Cross-sectional associations of active transport, employment status and objectively measured physical activity: analyses from the National Health and Nutrition Examination Survey

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ABSTRACT

Background To investigate associations between active transport, employment status and objectively measured moderate-to-vigorous physical activity (MVPA) in a representative sample of US adults.

Methods Cross-sectional analyses of data from the National Health and Nutrition Examination Survey. A total of 5180 adults (50.2 years old, 49.0% men) were classified by levels of active transportation and employment status. Outcome measure was weekly time spent in MVPA as recorded by the Actigraph accelerometer. Associations between active transport, employment status and objectively measured MVPA were examined using multivariable linear regression models adjusted for age, body mass index, race and ethnicity, education level, marital status, smoking status, working hour duration (among the employed only) and self-reported leisure time physical activity.

Results Patterns of active transport were similar between the employed (n=2897) and unemployed (n=2283), such that 76.0% employed and 77.5% unemployed engaged in no active transport. For employed adults, those engaging in high levels of active transport (≥90 min/week) had higher amount of MVPA than those who did not engage in active transport. This translated to 40.8 (95% CI 15.7 to 65.9) additional minutes MVPA per week in men and 57.9 (95% CI 32.1 to 83.7) additional minutes MVPA per week in women. Among the unemployed adults, higher levels of active transport were associated with more MVPA among men (44.8 min/week MVPA, 95% CI 9.2 to 80.5) only.

Conclusions Findings from the present study support interventions to promote active transport to increase population level physical activity. Additional strategies are likely required to promote physical activity among unemployed women.

INTRODUCTION

Regular and sustained participation in physical activity is associated with better physical and mental health and is associated with healthy ageing in adults.1–3 Consequently, the global physical activity recommendations developed by the WHO recommends that adults should do at least 150 min (2 hours and 30 min) a week of moderate intensity aerobic activity or 75 min (1 hour and 15 min) a week of vigorous-intensity aerobic activity, or an equivalent combination of moderate-intensity and vigorous-intensity aerobic activity.4 However, despite these recommendations, population levels of physical activity in the USA are low with just 51.7% of adults meeting the guidelines in 2016.5 To date, efforts to increase population levels of leisure or occupational physical activity have yielded limited success particularly over the long term.6,7

Active travel or active transport (walking and bicycling for transportation) may provide an alternative opportunity for physical activity. A recent British study8 in a sample of 1628 adults showed that changes in active transport were associated with commensurate changes in total physical activity. Compared with those whose active transport remained unchanged, total physical activity decreased by 176.9 min/week in those whose active transport had decreased (adjusted regression coefficient −154.9, 95% CI −195.3 to −114.5) and was 112.2 min/week greater among those whose active transport had increased (adjusted regression coefficient 135.1, 95% CI 94.3 to 175.9). Active transport is associated with a range of health outcomes9 and has recently been shown to be associated with lower risk (0.73 walking, 0.54 cycling) of cardiovascular disease (CVD) incidence, the leading cause of death worldwide,10 and lower risk of CVD mortality (0.48 cycling, 0.64 walking).11 To the best of our knowledge, similar data for the US population do not exist. It is possible that by transforming routine daily living into an opportunity for physical activity, active transport overcomes many of the traditional barriers to engaging in leisure time or occupational physical activity.

A previous systematic review12 investigating the association between active travel and physical activity reported mixed results across 15 studies: 5 studies found associations in the expected direction (more active transport associated with more physical activity), 9 studies found such associations in at least one gender group and 1 study reported no associations. One potential reason for conflicting results and an important factor that may influence the relationship between active travel and physical activity is employment status. Indeed, available evidence shows that adults from a lower socioeconomic-status (a proxy for unemployment) have lower levels of overall physical activity.13,14 In addition, physical activity patterns vary among different...
geographic regions, such that unemployment itself was associated with lower levels of physical activity in the US population but not in Sweden or Canada. However, it should be noted that the Canadian study was carried out over 20 years ago. To the authors’ knowledge, more recent data do not exist.

