DEMOGRAPHIC FACTORS AND WORKPLACE FACTORS TO ACTIVE TRANSPORTATION USE IN THE UNITED STATES: A SECONDARY ANALYSIS OF 2009 NHTS DATA

by

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Active transportation is defined by any transportation modality that requires human energy to perform. While the benefits of participating in active transportation are known, and are similar to that of regular exercise, participation rates within the United States are still very low. PURPOSE: To examine the relationships of demographic and workplace factors with active transportation use and active commuting within a United States population-based sample. METHODS: The 2009 National Household Travel Survey data was used to examine 6 demographic factors (age, gender, family income, education level, race, and household geographic location) as well as 5 workplace factors (time to work, distance to work, flextime availability, option to work from home, and work start time). The demographic factors were examined across active transportation use (walking, biking, or either) and active commuting (walking, biking, or either). The workplace factors were examined across active commuters (walking, biking, or either). Unadjusted frequencies, adjusted odds ratios, and adjusted prevalences were found for each factor. RESULTS: Increased odds of active commuting were seen in those with lower age, who were males, with lower income, who lived in an urban area, and who were more highly educated. Increased odds of active transportation use were seen in those who were of lower age, had lower income, were urban dwellers, had higher education, were male bikers, and were female walkers.

Odds of active commuting were increased with the availability of a flexible schedule, the option to work from home, a shorter time to work, a smaller distance to work, and a work arrival time between 11AM – 4PM. CONCLUSION: Mostly expected demographic factor relationships were found after adjustment for the other demographic factors. All workplace factors were found to be significantly related to active commuting behavior. These relationships should be considered and leveraged in governmental policy decisions, health promotion programming, workplace wellness programming, and workplace policy to possibly increase active transportation use within the United States.

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1.0 INTRODUCTION

1.1 PHYSICAL ACTIVITY AND ACTIVE TRANSPORTATION

Active transportation is defined by any transportation modality that requires physical activity to perform. Most commonly, active transportation includes bicycling or walking to and from social events, recreational trips, and to school (Pucher & Renee, 2003). Additionally active transportation is used to travel to and from work (Pucher & Renee, 2003). Participation in active transportation, on the population level, is low in the United States with 76% of people reporting no active transportation (Furie & Desai, 2012). Although it is still not completely understood, health, financial, and environmental benefits may exist from active transportation use (Litman, 2004). Both factors can be considered and leveraged to drive public policy support, inform program design, and increase individual behaviors regarding active transportation. To better encourage these benefits and integrate active transportation more effectively into population level behavior, understanding the characteristics of persons engaging in and the factors contributing to active transportation use would be helpful.

In 2010-2012, 34.9% of adults in the United States were obese (Ogden, Carroll, Kit, & Flegal, 2014). Cardiovascular disease is the number one cause of death in the United States (Heidenreich 2011). An estimated 40.5% of the United States population is expected to have some form of cardiovascular disease by 2030 (Heidenreich 2011). One way to combat these preventable

ailments is through habitual exercise. The United Stated Department of Health and Human Services (USDHHS) recommends that every person should perform at least 150 minutes of moderate aerobic physical activity per week or 75 minutes of vigorous aerobic physical activity per week (USDHHS 2008). Similarly, the American College of Sports Medicine (ACSM) recommends that every American should undergo at least 30 minutes of moderate physical activity on at least 5 days of the week, for a total of 150 minutes of moderate intensity activity per week (American College of Sports Medicine 2013). Less than 10% of Americans meet the suggested physical activity recommendations on a regular basis, when objectively measured by accelerometry (Tucker, Welk, & Beyler, 2011). Yet, meeting these exercise recommendations has been shown to decrease all-cause mortality and reduce the risk of chronic diseases including heart disease, diabetes, hypertension, and certain cancers (American College of Sports Medicine 2013). Achieving only modest physical activity levels decreases risk for cardiovascular disease and significantly increases life expectancy (Franco et al., 2005).

Active transportation may provide an alternative, structured and habitual form of physical activity that meets the requirements set forth by ACSM and USDHHS for physical activity and improved health. Individuals who participate in low and high levels of active transportation have been shown to have an average lower BMI (-0.9 kg/m^2 and -1.2 kg/m^2 respectively) compared to no active transportation (Furie & Desai, 2012). Additionally, a lower waist circumference has been found among individuals who participate in active transportation (-2.2cm for low level of use and -3.1cm for high levels of use) when compared to no active transportation (Furie & Desai, 2012). When compared to no active transportation use, odds of having hypertension were 24% lower for low active transportation use and 31% lower for high active transportation use (Furie & Desai, 2012). More specifically, using bicycling as transportation has been inversely associated

with all-cause mortality in both men and women (Andersen, Schnohr, Schroll, & Hein, 2000).

Participation in active transportation is also financially desirable on both a public and personal level. With reduced reliance on fossil fuels and vehicular transportation options, increased use of active transportation has a low impact on public transportation infrastructure and capital. Financial benefits of active transportation include reduced road and parking facility costs, consumer cost savings, reduced energy cost (conservation of energy), and long term reduction in vehicle ownership costs (Litman, 2004). Maintenance and damage of roadways is dependent on vehicle weight, size, and frequency of use (Litman, 2004). Active transportation reduces the negative impact of motorized transportation on roadway infrastructure and, as a result, can reduce the public financial burden of transportation (Litman, 2004). Active transportation users also experience a low personal financial burden, as bicycling and walking are relatively inexpensive modes of transportation and physical activity.

Currently in the United States, it is estimated that about 76% of people report that they do not participate in active transportation, 11% report participating in low levels of active transportation, and 14% report participating in high levels of active transportation (Furie & Desai, 2012). Public policy and health promotion programs have recognized these low participation rates as an opportunity to increase overall physical activity participation and, consequently, the health of the U.S. population. An increase in active transportation use may result in increased health of the United States population. However, factors that influence participation in active transportation are not well understood. In particular, clarification of demographic factors and workplace factors related to active transportation use is needed. Improvements in understanding of these areas will allow programs designers, urban planners, and workplace administrators to more clearly understand their target population and possible

influences on intervention strategies that could promote active transportation use. Thus, this project aimed to address research gaps around factors that contribute to active transportation use in a nationally representative sample of U.S. adults.

1.1 SPECIFIC AIMS

1.1.1 Identify relationships between demographic factors and active transportation use:

a) Household Income

a.i) Relationship between total household income and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

b) Age

b.i) Relationship between age and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

c) Gender

c.i) Relationship between gender and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

d) Household Geographic Location (Rural vs. Urban)

d.i) Relationship between household being within or outside of a metropolitan statistical area and use of bicycle or walking as usual mode of transportation to work or use of

bicycle or walking for at least one trip in one day travel diary.

e) Race

e.i) Relationship between race and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

f) Education Level

f.i) Relationship between education level and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

1.1.2 Identify relationships between workplace factors and active transportation use:

a) Distance to work

a.i) Relationship between one-way distance to work and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

b) Travel time to work

b.i) Relationship between travel time to work in minutes and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel diary.

c) Work schedule policies

c.i) Relationship between the availability of schedule flexibility and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel dairy.

c.ii) Relationship between work arrival time and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel dairy.

c.iii) Relationship between option to work from home and use of bicycle or walking as usual mode of transportation to work or use of bicycle or walking for at least one trip in one day travel dairy.

1.2 SIGNIFICANCE

The ACSM recommends that every person should get at least 30 minutes of moderate physical activity on at least 5 days per week, for a total of 150 minutes per week (American College of Sports Medicine 2013). This recommendation is aimed at improving or maintaining overall health and lowering risk for chronic diseases. While there are many possible ways to achieve this physical activity goal, active transportation through bicycling or walking has been gaining in popularity in recent years. Active transportation is a healthy, economically advantageous, and environmentally friendly way to travel that could be promoted through public policy and public programs. Development of effective health promotion programs relies on an understanding of the target population and the environment by which they are surrounded.

The purpose of this study is to examine factors that contribute to active transportation use in the U.S. population. Two factor categories will be examined: demographic factors of users and user households, and workplace location and policy factors. A greater understanding of these factor categories in relation to active transportation use will provide support and focus for public health programs that aim to increase active transportation use on a community, city, state, or

national level.

With a greater understanding of demographic information regarding those who use active transportation, program focus on low user groups may be possible. Secondly, with a greater understanding of workplace factors such as flexibility of work schedule, option to work from home, and work arrival time that may influence a person's decision to use active transportation, a workplace health promotion program can utilize these areas to encourage active transportation. Information regarding influences of distance and travel time to work on active transportation use can be initialize when designing urban planning and mixed land use strategies. This information can help drive the focus of urban planning, public health programs, and public funds allocation management. Optimizing strategies to foster active transportation use could increase participation in physical activity by the U.S. population, which could ultimately result in more people realizing the many health benefits of regular physical activity.

2.0 REVIEW OF THE LITERATURE

2.1 INTRODUCTION

Physical inactivity is a growing concern within the United States. Only 40% of adults in the United States report completing the recommended amount of daily physical activity while only 10% meet recommendations when measured objectively with accelerometry (Tucker, 2011; Furie, 2012). The concern of physical inactivity is founded in its relationship with the growing obesity epidemic and other negative health outcomes. Obesity, defined by a body mass index (BMI) of greater than 30 kg/m^2, has become an epidemic within the United States. Rising prevalence rates over the last 30 years have leveled off at more than one third (34.9%) of United States adults being considered obese in 2011-2012 (Ogden, 2014; Dixon, 2010). Poor health outcomes and increased mortality have long been associated with obesity. The increased mortality rate among obese individuals is due to comorbidities such as cardiovascular disease, type 2 diabetes, certain cancer, and osteoarthritis (Dixon, 2010). It is important to recognize the risks of obesity within the population to motivate strong research and practice towards prevention and treatment of obesity beyond what is already available. It is clear that the solution to the obesity problem has not been found and finding a solution is a major public health priority.

Standard behavioral lifestyle intervention strategies have shown some success in preventing and treating obesity (Galani, 2007). However, long term maintenance of weight loss

has been harder to achieve with these strategies (Anderson, 2001; Wing, 2005). It has been shown that habitual physical activity may help in weight loss maintenance (Donnelly, 2009; Jakicic, 2008; Wing, 2005). Furthermore, among overweight and obese adults, negative health outcomes such as type 2 diabetes, cardiovascular disease, osteoarthritis, and mortality have been shown to be reduced among persons who engage in regular physical activity (World Health Organization, 2010). Thus, while weight loss and healthy weight maintenance are public health priorities, physical activity on the population level is also an important initiative to improve population health. One strategy for increasing daily physical activity is through active transportation.

Active transportation is a term used to identify any form of transportation that uses human power such as walking, bicycling, or others (e.g. skating) rather than standard forms of transportation such as driving a car or riding on a bus. Active transportation provides an alternative form of daily physical activity from what is thought of as traditional exercises (e.g. participating in team sports or in exercising in a gym or fitness center). This option may provide an opportunity and motivation for people to achieve regular physical activity at recommended levels due to the daily and habitual nature of the activity. It has been shown that active transportation is associated with increased compliance with physical activity recommendations (Berrigan, 2006; Gordon-Larsen, 2005). Active transportation users have also been shown to be of more normal weight (Gordon-Larsen, 2005). Active transportation use has been associated with lower BMI (-0.9 kg/m^2 in low levels and -1.2 kg/m^2 in high levels), decreased waist circumference (-2.2cm in low levels and -3.1cm in high levels), lower odds of hypertension (24% in low levels and 31% in high levels), and lower odds of diabetes (31% in high levels) when compared to non-active transportation users. All-cause mortality risk is reduced by 40% in

those who bicycle to work after multivariate adjustment that included adjustment for leisure time physical activity (Andersen, 2000).

