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Abstract: Background: Physical inactivity ranks as a leading cause of death and disability globally. Active transportation such as bicycling may increase physical activity levels. It is currently uncertain whether transport mode shift from motorized to bicycle commuting leads to increased physical activity overall or substitutes other forms of physical activity. Purpose: The study aims to disentangle whether bicycle commuting adds to or replaces other physical activities by comparing the physical activity performed by bicycle and motorized commuters. Methods: Physical activity, travel behavior, health status, socio-demographic and built environment characteristics were assessed for 752 adults, between June 2011 and May 2012, in Barcelona, Spain. Statistical analyses, done in 2013-14, included linear, non-linear and mixture models to estimate disparities and the dose-response relationship between physical activity duration and commute mode. Results: Regular bicycle commuters travelled by bicycle an average of 3.1 (SD = 2.5) hours in the previous week. Bicycle commuting contributed positively to physical activity duration across participants ($p < 0.05$). It amounted to 2.1 hour/week (95%CI = 0.84; 3.55) extra of physical activity for bicycle commuters vs. motorized commuters. Within bicycle travelers, there was a positive dose-response relationship between bicycle commuting and physical activity duration, with an average physical activity duration increase of 0.5 hour/week (95%CI: 0.4; 0.6) for every additional 1 hr/wk of bicycle commuting. Conclusions: Bicycle commuting will likely add to overall physical activity. Policy interventions to increase bicycle commuting, such as designated bicycle lanes, traffic calming and bicycle sharing programs may contribute to increased physical activity levels.

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COVER LETTER

Dear Sir/Madam,

We, the authors of this manuscript entitled ‘The added benefit of bicycle commuting on the regular amount of physical activity performed’, would like to assure that this work is original, has not been previously published whole or in part, and is not under consideration for publication elsewhere.

We would like to confirm that all authors have disclosed any actual or potential competing interests regarding the submitted article.

All authors have read the manuscript, agree that the work is ready for submission to a journal, and accept responsibility for the manuscript’s contents.

Yours sincerely,

David Donaire-Gonzalez

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1 THE ADDED BENEFIT OF BICYCLE COMMUTING ON THE REGULAR AMOUNT OF
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ABSTRACT

Background: Physical inactivity ranks as a leading cause of death and disability globally. Active transportation such as bicycling may increase physical activity levels. It is currently uncertain whether transport mode shift from motorized to bicycle commuting leads to increased physical activity overall or substitutes other forms of physical activity.

Purpose: The study aims to disentangle whether bicycle commuting adds to or replaces other physical activities by comparing the physical activity performed by bicycle and motorized commuters.

Methods: Physical activity, travel behavior, health status, socio-demographic and built environment characteristics were assessed for 752 adults, between June 2011 and May 2012, in Barcelona, Spain. Statistical analyses, done in 2013-14, included linear, non-linear and mixture models to estimate disparities and the dose-response relationship between physical activity duration and commute mode.

Results: Regular bicycle commuters travelled by bicycle an average of 3.1 (SD = 2.5) hours in the previous week. Bicycle commuting contributed positively to physical activity duration across participants ($p < 0.05$). It amounted to 2.1 hour/week (95%CI = 0.84; 3.55) extra of physical activity for bicycle commuters vs. motorized commuters. Within bicycle travelers, there was a positive dose-response relationship between bicycle commuting and physical activity duration, with an average physical activity duration increase of 0.5 hour/week (95%CI: 0.4; 0.6) for every additional 1 hr/wk of bicycle commuting.

62 Conclusions: Bicycle commuting will likely add to overall physical activity. Policy interventions
63 to increase bicycle commuting, such as designated bicycle lanes, traffic calming and bicycle
64 sharing programs may contribute to increased physical activity levels.

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INTRODUCTION

Physical inactivity is a major public health challenge, which affects one-third of the adult population worldwide.¹ Physical inactivity causes 6-10% of the global burden of non-communicable diseases and is responsible for 9% of premature deaths globally.² Physical inactivity also probably accounts for approximately 32 million Disability Adjusted Life Years (DALYs) (representing about 2.1% of global DALYs) each year.³ Furthermore, global trends suggest a widespread reduction in physical activity, which raises concern about worsening health burdens in the future from physical inactivity.⁴

To reverse the global trend toward physical inactivity, a holistic intervention including individual, social and cultural, environmental and policy levels has been recommended by many national and international organizations, including the Lancet Physical Activity Series Working Group.^{4,5} Implementing transportation policies that promote active modes such as bicycling has been proposed as a promising method to increase physical activity levels, reduce air and noise pollution, and therefore improve public health.⁵⁻⁷ Currently, however, it is uncertain whether a transport mode shift to bicycling from other less active commuting modes (such as motor vehicles) will lead to increased physical activity overall or substitutes other forms of physical activity.⁸⁻¹⁰

So, the study aims to disentangle whether bicycle commuting adds to physical activity levels or replaces other forms of physical activity by comparing the physical activity performed by bicycling and motorized commuters.

METHODS

Site and Design

Barcelona, one of the most populated cities in Europe (total population = 1,621,537), is located in Northeastern Spain with a temperate Mediterranean climate. Although the climate and land use are conducive to bicycling, data shows that the city has a low share of bicycle trips (i.e., 2%).¹¹ To promote more bicycling, the City began implementing a series of programs in 2006. Specifically the City implemented an infrastructure improvement plan, an educational program, and bicycling sharing program (called “Bicing”) to increase the ride share of bicycle commuting. To assess the impact of these bicycling program, a transportation and health survey was conducted to assess and characterize physical activity and travel behaviors as part of the Transportation, Air Pollution and Physical Activities (TAPAS) project between June 2011 and May 2012.

Sample Design and Subjects

Forty sampling points were selected to cover the City of Barcelona, four random points for each one of the ten districts of the City. Each point was sampled, by three trained interviewers, between 7:45 and 11:30 am during four weekdays within a randomly selected week. Interviewers were randomly assigned, at each sampling point, to a specific street to cover one mode of transport. The modes of transport were public motorized (bus, metro and tram), private motorized (motorcycle and car) and non-motorized (private and public bicycle). The interviewers were instructed to systematically invite all travelers, but prioritizing the recruitment of bicycling travelers over other travel modes when both appeared at the same time. This strategy was employed to ensure sufficient numbers of bicyclists due to the relatively low number of bicyclists commuters compared to other modes.