Interestingly, recent studies carried out in Canadian population-based samples have investigated neighbourhood walkability in relation to physical activity. One population-based study reported significant associations of higher walkability with higher overall physical activity in the adult population after adjustment for important confounding variables, including employment status. This association is likely driven by higher transport walking.

Nevertheless, to the best of our knowledge, no study has investigated the relationship between active transport and physical activity stratified by employment status. The employed individual may have greater opportunity for active transport (to and from work) as well as active transport to other destinations (eg, shop on lunch break). The unemployed individual is likely to have less structure in his or her life and will not have the opportunity to use active transport to and from work. This potential lower level of active transport may yield lower levels of total physical activity and increase the risk of non-communicable disease risk factors and poorer mental health.

The aim of the present analysis is to investigate the association between active transport and accelerometer-measured physical activity in a national representative population sample from the US National Health and Nutrition Examination Survey (NHANES). We hypothesise that those who are employed and use active transport will engage in higher levels of physical activity.

**METHODS**

**Study population**

The NHANES was designed to provide cross-sectional estimates on the prevalence of health, nutrition and potential risk factors among the civilian non-institutionalised US population up to 85 years of age. In brief, NHANES surveys a nationally representative complex, stratified, multistage, probability clustered sample of about 5000 participants each year in 15 counties across the country. Survey participants were asked to attend a physical examination in a mobile examination centre (MEC) or in the participants’ home. The present analysis aggregated data from waves 2003–2004 and 2005–2006. During these waves, objective physical activity assessment was implemented in the NHANES participants by fitting them with a hip-worn accelerometer (ActiGraph AM-7164) for 7 days. Participants provided written informed consent.

We extracted demographic information, employment status and working hour duration, measures of adiposity, smoking history, self-reported leisure time physical activity, self-reported walking and cycling for travel and objective physical activity and combined them into a single dataset for each data collection wave. We created a single dataset for each wave of data from NHANES 2003–2004 and 2005–2006 and excluded those who were younger than 25 years old, were pregnant or unable to walk or cycle.

**Accelerometer-measured physical activity**

NHANES participants were asked during their physical examinations at the MEC to wear an accelerometer (ActiGraph AM-7164, 1 min epochs) at the right hip for seven consecutive days to objectively measure free-living physical activity. The ActiGraph AM-7164 is a validated, small lightweight device that provides detailed information about the intensity, frequency and duration of physical activity. The epoch length was set at 1 min, and the Actigraph recorded count data for physical activity in the form of counts per minute (cpm). Non-wear time was defined as 60 min of consecutive zero counts. A recording of at least 10 hours of data was defined as a valid day, and four or more valid days were required to be included in the analysis. The total minutes of valid data were recorded as the accelerometer wear time. Data on raw moderate-to-vigorous physical activity (MVPA) were calculated from the minutes spent in MVPA bouts (>2020 cpm) of at least 10 min. Wear time-adjusted MVPA was computed by dividing raw MVPA minutes by total wear time and multiplying the resulting fraction by the average wear time of all participants. We summarised the adjusted total weekly minutes of MVPA for each participant.

**Active transport**

Participants self-reported their active transport behaviour in the 2003–2004 and 2005–2006 waves. Participants were asked if they ‘have walked or bicycled as part of getting to and from work, or school, or to do errands?’ over the past 30 days. Participants who answered ‘no’ to this question were classified as non-active transporters (0 minutes/week active transport). For those who answered ‘yes’, they were further asked about activity frequency (‘how often did you do this’) and duration (‘On those days when you walked or bicycled, about how long did you spend all together doing this’). Participants who reported spending less than 10 min ‘on these days when you walked or bicycled’ were also classified as non-active transporters (0 minutes/week active transport). Levels of active transport were calculated as the weekly minutes that participants reported participating in walking or cycling. The 30 days’ active transport was calculated by multiplying the number of days participants walked or bicycled by their daily duration. We summarised weekly active transport by dividing 30 days’ active transport by 30 then multiply by 7 days. Travel mode was defined as non-active transport (0 minutes/week active transport), low level of active transport (<90 minutes/week) and high level of active transport (≥90 minutes/week). Ninety minutes was used to approximate the median of the weekly active transport minutes in our study population, which further indicates the suggested minimum amount of weekly physical activity to achieve survival benefits.