While it is beneficial for people to use active transportation for health outcomes and there is an obvious need for increased physical activity and health within the United States, still few people use active transportation regularly (Berrigan, 2006, Gordon-Larsen, 2005; Kruger, 2008). It is important to understand who is participating in active transportation and who is not in order to develop effective interventions and health programming to encourage active transportation use. It is also important to define what factors contribute to or support active transportation to develop more effective strategies of infrastructure development and policy formulation in support of active transportation. This analysis focused on examining two factor categories for associations with active transportation use or non-use: demographic and workplace factors.

2.2 DEMOGRAPHIC FACTORS

Demographic characteristics such as age, gender, race, income level, and education level may have a relationship with use of active transportation. For example, Black Americans report lower rates of leisure-time physical activity than Whites and the variables influencing these behaviors may be different in men vs. women (Bopp, 2006). In a 2004 cross-sectional study, Frank et. al. found that daily walking varied across race (Black and White), showing that Blacks were twice as likely to be reported walkers and Black walkers reported a greater average walking distance per day (Frank, Andresen, & Schmid, 2004). The National Survey of Pedestrian and Bicyclist Attitudes and Behaviors summary report suggests increased bicycle transportation use among Hispanics compared to non-Hispanic Whites ("National Survey of Bicyclist and Pedestrian

Attitudes and Behavior Volume 1: Summary Report," 2012; Sener, Eluru, & Bhat, 2009). Age has been shown to be significantly associated with use of active transportation with a greater use in children and adolescences compared to adults and elderly people (Yang, 2011). Among adults, 25-45 year olds have been shown to bicycle more than 18-21 year olds (Sener, Eluru, & Bhat, 2009).

The relationship between socioeconomic variables and active transportation may be complex. Lower income groups have been shown to use active transportation more often than higher income groups (Yang, 2011). More specifically, however, higher income individuals have been shown to bicycle more than lower income individuals, suggesting a potentially nonlinear-relationship between income and active transportation (Sener, Eluru, & Bhat, 2009). Some evidence suggests that education level is positively correlated with physical activity levels in women (Bopp, 2006). Another study found that lower education was associated with lower likelihood of cycling (Winters, 2007). These relationships need further exploration due to mixed conclusions (Sener, Eluru, & Bhat, 2009). Importantly, higher active transportation use among racial minorities and lower income populations may address personal and economic barriers to physical activity participation and help reduce health disparities (Berrigan, Troiano, McNeel, DiSogra, & Ballard-Barbash, 2006).

2.3 WORKPLACE FACTORS

Regular active transportation is commonly achieved by traveling to and from work (hereafter called active commuting). It is important to understand the relationship that workplace location and policy may have with active commuting. It has been shown that shorter trip distance to work

may play a role in facilitating the use of active transportation (Pucher & Buehler, 2006). Bicycling transportation activity within the United States is much lower than in Canada, while trip distance to work is much higher in the United States (Pucher & Buehler, 2006). Shorter distance to work may be associated with both increased bicycling and walking use as a transportation modality (Pucher & Buehler, 2006). The effect of personal work schedule and workplace policies (e.g. option to work from home, availability of a flexible schedule, etc.) on active commuting use has not been previously examined.

3.0 METHODS

3.1 SURVEY AND SAMPLING METHODS

This study was a secondary data analysis of cross-sectional data from the 2009 National Household Transportation Survey (NHTS) (U.S. Department of Transportation, 2009; Pucher, 2011; Yang, 2011; Berrigan, 2006). This data set is available for public use by the United States Department of Transportation: Federal Highway Administration. The NHTS was a randomized telephone survey of landline numbers regarding travel behaviors of the Unites States population conducted from March 2008 to April 2009. Samples were taken from all days, weeks, and months of that time period, including weekends and holidays. The sample was recruited by random digit dialing stratified across all states, census regions, and metropolitan areas to provide a population-based sample of the U.S. population. The NHTS relied on a complex weighting system, giving initial weight based reciprocally on the known probability of selection. Additional weighting was provided for non-response based on region, state, city size, race/ethnicity, income, household size, vehicle ownership, and week/month of the year through a ranking procedure based on household and person levels. Households without land line telephones or only using cell phones were weighted after stratification using population estimates from the United States Census Bureau. The second release of the 2009 NHTS data (released November 2010), is publicly available and was used in this study.

The survey response rate was 20% which included 324,184 individuals, 150,147 households, and 1,167,321 individual trips. The sample population included United States., non-institutionalized, civilian persons. College students were included, given that they had a land line telephone number shared with less than 10 people. Any persons sharing living quarters with more than 10 non-related people were excluded from the survey. Children under five years old were excluded from the survey. Questions from the survey that were used in this study are available in the appendices A1-A3.

3.1.1 Active Transportation Measurement

An initial telephone interview was conducted to collect household data and was supplemented with individual one day travel diaries for every member of the household. Travel diaries were sent for each person in the household and each person was given a random day to record in their diary. Travel days represented all seasons and months of the year, all days of the week, and all holidays. A follow-up telephone interview was conducted for each household member to collect information regarding the travel diaries.

In the travel diary, each person was asked about their daily travel behavior and to record all trips made on that day. The 24-hour travel day was defined by a start time of 4:00AM until 3:59AM the next day. This was chosen because 4:00AM is the time when the least amount of people are traveling. The weekend travel days were defined as starting Friday at 6:00PM and ending at midnight on Sunday. Weekend days were included in this analysis to limit assumptions about typical work days. However, this choice introduced the potential limitation that people may not use active transportation regularly on weekend days even if they do during the week. Data about each trip included trip frequency, duration, length, purpose, and mode of

transportation. Trips within the travel diary were defined as "from one address to another" excluding walking trips around the workplace or to the mailbox. Trips walking or cycling to and from public transportation were also included as separate trips recorded in the public transportation data section. For this analysis, a trip was defined as any reported trip in the trip dairy.

Individual data such as age, race/ethnicity, gender, employment, income, and geographic location were collected via self-report during the initial household interview and follow-up individual phone interview. Usual mode of transportation was collected during the follow-up individual interview via self-report. Active transportation was defined as a dichotomous variable (users and non-users) via two different methods (commuting and overall) using the survey data for cycling, walking, and both. The first method to define active commuters vs. non-active commuters used the question, "How did you usually get to work last week?" that was asked to each person during the person interview. If the participant answered "walk" to the question, they were coded as an active commuting walker if they did not answer "walk," they were coded as a non-walking commuter. If the participant answered "bicycle" to the question, they were coded as an active commuting biker; if they did not answer bicycle, they were coded as a non-bicycle commuter. If the participant answered either "bicycle" or "walk" to the question, they were coded as an active commuting walker or biker; if they did not answer either "bicycle" or "walk" , they were be coded as a non-active commuter. The second method to define active transportation-users vs. non-active transportation users utilized the trip diary given to each participant and considered active transportation to work and for other purposes. For each trip, the participant answered the question, "How did you get to your current trip destination?". If the participant answered "walk" to one or greater trips, they were coded as an active transportation

walker; otherwise, they were coded as a non-walker. If the participant answered "bicycle" to one or greater trips, they were coded as an active transportation biker; otherwise, they were coded as a non-biker. If the participant answered either "bicycle" or "walk" for one or more trips, they were coded as an active transportation user; if they did not answer either "bicycle" or "walk", they were coded as a non-active transportation user. For specific information regarding question wording or format, see Appendix A1: NHTS Active Transportation Use Questions.

Of the 324,184 individuals surveyed in the NHTS, this analysis excluded the following participants: children (<18 yrs/old) (45,329 participants), and persons who had a temporary or permanent medical condition that made it difficult to travel outside of the home (33,757 participants). In addition, individuals who reported not working currently were excluded from the workplace factor and active commuting analysis. This exclusion included persons who were on temporary unemployment, did not answer the question, did not know the answer to the question, were temporarily absent from work, or had no fixed workplace currently (n= 187,834). Trips made for the purpose of exercise (jogging, walking, bicycling, etc.) were not included as active transportation trips for the active transportation analysis (33,836 trips) to limit any potential influence of detecting those types of trips rather than trips made for transportation only.

3.1.2 Demographic Measurement

All demographic variables were collected via self-report during the initial household telephone interview. Personal demographic data such as age, gender, race, working status, and education level were collected at this time. Initial demographic data of other household members (age, gender, race, working status, and education level) were reported by the same household member.

For this statistical analysis, age was stratified into categories (18-24 years, 25-44 years, 45-64 years, and ≥ 65 years). Education level was stratified using the survey criteria (less than high school graduate, high school graduate, some college or associates degree, and bachelor's degree, and graduate or professional school degree). Race was stratified into the following categories as provided by the survey methods: White, African American (Black), Asian, American Indian/Alaskan Native, Native Hawaiian/Pacific Islander, multiracial, Hispanic/Mexican, or other. Household income level for all household members combined was stratified into categories (<$24,999, ≥$25,000 – $49,999, ≥$50,000 – $74,999, and ≥$75,000). Self-reported household location was used for the household geographic location variable (rural vs. urban). Urban vs. Rural designations were determined using the 2000 Urbanized Areas Designations: Cartographic Boundary designations from the United States Census. For specific information regarding question wording or format, see Appendix A2: NHTS Demographic Factor Questions.

3.1.3 Workplace Factors Measurement

All workplace factors were collected via self-report during the follow-up interview of each household member. One-way distance to work in miles was stratified into categories to facilitate interpretation. The distance categories that used were: <1 mile, ≥1 mile to 5 miles, ≥5 miles to 10 miles, and ≥ 10 miles. One-way time to work in minutes was also stratified into categories. The travel time categories used were: <10 minutes, ≥10 minutes to 20 minutes, ≥ 20 minutes to 30 minutes, and ≥ 30 minutes. Work arrival time was stratified into categories. Work arrival time categories used were: ≥ 6:00AM to 11:00AM, ≥11:00AM to 4:00PM, ≥4:00PM to 9:00PM, ≥9:00PM to 1:00AM and ≥1:00AM to 6:00AM. The remaining work schedule variables were

dichotomous. The second aim evaluating associations with workplace factors only considered the usual mode of transportation to work (active commuting) as an outcome because workplace factors would be logically less associated with overall active transportation trips. For specific information regarding question wording or format, see Appendix A3: NHTS Workplace Factor Questions.

3.2 STATISTICAL METHODS

All statistical analyses were performed using STATA Version 14.0 (College Station, TX) and alpha was set at <0.05. Descriptive statistics were used to describe personal and household factors including age, race/ethnicity, gender, household income, and education level. Chi-square tests were used to analyze relationships between dichotomous and categorical variables.

Specific Aim 1 examined the relationships between demographic factors and active transportation definitions. Chi-square tests examined differences in the distribution of demographic characteristics in users vs. non-users of active transportation across each of the six dichotomous outcome definitions (active commuting by walking, bicycling, or either; active transportation by walking, bicycling, or either). Next, adjusted odds ratios and prevalences of the six outcome definitions of active transportation use were calculated across each category of demographic variable and adjusted for the remaining demographic factors using logistic regression. Missing demographic data (refused or not ascertained) was generally infrequent (<5%) and was modeled as a separate category in adjusted logistic regression models (data not shown).

Specific aim 2 examined the relationships between workplace factors and the three definitions of active commuting, adjusting for demographic factors. Chi-square tests examined differences in the distribution of workplace factors in active commuters versus non-active commuters across each of the three dichotomous outcome definitions: active commuting by walking, bicycling, or either. Next, adjusted odds ratios and prevalences of the three outcome definitions of active commuting were calculated across categories of workplace variables and adjusted for all six demographic factors (age, gender, income, education, race, and geographic location) using logistic regression.

4.0 RESULTS

4.1 UNADJUSTED RESULTS

The unadjusted prevalence of walking to work was 1.86%, biking to work was 0.56%, and either walking or biking to work was 2.42%. The unadjusted prevalence of walking as transportation was 10.4%, biking was 0.93%, and either walking or biking was 11.2%.

