associated with subjective well-being and a better work-life balance (Olsson et al., 2013; Martin et al., 2014; Herman and Larouche, 2021). Active commuting leads to improvements in several objective measures of health, since it is associated with a lower likelihood of cardiovascular disease, compared to using private transportation (Hamer and Chida, 2008). Specifically, commuting by cycling is related to a lower risk of all-cause mortality and cancer (Celis-Morales et al., 2017), while walking to work is related to a lower probability of hypertension and diabetes (Laverty et al., 2013; Tajalli and Hajbabaie, 2017). In addition, studies have found a negative link between active commuting and being overweight (Lindström, 2008; Flint et al., 2014; Tajalli and Hajbabaie, 2017). In contrast, there are documented factors associated with transportation that negatively affect the health of active commuters, such as exposure to traffic-related pollutants that are inhaled by commuters during their trips (Borghi et al., 2020; Boniardi et al., 2021).

Despite the substantial evidence connecting active commuting and mental and objective health, a less-explored link is that of active commuting and subjective health. Recent evidence for the UK indicates that mode switching in commuting, from public transit to active means, significantly increases subjective health (Jacob et al., 2021).

3. Data and variables

We rely on the Eating and Health (EH) Module in the American Time Use Survey (ATUS) for the years 2014, 2015, and 2016. To perform our analysis, we combine the 2014, 2015 and 2016 surveys to obtain a unique data set including all three years.[2] The ATUS is the official time use survey of the US and is fielded from January through December of each year. The aim of this module is to collect data on time use and eating patterns, as well as nutrition, obesity, food and nutrition assistance programs, and grocery shopping and meal preparation. The main instrument of this survey is the time-use questionnaire, in which diaries are completed by respondents on selected days, with each diary divided into duration intervals where the respondent records a main activity, and other features, such as where the activity took place, and the mode of transport.[3]

Our interest is to analyze the relationship between commuting by active modes of transport and health, so we restrict our sample to individuals between the ages of 21 and 65 travelling to/from work (Aguiar and Hurst, 2007; Gimenez-Nadal and Sevilla, 2012) on working days, defined as those days where individuals devote at least 60 min to market work activities (Gimenez-Nadal and Molina, 2019; Gimenez-Nadal, Molina and Velilla, 2018a; 2018b; Molina et al., 2020).[4] Our main sample amounts to 7515 individuals.

We focus on two different types of health outcomes. First, we use subjective health, as captured by a self-reported assessment of general health status, which ranges from 1 ("health is poor") to 5 ("health is excellent"). This is an interesting measure because it integrates several dimensions of individual health, such as biological, mental, social, and functional, and implicitly includes individual and cultural beliefs and behaviors (Stanojevic et al., 2017). According to this indicator, higher scores imply better health. Second, we use the body mass index (BMI), reflecting food consumption and health habits such as good nutrition and regular exercise (Reinhold and Jürges, 2010). For example, Christian (2012) finds for the US that more time spent in commuting is associated with reductions in health-related activities (i.e. physical activity, food preparation, time, eating with family, and sleeping). In this case, a higher index would imply worse health.[5]

Panel (A) of Table 1 indicates that on a scale from 1 to 5 the average for self-reported health is 3.7, which is almost a "very good" general health status. The most frequent answers are very good health (37.7%), good health (32.5%), and excellent health (20.3%). In turn, 14.2% of the sample reported poor general health, while 7.9% report fair health. Moreover, the average body mass index is close to 28, meaning that, on average, individuals are overweight.

[2] These surveys are available online and can be downloaded from: https://www.atusdata.org/atus/.

[3] The use of time surveys to analyze transportation behavior has increased in the last decade (Jara-Díaz and Rosales-Salas, 2015; Gimenez-Nadal et al., 2018a, 2018b, 2022; Echeverría et al., 2022).

[4] The ATUS also contains information on travel for other purposes (e.g., travel for leisure), but we do not focus on these, in order to minimize endogeneity issues. While commuting may be to some extent "mandatory" – at least for those who cannot work at home – other travel purposes such as travel for leisure, are voluntary and there may be selection factors. Individuals in poor health may engage in less leisure travel because they have a more sedentary life, which may affect the time devoted to travel for leisure. This selection increases the problems of endogeneity we face in the current context.

[5] An individual with a body mass index over 25 is considered overweight, and over 30 is considered obese. It is important to note that individuals with a body mass index below 18.5 also have relatively worse health (underweight). However, in the context of our data, the main health problem is being overweight and obese, as 66.1% of the sample has a body mass index above 25, while only 1.2% of the sample has a body mass index below 18.5. We have estimated all our regressions excluding those individuals with a body mass index below 18.5 and results are robust, indicating that the main health problem may be driven by being overweight and obesity.

Table 1
Descriptive statistics.

	Mean	Std. Dev.
Panel (A): health		
general health (1 “poor” to 5 “excellent”)	3.7	0.93
1 if health is "poor" (%)	14.2	11.8
1 if health is "fair" (%)	7.9	27.1
1 if health is "good" (%)	32.5	46.8
1 if health is "very good" (%)	37.7	48.4
1 if health is "excellent" (%)	20.3	40.2
body mass index	27.9	6.0
Panel (B): commuting duration		
commuting duration (minutes)	24.7	20.3
commuting duration cycling (minutes)	11.2	12.7
commuting duration walking (minutes)	15.6	11.2
% of individuals walking	6.6	24.8
% of individuals cycling	0.7	8.2
Panel (C): socio-demographic and family characteristics		
age	41.5	12.4
male	0.57	0.50
native	0.81	0.39
primary education	0.07	0.25
secondary education	0.27	0.44
higher education	0.66	0.47
full-time employee	0.87	0.33
presence of a partner	0.57	0.49
household size	3.0	1.5
number of children	0.8	1.1
home owner	0.69	0.46
family income <20,000 usd	0.08	0.28
family income >20,000 and < 50,000 usd	0.27	0.44
family income >50,000 usd	0.65	0.48
number of individuals	7515	

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Health variable is scaled from 1 (“poor”) to 5 (“excellent”).