**Sociodemographic characteristics**

Sociodemographic characteristics including age, gender, race and ethnicity, education, marital status, working hour duration and smoking status were extracted. Based on self-reported race and ethnicity, participants were classified into one of the three racial/ethnic groups: non-Hispanic white, non-Hispanic black, and Hispanic and others. Education levels were classified into four groups: less than 12th grade, high school, some college and college graduate or above. Participants’ marital status were summarised into two groups: live with someone (married and living with partner) and live alone (widowed, divorced, separated and never married). Based on self-reported occupation, we created a binary variable for employed (working at a job or business and with a job or business but not at work) and unemployed (looking for work and not working at a job or business). For those employed, we further extracted data on their working hour durations. Finally, we classified participants into three groups: never smokers (did not smoke 100 cigarettes and do not...
Body mass index (BMI)

Weight and height were measured at the time of physical examinations at the MEC. The measurements followed standard procedures and were carried out by trained technicians using standardised equipment. BMI was calculated as weight in kg/height in metres. We categorised study participants into standard BMI categories: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²) and obese (≥30.0 kg/m²). For analytic purposes, we combined underweight and normal weight participants (≤25 kg/m²).

Self-reported leisure-time physical activity (LTPA)

Using a list of 48 activities, participants self-reported whether they participated in any of these LTPA in the past 30 days, along with the frequencies and durations of these activities. Each activity was coded into a metabolic equivalent task (MET) score based on the 2011 Compendium of Physical Activities, a valid and globally used instrument to quantify the energy expenditure of physical activity in adults. For each reported activity, MET-minutes per week (MET-min/week) were calculated by multiplying the MET value of each reported activity by the minutes spent in the activity per 7 days. Overall, LTPA was summarised as the total MET-min per week of all reported activities. Participants were classified as inactive (0 MET-min/week), insufficiently active (<750 MET-min/week) and sufficiently active (≥750 MET-min/week) based on the standard definition. We used 750 MET-min/week as the threshold, because it approximates the amount of MET score for 150 min/week moderate-to-vigorous intensity (3.0–6.0 METs) physical activity that is recommended to adult populations by the WHO.

STATISTICAL ANALYSIS

Survey analysis procedures were used to account for the sample weights (MEC exam weight), stratification and clustering of the complex sampling design to ensure nationally representative estimates. We included participants with completed information.