Several inclusion criteria were employed, such as: (i) being 18 years or older; (ii) living in Barcelona since 2006 or earlier; (iii) currently working or studying in the City; (iv) self-report of being healthy enough to ride a bicycle for 20 minutes; (v) having a commute equivalent to a 10 minute walk or more; and (vi) using at least one mode of transport other than walking to commute.

Of the 18469 participants approached across the forty sampling random points, 6701 (36.3%) participants agreed to participate with no differences in response rate across commute modes; 1508 participants fulfilled the recruitment criteria and 871 (57.7% of those eligible) participants completed the subsequent telephone survey. We excluded 23 participants because they were walking commuters, 31 because they had difficulties riding a bicycle, 59 because they had a chronic disease that could affect validity of the self-reported physical activity and 6 because they did not live in Barcelona.

Our study protocol was approved by the Clinical Research Ethical Committee of the Parc de Salut Mar (CEIC-Parc de Salut Mar), and written informed consent was obtained from all participants.

Variables and Instruments of Measurement

Study participants answered a telephone survey administered using Computer Assisted Telephone Interviewing (CATI). The information collected in the questionnaire included: frequency and duration during the previous week of vigorous, moderate, walking and overall activity as measured by the International Physical Activity Questionnaire (IPAQ) short form;¹²

the frequency of walking for daily travel as measured by the Common Modes of Transport questionnaire;¹³ frequency and duration of traveling by bicycle in the previous week;¹⁴ commuter travel behavior;¹⁵ bicycle perceptions; mental stress level from the short form of the Perceived Stress Scale;¹⁶ health status, chronic disease and socio-demographic questions.

Bicycle travelers were defined as those participants who traveled by bicycle at least once in the previous week.¹⁴ Commute mode was defined as bicycle, public, motorcycle or car, according to the most frequent mode of commute, being motorized mixed-mode commuters classified according to the motorized mode. Willing-to-cycle commuters were defined as those participants who considered commuting by bicycle as a possibility, and thought bicycling was the most pleasant mode of transportation (whether they utilized the bicycle or not). Duration of overall physical activity was defined using the IPAQ, and included time spent walking, plus time spent in all other activities of moderate or vigorous intensity during the past seven days. Moderate-to-vigorous activity duration comprised only moderate or vigorous intensity activities.

A Geographic Information System (GIS) analysis was conducted, using the ArcGIS Desktop 10 Service Pack 4, to characterize the built environment in participant's neighborhood and route environments, because their potential confounding effects on the relationship between physical activity and commute mode.^{17,18} In summary, these environments were characterized by the walkability¹⁹, bikeability²⁰, distance, neighbourhood socio-economic status (deprivation index)²¹, transport facilities and altitudes (see online data supplement).

Other measurements considered as potential confounders were: socio-demographic factors, health status, smoking habit, nutritional status, self-efficacy, mental stress level, vigorous activity participation, and perceptions towards bicycle commuting (see online data supplement).

Statistical Analysis

The representativeness of the Barcelona population in the TAPAS sample was evaluated by comparing: (i) age and gender distributions between the TAPAS sample and the Barcelona Active Population Survey (Statistics and information service, Catalan government 2011), which is the most representative sample available of the working-age Barcelona population; (ii) the distribution of Neighbourhood Deprivation Index and population density in TAPAS participants' home addresses and Barcelona population;²² and (iii) the work address density per neighbourhood in TAPAS sample vs commercial outlet density per neighbourhood in Barcelona.

The relationship between the commute mode and physical activity level was evaluated using several approaches, including: (i) a multivariate linear model between commute mode and overall physical activity duration (log-transformed); (ii) the relationship between commute mode and non-travel physical activity duration (log-transformed), accounting for active travel duration (bicycle and walk) in previous multivariate linear model; and (iii) the relationship between commute mode and duration of each type of physical activity (vigorous, moderate and walking) was estimated using the Fletcher et al²³ procedure because of the zero-inflated lognormal distribution of physical activity outcomes (see online data supplement).

On the other hand, the dose-response and threshold relationship between bicycle commuting duration and moderate-to-vigorous physical activity duration, among bicycle travelers, was evaluated using locally weighted scatterplot smoothing (LOESS) and segmented regressions, respectively (see online data supplement).

Multivariate models included all previous variables that in bivariate analysis showed a statistically significant relationship either with physical activity or commute mode (at $p < 0.2$ level), and in multivariate analysis reached statistical significance (at $p < 0.05$ level) or changed by more than 10% the coefficient of the commute mode (Table S2). Furthermore, all two-way interactions between physical activity duration and one of age, gender and health status about were also tested in bivariate and multivariate analyses. In order to test if there was replacement within the most active population, the comparison against bicycle commuters was restricted to those motorized participants who both reported a willingness to shift to bicycling and performed regular vigorous activity. All analyses were conducted during 2013-14, using R 3.0.0 (2013 The R Foundation for Statistical Computing).

RESULTS

Table 1 shows the main characteristics of the total sample, which was composed of 752 participants, with a mean (SD) age of 37 (10) years, including 49% men, 87% workers, 70% with a bachelor's degree or equivalent, 73% non-smokers, 27% overweight based on body mass index and 20% with high levels of stress. Compared to the total sample, the 335 (45%) bicycling commuters were mainly men, younger, single, childless, non-smoker, with a bachelor's degree or higher and low stress levels. Bicycle commuters were also more physically active, and with a shorter, flatter, and bicycle-adapted commute route (Table 1 & S1). Of the motorized commuters

(n=417 using public transport, or their own car or motorcycle), 232 (55%) had access to a bicycle in Barcelona, of which 92 (40%) rode a bicycle for travel a median of three times per week. There were no statistically significant differences in age, gender, neighborhood deprivation index, population density and commercial outlet density between the TAPAS sample and the active population of Barcelona (Online Supplement, Figures S1, S2 and S3).

Multivariate regression analysis showed that there were differences in overall physical activity duration according to the commute mode used after accounting for personal, neighborhood and route characteristics (Table 2). Compared to bicycle commuters, public transport, motorcycle and car commuters had a geometric mean ratio (GMR) of weekly duration of physical activity 25% (95%CI: 14; 35), 23% (95%CI: 6; 36) and 33% (95%CI: 6; 52) lower, respectively (Table 2). The analysis of vigorous, moderate and walking physical activity duration showed that bicycle commuters participated more in moderate physical activity than motorized commuters, but bicycle commuters did less walking activity than public transport commuters (Figure 1B and Online Supplemental Table S2; $p<0.05$).