Our main variable of interest is the time in commuting, especially commuting by walking and by cycling.[6] Commuting is defined as the time in minutes that the individual devotes to travel to/from work, considering all commuting episodes of his/her diary, irrespective of mode of travel. Analogously, commuting duration of walking (cycling) is defined as the time in minutes that the individual devotes to travel to/from work by walking (bicycle) in his/her diary.

Panel (B) of Table 1 shows that individuals commute, on average, 24.7 min per day. Despite that individuals devote almost half an hour to commuting, only 6.6% of them walk and less than 1% commute by bicycle. Individuals who walk spend on average 11.2 min commuting, while individuals who travel by bicycle spend on average 15.6 min commuting.

We also consider a set of controls to account for individual and family characteristics. We include age, gender, native status, highest education level achieved (primary, secondary, or higher education), an indicator of whether the person is a full-time employee, if living with a partner, household size, the number of children in the household, home ownership, and family income. These controls are common in the literature analyzing commuting behavior (Aguiar and Hurst, 2007; McQuaid and Chen, 2012; Gimenez-Nadal, Molina and Velilla, 2018a; 2018b) and its relationship with health outcomes (e.g., Stutzer and Frey, 2008; Roberts et al., 2011; Hansson et al., 2011; Rietveld et al., 2014; Künn-Nelen, 2016).

Panel (C) of Table 1 describes the socio-demographic and family profile of our sample. We observe that commuters in the US are, on average, 41.5 years old, 57% are men, 81% are native, 7% have attained primary education, 27% secondary education, and 66% higher education. In addition, 87% are full-time employees. Regarding family structure, 57% of the sample live in couples, and families are composed, on average, of 3 members, including 1 child. Furthermore, 69% of individuals are home-owners, and 8% live in families with a total annual income below U$S 20,000, 27% in families with a total annual income between U$S 20,000 and U$S 50,000, and

[6] We exclude the analysis of commuting by public transit as it has not been linked to increased worker’s health. In fact, prior evidence has shown that the use of train, bus, subway, tram, or metro is related to sickness, self-rated health complaints, stress level and reductions of sleep, and a more homogeneous analysis of rail commuters shows elevation in salivary cortisol, perceived stress, and affective reactions to crowding (Norgate et al., 2020).

Table 2
Active commuting and health.

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration	−0.005***	−0.005***	0.015**	0.015**
	(0.001)	(0.001)	(0.007)	(0.007)
commuting duration squared	0.000***	0.000***	−0.000*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
commuting duration walking	–	0.005	–	−0.058***
		(0.005)		(0.022)
commuting duration walking squared	–	−0.000***	–	0.000***
		(0.000)		(0.000)
commuting duration cycling	–	0.036*	–	−0.280***
		(0.019)		(0.089)
commuting duration cycling squared	–	−0.000	–	0.004*
		(0.000)		(0.002)
F-statistic for joint significance:				
commuting duration [p-value]	8.62*** [0.0002]	8.19*** [0.0003]	2.48* [0.0842]	2.28 [0.1026]
commuting duration walking [p-value]	–	64.50*** [0.0000]	–	3.64** [0.0262]
commuting duration cycling [p-value]	–	4.80*** [0.0082]	–	15.55*** [0.0000]
Socio-demographic controls	Yes	Yes	Yes	Yes
Family characteristics controls	Yes	Yes	Yes	Yes
Occupation indicators	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.086	0.088	0.076	0.079
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Regressions include demographic and family controls at the individual-level: age (and its square), gender, native status, education level, full-time employee, living in couple, household size, number of children in the household, home ownership, and family income. Full set of estimates is reported in Table A1 of Appendix. Regressions include occupation, state, month, and year indicators. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

65% in families earning more than U$S 50,000 a year.

4. Empirical strategy

We are interested in the relationship between commuting via active modes of transport and health, for individuals travelling to/from work in the US, conditional on socio-demographic, family, and employment characteristics. We estimate Ordinary Least Squares models at the individual-level, in which we consider two dependent variables to capture the health of individuals (H_i): i) one variable indicating the self-reported general health status of the individual, and ii) the body mass index of the individual. We estimate the following model:

$$H_i = \alpha + \beta CT_i + \gamma CT_i^2 + \theta CTW_i + \eta CTW_i^2 + \delta CTC_i + \lambda CTC_i^2 + \mu X_i + \rho FE_i + \varepsilon_i \tag{1}$$

where H_i is either the subjective health or the body mass index of individual *i*. The subjective health variable is standardized so that each estimated coefficient can be interpreted as the change in terms of one standard deviation of health (i.e., z-score). In this analysis, we treat subjective health as a continuous variable, so that coefficients can be interpreted as marginal effects. In the robustness analyses, we estimate an alternative model by performing an ordered logit model.

Our explanatory variables of interest are commuting duration, in particular those of walking and cycling. CT_i and CT_i^2 denote the individual's commuting duration (in minutes) and its square, regardless of mode of transport, while CTW_i and CTW_i^2 denote commuting duration walking and its square, and CTC_i and CTC_i^2 commuting duration cycling and its square. Incorporating quadratic terms allows us to capture a potential non-linear and flexible relationship between active commuting duration and health. Prior evidence indicates that the relation between commuting time and body mass index exhibits an inverse U-shape, indicating that individuals commuting longer times by car, motorcycle/moped, or public transportation have a higher BMI, but this positive relation decreases with longer commuting times (Künn-Nelen, 2016). In order to evaluate the overall relationship between commuting duration and health, we perform three F-tests for joint significance: on commuting duration (joint test on β and γ), on commuting duration walking (joint test on θ and η), and on commuting duration cycling (joint test on δ and λ).