4.2 ACTIVE COMMUTING RESULTS

4.2.1 Unadjusted Active Commuting Results

Table 1 shows the unadjusted distributions of demographic factors across active commuting definitions (self-report of walking or biking as primary mode of transportation to work). Distributions of the following demographic characteristics were significantly different when comparing walkers vs. non-walkers: education level ($p<0.001$), age ($p<0.001$), gender ($p=0.026$) race ($p<0.001$), income level ($p<0.001$), and geographic location ($p<0.001$). Pairwise comparisons showed that significant differences existed between all education levels except between high school and bachelor's degree, and some college and bachelor's degree. Persons with very low (< high school) and very high (postgraduate) education levels had higher rates of

walking for commuting. Persons with high school through bachelor's degrees were less likely to walk to work. All pairwise comparisons of age categories were significant except for between the 18-24 and ≥65 groups, and between 25-44 and 45-64 groups. A significantly higher frequency of walkers was found among the youngest group. Hispanics were found to be significantly more likely to walk to work than Whites. All pairwise comparisons of income level and walkers were found to be significant. As income level increased, frequency of walking to work was decreased. Walkers were more likely to be urban dwellers rather than rural dwellers. Also, walking commuters were more likely to be male than female. For more details regarding *post hoc* pairwise comparisons within demographic categories, see Table B.1.1 in Appendix B.

Significant differences among bikers and non-bikers were seen in the distributions of education level ($p<0.001$), age ($p<0.001$), gender ($p<0.001$), income level ($p<0.001$), and geographic location ($p<0.001$). The distribution of race was not significantly different across bikers and non-bikers ($p=0.064$). Biking to work was again more likely among those in the lowest education group (<high school) and the highest group (postgraduate). The youngest two age categories (18-24 and 25-44) were the most likely to bicycle to work. Also, bicycle commuters were more likely to be male than female. Biking to work was more likely among those in the lowest income category ($0 - $24,999). Bicycle commuters were more likely to be urban dwellers than to live in a rural setting. For more details regarding *post hoc* pairwise comparisons within demographic categories, see Table B.1.1 in Appendix B.

When considering either commuting walkers or biker vs. non-active commuters, significant differences were shown in the distributions of all demographic factors: education ($p<0.001$), age ($p<0.001$), race ($p<0.001$), gender ($p<0.001$), income ($p<0.001$), and geographic location ($p<0.001$). The youngest age group category (18-24) and oldest (≥65) were most likely

to walk or bike to work. People of lowest and highest education levels were the most likely to walk or bike to work. Males were more likely to walk or bike to work. Hispanics were more likely to walk or bike to work; however, other racial patterns were not observed. Persons of the lowest income group ($0 - $24,999) were the most likely to walk or bike to work. Finally, walk or bicycle commuters tended to live in more urban settings. For more details regarding the results and significance levels of the active commuting pairwise comparisons, see Table B.1.1 in Appendix B.

Table 1 - Unadjusted Demographic Factors of Active Commuters (n=111,809)

	Non-Walker (n=109,726)	Walker (n=2,083)	Non-Biker (n=111,187)	Biker (n=622)	Neither Walk or Bike (n=109,104)	Walker or Biker (n=2,705)
Education						
Less than high school grad	4,101 (3.74%)	181 (8.69%)	4,239 (3.81%)	43 (6.91%)	4,058 (3.72%)	224 (8.28%)
High school grad or GED	25,592 (23.32%)	492 (23.62%)	25,977 (23.36%)	107 (17.20%)	25,485 (23.36%)	599 (22.14%)
Some college or associates degree	32,091 (29.25%)	475 (22.80%)	32,439 (29.18%)	127 (20.42%)	31,964 (29.30%)	602 (22.26%)
Bachelor's degree	26,823 (24.45%)	440 (21.12%)	27,121 (24.39%)	142 (22.83%)	2,6681 (24.45%)	582 (21.52%)
Graduate or professional degree	20,382(18.58%)	468 (22.47%)	20,657 (18.58%)	193 (31.03%)	20,189 (18.50%)	661 (24.44%)
Refused or not ascertained	737 (0.67%)	11 (1.30%)	754 (0.68%)	10 (1.61%)	727 (0.67%)	37 (1.37%)
P-Value		<0.001		<0.001		<0.001
Age, years						
18-24	6,677 (6.09%)	203 (9.75%)	6,813 (6.13%)	67 (10.77%)	6,610 (6.06%)	270 (9.98%)
25-44	33,439 (30.48%)	591 (28.37%)	33,789 (30.39%)	241 (38.75%)	33,198 (30.43%)	832 (30.76%)
45-64	60,713 (55.33%)	1,010 (48.49%)	61,430 (55.25%)	293 (47.11%)	60,420 (55.38%)	1,303 (48.17%)
≥65	8,897 (8.11%)	279 (13.39%)	9,155 (8.23%)	21 (3.38%)	8,876 (8.14%)	300 (11.09%)
P-Value		<0.001		<0.001		<0.001
Gender						
Female	53,857 (49.08%)	971 (46.62%)	54,670 (49.17%)	158 (25.40%)	53,699 (49.22%)	1,129 (41.74%)
Male	55,869 (50.92%)	1,112 (53.38%)	56,517 (50.83%)	646 (74.60%)	55,405 (50.78%)	1,576 (58.26%)
P-Value		0.026		<0.001		<0.001
Race						
White	93,894 (85.57%)	1,707 (81.95%)	95,065 (85.50%)	536 (86.17%)	93,358 (85.57%)	2,243 (82.92%)
African American, Black	5,878 (5.36%)	118 (5.66%)	5,975 (5.37%)	21 (3.38%)	5,857 (5.37%)	139 (5.14%)
Asian only	3,001 (2.73%)	74 (3.55%)	3,060 (2.75%)	15 (2.41%)	2,986 (2.74%)	89 (3.29%)
American Indian, Alaskan Native	782 (0.71%)	17 (0.82%)	792 (0.71%)	7 (1.13%)	775 (0.71%)	24 (0.89%)
Native Hawaiian, Pacific Islander	369 (0.34%)	9 (0.43%)	378 (0.34%)	0 (0.00%)	369 (0.34%)	9 (0.33%)
Multiracial	658 (0.60%)	13 (0.62%)	666 (0.60%)	5 (0.80%)	653 (0.60%)	18 (0.67%)
Hispanic/Mexican	3,158 (2.88%)	96 (4.61%)	3,227 (2.90%)	27 (4.34%)	3131 (2.87%)	123 (4.55%)
Other	1,137 (1.04%)	25 (1.20%)	1,156 (1.04%)	6 (0.96%)	1,131 (1.04%)	31 (1.15%)
Refused or not ascertained	849 (0.77%)	24 (1.15%)	868 (0.78%)	5 (0.80%)	844 (0.77%)	29 (1.07%)
P-Value		<0.001		0.064		<0.001
Family Income						
$0 - $24,999	8,378 (7.64%)	425 (20.40%)	85,705 (7.83%)	98 (15.76%)	8,280 (7.59%)	523 (19.33%)
$25,000 - $49,999	21,992 (20.04%)	523 (25.11%)	22,402 (20.15%)	113 (18.17%)	21,879 (20.05%)	636 (23.51%)
$50,000 - $74,999	21,911 (19.97%)	358 (17.19%)	22,162 (19.93%)	107 (17.20%)	21,804(19.98%)	465 (17.19%)
> $75,000	52,392 (47.75%)	679 (32.60%)	52,791 (47.48%)	280 (45.02%)	52,112 (47.76%)	959 (35.45%)
Refused or not ascertained	5,053 (4.61%)	98 (4.70%)	5,127 (4.61%)	24 (3.86%)	5,029 (4.61%)	122 (4.51%)
P-Value		<0.001		<0.001		<0.001
Urban vs. Rural						
Urban	76,815 (70.01%)	571 (27.41%)	77,778 (69.95%)	549 (88.26%)	76,266 (69.90%)	2,061 (76.19%)
Rural	32,910 (29.99%)	1,512 (72.59%)	33,408 (30.05%)	73 (11.74%)	32,837 (30.10%)	644 (23.81%)
P-Value		0.011		<0.001		<0.001
Note: Data were compared across categories by $\chi 2$ tests.						

4.2.2 Unadjusted Odds of Active Commuting by Demographic Factors

Table 2 shows the odds of being an active commuter by each demographic factor category, adjusted for all other demographic variables. A nonlinear relationship between education level and all three definitions of active commuting was shown. Compared to less than a high school education, the odds of using active commuting were lower for middle education categories (e.g. high school graduate, associate's degree) and then higher for highly educated persons (graduate or professional degree). This relationship was consistent for those commuting by walking, biking, or either. In all three definitions of active commuting, decreasing odds of commuting were shown for age categories above 18-24 years. Gender was significantly associated with active commuting with males being 14% more likely to walk to work ($p=0.005$), 186% more likely to bike to work ($p<0.001$), and 39% more likely to either bike or walk to work ($p<0.001$). Odds of being a walking commuter were not shown to be influenced by race. However, the odds of being a bike commuter were 47% less likely in African Americans and Asians when compared to Whites ($p=0.005$ and $p=0.016$ respectively). The odds of being either a walk commuter or bike commuter were decreased by 21% for African Americans when compared to Whites ($p=0.008$). All higher levels of family income were related to lower odds of being a walking commuter, biking commuter, or either when compared to the reference income of \$0 - \$24,999 (all $p<0.001$). Geographic location was not related to the adjusted odds of being a walking commuter but was shown to significantly influence the odds of being a bike commuter and either a walking commuter or bike commuter. Urban dwelling individuals were 3.1 times more likely to be bike commuters when compared to a rural dwellers ($p<0.001$). Additionally, the odds of being either a walking commuter or bike commuter were 33% higher for persons living in an urban setting ($p<0.001$).

Table 2 - Adjusted Odds of Being Active Commuters by Demographic Factors (n=111,809)

	Walker		Biker		Walker or Biker	
	Odds Ratio	P-Value	Odds Ratio	P-value	Odds Ratio	P-value
Education						
Less than high school grad	1.00		1.00		1.00	
High school grad or GED	0.63	<0.001	0.60	0.007	0.62	<0.001
Some college or associates degree	0.57	<0.001	0.61	0.010	0.58	<0.001
Bachelor's degree	0.80	0.023	0.90	0.605	0.81	0.021
Graduate or professional degree	1.23	0.044	1.75	0.004	1.34	0.001
Age, years						
18-24	1.00		1.00		1.00	
25-44	0.56	<0.001	0.61	<0.001	0.58	<0.001
45-64	0.56	<0.001	0.42	<0.001	0.52	<0.001
≥65	0.83	0.056	0.17	<0.001	0.65	<0.001
Gender						
Female	1.00		1.00		1.00	
Male	1.14	0.005	2.86	<0.001	1.39	<0.001
Race						
White	1.00		1.00		1.00	
African American, Black	0.87	0.161	0.53	0.005	0.79	0.008
Asian Only	1.24	0.076	0.53	0.016	1.03	0.820
American Indian, Alaskan Native	1.00	0.993	1.40	0.381	1.09	0.685
Native Hawaiian, Pacific Islander	1.21	0.573	N/A	N/A	0.86	0.669
Multiracial	0.93	0.804	1.05	0.922	0.96	0.861
Hispanic/Mexican	0.99	0.905	0.74	0.163	0.91	0.368
Other	0.91	0.629	0.62	0.243	0.82	0.292
Family Income						
$0 - $24,999	1.00		1.00		1.00	
$25,000 - $49,999	0.50	<0.001	0.45	<0.001	0.48	<0.001
$50,000 - $74,999	0.33	<0.001	0.37	<0.001	0.33	<0.001
> $75,000	0.23	<0.001	0.30	<0.001	0.24	<0.001
Urban vs. Rural						
Rural	1.00		1.00		1.00	
Urban	1.10	0.070	3.10	<0.001	1.33	<0.001
Note: Logistic models were adjusted for all other variables in the model.						