In contrast, analysis for total duration of non-travel physical activity showed no differences according to commuting mode (Figures 1A and 1C). The analysis of time spent within each type of non-travel physical activity showed that public transport commuters were 60% (95% CI: 20; 60) less likely to participate in leisure-time moderate-intensity physical activity than bicycle commuters, but that their duration of recreational walking activity was 47% (95% CI: 27; 69) higher than that of bicycle commuters (Figure 1C).

Finally, the analysis of the dose-response between bicycle commuting duration and moderate-to-vigorous physical activity duration showed that bicycle commuting explained 11% out of the total variance explained of moderate-to-vigorous activity (Adjusted R-square 0.17). Participants' moderate-to-vigorous physical activity duration increased on average 0.48 hr/wk (95% CI: 0.40; 0.56) for every 1 hr/wk extra of bicycle commuting (Figure 2; Table S3). Furthermore, there was a lower and an upper threshold (<0.48 hr/wk and >9.5 hr/wk, respectively) in the positive relationship between bicycle commuting and physical activity (Figure 2).

The differences in physical activity duration remained statistically significant when the bicycle commuters were compared to motorized commuters who were both willing to shift to cycle commuting and performed regular vigorous activity (data not shown).

DISCUSSION

The physical activity from bicycle commuting is seen to be an addition, rather than substitution, to the regular physical activity performed by individuals. The extra physical activity performed by bicycle commuters is the result of performing more moderate physical activity while travelling by bicycle. Furthermore, this extra physical activity was observed to follow a dose-response relationship with bicycle commuting duration, being the increase of 0.5 hr/wk in moderate-to-vigorous physical activity for every 1 hr/wk increase in bicycling duration.

Comparison with previous studies

Overall physical activity duration

Higher overall physical activity duration was found in participants who performed their commute by bicycle, which is consistent with previous research regarding active travel among adults.^{26,27}

In agreement with Dombois et al, the differences were due to higher levels of moderate-intensity physical activities.²⁶ In other studies, the effect of an active commute mode on physical activity duration was shown to increase with commute distance.²⁸⁻³⁰ This was not the case in TAPAS study, possibly because the distances travelled in this study were too short, with median of 3.3 km (25th and 75th percentile: 2.1; 4.7). On the other hand, and as it is expected from previous literature, perceiving bicycle commuting as enjoyable was related to more participation in moderate activity, while perceiving bicycle commuting as traffic-risky was related to perform more walking activity.³¹ Finally, it is worth noting that bicycle commuters showed a lower prevalence of mental stress than motorized commuters. This finding is novel and important in preventing adverse health outcomes, such as heart diseases.³² However, this finding needs further investigation to understand whether this was mediated by the extra physical activity performed or it was an additional benefit of bicycling.

Non-travel physical activity duration

The results showed that there was no difference in non-travel physical activity when comparing across commute modes, supporting the idea that active travel acts as an additional form of physical activity rather than a substitution of other forms of physical activity. Furthermore, this finding is consistent with studies conducted in England and the United States.^{29,33} On the other hand, and in agreement with Terzano and colleagues,²⁹ the participants performed different types of non-travel physical activity (walk vs. other moderate-intensity activities) according to the commute mode used. Studies on children have found similar results on commute mode and types of leisure-time physical activity.^{28,34} We believe that the freedom and traveling speed of bicycle commuters allow them to engage in a larger variety of forms of physical activity, explaining the differences in type of physical activity performed.

280

281 *Dose-response physical activity duration*

282 To the best of our knowledge, this is the first epidemiological study assessing the dose-response
 283 relationship between bicycle commuting duration and moderate-to-vigorous physical activity
 284 duration. There is an increase of 0.5 hours in the duration of moderate-to-vigorous physical
 285 activity performed per week for every one-hour per week increase in bicycle commuting, while
 286 the duration of bicycle commuting varies from 0.5 to 9.5 hr/wk. Despite the current study design
 287 do not allow us to establish a causal relationship, this finding reinforces the evidence that bicycle
 288 commuting adds to current physical activity performed by an individual, rather than replaces
 289 other physical activities.

290

291 **Applicability of the results**

292 In the setting of the current study, bicycle commuting accounted for 2 extra hours of physical
 293 activity per week compared to motorized commuting. This increase, by itself, is almost equal to
 294 the minimum recommended amount of physical activity (30 min on five days each week),
 295 required to promote and maintain physical health (i.e., reducing the risk of chronic disease and
 296 premature mortality).^{35,36} The promotion of physical activity, apart from being effective in the
 297 prevention of disease,² has proven to be financially beneficial for public health systems.³⁷⁻³⁹
 298 Particularly, the inclusion of the bicycle as a mean of transport can be a cost-effective
 299 intervention, assuming the provision of appropriate infrastructures and the possibility of
 300 integration into an individual's daily routine.^{5,6} In addition, focusing on interventions towards
 301 promoting trips by bicycle instead of walking has been shown to provide a more health-beneficial
 302 cardiovascular stimulus, even in young adults.⁴⁰ Consequently, based on the current evidence,
 303 public health policy-makers should may wish to promote bicycle commuting.

Strengths and limitations

One of the main strengths of this study is that the sample is representative of the distribution of the active population of Barcelona with respect to personal, neighborhood and route characteristics. Another strength is the control for the most likely confounders (socio-demographic factors, smoking habit, nutritional and health status, bicycle commuting perceptions and built environment) of the relationship between physical activity and bicycle commuting, which prevents the risk of residual confounding in the shown effect.¹⁷ In addition, according to authors knowledge, this was the first study to use independent questions to assess bicycling and physical activity duration. Finally, the statistical methods utilized were the most appropriate and conservative statistical methods to quantify both difference and dose-response relationship of outcomes with log-normal zero inflated distributions, as it is the case of physical activity outcomes.

A limitation of the study was the low response rate from the street recruitment. However, it is important to note that there were no differences in response rate by mode of commute and the sample is representative of the active population and neighborhood distribution of Barcelona. So, we believe that in the worse scenario the low response rate might have led to an overrepresentation of active population within TAPAS sample, but the relationship between physical activity levels and bicycling is still valid and original. A second limitation was the low number of car users sampled. Although it corresponds to the low prevalence of car trips within Barcelona city (7%) (Dades bàsiques de mobilitat 2011, Catalan government 2012), it limited the accuracy of the estimates of car commuters. Another limitation of the study was the cross-sectional design of the study, which limits causal inference between travelling by bicycle and the

higher physical activity level. The use self-reported data could be understood as another limitation, but it is the most cost-effective method to measure the effects of bicycling on physical activity due to the weakness of accelerometers' assessment of bicycling and the high costs of double label water assessment. The selection of a recall questionnaire, which assign 8 METs for any kind of self-reported vigorous activity, instead of a quantitative history questionnaire which allows a detailed measurement of the intensity of physical activities performed, prevented the study of the relationship between the volume of physical activity performed (energy expenditure) and commute mode.⁴¹ Future studies should assess the energy expenditure because it takes into account the different intensities of each type of physical activity performed which would assess better the added value of active transportation on the promotion of physical activity.