Lastly, X_i is a set of controls including age (and its square), gender,[7] native status, education level (primary, secondary, or higher education), full-time employee, living in couple, household size, number of children in the household, home ownership, and family income. We incorporate a set of indicator variables to account for the occupation of the individual, using the categories included in the ATUS. Further, FE_i controls for state of residence, and month (January to December) and year (2014, 2015 or 2016) of the interview. Robust standard errors are estimated, and observations are weighted at the individual level using survey weights.

After estimating Equation (1), we perform several robustness checks to test the sensitivity of our main results. First, we estimate an alternative model to deal with possible measurement errors in reported commuting duration. In particular, we treat commuting duration as an ordinal measure by including a set of indicators for duration intervals, similar to Künn-Nelen (2016), rather than as a continuous variable.[8] In addition, we estimate a model including two indicator variables to capture whether the individual commutes by walking or by cycling. Second, we exclude from the analysis variables through which individuals are potentially compensated for their longer commutes (i.e. income, full-time employment, and type of occupation). In the main analysis, we include these variables, following Hansson et al. (2011) and Roberts et al. (2011), because commuting can bring benefits in terms of higher incomes and better jobs that are likely to be associated with health outcomes. However, Stutzer and Frey (2008) argue that channels for compensation such as income or working hours should remain uncontrolled for, because if, for example, income is included, people who spend more time commuting are, ceteris paribus, worse off. Third, we alter the estimation method for the subjective health regression in order to treat it as an ordinal variable, by estimating an ordered logit model. Fourth, we estimate the main model adding a control variable that indicates the daily time devoted to leisure-based physical activity (i.e. sports, exercise, and recreational activities), given that is possible that health is correlated with leisure-based physical activity as well as transport-based physical activity.

5. Results

Table 2 reports our main results from estimating Equation (1) at the individual-level. Panel (A) shows the results for subjective health and Panel (B) for the body mass index. In turn, Column (1) in all Panels refers to estimations including only the commuting duration (and its square) as an independent variable, irrespective of mode of transport, while Column (2) in all Panels refers to estimations including commuting duration by walking and by cycling (and their squares). Because we include both commuting duration and its square, Table 2 reports the F-statistics and *p*-values of the joint significance in all estimations. We show our main parameters of interest in each table, and we also report the full set of estimates in the Appendix.[9]

Estimates in Column (1) allow us to analyze commuting duration without considering modes of transportation. However, because 94% of individuals commute by private transport, estimates of Column (1) are mainly driven by the use of the car. In Panel (A), results show a significant and negative relationship between commuting duration and subjective health, and the positive sign in the estimate of commuting duration squared suggests that this negative relationship flattens out as commuting duration increases. Rejection at the 1% level of the F-statistic shows the joint significance of the commuting duration variables. However, and even though the correlation is significant, its size is rather small. In particular, one additional minute of commuting duration is related to a lower health level of 0.005 of a standard deviation of health. The sign and magnitude of our findings are in line with those of Hansson et al. (2011) using cross-sectional data for Sweden, and of Künn-Nelen (2016) using panel data to take into account fixed unobserved effects for the UK.

In contrast, Column (1) of Panel (B) shows that individuals who commute longer times report a statistically significant higher body mass index, but this positive association decreases as commuting duration increases. Rejection at the 10% level of the F-statistic suggests a joint but borderline significance of the commuting duration variables. As in prior studies (Frank et al., 2004; Lindström, 2008; Künn-Nelen, 2016), our estimates indicate that one extra minute of commuting duration is associated with a 0.015 higher body mass index. Column (2) shows our main results of interest; that is, the estimates of the relationship between health and active commuting. Results in Panel (A) show that individuals who commute more time by walking report statistically significant higher levels of subjective health, at the 1% level, as indicated by the F-test of joint significance. In the same line, individuals who commute longer by bicycle also report higher levels of subjective health at the 1% level. In the case of commuting duration by walking, the association flattens out as commuting duration increases, while in the case of cycling the evidence points to a linear relationship with subjective health.

In turn, estimates in Panel (B) suggest that individuals who commute longer by walking and cycling report a statistically significant lower body mass index (at the 5% and 1% levels, respectively). In particular, one additional minute of commuting duration by walking

[7] We also explore the interaction between active commuting duration and gender, given that prior research indicates that the effect of commuting on weight is greater for self-identifying men than women (Dons et al., 2017). Results (available upon request) show no gender differences in the relationship between active commuting and health.

[8] Duration intervals are defined differently for overall commuting and commuting by walking and cycling, given the shorter times that individuals commute by active modes. We define duration intervals as 0–15 min, 15–30 min, 30–45 min, 45–60 min and more than 60 min in the case of overall commuting. In turn, we define duration intervals 0–5 min, 5–10 min, 10–15 min and more than 15 min in the case of walking and cycling.

[9] The low values of the coefficient of determination (R^2) indicate a relatively low explanatory power. However, prior research on commuting duration has also shown low values for this coefficient (Giménez-Nadal nd Molina, 2019; Gimenez-Nadal et al., 2022; Echeverría, Giménez-Nadal et al., 2022).

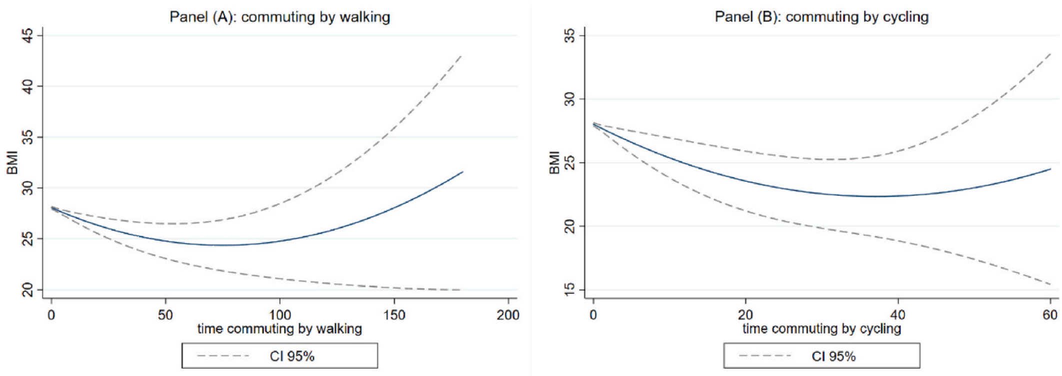

Fig. 1. Active commuting and body mass index.