4.3 ACTIVE TRANSPORTATION RESULTS

4.3.1 Unadjusted Demographic Factor Results by Active Transportation

Table 3 shows the unadjusted distributions of persons with versus without an active transportation trip (walking, biking, or either from the trip diary) by demographic factors. Significant differences existed in the distributions of all demographic variables across walkers and non-walkers: education ($p<0.001$), age ($p<0.001$), race ($p<0.001$), gender ($p<0.001$), income ($p<0.001$), and geographic location ($p<0.001$). Persons with postgraduate educations had a higher likelihood of walking as transportation. Forty-five to 64 year olds were slightly more likely to walk for transportation, while the oldest group had slightly lower rates. Females were more likely to walk for transportation than males. Hispanics had greater rates of walking transportation compared to other racial groups. Those in the highest and lowest income groups were more likely to walk for transportation than the middle categories. Urban dwellers were more likely to walk for transportation than people in rural environments. For more details regarding the results and significance levels of the active transportation *post hoc* pairwise comparisons, see Table B.1.2 in Appendix B.

Significant differences in all demographic factors were observed across bikers and non-bikers: education ($p<0.001$), age ($p<0.001$), race ($p=0.0.014$), gender ($p<0.001$), income ($p<0.001$), and geographic location ($p<0.001$). The unadjusted demographic distribution of biking for transportation differed from walking only. People using bicycling as transportation were more likely to be of higher education, younger, male, have a higher income, and live in an urban area. For more details regarding the results and significance levels of the active transportation pairwise comparisons, see Table B.1.2 in Appendix B.

When comparing persons with biking or walking active transportation trips versus neither, significant differences were observed in education ($p<0.001$), age ($p<0.001$), race ($p<0.001$), income ($p<0.001$), and geographic location ($p<0.001$). No difference was found in gender distribution between persons who travelled by walking or biking and persons with no active transportation ($p=0.122$). Reflecting that more individuals had walking than biking trips, the combined definition showed very similar results as from walking transportation only. Individuals were more likely to either walk or bike if they were more highly educated, 45-65 years old, or Hispanic, had higher income, and lived in an urban area. For more details regarding the results and significance levels of the active transportation pairwise comparisons, see Table B.1.2 in Appendix B.

Table 3 - Unadjusted Demographic Factors of Individuals Engaging in Active Travel (n=152,573)

	Non-Walker (n=136,635)	Walker (n=159,38)	Non-Biker (n=151,153)	Biker (n=1,420)	Neither Walk or Bike (n=135,488)	Walker or Biker (n=17,085)
Education						
Less than high school grad	7,790 (5.70%)	851 (5.34%)	8,574 (5.67%)	67 (4.72%)	7,733 (5.71%)	908 (5.31%)
High school grad or GED	35,848 (26.24%)	2,905 (18.23%)	38,485 (25.46%)	268 (18.87%)	35,627 (26.30%)	3,126 (18.30%)
Some college or associates degree	39,180 (28.67%)	3,907 (24.51%)	42,755 (28.29%)	332 (23.38%)	38,906 (28.72%)	4,181 (24.47%)
Bachelor's degree	30,856 (22.58%)	4,196 (26.33%)	34,653 (22.93%)	399 (28.10%)	30,527 (22.53%)	4,525 (26.49%)
Graduate or professional degree	21,919 (16.04%)	3,979 (24.97%)	25,555 (16.91%)	343 (24.15%)	21,659 (15.99%)	4,239 (24.81%)
Refused or not ascertained	1,042 (0.76%)	100 (0.63%)	1,131 (0.75%)	11 (0.77%)	1,036 (0.76%)	106 (0.62%)
P-Value		<0.001		<0.001		<0.001
Age, years						
18-24	7,128 (5.22%)	718 (4.50%)	7,746 (5.12%)	100 (7.04%)	7039 (5.20%)	807 (4.72%)
25-44	31,019 (22.72%)	3,577 (22.44%)	34,217 (22.64%)	379 (26.69%)	30,698 (22.66%)	3,898 (22.82%)
45-64	61,223 (44.81%)	7,513 (47.14%)	68,034 (45.01%)	702 (49.44%)	60,681 (44.79%)	8,055 (47.15%)
≥65	37,265 (27.25%)	4,130 (25.91%)	41,156 (27.23%)	239 (16.83%)	37,070 (27.36%)	4,325 (25.31%)
P-Value		<0.001		<0.001		<0.001
Gender						
Female	71,896 (52.62%)	8,794 (55.18%)	80,245 (53.09%)	445 (31.34%)	71,559 (52.82%)	9,131 (53.44%)
Male	64,739 (47.38%)	7,144 (44.82%)	70,908 (46.91%)	975 (68.66%)	63,929 (47.18%)	7,954 (46.56%)
P-Value		<0.001		<0.001		0.122
Race						
White	118,358 (86.62%)	13,584 (85.23%)	130,695 (86.47%)	1,247 (87.82%)	117,362 (86.62%)	14,580 (85.34%)
African American, Black	7,050 (5.16%)	781 (4.90%)	7,786 (5.15%)	45 (3.17%)	7,010 (5.17%)	821 (4.81%)
Asian only	3,072 (2.25%)	422 (2.65%)	3,468 (2.29%)	26 (1.83%)	3,049 (2.25%)	445 (2.60%)
American Indian, Alaskan Native	850 (0.62%)	126 (0.79%)	967 (0.64%)	9 (0.63%)	842 (0.62%)	134 (0.78%)
Native Hawaiian, Pacific Islander	397 (0.29%)	45 (0.28%)	440 (0.29%)	2 (0.14%)	395 (0.29%)	47 (0.28%)
Multiracial	776 (0.57%)	101 (0.63%)	864 (0.57%)	13 (0.92%)	763 (0.56%)	114 (0.67%)
Hispanic/Mexican	3,663 (2.68%)	513 (3.22%)	4,132 (2.73%)	44 (3.10%)	3,625 (2.68%)	551 (3.23%)
Other	1,437 (1.05%)	196 (1.23%)	1,615 (1.07%)	18 (1.27%)	1,423 (1.05%)	210 (1.23%)
Refused or not ascertained	1,032 (0.76%)	170 (1.07%)	1,186 (0.78%)	16 (1.13%)	1,019 (0.75%)	183 (1.07%)
P-Value		<0.001		0.014		<0.001
Family Income						
$0 - $24,999	17,012 (12.45%)	2,233 (14.01%)	19,050 (12.60%)	195 (13.73%)	16,862 (12.45%)	2,383 (13.95%)
$25,000 - $49,999	32,361 (23.68%)	3,199 (20.07%)	35,275 (23.34%)	285 (20.07%)	32,123 (23.71%)	3,437 (20.12%)
$50,000 - $74,999	25,539 (18.70%)	2,569 (16.12%)	27,874 (18.44%)	234 (16.48%)	25,345 (18.71%)	2,763 (16.17%)
> $75,000	52,811 (38.66%)	6,917 (43.40%)	59,103 (39.10%)	625 (44.01%)	52,315 (38.61%)	7,413 (43.39%)
Refused or not ascertained	8,912 (6.52%)	1,020 (6.40%)	9,851 (6.52%)	81 (5.70%)	8,843 (6.53%)	1,089 (6.37%)
P-Value		<0.001		<0.001		<0.001
Urban vs. Rural						
Urban	95,024 (69.55%)	12,553 (78.76%)	106,455 (70.43%)	1,122 (79.01%)	94,119 (69.47%)	13,458 (78.77%)
Rural	41,611 (30.45%)	3,385 (21.24%)	44,698 (29.57%)	298 (20.99%)	41,369 (30.53%)	3,627 (21.23%)
P-Value		<0.001		<0.001		<0.001
Note: Data were compared across categories by $\chi 2$ tests.						

4.3.2 Adjusted Odds of Being an Active Transporter by Demographic Factors

Table 4 shows the adjusted odds of being an active transporter by each demographic factor category. Odds of active transportation use remained significantly higher in the most educated people (bachelor's degree and graduate or professional degree holders) in all three definitions of active transportation after adjustment for all other demographic variables. A nonlinear relationship was seen again in walkers and walkers or bikers where, compared to the lowest education level, the middle education levels had lower odds of active transportation and the higher education categories having higher odds of active transportation. The odds of being a walking transportation user were not influenced by age; however the odds of being a bike transporter were lower in higher age categories. Those persons ≥65 years of age were shown to be 11% less likely to walk or bike as active transportation when compared to 18-24 year olds ($p=0.008$). Males were 13% less likely to be a walking transporter ($p<0.001$) but were 149% more likely to be bike transporters ($p<0.001$) than females. Males were 4% less likely to be either a walk or bike transporter than females ($p=0.016$). Several racial groups were shown to have increased or decreased odds of being an active transporter when compared to whites. Hispanics were 23% more likely to walk for transportation than Whites ($p<0.001$). American Indians or Alaskan Natives were 35% more likely to use walking or biking as transportation than Whites ($p=0.002$). African Americans were 42% less likely to use bike transportation than whites ($p<0.001$) and Asians were 44% less likely ($p=0.004$). African Americans were 10% less likely to either walk or bike as transportation than Whites ($p=0.009$). Hispanics were 22% more likely to walk or bike as transportation than Whites ($p<0.001$). American Indians or Alaska Natives were 33% more likely to walk or bike than Whites ($p=0.003$). Unlike the unadjusted results

which found that higher income categories had higher rates of walking and walking or biking, the adjusted results found that the lowest family income group ($0-$24,999) had the highest odds of walking, biking, or either as transportation and all higher income categories having significantly lower odds (all p<0.001). Living in an urban setting increased the odds of walking by 52%, biking by 55%, and either by 53% when compared to living in a rural setting (all p<0.001).

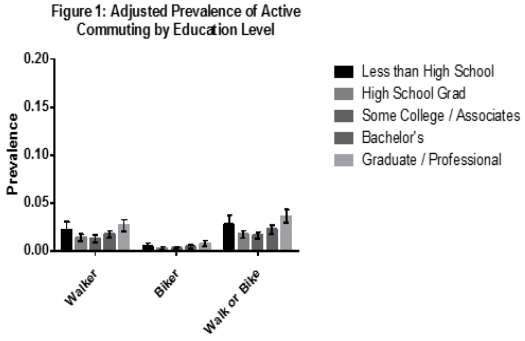
Table 4 - Adjusted Odds of Being Active Transporters by Demographic Factors (n=152,573)

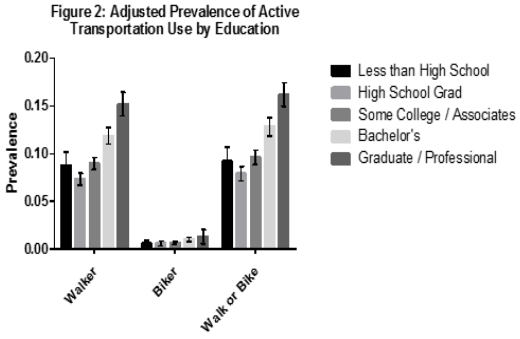
	Walker		Biker		Walker or Biker	
	Odds Ratio	P-Value	Odds Ratio	P-value	Odds Ratio	P-value
Education						
Less than high school grad	1.00		1.00		1.00	
High school grad or GED	0.83	<0.001	1.05	0.710	0.84	<0.001
Some college or associates degree	1.04	0.405	1.17	0.261	1.04	0.300
Bachelor's degree	1.42	<0.001	1.74	<0.001	1.44	<0.001
Graduate or professional degree	1.89	<0.001	2.07	<0.001	1.91	<0.001
Age, years						
18-24	1.00		1.00		1.00	
25-44	0.95	0.269	0.76	0.019	0.93	0.064
45-64	1.05	0.278	0.70	0.001	0.99	0.918
≥65	0.97	0.532	0.37	<0.001	0.89	0.008
Gender						
Female	1.00		1.00		1.00	
Male	0.87	<0.001	2.49	<0.001	0.96	0.016
Race						
White	1.00		1.00		1.00	
African American, Black	0.93	0.052	0.58	<0.001	0.90	0.009
Asian Only	0.97	0.513	0.56	0.004	0.94	0.201
American Indian, Alaskan Native	1.35	0.002	0.89	0.742	1.33	0.003
Native Hawaiian, Pacific Islander	0.97	0.824	0.41	0.206	0.92	0.615
Multiracial	1.10	0.387	1.37	0.267	1.15	0.162
Hispanic/Mexican	1.23	<0.001	0.93	0.676	1.22	0.000
Other	1.16	0.059	1.03	0.887	1.15	0.067
Family Income						
$0 - $24,999	1.00		1.00		1.00	
$25,000 - $49,999	0.71	<0.001	0.67	<0.001	0.71	<0.001
$50,000 - $74,999	0.66	<0.001	0.57	<0.001	0.65	<0.001
> $75,000	0.74	<0.001	0.58	<0.001	0.72	<0.001
Urban vs. Rural						
Rural	1.00		1.00		1.00	
Urban	1.52	<0.001	1.55	<0.001	1.53	<0.001
Note: Logistic models were adjusted for all other variables in the model.						