CONCLUSIONS

Bicycle commuting will likely add to overall physical activity. This highlights the importance of active transportation, especially bicycle commuting, as a facilitator of active lifestyle habits that could improve public health. Policy interventions to increase bicycle commuting, such as designated bicycle lanes, traffic calming and bicycle sharing programs may contribute to increased physical activity levels.

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Figure 1. Distribution of adjusted^a overall and non-travel physical activity duration, according to the commute mode.

Figure footnote:

(A) This figure shows the adjusted geometric mean and the confidence interval obtained from Fletcher and bootstrap approach of overall and non travel physical activity. (B & C) These figures show the contribution of vigorous, moderate and walking activity to the adjusted geometric mean of overall and non travel physical. ^a Final Models for each level and overall physical activity measures are available in Supplemental Table S2.

Figure 2. Dose-response relationship between bicycle commuting and moderate-to-vigorous physical activity duration (locally weighted scatterplot smoothing regression).

Figure footnote:

Solid and dashed lines indicate the geometric mean and the 95% confidence intervals of the weekly increase in moderate-to-vigorous physical activity duration according to bicycle commuting duration, from a LOESS regression model with bicycle commuting duration, and adjusted for age and number of children. The serrated vertical lines depict the thresholds in the dose-response relationship identified by segmented regression analysis, which were 0.5 hr/wk and 9.5 hr/wk of bicycle commuting, respectively.

ONLINE DATA SUPPLEMENT

THE ADDED BENEFIT OF BICYCLE COMMUTING ON THE REGULAR AMOUNT OF PHYSICAL ACTIVITY PERFORMED

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METHODS (complete version)

RESULTS:

- **Table S1.** Built Environment characteristics of participants according to the commute mode.
- **Figure S1.** Comparison of age and gender distributions between the Barcelona Active Population Survey (BAPS) sample (Statistics and information service, Catalan government 2011) and the Transportation, Air Pollution and Physical Activities (TAPAS) sample.
- **Figure S2.** Comparison of the Neighborhood deprivation index distribution between Barcelona and in TAPAS survey participants' home neighbourhood.
- **Figure S3.1.** Spatial distribution and linear relationship between population density of Barcelona (Statistics and information service, Catalan government 2011) and TAPAS survey participants' home address.

- **Figure S3.2.** Spatial distribution and linear relationship between commercial outlet density of Barcelona (Statistics and information service, Catalan government 2011) and TAPAS survey participants' work address.
- **Table S2.** Detailed multivariate regression models between commute mode and physical activity participation and duration for each level and overall physical activity.
- **Table S3.** Description of the dose-response effect of bicycle commute duration on Moderate-to-Vigorous and Overall physical activity.

REFERENCES

METHODS

Site and Design

Barcelona, one of the populated cities in Europe (total population = 1,621,537), is located in Northeastern Spain with a temperate Mediterranean climate. Although the climate and land use are conducive to bicycling, data shows that the city has a low share of bicycle trips (i.e., 2%).¹ To promote more bicycling, the City began implementing a series of programs in 2006. Specifically the City implemented an infrastructure improvement plan, an educational program, and bicycling sharing program (called “Bicing”) to increase the ride share of bicycle commuting. To assess the impact of these cycling programs, we conducted a transportation and health survey to assess and characterize physical activity and travel behaviors as part of the Transportation, Air Pollution and Physical Activities (TAPAS) project between June 2011 and May 2012.

Sample Design and Subjects

Forty sampling points were selected to cover the City of Barcelona, four random points for each one of the ten districts of the City. Each point was sampled, by three trained interviewers, between 7:45 and 11:30 am during four days within a randomly selected week. Interviewers were randomly assigned, at each sampling point, to a specific street to cover one mode of transport. The modes of transport were public motorized (bus, metro and tram), private motorized (motorcycle and car) and non-motorized (private and public bicycle). The interviewers were instructed to systematically invite all travelers, but prioritizing the recruitment of bicycling travelers over other travel modes when both appeared at the same time. This strategy was

employed to ensure sufficient numbers of bicyclists due to the relatively low number of bicyclists commuters compared to other modes.

Several inclusion criteria were employed, such as: (i) being 18 years or older; (ii) living in Barcelona since 2006 or earlier; (iii) currently working or studying in the City; (iv) self-report of being healthy enough to ride a bicycle for 20 minutes; (v) having a commute equivalent to a 10 minute walk or more; and (vi) using at least one mode of transport other than walking to commute.

Of the 18469 participants approached across the forty sampling random points, 6701 (36.3%) participants agreed to participate with no differences in response rate across commute modes; 1508 participants fulfilled the recruitment criteria and 871 (57.7% of those eligible) participants completed the subsequent telephone survey. We excluded 23 participants because they were walking commuters, 31 because they had difficulties riding a bicycle, 59 because they had a chronic disease that could affect validity of the self-reported physical activity and 6 because they did not live in Barcelona.

Our study protocol was approved by the Clinical Research Ethical Committee of the Parc de Salut Mar (CEIC-Parc de Salut Mar), and written informed consent was obtained from all participants.

Variables and Instruments of Measurement

Study participants answered a telephone survey administered using Computer Assisted Telephone Interviewing (CATI). Survey administration took approximately thirty minutes to

complete. The information collected in the questionnaire included: frequency and duration during the previous week of vigorous, moderate, walking and total physical activity as measured by the International Physical Activity Questionnaire (IPAQ) short form;² the frequency of bicycling and walking for daily travel as measured by the Common Modes of Transport questionnaire;³ frequency and duration of traveling by bicycle in the previous week;⁴ commuter travel behavior;⁵ bicycle perceptions; stress level from the short form of the Perceived Stress Scale;⁶ health status, chronic disease and socio-demographic questions.