(cycling) is related to a 0.058 (0.28) lower body mass index. Further, we observe that when incorporating active commuting variables, (overall) commuting duration remains statistically significant at the 1% level in the case of subjective health, but loses its (already weak) statistical significance in terms of the body mass index. Fig. 1 depicts the non-linear associations between body mass index and commuting duration by walking (Panel (A)) and commuting duration by cycling (Panel (B)). The negative associations decrease as

Table 3
Active commuting and health: Robustness check to specification (intervals).

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration 15–30 min (ref.: <15)	−0.069**	−0.068**	−0.128	−0.129
	(0.033)	(0.033)	(0.195)	(0.196)
commuting duration 30–45 min.	−0.125***	−0.121***	0.545*	0.512*
	(0.043)	(0.043)	(0.284)	(0.285)
commuting duration 45–60 min.	−0.154**	−0.152**	0.227	0.192
	(0.064)	(0.064)	(0.324)	(0.325)
commuting duration >60 min.	−0.185**	−0.180**	1.181***	1.118**
	(0.084)	(0.084)	(0.434)	(0.436)
commuting duration walking 5–10 min (ref.: <5)	–	0.038	–	−0.394
		(0.105)		(0.514)
commuting duration walking 10–15 min.	–	0.065	–	−1.623**
		(0.171)		(0.812)
commuting duration walking >15 min.	–	−0.048	–	−0.945*
		(0.170)		(0.518)
commuting duration cycling 5–10 min (ref.: <5)	–	−0.014	–	−1.362
		(0.380)		(2.708)
commuting duration cycling 10–15 min.	–	0.351	–	−4.730***
		(0.308)		(1.088)
commuting duration cycling >15 min.	–	0.780***	–	−3.786***
		(0.266)		(0.949)
F-statistic for joint significance:				
commuting intervals [p-value]	3.71*** [0.0051]	3.51*** [0.0072]	3.24** [0.0115]	2.89** [0.0211]
commuting by walking intervals [p-value]	–	0.12 [0.9467]	–	2.45* [0.0618]
commuting by cycling intervals [p-value]	–	3.29** [0.0199]	–	11.65*** [0.0000]
Socio-demographic controls	Yes	Yes	Yes	Yes
Family characteristics controls	Yes	Yes	Yes	Yes
Occupation indicators	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.086	0.087	0.077	0.081
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Regressions include demographic and family controls at the individual-level: age (and its square), gender, native status, education level, full-time employee, living in couple, household size, number of children in the household, home ownership and family income. Full set of estimates is reported in Table A2 of Appendix. Regressions include occupation, state, month and year indicators. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

commuting duration increases. Even though the estimates suggest a U-shaped relationship, implying a positive relationship between body mass index and active commuting duration in the case of longer commutes, note that the turning point for time commuting by walking (cycling) is 81 min (40 min) of duration, and because 99% (99%) of the sample reports a commuting duration by walking (cycling) below 81 min (40 min), the negative, but flattened out, relationship between active commuting and body mass index holds for practically the entire sample.

Overall, we find that individuals who commute for longer times report lower subjective health status, while individuals who engage in longer commutes either by walking or cycling report higher subjective health and lower body mass index.

We perform several robustness checks to assess the sensitivity of our main findings, as described in Section 4. In Table 3, we report the results of an alternative model in which commuting duration is treated as an ordinal measure by including a set of indicators for duration intervals. The reference category for (overall) commuting duration is less than 15 min, while the reference for active commuting is less than 5 min. Column (1) of Panel (A) shows that all time indicators are negative and statistically significant, meaning that individuals commuting for longer times report lower levels of subjective health, and the magnitude of this negative association increases as commute time increases. As expected, all commuting duration dummies are jointly significantly related to subjective health at the 1% level. Column (1) of Panel (B) shows that only certain time indicators are significantly and negatively related to the body mass index, but all commuting duration dummies are jointly significant at the 5% level. This evidence strengthens our previous findings.

Column (2) of Panel (A) indicates that duration indicators for walking are not significantly related to subjective health, either individually or jointly. However, commuting more than 15 min by bicycle is related to higher levels of subjective health – in comparison to commuting less than 5 min by bicycle. As a consequence, all commuting duration intervals are jointly significant at the 5% level in the case of commuting by bicycle. Lastly, commuting duration indicators for walking are jointly but weakly (at the 10% level) related to the body mass index, while indicators for cycling are jointly significantly related to the body mass index at the 1% level. These results suggest that our main estimates are robust, with the exception of the relationship between walking to commute and subjective health.[10]

Table 4
Active commuting and health: Robustness check to specification (indicators).

	(A) Subjective Health	(B) BMI
commuting duration	−0.005***	0.014*
	(0.001)	(0.007)
commuting duration squared	0.000***	−0.000*
	(0.000)	(0.000)
1 if commutes walking	0.015	−0.410
	(0.060)	(0.320)
1 if commutes cycling	0.442***	−3.177***
	(0.165)	(0.865)
F-statistic for joint significance:		
commuting duration [p-value]	8.05*** [0.0002]	1.90 [0.1490]
Socio-demographic controls	Yes	Yes
Family characteristics controls	Yes	Yes
Occupation indicators	Yes	Yes
State indicators	Yes	Yes
Year and month indicators	Yes	Yes
R-squared	0.087	0.078
number of individuals	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Regressions include demographic and family controls at the individual-level: age (and its square), gender, native status, education level, full-time employee, living in couple, household size, number of children in the household, home ownership and family income. Full set of estimates is reported in Table A3 of Appendix. Regressions include occupation, state, month and year indicators. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

[10] The results for walking may indicate that this relationship is weaker/non-detectable because 10–15 min of walking is too little to achieve the benefits associated with physical activity.