| Characteristics                     | Employed |          | Unemployed |          |
|-------------------------------------|----------|----------|------------|----------|
|                                     | Men      | Women    | P values   | Men      | Women    | P values   |
| N                                   | 1662     | 1235     |            | 1017     | 1266     |            |
| Weighted N*                         | 43 458 242 | 36 306 134 | 0.26       | 15 204 399 | 24 454 478 | 0.04       |
| Age (year)                          | 44.4 (0.4) | 45.0 (0.4) |            | 62.1 (0.8) | 60.6 (0.7) |            |
| BMI (%)                             | <0.001   |          |            | <0.001   |          |            |
| <18.5                               | 0.7      | 1.1      |            | 1.4      | 2.2      |            |
| 18.5–24.9                           | 25.4     | 35.4     |            | 23.9     | 33.9     |            |
| 25.0–29.9                           | 42.4     | 28.9     |            | 42.5     | 30.5     |            |
| ≥30                                 | 31.5     | 34.6     |            | 32.2     | 33.4     |            |
| Race (%)                            |          | 0.008    |            |          | 0.001    |            |
| Non-Hispanic white                  | 72.9     | 74.1     |            | 80.8     | 74.6     |            |
| Non-Hispanic black                  | 8.6      | 10.7     |            | 9.7      | 9.6      |            |
| Hispanic and other                  | 18.5     | 15.2     |            | 9.5      | 15.8     |            |
| Education (%)                       |          | <0.001   |            |          | 0.11     |            |
| Less than 12th grade                | 13.4     | 9.5      |            | 24.7     | 23.7     |            |
| High school                         | 25.3     | 22.5     |            | 26.1     | 31.4     |            |
| Some college                        | 30.2     | 37.1     |            | 28.7     | 27.3     |            |
| College graduate or above           | 31.1     | 30.9     |            | 20.5     | 17.6     |            |
| Marital status (%)                  |          | <0.001   |            |          | 0.01     |            |
| Live with someone                   | 79.2     | 65.4     |            | 69.7     | 63.2     |            |
| Live alone                          | 20.8     | 34.6     |            | 30.3     | 36.8     |            |
| Smoking (%)                         |          | <0.001   |            |          | <0.001   |            |
| Never smoker                        | 47.6     | 61.2     |            | 29.8     | 56.9     |            |
| Former smoker                       | 27.8     | 21.2     |            | 48.5     | 25.4     |            |
| Current smoker                      | 24.6     | 17.6     |            | 21.7     | 17.7     |            |
| Working hour duration (hours/week), | 45.8 (0.5) | 38.9 (0.4) | <0.001   | n.a.     | n.a.     | <0.001   |
| mean (SE)                           |          |          |            |          |          |            |
| Leisure-time physical activity (%)  | 0.01     |          |            | 0.18     |          |            |
| Inactive                            | 30.5     | 27.9     |            | 39.6     | 42.0     |            |
| Insufficiently active               | 31.0     | 38.9     |            | 28.6     | 29.9     |            |
| Sufficiently active                 | 38.5     | 33.2     |            | 31.8     | 28.1     |            |
| Accelerometer-measured moderate-to-vigorous | 57.1 (3.7) | 45.6 (3.6) | 0.004 | 41.1 (4.8) | 28.8 (2.2) | 0.02 |
| physical activity (min/week), mean (SE) |          |          |            |          |          |            |

*Weighted sample size to account for the complex survey design (including oversampling), survey non-response and poststratification in the NHANES study. BMI, body mass index; NHANES, National Health and Nutrition Examination Survey.
on accelerometer-measured physical activity, active transport behaviour, employment status, sociodemographic characteristics, weight, height, smoking and self-reported LTPA. We calculated the descriptive statistics for participants’ characteristics, LTPA categories and accelerometer-measured MVPA by their employment status and gender. We summarised weighted means and SEs for continuous variables and weighted proportions for categorical variables.

Linear regressions were carried out to quantify associations between levels of self-reported active transport and accelerometer-measured MVPA, stratified by employment status. Because of the documented difference in walking and cycling behaviour between men and women, we tested for the interactions of active travel and gender. We then further stratified our analyses by gender provided the significant interaction. The multi-variable linear regression models for accelerometer-measured MVPA were adjusted for age, BMI, race and ethnicity, education level, marital status, smoking status, self-reported LTPA and working hour duration among the employed only. We examined the normality of residuals by kernel density estimate and standardised normal probability plots for all the linear regression models. All statistical significance was set at p<0.05. All statistical analyses were performed using Stata V.14.0.

RESULTS
A total of 5506 adults aged 25 years or older had sufficient data on accelerometer-measured MVPA. Of these, we excluded 218 (5%) participants who did not provide data on active transport or employment status. We further excluded 44 (1%) participants who did not provide information on sociodemographic characteristics or self-reported LTPA. Our study population consisted of 5180 adults with completed data. The majority of the study population were employed (66.8%). Employed participants’ mean age at the time of baseline examination was 44.7 years with mean BMI of 28.5 kg/m², whereas the unemployed participants were older (61.2 years, p<0.001) with similar BMI (28.5 kg/m², p=0.96). Accelerometer-measured MVPA was significantly higher among those who were employed than the unemployed (51.8 min/week vs 33.5 min/week, p<0.001). Yet, patterns of active transport were similar between the employed and unemployed, such that 76% employed and 77.5% (p=0.3) unemployed engaged in no active transport, and 11.8% employed and 13.2% unemployed achieved 90 or more weekly minutes walking and cycling for travel purpose. We observed statistically significant differences between men and women for most characteristics, except for age among the employed and education and leisure time physical activity among the unemployed (table 1).