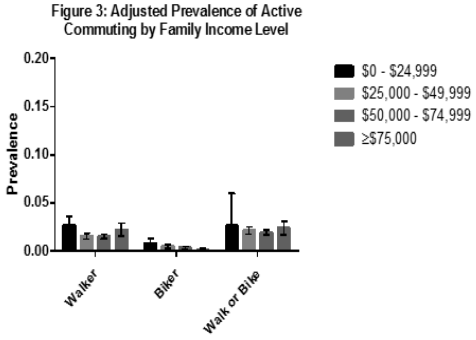
4.4 ADJUSTED PREVALENCES OF ACTIVE TRANSPORTATION USE AND ACTIVE COMMUTING BY DEMOGRAPHIC FACTORS

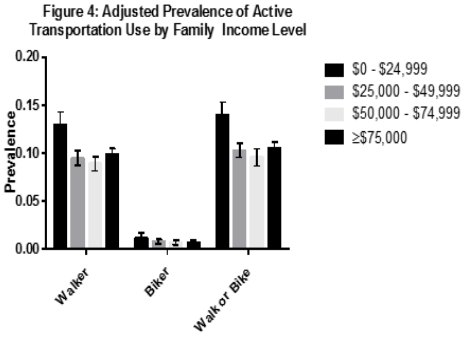
Adjusted prevalences of active commuting were calculated for each demographic factor category to inform actual, in addition to relative, rates of participation. Across all demographic comparisons, absolute frequency of active transportation was much higher than active commuting. Also, bicycling was done much less frequently than walking or either in all cases. The prevalence of active commuting and active transportation use by education level showed a nonlinear trend with the lowest educated and highest educated individuals having the higher prevalences of active commuting and the highest educated individuals having the highest prevalence of active transportation (Figures 1 and 2). This nonlinear pattern was consistent across walking, biking, and either walking or biking across education levels. As shown in Figures 3 and 4, across family income levels, the prevalence of active commuting and active transportation showed a similar non-linear trend for active commuting but was significantly decreased in all higher income levels for active transportation use. In Figures 5 and 6, the prevalence of active commuting and active transportation use was similar across racial groups. Figures 7 and 8 show adjusted prevalences of active transportation use by gender. Females were more likely to take walking active transportation trips and males were more likely to commute by walking or biking and take only biking trips. Prevalence of either walking or biking did not seem to be related to gender. Active commuting, via walking, was done more often by younger individuals compared to older persons. Within active transportation, walking for transportation did not follow a definite pattern across age groups. Bicycling was done more by younger individuals for both active commuting and active transportation. Active commuting and active transportation use prevalences varied significantly by geographic location category (Figures 9

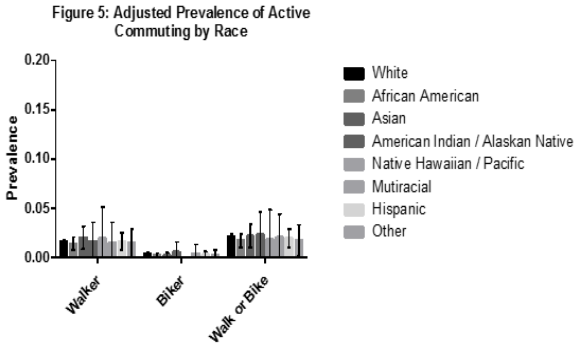
and 10). All modes of active transportation were more prevalent in persons that lived within an urban setting rather than a rural setting.











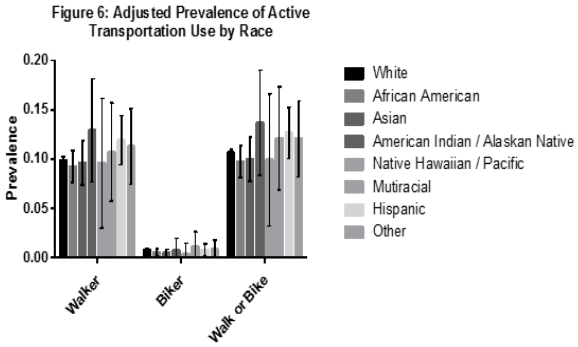


Figure 7: Adjusted Prevalence of Active Commuting by Gender

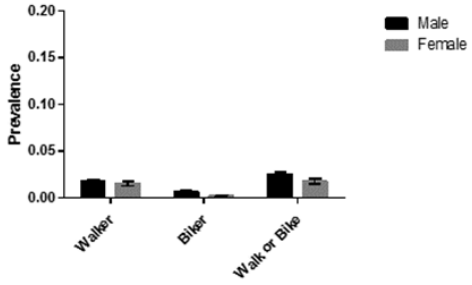


Figure 8: Adjusted Prevalence of Active Transportation Use by Gender

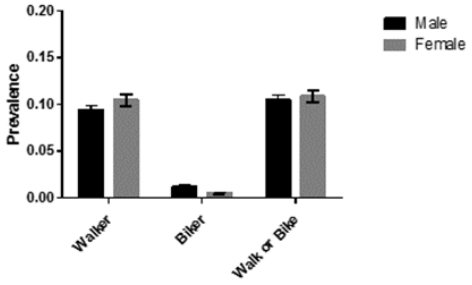


Figure 9: Adjusted Prevalence of Active Commuting by Geographic Location

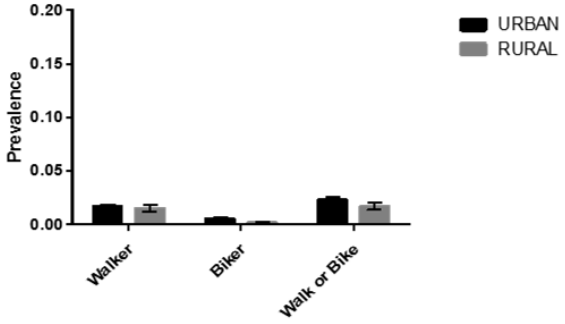


Figure 10: Adjusted Prevalence of Active Transportation Use by Geographic Location

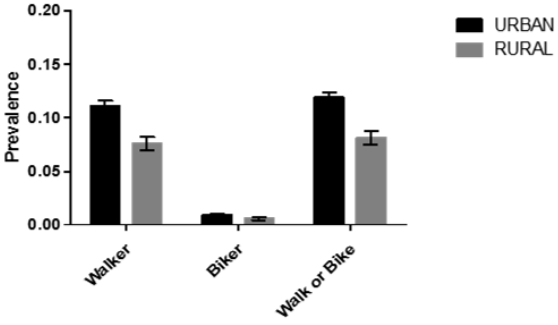


Figure 11: Adjusted Prevalence of Active Commuting by Age

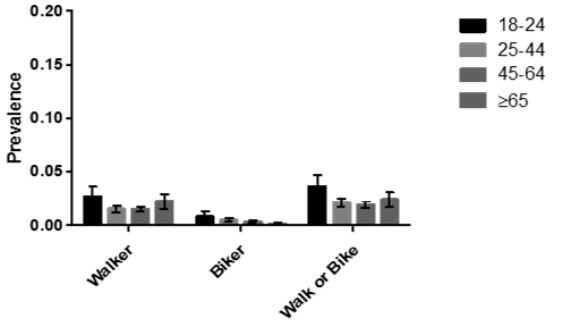
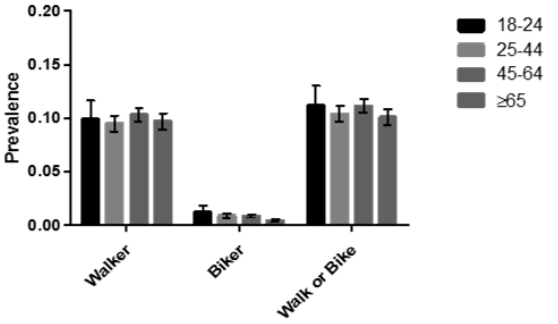


Figure 12: Adjusted Prevalence of Active Transportation Use by Age



4.5 WORKPLACE FACTORS AND ACTIVE COMMUTING RESULTS

4.5.1 Unadjusted Workplace Factor and Active Commuting Results

Five workplace factors were analyzed for unadjusted relationships with active commuting: the availability of a flexible schedule, the option to work from home, distance to work, time it takes to get to work, and work start time. Each of these workplace factors were related to different rates of active commuting by walking, biking, or either (Table 5). Significant differences were shown with walkers having a greater availability of flexible scheduling ($p<0.001$) and an increased frequency of the option to work from home ($p<0.001$). Significant differences were also observed for time to work ($p<0.001$), distance to work ($p<0.001$) and work start time ($p<0.001$). Short time to work, decreased distance to work, and work start time between 11:00AM and 4:00PM were each associated with increased active commuting via walking. *Post hoc* pairwise comparisons are provided in Table B.2 in Appendix B.

Significant differences across bikers and non-bikers were shown with bikers having a greater availability of flexible scheduling ($p<0.001$), were more likely to have the option to work from home ($p<0.001$), had shorter time to work ($p<0.001$), and had shorter distance to work ($p <0.001$). The same trends seen in walking commuters were found in the biking commuters. Biking commuters tend to have flexible time available, can work from home, had a shorter time to work, and had a shorter distance to work. Rates of biking to work also varied by work start time ($p <0.001$), with starting between 11:00AM and 4:00PM being related to higher rates of commuting by bike. *Post hoc* pairwise comparisons can be seen in Table B.2 in Appendix B.

When combining the two commuting groups, significant differences in active commuting rates were found across all workplace factors. Significant differences were shown in availability of flexible scheduling ($p<0.001$), option to work from home ($p<0.001$), time to work ($p<0.001$), distance to work ($p<0.001$) and work start time ($p<0.001$). People were more likely to be active commuters if they had flexible time available, could work from home, had a shorter time to work, had a shorter distance to work, and started between 11:00AM and 4:00PM. *Post hoc* pairwise comparisons are provided in Table A5.3 in Appendix A5.