Table 5
Active commuting and health: Robustness check to excluding compensating factors.

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration	−0.004***	−0.004***	0.014**	0.014*
	(0.001)	(0.001)	(0.007)	(0.007)
commuting duration squared	0.000***	0.000***	−0.000*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
commuting duration walking	–	0.006	–	−0.067***
		(0.005)		(0.023)
commuting duration walking squared	–	−0.000***	–	0.000***
		(0.000)		(0.000)
commuting duration cycling	–	0.037*	–	−0.291***
		(0.020)		(0.093)
commuting duration cycling squared	–	−0.000	–	0.004*
		(0.000)		(0.002)
F-statistic for joint significance:				
commuting duration [p-value]	7.07*** [0.0009]	6.71*** [0.0012]	2.05 [0.1293]	1.86 [0.1564]
commuting duration walking [p-value]	–	97.57*** [0.0000]	–	4.48** [0.0114]
commuting duration cycling [p-value]	–	4.54** [0.0107]	–	13.08*** [0.0000]
Socio-demographic controls	Yes	Yes	Yes	Yes
Family characteristics controls	Yes	Yes	Yes	Yes
Occupation/Income controls	No	No	No	No
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.061	0.064	0.058	0.061
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Regressions include demographic and family controls at the individual-level: age (and its square), gender, native status, education level, full-time employee, living in couple, household size, number of children in the household and home ownership. Full set of estimates is reported in Table A4 of Appendix. Regressions include state, month and year indicators. We exclude income, full-time employment and occupation indicators. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 6
Active commuting and health: Robustness check to estimation method (ordered logit).

	Subjective Health
commuting duration	−0.010***
	(0.002)
commuting duration squared	0.000***
	(0.000)
commuting duration walking	0.013
	(0.010)
commuting duration walking squared	−0.000***
	(0.000)
commuting duration cycling	0.096**
	(0.044)
commuting duration cycling squared	−0.001
	(0.001)
F-statistic for joint significance:	
commuting duration [p-value]	16.46*** [0.0003]
commuting duration walking [p-value]	15.21*** [0.0005]
commuting duration cycling [p-value]	8.71** [0.0128]
Socio-demographic controls	Yes
Family characteristics controls	Yes
Occupation indicators	Yes
State indicators	Yes
Year and month indicators	Yes
R-squared	0.036
number of individuals	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable is the general health status of the individual standardized (z-score rescaled). Regression includes demographic and family controls at the individual-level: age (and its square), gender, native status, education level, full-time employee, living in couple, household size, number of children in the household, home ownership and family income. Full set of estimates is reported in Table A5 of Appendix. Regressions include occupation, state, month and year indicators. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

In Table 4, we estimate a model including two indicator variables to capture whether the individual commutes by walking or cycling.[11] Results indicate that (overall) commuting duration is significantly related to subjective health, but not significant in the case of the body mass index, as indicated by the F-test. Further, commuting on foot is not significant when analyzing subjective health or the body mass index, while commuting by cycling is positively (negatively) related to subjective health (body mass index) at the 1% level. These results confirm that our main estimates regarding commuting by cycling are robust.

In Table 5, we exclude from the analysis variables capturing potentially compensating factors. Our estimation shows that estimates are very similar in size to those of our main model, suggesting that compensating factors do not substantially (or significantly) alter the relationship between commuting and health measures.

Table 6 reports an ordered logit model to account for the ordinal nature of the subjective health variable. We observe that commuting duration estimates are longer than those reported in Table 2 (Column (2) of Panel (A)), but their sign is consistent and their statistical significance holds. This is in line with prior literature on well-being of individuals showing that results are typically robust to accounting for the ordinal character of the dependent variables (Ferrer-i-Carbonell and Frijters, 2004).

Table 7 reports the results of estimating Equation (1) incorporating an additional control variable that indicates the daily time devoted to leisure-based physical activity (i.e. sports, exercise, and recreational activities). As expected, we find that time devoted to other physical activities engaged in by the individual is positively correlated with subjective health and negatively correlated with body mass index. However, these significant correlations do not alter the sign or magnitude of our main coefficients our interest.

Overall, our robustness checks confirm our finding that individuals commuting for longer times report lower subjective health status, while individuals commuting by bicycle report higher subjective health and lower body mass index. In turn, commuting on foot is weakly related to health measures since the statistical significance changes in some of our robustness analyses.

[11] Note that in this case Columns (1) are omitted since results are the same as those reported in Table 2.

Table 7
Active commuting and health: Robustness check to controlling for physical activity.