Associations between active transport and accelerometer-measured MVPA

Table 2 summarises both the non-adjusted and adjusted associations between levels of active transport and accelerometer-measured MVPA in linear regression models. For employed adults, engaging in high levels of active transport (≥90 minutes/week) had higher accelerometer-measured MVPA than those who did not engage in active transport in univariate analyses, and these findings were maintained in multivariable analyses. This translated to 40.8 (95% CI 15.7 to 65.9) additional minutes MVPA per week in men and 57.9 (95% CI 32.1 to 83.7) additional minutes MVPA per week in women in the multivariable-adjusted models. Among the unemployed adults, higher levels of active transport were associated with more accelerometer-measured MVPA in both men and women in the unadjusted models. However, in multivariable-adjusted models, the association was only retained among men who engaged in 90 min or more active transport per week (44.8 min/week MVPA, 95% CI 9.2 to 80.5).

Table 2 Associations between levels of active travel (transport) and accelerometer-measured moderate-to-vigorous intensity physical activity (min/week) from unadjusted and multivariable linear regression models among employed and unemployed adults aged 25 years or older from the NHANES (2003–2006)

| Accelerometer-measured MVPA (min/week) | Men | Women |
|----------------------------------------|-----|-------|
| **Employed (commuters, n=2897)** | | |
| Unadjusted | Adjusted* | Unadjusted | Adjusted* |
| **Zero active travel** | Reference | Reference | |
| Lower level active travel (<90 min/week) | 21.2 (3.0 to 39.5) | 8.15 (−8.5 to 24.8) | 18.1 (4.1 to 32.2) | 5.8 (−5.8 to 17.4) |
| High-level active travel (≥90 min/week) | 55.6 (29.9 to 81.4) | 40.8 (15.7 to 65.9) | 64.9 (36.2 to 93.6) | 57.9 (32.1 to 83.7) |
| P for trend | <0.001 | 0.002 | <0.001 | <0.001 |
| **Unemployed (n=2283)** | | |
| Unadjusted | Adjusted† | Unadjusted | Adjusted† |
| **Zero active travel** | | | |
| Lower level active travel (<90 min/week) | 19.5 (−5.3 to 44.3) | 10.0 (−14.8 to 34.9) | 8.9 (−8.9 to 26.6) | 2.1 (−12.7, 16.9) |
| High-level active travel (≥90 min/week) | 61.3 (24.6 to 97.9) | 44.8 (9.2 to 80.5) | 18.9 (6.7 to 31.1) | 9.5 (−4.5, 23.6) |
| P for trend | 0.001 | 0.01 | 0.001 | 0.18 |

*Adjusted for age, BMI, race and ethnicity, education, marital status, smoking status, work hour duration and level of leisure-time physical activity.
†Adjusted for age, BMI, race and ethnicity, education, marital status, smoking status and level of leisure-time physical activity.

BMI, body mass index; MVPA, moderate-to-vigorous physical activity; NHANES, National Health and Nutrition Examination Survey.
DISCUSSION

To the best of our knowledge, the current study is the first to investigate the relationship between active transport and MVPA in a US national representative sample. In this large sample, we found that those who were employed and those who were unemployed displayed a similar pattern of active and non-active transport. Interestingly, employed men and women who reported using active transport achieved significantly higher levels of MVPA than those who did not use an active transport mode. However, in the unemployed such an association only existed in men.

Findings from the present study support previous literature that has shown associations between the use of active transport and higher levels of physical activity. However, the systematic review by Wanner et al. produced mixed results, potentially due to the lack of considering employment status. For instance, most previous studies investigating the association of active transport and physical activity have either included student populations or exclusively commuting populations. Even among studies that have included adults of mixed employment status, only one study adjusted for working status in their multivariable logistic regression, which reported a positive association of walking and cycling with physical activity. Our findings suggest that employment status, particularly among women, is an important factor in the association between active transport and objectively-measured MVPA. Future research should consider employment status and an equal distribution of men and women in all groups.