Table 5 - Unadjusted Workplace Factors of Active Commuters vs. Non-Active Commuters (n=111,809)

	Non-Walker (n=109726)	Walker (n=2083)	Non-Biker (n=111327)	Biker (n=482)	Neither Walk or Bike (n=110512)	Walker or Biker (n=1297)
Flextime						
Yes	47,281 (43.09%)	1,188 (57.03%)	48,130 (43.29%)	339 (54.50%)	46,942 (43.03%)	1,527 (56.45%)
No	62,214 (56.70%)	891 (42.77%)	62,826 (56.50%)	279 (44.86%)	61,935 (56.77%)	1,170 (43.25%)
Refused or not ascertained	231 (0.21%)	4 (0.19%)	231 (0.21%)	4 (0.64%)	227 (0.21%)	8 (0.30%)
P-value	<0.001		<0.001		<0.001	
Work From Home						
Yes	15,079 (13.74%)	1,411 (67.74%)	15,622 (14.05%)	121 (19.45%)	14,958 (13.71%)	785 (29.02%)
No	94,530 (86.15%)	664 (31.88%)	95,440 (85.84%)	501 (80.55%)	94,029 (86.18%)	1,912 (70.68%)
Refused or not ascertained	117 (0.11%)	8 (0.38%)	125 (0.11%)	0 (0.00%)	117 (0.11%)	8 (0.30%)
P-value	<0.001		<0.001		<0.001	
Time to Work						
<10 mins	15,954 (14.54%)	1,190 (57.13%)	17,009 (15.30%)	135 (21.70%)	15,819 (14.50%)	1,325 (48.98%)
≥10-20 mins	33,766 (30.77%)	475 (22.80%)	34,033 (30.61%)	208 (33.44%)	33,558 (30.76%)	683 (25.25%)
≥20-30 mins	25,497 (23.24%)	177 (8.50%)	25,542 (22.97%)	132 (21.22%)	25,365 (23.25%)	309 (11.42%)
≥30 mins	33,903 (30.90%)	163 (7.83%)	33,924 (30.51%)	142 (22.83%)	33,761 (30.94%)	305 (11.28%)
Refused or not ascertained	606 (0.55%)	78 (3.74%)	679 (0.61%)	5 (0.80%)	601 (0.55%)	83 (3.07%)
P-value	<0.001		<0.001		<0.001	
Distance to Work						
≤1 mile	6,690 (6.10%)	1,719 (82.53%)	8,221 (7.39%)	188 (30.23%)	6,502 (5.96%)	1,907 (70.50%)
>1-5 miles	18,949 (17.27%)	204 (9.79%)	18,895 (16.99%)	258 (41.48%)	18,691 (17.13%)	462 (17.08%)
≥5-10 miles	26,317 (23.98%)	12 (0.58%)	26,201 (23.56%)	128 (20.58%)	26,189 (24.00%)	140 (5.18%)
≥10 miles	55,920 (50.96%)	19 (0.91%)	55,901 (50.28%)	38 (6.11%)	55,882 (51.22%)	57 (2.11%)
Refused or not ascertained	1,850 (1.69%)	129 (6.19%)	1,969 (1.77%)	10 (1.61%)	1,840 (1.69%)	139 (5.14%)
P-value	<0.001		<0.001		<0.001	
Work Start Time						
≥6:00AM – 11:00AM	87,559 (79.80%)	1,589 (76.28%)	88,667 (79.75%)	481 (77.33%)	87,078 (79.81%)	2,070 (76.52%)
≥11:00AM – 4:00PM	6,701 (6.11%)	176 (8.45%)	6,813 (6.13%)	64 (10.29%)	6,637 (6.08%)	240 (8.87%)
≥4:00PM – 9:00PM	3,788 (3.45%)	82 (3.94%)	3,844 (3.46%)	26 (4.18%)	3,762 (3.45%)	108 (3.99%)
≥9:00PM – 1:00AM	1,512 (1.38%)	24 (1.15%)	1,533 (1.38%)	3 (0.48%)	1,509 (1.38%)	27 (1.00%)
≥1:00AM – 6:00AM	6,584 (6.00%)	99 (4.75%)	6,660 (5.99%)	23 (3.70%)	6,561 (6.01%)	122 (4.51%)
Refused or not ascertained	3,582 (3.26%)	113 (5.42%)	3670 (3.30%)	25 (4.02%)	3,557 (3.26%)	138 (5.10%)
P-value	<0.001		<0.001		<0.001	

Note: Data were compared across categories by $\chi 2$ tests.

4.5.2 Adjusted Odds of Active Commuting by Workplace Factors

Table 6 shows the odds of actively commuting by workplace factors. Increased odds of being an active commuter were strongly associated with the availability of flextime in the workplace in all three definitions of active commuting when compared to not having the option of flextime: walking (OR=2.06, $p<0.001$), biking (OR=1.52, $p<0.001$), and walking or biking (OR=1.95, $p<0.001$). Increased odds for walking and either walking or biking were also seen in those who have the option to work from home compared to those who did not: walking (OR=3.32, $p<0.001$), walking or biking (OR=2.70, $p<0.001$). Odds of active commuting were lower with greater time to work in all three definitions of active commuting when compared to the reference group of <10 minutes (all $p<0.001$). A similar relationship was seen where the odds of active commuting were lower with greater distances to work when compared to the reference group of ≤1 mile (all $p<0.001$). A significant increase in odds of active commuting was seen in the ≥11:00AM – 4:00PM group when compared to the ≥6:00AM – 11:00AM group: walking (OR=1.26, $p=0.005$), biking (OR=1.70, $p<0.001$), and walking or biking (OR=1.36, $p<0.001$). Additionally, start time of ≥1:00AM – 6:00AM was associated with significantly decreased active commuting for all transportation modes (all $p<0.05$).

Table 6 - Adjusted Odd of Active Commuting by Workplace Factor (n=111,809)

	Walker		Biker		Walker or Biker	
	Odds Ratio	P-Value	Odds Ratio	P-value	Odds Ratio	P-value
Flextime						
No	1.00		1.00		1.00	
Yes	2.06	<0.001	1.52	<0.001	1.95	<0.001
Work From Home						
No	1.00		1.00		1.00	
Yes	3.32	<0.001	1.20	0.086	2.70	<0.001
Time to Work						
<10 mins	1.00		1.00		1.00	
≥10-20 mins	0.19	<0.001	0.75	0.009	0.24	<0.001
≥20-30 mins	0.09	<0.001	0.64	<0.001	0.14	<0.001
≥30 mins	0.06	<0.001	0.49	<0.001	0.11	<0.001
Distance to Work						
≤1 mile	1.000		1.000		1.000	
>1-5 miles	0.042	<0.001	0.553	<0.001	0.081	<0.001
≥5-10 miles	0.002	<0.001	0.200	<0.001	0.017	<0.001
≥10 miles	0.001	<0.001	0.027	<0.001	0.003	<0.001
Work Start Time						
≥6:00AM – 11:00AM	1.00		1.00		1.00	
≥11:00AM – 4:00PM	1.26	0.005	1.70	<0.001	1.36	<0.001
≥4:00PM – 9:00PM	0.99	0.988	1.10	0.656	1.02	0.871
≥9:00PM – 1:00AM	0.88	0.523	0.37	0.089	0.75	0.151
≥1:00AM – 6:00AM	0.81	0.044	0.64	0.038	0.76	0.004
Note: Logistic models were adjusted for education, age, gender, race, family income, and geographic location.						

4.5.3 Adjusted Prevalences of Active Commuting by Workplace Factor

Prevalences of active commuting were examined by workplace factors after adjusting for demographic factors. Figure 13 shows that the prevalence of active commuting was greater in individuals with the availability of a flexible schedule. This pattern was seen across walking, biking, and either walking or biking in both active commuting and active transportation use. A similar trend was seen in Figure 14, when considering the option to work from home. Increased prevalence of active commuting was seen in those who had the option to work from home. The

prevalence of active commuting differed across various lengths of time to work as seen in Figure 15. The group with the shortest time to work (<10 mins) showed the highest prevalence of active commuting in all three definitions of active commuting However, this pattern was seen more drastically in walking only and walking or biking. This same pattern was seen in Figure 16 when comparing prevalence of active commuting across categories of distance to work. The highest prevalence was seen in the shortest commuting distance (< 1 mile) in walking, biking, and walking or biking. The prevalence of active commuting in relation to start time of work was highest in the ≥11:00am – 4:00PM group, as seen in Figure 17. Lower prevalences of active commuting were seen in the ≥9:00PM-1:00AM and ≥1:00AM-6:00AM groups.

Figure 13: Adjusted Prevalence of Active Commuting by Availibility of Flextime

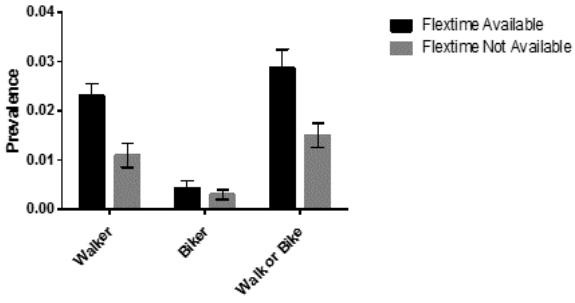


Figure 14: Adjusted Prevalence of Active Commuting by Option to Work From Home

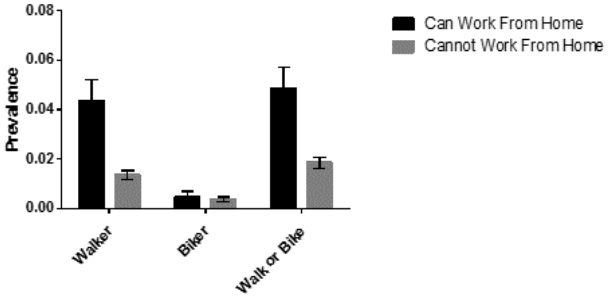


Figure 15: Adjusted Prevalence Active Commuting by Time to Work

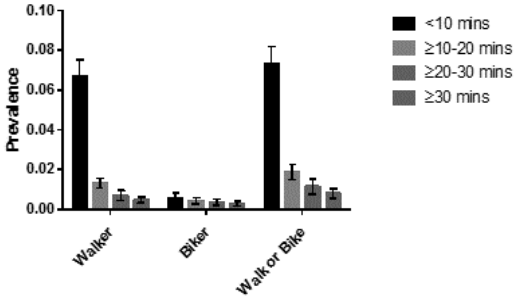


Figure 16: Adjusted Prevalence of Active Commuting by Distance to Work

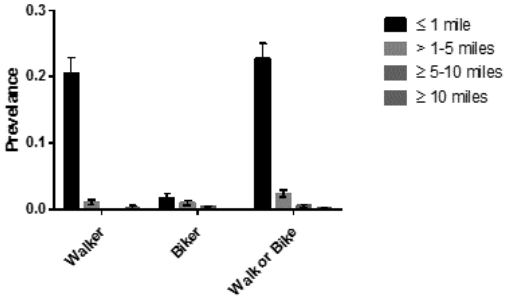
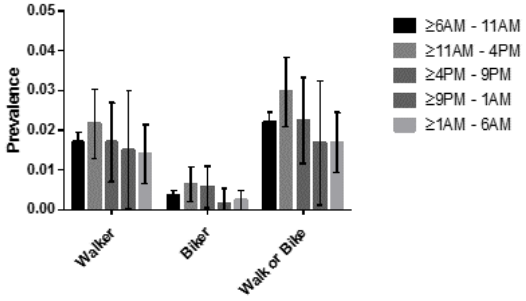


Figure 17: Adjusted Prevalence of Active Commuting by Work Start Time



5.0 DISCUSSION

This analysis examined the relationships of active transportation use and active commuting with demographic factors as well as with workplace factors in a large, population-based sample of American adults. In general, rates of active transportation (11.2%) and active commuting (2.4%) were very low, highlighting an opportunity for public health programming and policy to improve participation and, in turn, population-level physical activity. Demographic factor analysis showed expected relationships between active transportation use and demographic factors that were consistent across active commuting and active transportation definitions. Additionally, this analysis revealed unique relationships between active commuting and workplace factors including a flexible schedule, the option to work from home, and work start time. These novel findings are important for application because workplace factors are potentially more modifiable than demographic factors and could possibly be used to influence active transportation behavior.