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration	−0.004***	−0.004***	0.014**	0.014*
	(0.001)	(0.001)	(0.007)	(0.007)
commuting duration squared	0.000***	0.000***	−0.000*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
commuting duration walking	–	0.005	–	−0.057***
		(0.005)		(0.022)
commuting duration walking squared	–	−0.000***	–	0.000***
		(0.000)		(0.000)
commuting duration cycling	–	0.036*	–	−0.281***
		(0.019)		(0.090)
commuting duration cycling squared	–	−0.000	–	0.003*
		(0.000)		(0.002)
time in leisure-based physical activity	0.003***	0.003***	−0.007***	−0.007***
	(0.000)	(0.000)	(0.003)	(0.003)
F-statistic for joint significance:				
commuting duration [p-value]	7.05*** [0.0009]	6.71*** [0.0012]	2.05 [0.1284]	1.90 [0.1495]
commuting duration walking [p-value]	–	67.81*** [0.0000]	–	3.64** [0.0313]
commuting duration cycling [p-value]	–	4.91*** [0.0074]	–	16.05*** [0.0000]
Socio-demographic controls	Yes	Yes	Yes	Yes
Family characteristics controls	Yes	Yes	Yes	Yes
Occupation indicators	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.098	0.100	0.077	0.080
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Regressions include demographic and family controls at the individual-level: age (and its square), gender, native status, education level, full-time employee, living in couple, household size, number of children in the household, home ownership, and family income. Full set of estimates is reported in Table A6 of Appendix. Regressions include occupation, state, month, and year indicators. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

6. Discussion

The present work exploits the information on health contained in the ATUS, a nationally representative time diary survey, allowing for an in-depth analysis of active travel behavior. Our results show that individuals who commute longer by bicycle report higher subjective health and lower body mass index. This result is robust to possible measurement errors in reported commuting duration, to the exclusion of compensating factors, to the estimation method, and to the inclusion of time devoted to leisure-based physical activities. In turn, commuting by walking is only weakly related to both health measures, since the statistical significance changes in some of our robustness analyses.

Despite the relevant and robust findings, this work has some caveats related to data availability. On the one hand, our analysis permits us to uncover conditional associations between travel duration in sustainable modes of transport and health, exploiting cross-sectional information, but does not address causal effects because we cannot control for the unobserved heterogeneity of individuals. Furthermore, it would be desirable to analyze the relationship between health and commuting distance. However, we face a limitation in the data, as the ATUS does not include information on distance travelled. In addition, the EH Module of the ATUS does not contain other measures of physical health besides the body mass index. We rely on the only measures available to capture objective health.

Another limitation of the current analysis is that it does not account for the spatial or the temporal aspect. Regarding the spatial aspect, in certain places within the study area these findings may not be applicable, whereas in others they may apply in greater magnitude. However, there is no detailed information on the place of residence so this analysis cannot be done. Regarding the temporal aspect, it is well-documented that there is a seasonality in cycling behavior (e.g., high in the summer and low in winter, Liu, X., and Pelechrinis 2021), and although we take into account the month of respondent interviews, this is an issue that should be considered in future research.

7. Conclusions

Commuting is part of the daily life of workers worldwide, and in some countries, such as the US, this activity is primarily done with the use of private cars. This is important for both public health, for employees, and for employers alike, as the literature has shown that commuting by car has negative impacts on health and is related to increased body mass index. Alternative modes of transport for commuting, including active modes such as walking and cycling, have been reported to be related to lower body mass index, especially cycling. Analyzing a sample of workers from the ATUS, we examine the relationship between active commuting and health (subjective health and body mass index) and find that longer commutes by bicycle are significantly related to higher levels of subjective health and a lower body mass index. The results for walking as a means of commuting are not conclusive. Thus, our results point to the use of the bicycle for commuting as a way to increase the health of workers.

In a context where being overweight and obese is an important problem in terms of public health and employment, since poor health of workers represents a cost for the government and for companies, public policies and employer interventions aimed at boosting the use of bicycles among their workers are desirable. Interventions on the part of policy makers may involve investments in infrastructure (e.g., bike lanes, bike-sharing schemes), legislation (e.g., preference to cyclists in central areas of cities) or the control of bicycle theft and greater citizen security. Interventions on the part of companies may involve incentive schemes for workers, or preferences when choosing work schedules for those who cycle.

Understanding the factors that influence the decision to adopt more environmentally friendly modes of transport for commuting is fundamental to the transition towards a new era of sustainable development (Brundtland, 1987). Cycling for commuting may have benefits beyond health, including environmental benefits, and thus developing strategies to promote alternative modes of mobility via physical activity may reduce GHG emissions. Thus, appropriate investments in infrastructure related to cycling are crucial to aid in the "greening" of individual behaviors in travel activities, which would complement strategies to produce behavioral, pro-environmental changes, such as shifting consumption patterns to relatively low-impact alternatives, or decreasing overall consumption (Stern et al., 1999; Shwom and Lorenzen, 2012; Schmitt et al., 2018).

Author statement

Lucía Echeverría: Methodology, Software, Data curation, Writing- Original draft preparation José Ignacio Giménez-Nadal: Conceptualization, Supervision, Validation, Writing - Reviewing and Editing. José Alberto Molina: Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

Table A1
Active Commuting and Health, Full Set of Estimates of Table 2

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration	−0.005***	−0.005***	0.015**	0.015**
	(0.001)	(0.001)	(0.007)	(0.007)
commuting duration squared	0.000***	0.000***	−0.000*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
commuting duration walking	–	0.005	–	−0.058***
		(0.005)		(0.022)
commuting duration walking squared	–	−0.000***	–	0.000***
		(0.000)		(0.000)
commuting duration cycling	–	0.036*	–	−0.280***
		(0.019)		(0.089)
commuting duration cycling squared	–	−0.000	–	0.004*
		(0.000)		(0.002)
age	−0.035***	−0.035***	0.378***	0.379***
	(0.011)	(0.011)	(0.064)	(0.064)
age squared	0.000***	0.000***	−0.004***	−0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
male	0.074**	0.072**	0.840***	0.870***
	(0.032)	(0.032)	(0.203)	(0.202)
native	−0.005	−0.009	1.374***	1.390***
	(0.040)	(0.040)	(0.229)	(0.229)

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Table A1 (*continued*)