Bicycle travelers were defined as those participants who traveled by bicycle at least once in the previous week.⁴ Commute mode was defined, as bicycle, public, motorcycle or car, according to the most frequent mode of commute, being motorized mixed-mode commutes classified according their motorized mode. Willing-to-cycle commuters were defined as those participants who considered commuting by bicycle in Barcelona as a possibility, and thought bicycling was the most pleasant mode of transportation (whether they utilized the bicycled or not). Duration of overall physical activity was defined using the IPAQ, and included time spent walking, plus time spent in all other activities of moderate or vigorous intensity during the past seven days. Moderate-to-vigorous activity duration comprised only moderate or vigorous intensity. Self-efficacy was assessed through the degree of agreement with the sentence "I have enough abilities to ride a bicycle". Participants with positive responses (score ≥ 4) in each of the four questions of the short form of Perceived Stress Scale were defined as being under high stress.⁶

A Geographic Information System (GIS) analysis was conducted, using the ArcGIS Desktop 10 Service Pack 4, to characterize the built environment in the likely commute route and home and work addresses because their potential confounding effects on the relationship between physical

activity and commute mode.^{7,8} Likely commute route was defined as the smallest rectangle enclosing the shortest route between home and work. Home and work addresses were defined as the area within a 400-meter circle drawn around each address. These environments were characterized by their walkability and bikeability index.^{9,10} On the other hand, commute route included also distance and duration (self-reported), and home and work environment were also evaluated regarding their altitude, transport facilities and neighbourhood socio-economic status (Deprivation Index)¹¹.

Walkability index seeks to measure how conducive an area is to walking and biking.⁹ It was assessed following the Frank LD and others approach, as the sum of 3 z-scores (Population Density, Land Use Mix and connectivity). Population density was defined as inhabitants per square kilometer. Land Use Mix (LUM) quantifies the heterogeneity of land uses by neighbourhood (Residential, Commercial, Offices, Education, Health, Bars and Restaurants, Sport, Religion, Leisure) within a range from 0 to 1, when LUM is high, the neighborhood is friendlier. Street connectivity was defined by the number of intersections per square kilometer and had twice the weight of the other variables.

Bikeability index was calculated, following the Winters M and colleagues approach, as the sum of 5 independent outcomes (Bicycle lane density, slope, percent of segregated bicycle lanes, connectivity of bicycle-friendly streets and commercial outlet destination density).¹⁰ Bikeability index ranges from 1 to 10, with a higher index value indicating a friendlier environment for bicycling. Bicycle lane density was defined as the kilometres of bicycle lane divided by square kilometres of the corresponding environment. The slope was defined as the average slope. The bicycle-friendly streets were defined as all streets with a bicycle line or reduced traffic density

($\leq 10\%$ of the major roads; $< 1,305$ veh/hr). Commercial outlet destination density was computed as the percent of extension destined to facilities out of environment extension.

Deprivation Index measures unfavorable socioeconomic characteristics from census tracts of cities. The index values have a mean of 0, a standard deviation of 1 and the highest values correspond to a lower socioeconomic status.

Other measurements considered as potential confounders were: socio-demographic factors, health status, smoking habit, nutritional status, self-efficacy, mental stress, vigorous activity participation (at least ones a week), and perceptions towards bicycle commuting (such as enjoy cycle-commuting, traffic safety or keeping personal appearance). Self-efficacy was assessed through the degree of agreement with the sentence "I have enough abilities to ride a bicycle". Participants with positive responses (score ≥ 4) in each of the four questions of the short form of Perceived Stress Scale were defined as being under high stress.¹⁶ Perception towards bicycle commuting was determined by the degree of agreement with the following sentences:

- "I enjoy more during my trip if I ride in bicycle", when we assessed "Enjoy cycle-commuting".
- "The risk of suffer and accident stop me to ride in bicycle", when we assessed "Traffic safety".
- "The difficulty to keep the personal appearance (ex. Hairstyle, suit and jacket) stop me to use the bicycle", when we assessed "keeping personal appearance".

Statistical Analysis

The representativeness of the Barcelona population in the TAPAS sample was evaluated by comparing: (i) age and gender distributions between the TAPAS sample and the Barcelona Active Population Survey (Statistics and information service, Catalan government 2011), which is the most representative sample available of the working-age Barcelona population; (ii) the distribution of Neighbourhood Deprivation Index and population density in TAPAS participants' home addresses and Barcelona population;¹⁹ and (iii) the work address density per neighbourhood in TAPAS sample vs commercial outlet density per neighbourhood in Barcelona.

The relationship between the commute mode and physical activity level was evaluated using several approaches, including: (i) a multivariate linear model between commute mode and overall physical activity duration (log-transformed); (ii) the relationship between commute mode and non-travel physical activity duration (log-transformed), accounting for active travel duration (bicycle and walk) in previous multivariate linear model; and (iii) the relationship between commute mode and duration of each type of physical activity (vigorous, moderate and walking) was estimated using the Fletcher et al²⁰ procedure because the zero-inflated lognormal distribution of physical activity outcomes. The Fletcher's and colleagues procedure combines ordinary and logistic regression to assess participation and amount of outcomes with log-normal zero inflated distribution, such as physical activity duration.

On the other hand, the dose-response and threshold relationship between bicycle travel duration and physical activity duration, among bicycle travelers, was evaluated using locally weighted scatterplot smoothing (LOESS), and segmented regressions, respectively. LOESS is a nonparametric regression method that fits the shape of the relationship applying local smoothing parameters, is robust to outliers, and makes no assumptions about the distribution of the data.²⁴

Segmented regression, which estimates the dose-response function with piecewise linear segments, was used to find the inflection points (thresholds) in the dose-response curve.²⁵

Multivariate models included all previous variables that in bivariate analysis showed a statistically significant relationship either with physical activity or commute mode (at $p < 0.2$ level), and in multivariate analysis reached statistical significance (at $p < 0.05$ level) or changed by more than 10% the coefficient of the commute mode. Table S1 show all variables included in the final multivariate regression models. Furthermore, all two-way interactions between physical activity duration and one of age, gender and civil status about were also tested in bivariate and multivariate analyses. In order to test if there was replacement within the most active population, the comparison against bicycle commuters was restricted to those motorized participants who both reported a willingness to shift to bicycling and performed regular vigorous activity. All analyses were conducted during 2013-14, using R 3.0.0 (2013 The R Foundation for Statistical Computing).

Table S1. Built Environment characteristics of participants according to the commute mode.