The relationships observed in the current study between several demographic factors and active transportation aligned with associations observed in previous research. Specifically, this and other studies have found that persons who are younger (Yang, 2011, Berrigan et. al, 2006), have lower income (Yang, 2011, Berrigan et. al, 2006), are urban dwelling (Saelens et al, 2003), and are male (Berrigan et al. 2006; Bopp, 2006) were more likely to walk on their commute to work. Active commuting may also be inversely related to age due to increasing responsibilities with increasing age such as career obligations or children and other family obligations.

Increasing age was shown, in this analysis to be negatively associated with active transportation use and active commuting while other studies have shown varying result (Besser, 2005, McDonald, 2008). Although, Sener et. al. found an inverse relationship with age and active transportation use (Sener, Eluru, & Bhat, 2009). As expected, geographic location within an urban setting was associated with increased odds of using active transportation. This finding is consistent with other research finding increased walking behaviors with increasing population density (Besser et. al. 2005). Finally, the observed greater active commuting (walking and biking) and active transportation (biking) participation in males and younger age is also consistent with typical patterns in physical activity (Caspersen et. al. 2000).

A non-linear relationship between active commuting and transportation with education was found with individuals having middle levels of education also having decreased odds of active transportation or commuting and those with the highest education levels having the highest odds of actively commuting to work or transportation. While this non-linear relationship persisted in education after adjustment, a similar nonlinear pattern was observed for income with the odds of active transportation before but not after multivariate adjustment. Because income and education are both surrogate measures of socioeconomic status, the decreased positive effect of higher income after adjustment may be explained by colinearity between income and education levels. Specifically, and consistent with population trends that show more highly educated individuals are more likely to be involved in leisure time physical activity (He et. al., 2005), higher rates of active commuting and transportation at higher education and income levels may be mostly due to an effect of higher education. Lower income individuals may have higher rates of active transportation for economic reasons such as the inability to afford a car for commuting. This could further result in individual choices that could facilitate active

commuting, such as choosing work and housing that is closer in proximity to each other. This relationship is consistent with the findings of Besser et. al. using the 2001 NHTS to examine walking to public transit and meeting physical activity recommendations (Besser et al, 2005). Similarly from the 2001 NHTS, McDonald showed that lower income families have higher rates of active transportation use (McDonald, 2008).

Unlike several other studies that have found increased active transportation use among minorities (Frank et al, 2004; Berrigan, 2006; McDonald, 2008), this study found few relationships where minorities participated in active transportation at greater rates in adjusted models. Compared to Whites, only Hispanics and American Indians/Alaskan Natives were more likely to engage in active transportation by walking. Also, we found that Blacks as well as Asians were less likely than Whites to commute by biking. This finding is inconsistent compared to a previous study showing that African Americans may have as much as two times greater odds of being active transporters compared to Whites (Frank, Andresen, & Schmid, 2004). However, this higher rate in African Americans was found in a sample population drawn only from the Atlanta area, as compared to our nationally representative sample. This fact could help explain the difference in the results from the current analysis. In another cross-sectional analysis, Berrigan et al. examined a sample population from the 2001 California Health Interview Survey (n=55,151) to determine demographic factors of persons meeting or not meeting physical activity recommendations from non-leisure time walking or biking (NLTWB) (Berrigan, 2006). This analysis found that all non-White minority populations were more likely to meet recommendations via NLTWB than Whites, after adjustment for other demographic factors. Our findings may differ from those results due to the fact that the sample was limited to only California residents or because of differences in the definition of active transportation across the

two studies. Additionally, some racial groups, in this analysis, were small and may have been underpowered to observe differences.

We confirmed the hypotheses that each of the five workplace factors examined were related to active commuting. It was shown that the availability of a flexible schedule was positively related to both walking and biking active commuting behaviors. While this factor has not, to our knowledge, been considered before, possible mechanisms of this relationship could include that a flexible schedule could allow the employee to schedule their commute around adverse weather patterns and might reduce stress due to the uncertainty of trip duration involved with active transportation. Similarly, the option to work from home was associated with a more than 3-fold increase in active commuting by walking when compared with no option. Possible explanations for this relationship could include that individuals who can work from home have more casual work environments (for example, are less likely to meet with clients or to need to wear formal business attire) which are more conducive to active transportation. Increasing distance to work and time to work were both shown to be negatively associated with active commuting habits. This association is expected as people are less likely to choose to walk or bike to work if it will take a very long time. The investigation of work start time showed that active commuting was more common during start time category between 11:00AM and 4:00PM. This result could reflect that people may be less likely to actively commute during rush hour traffic times due to busy streets and safety concerns. Though this relationship has not been studied thoroughly, some evidence suggests people may feel too unsafe or concerned about noise and congestion during rush hour times to actively commute (Michael et. al. 2006).

The adjusted prevalence figures provide valuable information about the absolute rates of active transportation and active commuting within the sample population. Active commuting was

much less frequent than active transportation. Also, these figures showed that, overwhelmingly, walking had a much higher frequency than biking in both active commuting and active travel in general. It is potentially most important to recognize from these figures that the absolute rates of both modalities of active commuting and transportation are quite low. Our findings can be interpreted in the context of others that have shown that the United States has very low participation rates when compared to Europe for walking (140 km versus 382 km per person per year) and biking (40km versus 188 km per person per year) (Bassett Jr, D. R. et. al, 2008). Thus, despite some of the strong relative relationships that were presented (i.e. odds ratios >2 for some workplace factors), much work still needs to be done to identify ways to increase absolute rates of active transportation.

The strengths of this analysis included a large, population-based study population and a unique survey that allowed for demographic adjustment and measured workplace factors. Additionally, this analysis benefitted from the ability to use and compare different modalities (walking, biking, or both) and two different definitions of active transportation (active commuting or any active transportation). Separating commuting to work and general transportation trips was valuable in this analysis because it allowed for the inclusion of the entire population rather than just those employed outside of the home. This improves the generalizability of our findings between demographic factors and active transportation to the broader United States population. The two definitions showed mostly similar results across demographic factors, which strengthened our conclusions about the observed relationships in this analysis.

Several weaknesses of this analysis exist. Firstly, the study design was cross-sectional which provides no information regarding temporal relationships between workplace factors and

active transportation behaviors. This decreases our ability to infer causality. All data were self-reported which could have introduced bias due to social desirability (e.g. over-reporting of number of walking trips taken) or participant error (e.g. poor estimation of distance to work). However, it is unlikely that a person would be misclassified as an active commuter due to this bias. For example, a person who never bikes to work is less likely to report that they bike as their usual mode of transportation to work. Though use of the one-day travel diary may have reduced recall bias for participants who completed the data collection in real time, the data was then relayed by telephone to a NHTS interviewer and persons with less accurate or incomplete diaries may have had less reliable data. The categorical workplace factors could also have been subject to measurement error because variables such as flexible schedule (yes/no) or the predefined windows of work start time might have been too broad or may not have accommodated persons with variable schedules. Finally, this analysis would have benefitted from additional information. Other workplace factors, including the availability of workplace facilities such as showers and locker rooms as well as specific job classifications might also have significant influence on active commuting behavior and should be explored in future research. Also, a greater understanding of perceived barriers to active transportation is another area in need of research for designing individual and population-level interventions. The increased understanding of barriers to the behavior of active transportation use would allow interventionists to target barrier reduction strategies within interventions to possibly more effectively change behavior.

The results of this analysis shed vital light on factors that are associated with the use of active transportation, which can be used to develop policy and interventions that promote active transportation. For related demographic factors that cannot be easily changed, like age and

gender, intervention strategies could focus on encouraging low user groups to use active transportation. The findings of this study help to characterize this low user group. Though it has been suggested that active transportation might reduce disparities related to physical activity and health in minority populations, few relationships were found between race/ethnicity and active transportation after adjustment for other demographic factors in the current analysis and these were not always higher rates in minority populations. Therefore, it seems that all racial groups could benefit from interventions to increase active transportation. Other demographic factors that can be modified, such as education level, suggest that increased access and support of education could benefit active transportation use. Moreover, those more likely to be active transporters, based on the results of this study, can be encouraged to increase or maintain their current behaviors.

The workplace analysis has provided evidence for a new area of focus for policy changes that could encourage active transportation. This analysis has shown that the availability of a flexible schedule and the option to work from home both have a positive relationship with active commuting behaviors. While a causal relationship cannot be determined from these results and it is possible that persons wishing to engage in active commuting behaviors might have selected jobs with these attributes, the observed relationships suggest that creating policies to allow these options for employees could facilitate active transportation. Also, this analysis has shown that living closer to work and having a shorter commute time is positively associated with active transportation use. While employers cannot control where their employees live, they can prioritize office locations in multi-use land areas that provide workplaces close to residential areas. This type of design encourages people to work closer to where they live and creates the practical option to use active transportation. Although not as strong of a relationship as some, a

work start time of 11:00AM-4:00PM was associated with higher prevalence of active commuting. Workplace health promotion programs and workplace policy could encourage variable scheduling to allow employees to determine their own start time or to encourage start times during this interval.

It is also, important to understand the limitations of these findings regarding implementation. Some workplace environments are constrained by shift work, location stability, and other factors that may limit the practicality of this type of policy changes. It is important to apply these results and possible implications to workplaces that have the ability to make these changes. Workplaces outside this type may not be directly affected by changes in these factors and more research needs to be done to further understand factors that may be related to active transportation in every type of workplace.

Future research should seek to develop causal relationships between the factors explored in this analysis and active transportation use. With the nationwide implementation of community and workplace policy changes that could facilitate active transportation, natural experiment designs that take advantage of changes within communities and workplaces to study the effects of these policy changes on behavior patterns could be valuable. Additionally, intervention studies within workplaces could be performed to study the possible causal effects of modifying workplace factors. Also, measurement of additional workplace factors (e.g. access to showers), perceived barriers, other physical activity, and the contributions of active commuting to economic and health benefits are areas in need of more study.

In conclusion, the frequency of active transportation use in the NHTS, population-based sample, was very low and strategies to increase active transportation behavior may be helpful to increase overall physical activity levels, decrease adverse health risks, and reduce the economic

burden of transporting in motor vehicles. Both demographic factors and workplace factors were significantly associated with active transportation, and these relationships can be leveraged in governmental policy and workplace health promotion to encourage active transportation. Although these relationships have been established here in a US population-based sample, causal relationships of workplace factors and active transportation cannot be certain and additional research is needed to confirm and further explore these relationships. The potential for development of these ideas and program execution based on these relationships gives a challenging yet hopeful perspective to behavior change regarding active transportation and physical activity in general. This analysis sheds light on possible intervention targets to increase physical activity levels in the United States through small changes in governmental or workplace policy to encourage habitual exercise through active transportation.

APPENDIX A

NHTS QUESTIONS

A.1 ACTIVE TRANSPORTATION QUESTIONS

E16. How did {you/SUBJECT} **usually** get to work last week?

(WRKTRANS)

[IF NEEDED: That is, the one used for most of the distance?]