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
secondary education	0.278***	0.272***	−0.241	−0.231
	(0.075)	(0.075)	(0.417)	(0.417)
higher education	0.382***	0.375***	−0.809*	−0.784*
	(0.075)	(0.074)	(0.419)	(0.420)
full-time employee	0.067	0.064	0.479*	0.471
	(0.051)	(0.051)	(0.290)	(0.290)
presence of a partner	0.091***	0.091***	0.019	0.003
	(0.034)	(0.034)	(0.216)	(0.216)
household size	−0.039**	−0.040**	0.309***	0.316***
	(0.019)	(0.019)	(0.111)	(0.110)
number of children	0.007	0.008	−0.222	−0.233
	(0.024)	(0.024)	(0.143)	(0.142)
home owner	0.020	0.028	−0.206	−0.278
	(0.038)	(0.037)	(0.218)	(0.219)
family income >20.000 and < 50.000	0.101*	0.106*	−0.261	−0.311
	(0.060)	(0.061)	(0.358)	(0.359)
family income >50.000	0.289***	0.293***	−1.127***	−1.165***
	(0.063)	(0.063)	(0.366)	(0.367)
Occupation indicators	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.086	0.088	0.076	0.079
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table A2
Active Commuting and Health: Robustness Check to Specification (Intervals), Full Set of Estimates of Table 3

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration 15–30 min (ref.: <15)	−0.069**	−0.068**	−0.128	−0.129
	(0.033)	(0.033)	(0.195)	(0.196)
commuting duration 30–45 min.	−0.125***	−0.121***	0.545*	0.512*
	(0.043)	(0.043)	(0.284)	(0.285)
commuting duration 45–60 min.	−0.154**	−0.152**	0.227	0.192
	(0.064)	(0.064)	(0.324)	(0.325)
commuting duration >60 min.	−0.185**	−0.180**	1.181***	1.118**
	(0.084)	(0.084)	(0.434)	(0.436)
commuting duration walking 5–10 min (ref.: <5)	–	0.038	–	−0.394
		(0.105)		(0.514)
commuting duration walking 10–15 min.	–	0.065	–	−1.623**
		(0.171)		(0.812)
commuting duration walking >15 min.	–	−0.048	–	−0.945*
		(0.170)		(0.518)
commuting duration cycling 5–10 min (ref.: <5)	–	−0.014	–	−1.362
		(0.380)		(2.708)
commuting duration cycling 10–15 min.	–	0.351	–	−4.730***
		(0.308)		(1.088)
commuting duration cycling >15 min.	–	0.780***	–	−3.786***
		(0.266)		(0.949)
age	−0.035***	−0.035***	0.376***	0.378***
	(0.011)	(0.011)	(0.064)	(0.064)
age squared	0.000***	0.000***	−0.004***	−0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
male	0.075**	0.073**	0.838***	0.870***
	(0.032)	(0.032)	(0.202)	(0.202)
native	−0.005	−0.008	1.365***	1.385***
	(0.040)	(0.040)	(0.229)	(0.229)
secondary education	0.277***	0.276***	−0.240	−0.225
	(0.075)	(0.075)	(0.415)	(0.414)
higher education	0.383***	0.380***	−0.800*	−0.778*
	(0.075)	(0.075)	(0.417)	(0.417)
full-time employee	0.067	0.067	0.484*	0.477*
	(0.051)	(0.051)	(0.289)	(0.288)
presence of a partner	0.090***	0.092***	0.033	0.007

(*continued on next page*)

Table A2 (*continued*)

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
	(0.034)	(0.034)	(0.217)	(0.217)
household size	−0.039**	−0.040**	0.310***	0.320***
	(0.019)	(0.019)	(0.110)	(0.110)
number of children	0.008	0.008	−0.229	−0.241*
	(0.024)	(0.024)	(0.142)	(0.142)
home owner	0.022	0.026	−0.204	−0.280
	(0.037)	(0.037)	(0.218)	(0.219)
family income >20.000 and < 50.000	0.103*	0.101*	−0.254	−0.305
	(0.060)	(0.061)	(0.356)	(0.357)
family income >50.000	0.288***	0.288***	−1.108***	−1.140***
	(0.063)	(0.064)	(0.364)	(0.364)
Occupation indicators	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.086	0.087	0.077	0.081
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table A3

Active Commuting and Health: Robustness Check to Specification (Indicators), Full Set of Estimates of Table 4

	(A) Subjective Health	(B) BMI
commuting duration	−0.005***	0.014*
	(0.001)	(0.007)
commuting duration squared	0.000***	−0.000*
	(0.000)	(0.000)
1 if commutes walking	0.015	−0.410
	(0.060)	(0.320)
1 if commutes cycling	0.442***	−3.177***
	(0.165)	(0.865)
age	−0.035***	0.379***
	(0.011)	(0.064)
age squared	0.000***	−0.004***
	(0.000)	(0.001)
male	0.072**	0.864***
	(0.032)	(0.202)
native	−0.007	1.380***
	(0.040)	(0.229)
secondary education	0.278***	−0.247
	(0.075)	(0.417)
higher education	0.381***	−0.800*
	(0.075)	(0.420)
full-time employee	0.068	0.466
	(0.051)	(0.290)
presence of a partner	0.092***	0.008
	(0.034)	(0.217)
household size	−0.040**	0.314***
	(0.019)	(0.110)
number of children	0.008	−0.230
	(0.024)	(0.142)
home owner	0.024	−0.252
	(0.037)	(0.220)
family income >20.000 and < 50.000	0.102*	−0.279
	(0.060)	(0.358)
family income >50.000	0.291***	−1.142***
	(0.063)	(0.367)
Occupation indicators	Yes	Yes
State indicators	Yes	Yes
Year and month indicators	Yes	Yes
R-squared	0.087	0.078
number of individuals	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table A4
Active Commuting and Health: Robustness Check to Excluding Compensating Factors, Full Set of Estimates of Table 5