Built Environment	ALL	Bike	Public	Moto	Car	p-value
Commute	n= 728	324(45%)	279(38%)	99(14%)	26(4%)	
Bikeability index [median(IQR)]	6.9(1.5)	7.1(1.2)	6.7(1.7)	6.7(1.9)	6.0 (2.2)	<0.001
Bike route density (km/km2) [median(IQR)]	1.68(1.4)	1.83(1.4)	1.57(1.3)	1.51(1.4)	0.93(1.2)	<0.001
Bike route separation (%) [median(IQR)]	54(34)	58(30)	54(37)	51(33)	41(33)	<0.001
Bicycle friendly street connectivity (n/km ²) [median(IQR)]	49(22)	50(23)	48(20)	50(23)	51(23)	0.952
Slope (%) [median(IQR)]	2.2(2.3)	2(1.4)	2.5(3.6)	2.5(3.1)	3.9(5.5)	<0.001
Commercial Outlet Density (%) [median(IQR)]	71(36.2)	73(35.6)	68(34.6)	71(36.5)	59(45.2)	0.051
Walkability	0.4(1.7)	0.4(1.7)	0.5(1.4)	0.5(2.0)	0.0 (2.7)	0.747
Population density (z-score)	0.32(0.67)	0.32(0.67)	0.31(0.60)	0.36(0.80)	0.03(0.84)	0.546
Street Connectivity (z-score)	-0.02(0.50)	-0.05(0.58)	-0.02(0.42)	-0.05(0.49)	0.05(0.48)	0.813
Land Use Mix (z-score)	0.00(0.77)	-0.03(0.89)	0.04(0.68)	0.02(0.77)	-0.07(0.78)	0.332
Commuting duration (min) [median(IQR)]	20(15)	20(13)	29(20)	15(10)	20(15)	<0.001
Commuting distance, street length (km)	3.5(2.6)	3(2.2)	3.9(2.7)	3.6(2.4)	4.7(4.4)	<0.001
Origin						
Bikeability index [median(IQR)]	6.3(2.2)	6.6(1.9)	6.1(2.4)	5.9(2.3)	5.7(2.4)	<0.001
Bike route density (km/km2) [median(IQR)]	1.15(1.6)	1.36(1.8)	1.02(1.4)	0.73(1.6)	0.53(1.3)	0.003
Bike route separation (%) [median(IQR)]	44(60)	49(59)	44(55)	39(66)	15(50)	0.016
Bicycle friendly street connectivity (n/km ²) [median(IQR)]	53(36)	54(37)	50(35)	52(33)	61(37)	0.697
Slope (%) [median(IQR)]	2.3(3.4)	2.1(2.2)	2.5(4.7)	2.5(3.8)	4.2(7.5)	<0.001
Commercial Outlet Density (%) [median(IQR)]	49(39.8)	57(41.0)	44(38.9)	55(40.2)	39(32.6)	0.001
Walkability	0.5(3.0)	0.5(2.8)	0.6(3.0)	0.4(3.3)	0.4(2.6)	0.833
Population density (z-score)	0.32(1.17)	0.35(1.16)	0.28(1.21)	0.40(1.12)	0.32(1.28)	0.507
Street Connectivity (z-score)	0.00(0.75)	0.00(0.78)	0.03(0.71)	-0.03(0.75)	-0.06(0.62)	0.837
Land Use Mix (z-score)	-0.08(1.34)	-0.12(1.44)	-0.07(1.26)	-0.13(1.49)	-0.01(0.94)	0.778
Deprivation Index (z-score)	-0.2(1.0)	-0.2(0.9)	-0.1(1.1)	-0.4(0.9)	-0.3(1.4)	0.015
Altitude	42(37)	35(31)	46(41)	47(37)	73.4(59.1)	<0.001
Number of Bicycle parks	12(26)	18(26)	11(27)	11(22)	6(15)	<0.001
Number of Bicing stations	4.2(2.5)	4.7(2.4)	3.9(2.6)	3.8(2.4)	3.3(2.8)	<0.001
Number of public transport stations	12.3(5.3)	12.5(5.1)	12.2(5)	12.9(6.7)	10.5(4.1)	0.325
Destination						
Bikeability index [median(IQR)]	6.9(2)	7.1(1.8)	6.8(2.1)	7(2.7)	6.4(2.3)	0.008
Bike route density (km/km2) [median(IQR)]	1.53(1.7)	1.61(1.6)	1.44(1.6)	1.52(2.4)	1.16(1.6)	0.049
Bike route separation (%) [median(IQR)]	57(48)	61(43)	57(45)	38(67)	58(41)	0.021

Bicycle friendly street connectivity (n/km ²) [median(IQR)]	42(38)	45(36)	39(38)	38(39)	33(29)	0.206
Slope (%) [median(IQR)]	2(2.1)	1.9(1.5)	2.2(3.1)	1.8(2.4)	2.2(2.5)	0.022
Commercial Outlet Density (%) [median(IQR)]	68(53.4)	72(50.8)	65(53.5)	72(58.3)	43(44.1)	0.018
Walkability	-0.3(3.2)	0.3(3.1)	-0.5(3.4)	-1.0 (2.9)	-1.1(3.3)	0.054
Population density (z-score)	-0.03(1.2)	0.11(0.95)	-0.12(1.25)	-0.15(1.32)	-0.22(1.35)	0.128
Street Connectivity (z-score)	-0.21(0.82)	-0.12(0.88)	-0.23(0.77)	-0.30(0.81)	-0.33(0.55)	0.026
Land Use Mix (z-score)	-0.54(1.42)	-0.57(1.32)	-0.50(1.47)	-0.58(0.89)	-0.37(1.27)	0.180
Altitude	40(38)	32(27)	47(40)	47(53)	46(43)	<0.001
Number of Bicycle parks	25(28)	26(26)	24(29)	26(39)	15(25)	0.006
Number of Bicing stations	4.9(3.1)	5.4(3.0)	4.5(3.1)	4.7(3.4)	3.5(2.4)	0.001
Number of public transport stations	15.3(7.7)	15.7(7.4)	15.5(7.6)	14.7(8.8)	11.9(6.2)	0.031

Abbreviation, definition: IQR, inter-quartile range; SD, standard deviation.

P-value: ANOVA or Kruskal-wallis for continuous variables, Chi-squared for categorical variables.

Figure S1. Comparison of age and gender distributions between the Barcelona Active Population Survey (BAPS) sample (Statistics and information service, Catalan government 2011) and the Transportation, Air Pollution and Physical Activities (TAPAS) sample.

Figure S2. Comparison of the Neighborhood deprivation index distribution between Barcelona and in TAPAS survey participants' home neighbourhood.

Figure S3.1. Spatial distribution and linear relationship between population density of Barcelona (Statistics and information service, Catalan government 2011) and TAPAS survey participants' home address.