Active transport in adults can yield higher levels of physical activity via active transport per se, an increase in self-efficacy encouraging physical activity in other areas of one’s life and potentially spontaneous activity en route. It is likely that employed adults achieved higher levels of physical activity compared with the unemployed, despite similar travel mode distributions, owing to a higher frequency of trips and a more stable pattern of active transport. Employed men and women who used active transport achieved an additional 40.8 min and 57.9 min of MVPA a week, respectively. This amount of additional MVPA is associated with up to 20% reduction in all-cause mortality and mortality due to CVD and 13% reduction in cancer mortality. Furthermore, this amount equates to 20% and 28% of the total required MVPA for men and women, respectively, which could improve their mental states. These findings encourage the promotion of active transport among the employed who commute via motorised transport.

In the present study, unemployed men who use active transport yield higher levels of physical activity than those who use non-active modes. However, this association did not exist in women. According to the US time use survey, a higher proportion of unemployed men are spending time educating themselves than unemployed women. It is likely that if one is in full-time education, they may have a similar commuting routine as to one who is employed and thus will likely have a high frequency of trips and a stable pattern of active transport. Moreover, unemployed women spend a much greater proportion of their day in taking care of the house or family and thus limiting their discretionary time to travel actively to various destinations. Further research is needed to identify appropriate strategies to promote physical activity among unemployed women.

Key strengths of this study are the large sample representative of the US adult population, objective measures of physical activity and assessment of active transport for any purpose rather than just for commuting. However, the study is not without limitations. The cross-sectional design prohibits attributing causality to the associations between active transport and MVPA. That is, it is not known if active transport results in higher levels of MVPA or if those who have high levels of MVPA are more likely to use active modes of travel. Further investigation using a prospective study design is needed to refute/confirm our results. However, prospective studies in British samples have shown that a change from non-active to active transport results in higher levels of physical activity. A further limitation involves the use of accelerometers, which are calibrated to record ambulatory activity (hip movement) and may therefore underestimate physical activity undertaken during cycling.

CONCLUSION

In this large representative sample of US adults, the distribution of active transport was similar between those who were employed and those who were not, such that 76.0% employed and 77.5% unemployed engaged in no active transport. Employed men and women who used active transport achieved an additional 40.8 min and 57.9 min of accelerometer-measured moderate-to-vigorous physical activity (MVPA) a week, respectively. This amount of additional MVPA is associated with up to 20% reduction in all-cause mortality and mortality due to cardiovascular disease and 13% reduction in cancer mortality. Among the unemployed adults, higher levels of active transport were associated with higher accelerometer-measured MVPA in men (44.8 min/week MVPA, 95% CI 9.2 to 80.5) only. Additional strategies are likely required to promote physical activity among unemployed women.

What is already known on this subject

► Regular and sustained participation in physical activity is associated with better physical and mental health and is associated with healthy ageing in adults, but most adults in the USA and other developed countries are not sufficiently active.

► Efforts to increase population levels of leisure or occupational physical activity have yielded limited success particularly over the long term. Active transport (walking and bicycling for transportation) has the potential to transform routine daily living into an opportunity for physical activity.

► Previous studies investigating the association between active travel and physical activity yield mixed results, probably due to lack of considering employment status and lack of sufficient sample in both gender groups. In addition, most studies used self-reported measures for physical activity assessment.

What this study adds

► In a large representative sample of US adults, the distribution of active transport was similar between those who were employed and those who were not, such that 76.0% employed and 77.5% unemployed engaged in no active transport.

► Employed men and women who used active transport achieved an additional 40.8 min and 57.9 min of accelerometer-measured moderate-to-vigorous physical activity (MVPA) a week, respectively. This amount of additional MVPA is associated with up to 20% reduction in all-cause mortality and mortality due to cardiovascular disease and 13% reduction in cancer mortality.