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration	−0.004***	−0.004***	0.014**	0.014*
	(0.001)	(0.001)	(0.007)	(0.007)
commuting duration squared	0.000***	0.000***	−0.000*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
commuting duration walking	–	0.006	–	−0.067***
		(0.005)		(0.023)
commuting duration walking squared	–	−0.000***	–	0.000***
		(0.000)		(0.000)
commuting duration cycling	–	0.037*	–	−0.291***
		(0.020)		(0.093)
commuting duration cycling squared	–	−0.000	–	0.004*
		(0.000)		(0.002)
age	−0.025**	−0.025**	0.369***	0.369***
	(0.011)	(0.011)	(0.063)	(0.062)
age squared	0.000*	0.000*	−0.004***	−0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
male	0.063**	0.060**	0.817***	0.847***
	(0.029)	(0.029)	(0.179)	(0.178)
native	0.029	0.026	1.318***	1.334***
	(0.040)	(0.040)	(0.227)	(0.227)
secondary education	0.335***	0.330***	−0.242	−0.234
	(0.071)	(0.071)	(0.398)	(0.398)
higher education	0.558***	0.550***	−1.133***	−1.102***
	(0.067)	(0.067)	(0.373)	(0.374)
presence of a partner	0.154***	0.154***	−0.189	−0.210
	(0.034)	(0.034)	(0.213)	(0.212)
household size	−0.037*	−0.038**	0.290***	0.297***
	(0.019)	(0.019)	(0.112)	(0.110)
number of children	−0.008	−0.007	−0.151	−0.165
	(0.024)	(0.024)	(0.144)	(0.143)
home owner	0.088**	0.097***	−0.517**	−0.600***
	(0.037)	(0.037)	(0.216)	(0.216)
Occupation/Income indicators	No	No	No	No
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.061	0.064	0.058	0.061
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table A5
Active Commuting and Health: Robustness Check to Estimation Method (Ordered Logit), Full Set of Estimates of Table 6

	Subjective Health
commuting duration	−0.010***
	(0.002)
commuting duration squared	0.000***
	(0.000)
commuting duration walking	0.013
	(0.010)
commuting duration walking squared	−0.000***
	(0.000)
commuting duration cycling	0.096**
	(0.044)
commuting duration cycling squared	−0.001
	(0.001)
age	−0.073***
	(0.021)
age squared	0.001***
	(0.000)

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Table A5 (*continued*)

	Subjective Health
male	0.113*
	(0.062)
native	−0.026
	(0.077)
secondary education	0.539***
	(0.145)
higher education	0.733***
	(0.144)
full-time employee	0.120
	(0.097)
presence of a partner	0.174***
	(0.067)
household size	−0.079**
	(0.038)
number of children	0.012
	(0.048)
home owner	0.056
	(0.073)
family income >20.000 and < 50.000	0.190
	(0.117)
family income >50.000	0.563***
	(0.123)
Occupation indicators	Yes
State indicators	Yes
Year and month indicators	Yes
R-squared	0.036
number of individuals	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable is the general health status of the individual standardized (z-score rescaled). Robust standard errors in parentheses * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table A6
Active Commuting and Health: Robustness Check to Controlling for Physical Activity, Full Set of Estimates of Table 7

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
commuting duration	−0.004***	−0.004***	0.014**	0.014*
	(0.001)	(0.001)	(0.007)	(0.007)
commuting duration squared	0.000***	0.000***	−0.000*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
commuting duration walking	–	0.005	–	−0.057***
		(0.005)		(0.022)
commuting duration walking squared	–	−0.000***	–	0.000***
		(0.000)		(0.000)
commuting duration cycling	–	0.036*	–	−0.281***
		(0.019)		(0.090)
commuting duration cycling squared	–	−0.000	–	0.003*
		(0.000)		(0.002)
time in leisure-based physical activity	0.003***	0.003***	−0.007***	−0.007***
	(0.000)	(0.000)	(0.003)	(0.003)
age	−0.034***	−0.034***	0.375***	0.376***
	(0.011)	(0.011)	(0.064)	(0.064)
age squared	0.000***	0.000***	−0.004***	−0.004***
	(0.000)	(0.000)	(0.001)	(0.001)
male	0.061*	0.058*	0.869***	0.898***
	(0.032)	(0.032)	(0.203)	(0.202)
native	−0.004	−0.007	1.371***	1.388***
	(0.040)	(0.040)	(0.229)	(0.229)
secondary education	0.278***	0.274***	−0.243	−0.234
	(0.075)	(0.074)	(0.417)	(0.417)
higher education	0.368***	0.361***	−0.779*	−0.754*
	(0.074)	(0.074)	(0.420)	(0.420)
full-time employee	0.078	0.075	0.454	0.447

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Table A6 (*continued*)

	(A) Subjective Health		(B) BMI	
	(1)	(2)	(1)	(2)
	(0.051)	(0.051)	(0.290)	(0.290)
presence of a partner	0.097***	0.097***	0.006	−0.011
	(0.034)	(0.034)	(0.216)	(0.216)
household size	−0.039**	−0.040**	0.310***	0.317***
	(0.019)	(0.019)	(0.111)	(0.110)
number of children	0.012	0.013	−0.231	−0.243*
	(0.024)	(0.024)	(0.143)	(0.142)
home owner	0.011	0.019	−0.187	−0.259
	(0.037)	(0.037)	(0.218)	(0.219)
family income >20.000 and < 50.000	0.105*	0.109*	−0.268	−0.318
	(0.059)	(0.060)	(0.357)	(0.359)
family income >50.000	0.278***	0.281***	−1.103***	−1.141***
	(0.062)	(0.062)	(0.365)	(0.366)
Occupation indicators	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Year and month indicators	Yes	Yes	Yes	Yes
R-squared	0.098	0.100	0.077	0.080
number of individuals	7515	7515	7515	7515

Note: Sample consists of working individuals aged 21–65 years old travelling to/from work, from the ATUS Eating and Health Module 2014-2015-2016. Dependent variable in Panel (A) is the general health status of the individual standardized (z-score rescaled). Dependent variable in Panel (B) is the body mass index. Robust standard errors in parentheses.
*Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

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