Figure S3.2. Spatial distribution and linear relationship between commercial outlet density of Barcelona (Statistics and information service, Catalan government 2011) and TAPAS survey participants' work address.

Table S2. Detailed multivariate regression models between commute mode and physical activity participation and duration for each level and overall physical activity.

	Vigorous Activity		Moderate Activity		Walking Activity		Overall Physical Activity
	Yes/No OR(95%CI)	Duration GMR(95%CI)	Yes/No OR(95%CI)	Duration GMR(95%CI)	Yes/No OR(95%CI)	Duration GMR(95%CI)	Duration GMR(95%CI)
Socio-Demographic Factors:							
Age:							
[18-35]	0.92(0.62;1.35)	1.23(1.02;1.47)	-	-	-	-	1.07(0.93;1.23)
(35-50)	ref.	ref.	-	-	-	-	ref.
[50-70]	0.60(0.35;1.05)	1.39(1.04;1.86)	-	-	-	-	1.15(0.94;1.41)
Family bigger than two, yes	-	-	0.68(0.47;0.99)	-	-	-	-
Number of Children	0.74(0.61;0.91)	0.92(0.82;1.02)	-	-	-	0.95(0.88;1.03)	0.92(0.85;0.98)
Working Status, Studing	-	-	-	0.72(0.57;0.91)	-	0.77(0.62;0.96)	-
Educational Level:							
High School or lower	0.49(0.34;0.70)	-	-	-	-	1.13(0.97;1.33)	-
Educational Level:							
Bachelor	-	0.79(0.67;0.92)	-	-	-	-	-
Smoking Habit, Current Smoker	-	-	-	-	-	1.13(0.97;1.31)	-
Biological Factors:							
Health Status:							
Bad Health in Men	ref.	ref.	ref.	-	-	-	ref.
Bad Health in Women	0.62(0.40;0.96)	0.85(0.69;1.06)	0.87(0.54;1.41)	-	-	-	0.99(0.84;1.16)
Good Health in Men	1.80(1.09;3.03)	1.07(0.87;1.33)	2.62(1.50;4.66)	-	-	-	1.33(1.12;1.58)
Good Health in women (compared to good health Men)	0.44(0.26;0.75)	0.75(0.60;0.94)	0.45(0.24;0.81)	-	-	-	0.80(0.67;0.96)
Self-efficacy:							
Totally self-sufficient	ref.	ref.	-	-	-	-	-
Self-sufficient	0.73(0.51;1.04)	1.06(0.90;1.25)	-	-	-	-	-
Partially self-sufficient	0.99(0.31;3.33)	1.74(0.98;3.08)	-	-	-	-	-
BMI (continious)	-	-	-	1.05(1.02;1.08)	-	-	-
BMI:							
Normal (<25)	ref.	-	-	-	-	-	-
Overweight (≥25)	0.71(0.48;1.05)	-	-	-	-	-	-
Gender:							
Men	-	-	-	-	-	ref.	-
Women	-	-	-	-	-	1.11(0.94;1.30)	-
Overweight Men (≥25)	-	-	-	-	-	1.03(0.84;1.27)	-
Overweight Women (≥25) (compared to Overweight Men)	-	-	-	-	-	1.37(1.07;1.76)	-

Bicycle Commuting Perceptions							
Enjoying:							
Regular	ref.	ref.		ref.			
Agree & Totally Agree	1.17(0.74;1.84)	1.12(0.90;1.40)	-	0.94(0.71;1.25)	-	-	-
Enjoying:							
Regular	-	-	ref.				
Agree	-	-	1.54(0.97;2.45)	-	-	-	-
Totally Agree	-	-	2.17(1.14;4.18)	-	-	-	-
Safety:							
Totally agree	ref.	ref.	-	-	ref.	-	-
Agree	0.81(0.47;1.36)	0.76(0.62;0.95)	-	-	1.62(0.65;3.72)	-	-
Disagree	0.70(0.37;1.29)	0.78(0.60;1.01)	-	-	2.91(0.92;9.74)	-	-
Home Built Environment							
Street Connectivity (n/km ²)	-	0.89(0.78;1.01)	-	-	-	-	-
Slope (%)	-	-	-	-	-	1.01(1.00;1.03)	-
Bicycle lane (km/km ²)	1.09(0.93;1.27)	-	-	-	-	-	-
Population density (hab/km ²)	-	-	1.26(0.99;1.60)	-	-	-	-
Commercial outlet density (%)	-	-	-	0.996 (0.993;0.999)	-	-	-
Number of Bicing stations (n)	-	-	1.10(1.02;1.18)	-	-	-	-
Deprivation Index (z-score)	-	-	-	-	1.64(1.05;2.66)	-	1.09(1.02;1.17)
Work/Studing Built Environment							
Walkability Index	-	-	-	-	-	1.04(1.01;1.08)	1.04(1.01;1.07)
Commercial outlet density (%)	1.00(0.99;1.00)	-	-	-	-	-	-
Nº of public transport stations (n)	-	-	-	-	-	0.99(0.98;1.00)	-
Commute Built Environment							
Slope (>3%)	-	-	-	0.85(0.69;1.06)	-	-	-
Population density (hab/km ²)	-	-	-	1.16(0.98;1.36)	-	-	-
Destination altitude * Slope (km*%)	-	-	-	-	0.92(0.87;0.98)	-	0.98(0.97;0.998)
Mode:							
Coche	1.37(0.54;3.61)	0.91(0.59;1.40)	0.11(0.04;0.28)	0.57(0.33;0.97)	1.25(0.23;23.4)	0.86(0.59;1.26)	0.70(0.50;0.97)
Moto	1.86(1.06;3.34)	0.96(0.76;1.22)	0.14(0.08;0.26)	0.84(0.63;1.13)	0.29(0.13;0.66)	1.04(0.83;1.29)	0.79(0.66;0.95)
Public	0.66(0.44;0.98)	0.87(0.72;1.06)	0.09(0.05;0.14)	0.63(0.51;0.77)	1.93(0.72;5.93)	1.39(1.19;1.62)	0.77(0.67;0.88)

Abbreviation, definition: CI, confidence interval; GMR, geometric mean ratio; OR, odds ratio; ref, reference category; -, not included in final model because in multivariate analysis didn't reach statistical significance (at p<0.05 level) or didn't change by more than 10% the coefficient of the commute mode.

Table S3. Description of the dose-response effect of bicycle commute duration on Moderate-to-Vigorous and Overall physical activity.