► Among the unemployed adults, higher levels of active transport were associated with higher accelerometer-measured MVPA in men (44.8 min/week MVPA, 95% CI 9.2 to 80.5) only. Additional strategies are likely required to promote physical activity among unemployed women.

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768 Yang L, et al. J Epidemiol Community Health 2018;72:764–769. doi:10.1136/jech-2017-210265
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Competing interests
None declared.

Patient consent
Not required.

Ethics approval
The National Health and Nutrition Examination Survey obtained ethical approval from the National Center for Health Statistics Research Ethics Review Board.

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REFERENCES
1 Warburton DER, Bredin SSD. Health benefits of physical activity: a systematic review of current systematic reviews. Curr Opin Cardiol 2017;32:541–56.
2 Schuch FB, van Sluijs EF, Dunstan DW, et al. Exercise as a treatment for depression: A meta-analysis adjusting for publication bias. J Psychiatr Res 2016;77:42–51.
3 Daskalopoulou C, Stubbs B, Kralj C, et al. Physical activity and healthy ageing: A systematic review and meta-analysis of longitudinal cohort studies. Ageing Res Rev 2017;38:6–17.
4 World Health Organization. Global recommendations on physical activity for health, 2018.
5 Clarke TC, Norris T, Schiller JS. What are the health benefits of active commuting for university students. Prev Med 2010;51:136–8.
6 Badland HM, Schofield GM. Health Associations with Transport-Related Physical Activity and Motorized Travel to Destinations. International Journal of Sustainable Transportation 2008;2:77–90.
7 Gordon-Larsen P, Boone-Heinonen J, Sidney S, et al. Active commuting and cardiovascular disease risk: the CARDIA study. Arch Intern Med 2009;169:1216–23.
8 Kwasiwemk A, Kaczynskiy-Chalas K, Pitaka M, et al. Socio-demographic and lifestyle correlates of commuting activity in Poland. Prev Med 2010;50:257–61.
9 Gu P, Pekkarinen H, Hänninen O, et al. Commuting, leisure-time physical activity, and cardiovascular risk factors in China. Med Sci Sports Exerc 2011;43:1575–81.
10 Tiné T, Strømgren WJ, Janschitz S, et al. Association of built-environment, social-environment and personal factors with bicycling as a mode of transportation among Austrian city dwellers. Prev Med 2008;47:252–9.
11 Boone-Heinonen J, Jacobs DR, Sidney S, et al. A walk (or cycle) to the park: active transit to neighborhood amenities, the CARDIA study. Am J Prev Med 2009;37:285–92.
12 Sugiyama T, Merom D, Reeves M, et al. Habitual active transport moderates the association of TV viewing time with body mass index. J Phys Act Health 2010;7:11–16.
13 Gómez LE, Samiento CI, Lucumi DI, et al. Prevalence and Factors Associated with Walking and Bicycling for Transport among Young Adults in Two Low-Income Localities of Bogotá, Colombia. Journal of Physical Activity and Health 2013;10:245–59.
14 Becker S, Zimmermann-Stenzl M, Physical activity, obesity, and educational attainment in 50- to 70-year-old adults. J Public Health 2009;17:145–53.
15 Dombois OT, Braun-Fahrlander C, Martin-Diener E. Comparison of adult physical activity levels in three Swiss alpine communities with varying access to motorized transportation. Health Place 2007;13:755–66.
16 Butler GP, Orpana HM, Wiens AJ. By your own two feet: factors associated with active transportation in Canada. Can J Public Health 2007;98:259–64.
17 McAlley E, Blissmer B. Self-efficacy determinants and consequences of physical activity. Exerc Sport Sci Rev 2000;28:85–8.
18 Aren H, Moore SC, Patel A, et al. Leisure time physical activity and mortality: a detailed pooled analysis of the dose-response relationship. JAMA Intern Med 2015;175:959–67.
19 Katz J. How nonemployed americans spend their weekdays: men vs women. New York Times, 2015.