Bicycle Commuting (hr/wk)	Moderate-to-Vigorous		
	Value (hr/wk)	Increase (hr/wk)	Increase (%)
0.0	2.44	-	-
0.5	2.44	-	-
1.0	2.71	0.27	10.93
1.5	3.04	0.33	12.09
2.0	3.39	0.35	11.46
2.5	3.74	0.35	10.30
3.0	4.07	0.34	9.01
3.5	4.39	0.31	7.70
4.0	4.69	0.30	6.87
4.5	4.97	0.29	6.13
5.0	5.25	0.27	5.46
5.5	5.50	0.25	4.84
6.0	5.73	0.23	4.27
6.5	5.95	0.21	3.73
7.0	6.14	0.19	3.23
7.5	6.31	0.17	2.76
8.0	6.46	0.15	2.31
8.5	6.58	0.12	1.88
9.0	6.67	0.10	1.47
9.5	6.74	0.07	1.07

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Table 1

Table 1. Socio-demographic, bicycle behavior and perception, and physical activity characteristics of participants according to commute mode.

	ALL n= 752	Bicycle 335(45%)	Public Transport 288(38%)	Motorcycle 102(14%)	Car 27(4%)	p-value
Sociodemographic						
Sex: Male, n(%)	365(49)	182(54)	109(38)	58(57)	16(59)	< 0.001
Age (years), mean (SD)*	37(10)	36(10)	37(12)	38(10)	40(8)	0.012
Civil status: single, n(%) *	142(19)	78(23)	44(15)	19(19)	1(4)	0.002
Has child(ren): Yes, n(%) *	271(36)	109(33)	99(34)	47(46)	16(59)	0.005
Education level: more than secondary, n(%)*	523(70)	257(77)	178(62)	73(72)	15(56)	< 0.001
Foreigner: Yes, n(%)	98(13)	51(15)	37(13)	7(7)	3(11)	0.177
Smoking status: current smoker, n(%)*	209(28)	72(22)	89(31)	36(35)	12(44)	0.002
BMI (≥ 25), n(%)*	205(27)	70(21)	12(44)	33(32)	90(31)	0.006
High Stress Level, Yes, n(%)*	151(20)	44(14)	70(25)	31(31)	6(22)	< 0.001
Health Status: Very good or excelent, n(%)	315(42)	155(46)	105(37)	46(45)	9(33)	0.066
Bicycle behaviour and perception						
Bicycle access (own or public access): Yes, n(%)	567(75)	335(100)	156(54)	60(59)	16(59)	< 0.001
Public shared bicycle registred: Yes, n(%)	392(52)	282(84)	76(26)	26(26)	8(30)	< 0.001
Use bicycle for travel: Yes, n(%)	422(56)	330(99)	65(23)	18(18)	9(33)	< 0.001
Bicycle travel frequency: days, median(IQR)	6 (4)	6 (3)	3 (3)	3 (3)	3 (3)	< 0.001
Bicycle travel duration: h/week, median(IQR)	2.5(3)	2.9(3)	1.2(1)	1.0(2)	0.7(1)	< 0.001
Self-efficacy: Totally self-sufficient, n(%)	346(46)	191(57)	96(33)	46(45)	13(48)	< 0.001
Willingness to shift to Bicycling: Totally ready, n(%)	38(9)	-	31(11)	3(3)	4(17)	< 0.001
Enjoy Bicycle commuting: Yes, n(%) ^a	600(81)	324(98)	18(69)	58(59)	200(71)	< 0.001
Traffic Safety: Yes, n(%) ^a	545(73)	303(91)	158(55)	68(68)	16(59)	< 0.001
Keeping personal appearance: Impossible, n(%) ^a	196(26)	35(10)	96(33)	50(51)	15(56)	< 0.001
Physical Activity median(IQR)						
Vigorous Activity Duration (hr/wk)	1(3)	2(4)	0(2)	2(4)	1(3)	< 0.001
Moderate Activity Duration (hr/wk)	1(3)	3(3)	0(1)	0(2)	0(1)	< 0.001
Walking Activity Duration (hr/wk)	4(4)	3(3)	4(5)	3(4)	3(3)	< 0.001
Overall Activity Duration (hr/wk)	7(7)	8(7)	7(6)	6(8)	5(9)	< 0.001
Energy Expenditure in Activity (METs-h/week)	32(34)	38(31)	25(31)	28(43)	22(41)	< 0.001
Built Environment median(IQR)						
Commuting duration (min)	20(15)	20(13)	29(20)	15(10)	20(15)	< 0.001
Commuting network distance (km) ^a	3.5(2.6)	3(2.2)	3.9(2.7)	3.6(2.4)	4.7(4.4)	< 0.001
Bikeability index at Home (0 to 10) ^a	6.3(2.2)	6.6(1.9)	6.1(2.4)	5.9(2.3)	5.7(2.4)	< 0.001
Walkability index at Home (-4 to 11) ^a	0.5(3)	0.5(2.8)	0.6(3)	0.4(3.3)	0.4(2.6)	0.833

Abbreviation, definition: CI, confidence interval; IQR, inter-quartile range; High Stress levels, having a score ≥ 4 in each question of the short form of Perceived Stress Scale¹⁶; MET, metabolic equivalent tasks; p-value, ANOVA or Kruskal-wallis for continuous variables, Chi-squared for categorical variables; SD, standard deviation.

^a Some variables have missing values: 1 in age, 1 in civil status, 2 in child, 3 in Education level, 1 in smoking status, 2 in BMI, 12 in stress, 4 in traffic safety, 3 in keeping personal appearance and 24 in Built Environment.

Table 2. Crude and Adjusted^a linear association between commute mode and physical activity duration.

Commute mode (Reference Bicycle)		All Physical Activity Duration GMR (95%CI)	Non Travel Physical Activity Duration GMR (95%CI)
Public Transport			
	Crude	0.73(0.65 ; 0.84)	0.97(0.83 ; 1.14)
	Adjusted ^a	0.75(0.66 ; 0.86)	0.99(0.84 ; 1.17)
Motorcycle			
	Crude	0.73(0.61 ; 0.87)	1.07(0.87 ; 1.32)
	Adjusted ^a	0.77(0.64 ; 0.94)	1.17(0.93 ; 1.46)
Car			
	Crude	0.60(0.44 ; 0.83)	0.89(0.64 ; 1.23)
	Adjusted ^a	0.67(0.48 ; 0.94)	0.99(0.69 ; 1.40)

GMR: geometric mean ratio because physical activity was log-transformed; CI: confidence interval.
^a Detailed Multivariate regression models are available in Table S2.

Figure 1
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Figure 2
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