PERSONAL VEHICLES

CAR..... 1
VAN..... 2
SUV..... 3
PICKUP TRUCK..... 4
OTHER TRUCK..... 5
RV..... 6
MOTORCYCLE..... 7
LIGHT ELECTRIC VEHICLE (GOLF CART) 8

BUS TRAVEL

LOCAL PUBLIC TRANSIT..... 9
COMMUTER BUS..... 10
SCHOOL BUS..... 11
CHARTER/TOUR BUS..... 12
CITY TO CITY (GREYHOUND/PETERPAN) 13
SHUTTLE BUS (SUCH AS A SENIOR
OR AIRPORT SHUTTLE)..... 14

TRAIN TRAVEL

AMTRAK/INTER CITY..... 15
COMMUTER TRAIN..... 16
SUBWAY/ELEVATED..... 17
STREET CAR/TROLLEY..... 18

OTHER

TAXICAB..... 19
FERRY..... 20
AIRPLANE..... 21
BICYCLE..... 22

WALK..... 23
SPECIAL TRANSIT FOR PEOPLE WITH
DISABILITIES (DIAL-A-RIDE)..... 24
OTHER?..... 97
(SPECIFY)_____
(WRKTRNOS)
REFUSED..... -7
DON'T KNOW..... -8

G34. How did {you/SUBJECT} get to {CURRENT TRIP DESTINATION}?
(TRPTRANS)
[IF NEEDED: That is, what means of transportation did {you/SUBJECT} use for this trip?]

PERSONAL VEHICLES
CAR..... 1
VAN..... 2
SUV..... 3
PICKUP TRUCK..... 4
OTHER TRUCK..... 5
RV..... 6
MOTORCYCLE..... 7
LIGHT ELECTRIC VEHICLE (GOLF CART) 8

BUS TRAVEL
LOCAL PUBLIC TRANSIT..... 9 GO TO NY_G27a
COMMUTER BUS..... 10 GO TO NY_G27a
SCHOOL BUS..... 11
CHARTER/TOUR BUS..... 12
CITY TO CITY (GREYHOUND/PETERPAN) 13
SHUTTLE BUS (SUCH AS A SENIOR
OR AIRPORT SHUTTLE)..... 14

TRAIN TRAVEL
AMTRAK/INTER CITY..... 15
COMMUTER TRAIN..... 16 GO TO NY_G27b
SUBWAY/ELEVATED..... 17 GO TO NY_G27c
STREET CAR/TROLLEY..... 18

OTHER
TAXICAB..... 19
FERRY..... 20 GO TO NY_G27d
AIRPLANE..... 21 GO TO NY_G27e
BICYCLE..... 22
WALK..... 23
SPECIAL TRANSIT FOR PEOPLE WITH
DISABILITIES (DIAL-A-RIDE)..... 24
OTHER?..... 97
(SPECIFY)_____
(WRKTRNOS)
REFUSED..... -7
DON'T KNOW..... -8

A.2 DEMOGRAPHIC FACTOR QUESTIONS

M13. In surveys like these, households are sometimes grouped according to income. Please stop me when I get to the category that best describes your total household income, before taxes, in the past 12 months.
(HHFAMINC_C)

[IF NEEDED: We want to include income from sources such as wages and salaries, income from a business or a farm, Social Security, pensions, dividends, interest, rent, and any other income received.]

Less than $10,000,..... 1 GO TO M14
$10,000 to $20,000,..... 2 GO TO M15
$20,000 to $30,000,..... 3 GO TO M16
$30,000 to $40,000,..... 4 GO TO M17
$40,000 to $50,000,..... 5 GO TO M18
$50,000 to $60,000,..... 6 GO TO M19
$60,000 to $70,000,..... 7 GO TO M20
$70,000 to $80,000,..... 8 GO TO M21
$80,000 to $100,000, or..... 9 GO TO BOX BEFORE M22
$100,000 or more?.....10 GO TO BOX BEFORE M22
REFUSED..... -7 GO TO BOX BEFORE N1
DON'T KNOW..... -8 GO TO BOX BEFORE N1

C5. Please tell me your first name, age and gender.
(FNAME, R_AGE, R_SEX)

FIRST NAME: _____
AGE: _____
GENDER: _____ [M=MALE, F=FEMALE]
REFUSED..... -7

DON'T KNOW..... -8

C8. Please tell me the first name and age of everyone living in the household.
[What is {FNAME/AGE/SEX OF NEXT HHM}'s relationship to {you/FNAME/AGE/SEX OF 1ST SCREENER RESPONDENT}?]
{{Are you/Is {FNAME/AGE/SEX}} a driver?}
{Have you/Has FNAME/AGE/SEX}} ever been a driver?}
[ENTER AGE AS 0 FOR EVERYONE UNDER ONE YEAR.]
[1=YES, 2=NO]

	(FNAME) FIRST NAME	**(R_AGE)** AGE	**(R_SEX)** M/F	**(SCRESP)** X BY SCREENER RESPONDENT	**(R_RELAT)** RELATIONSHIP TO REFERENCE PERSON	**(DRVR)**	**(EVERDROV)** DRIVER EVER
01							
02							
03							
04							
05							
thru' 99							

1. REFERENCE PERSON
2. SPOUSE
3. CHILD
4. PARENT
5. BROTHER/SISTER
6. OTHER RELATIVE
7. UNMARRIED PARTNER
8. NON-RELATIVE

C7. I'm going to read a list of races. {In addition to being Hispanic, please/Please} tell me which <u>best</u> describes your race. Are you…
(HH_RACE)

White,..... 1
African American, Black,..... 2
Asian,..... 3
American Indian, Alaskan Native,..... 4
Native Hawaiian, or other Pacific Islander?..... 5
MULTIRACIAL..... 6
HISPANIC/MEXICAN..... 7
OTHER **(HH_RACOS)**..... 97
[SPECIFY]_____
REFUSED..... -7
DON'T KNOW..... -8

M7. What is the highest grade or year of school {you have/FNAME/AGE/SEX has } completed? (EDUC)

LESS THAN HIGH SCHOOL GRADUATE.....1

HIGH SCHOOL GRADUATE, INCLUDING GED.....2
SOME COLLEGE OR ASSOCIATE'S DEGREE (FOR EXAMPLE, AA ALSO INCLUDES

VOCATIONAL, BUSINESS OR TRADE SCHOOL).....3
BACHELOR'S DEGREE (FOR EXAMPLE, BA, AB, BS).....4
GRADUATE OR PROFESSIONAL SCHOOL DEGREE (FOR EXAMPLE, MA, MS, MBA, MD, DDS, PHD, EdD, JD).....5
REFUSED.....-7
DON'T KNOW.....-8

D7.
STREET ADDRESS:
APARTMENT NUMBER:
CITY:
STATE:
ZIP CODE:
RECORD IF THE STREET ADDRESS DISPLAYED IS A:
(D7_QUEST)

NORMAL STREET ADDRESS [NOT A PO BOX, RURAL ROUTE/RR, RURAL DELIVERY/RD, OR RFD]..... 1
PO BOX, RR, RD, OR RFD..... 2

A.3 WORKPLACE FACTOR QUESTIONS

E14. What is the one-way distance from {your/SUBJECT'S} home to {your/his/her} {primary} workplace?

(DISTTOWK, DISTUNIT)

[IF LESS THAN 1 BLOCK, ENTER O BLOCKS. IF LESS THAN 1 MILE ENTER AS BLOCKS.]

[¼ MILE = 2 BLOCKS

½ MILE = 5 BLOCKS

¾ MILE = 7 BLOCKS]

NUMBER.....|___|___|___|

UNIT.....|___|

1 = BLOCKS

2 = MILES

REFUSED..... -7

DON'T KNOW..... -8

E15. How many minutes did it usually take {you/SUBJECT} to get from home to work last week?

(TIMETOWK)

MINUTES.....|___|___|___|

DID NOT WORK IN USUAL

WORKPLACE LAST WEEK.....998 GO TO BOX BEFORE E5

DID NOT WORK LAST WEEK.....999 GO TO BOX BEFORE E5

REFUSED..... -7

DON'T KNOW..... -8

EVA3. Which of the following best describes {your/SUBJECT's} current work schedule on a weekly basis? Would you say…

(EVA3)

a. {I work/SUBJECT works} the same schedule

every week,..... 1

b. {I often work/SUBJECT often works} a different

schedule from week to week, or 2

c. {My/SUBJECT's} work schedule changes once

in a while?..... 3

REFUSED..... -7

DON'T KNOW..... -8

Ec. {Do you/Does SUBJECT} have the ability to set or change your own start work time?

(FLEXTIME)

YES..... 1

NO..... 2

REFUSED..... -7

DON'T KNOW..... -8

Eb. What time {do you/does SUBJECT} usually arrive at work?

(WRKHR, WRKMIN, WRKAMPM – DERIVE WRKTIME AS HR:MINAM/PM)

HOUR.....|___|___|

TIME OF DAY.....|___|

1 = AM

2 = PM

REFUSED..... -7

DON'T KNOW..... -8

Ed. {Do you/Does SUBJECT} have the option of working at home instead of going into your primary workplace?

(WKRMHM)

YES..... 1

NO..... 2 GO TO BOX BEFORE F1

REFUSED..... -7 GO TO BOX BEFORE F1

DON’T KNOW..... -8 GO TO BOX BEFORE F1

APPENDIX B

POST HOC TESTING RESULTS

B.1 DEMOGRAPHIC PAIRWISE COMPARISONS

Table B.1.1 – Post Hoc Pairwise Comparisons of Demographic Factors and Active Commuting

Walker			Biker			Walk or Bike		
EDUCATION		p-value	**EDUCATION**		p-value	**EDUCATION**		p-value
<High School vs.	High School or GED	<0.001	<High School vs.	High School or GED	<0.001	<High School vs.	High School or GED	<0.001
	Some College or Associates Degree	<0.001		Some College or Associates Degree	<0.001		Some College or Associates Degree	<0.001
	Bachelor's Degree	<0.001		Bachelor's Degree	0.030		Bachelor's Degree	<0.001
	Graduate or Professional Degree	<0.001		Graduate or Professional Degree	1.000		Graduate or Professional Degree	<0.001
High School or GED vs.	Some College or Associates Degree	<0.001	High School or GED vs.	Some College or Associates Degree	1.000	High School or GED vs.	Some College or Associates Degree	<0.001
	Bachelor's Degree	0.016		Bachelor's Degree	0.610		Bachelor's Degree	1.000
	Graduate or Professional Degree	0.06		Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001
Some College or Associates Degree vs.	Bachelor's Degree	0.123	Some College or Associates Degree vs.	Bachelor's Degree	0.170	Some College or Associates Degree vs.	Bachelor's Degree	0.120
	Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001
Bachelor's Degree vs.	Graduate or Professional Degree	<0.001	Bachelor's Degree vs.	Graduate or Professional Degree	<0.001	Bachelor's Degree vs.	Graduate or Professional Degree	<0.001
INCOME			**INCOME**			**INCOME**		
$0 - $24,999 vs.	$25,000 - $49,999	<0.001	$0 - $24,999 vs.	$25,000 - $49,999	<0.001	$0 - $24,999 vs.	$25,000 - $49,999	<0.001
	$50,000 - $74,999	<0.001		$50,000 - $74,999	<0.001		$50,000 - $74,999	<0.001
	> $75,000	<0.001		> $75,000	<0.001		> $75,000	<0.001
$25,000 - $49,999 vs	$50,000 - $74,999	<0.001	$25,000 - $49,999 vs	$50,000 - $74,999	1.000	$25,000 - $49,999 vs	$50,000 - $74,999	0.070
	> $75,000	<0.001		> $75,000	1.000		> $75,000	<0.001
$50,000 - $74,999	> $75,000	<0.001	$50,000 - $74,999	> $75,000	1.000	$50,000 - $74,999	> $75,000	0.100
RACE			**RACE**			**RACE**		
White vs.	African American, Black	1.000	White vs.	African American, Black	N/A	White vs.	African American, Black	1.000
	Asian only	0.308		Asian only	N/A		Asian only	1.000
	American Indian, Alaskan Native	1.000		American Indian, Alaskan Native	N/A		American Indian, Alaskan Native	1.000
	Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	N/A		Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	N/A		Multiracial	1.000
	Hispanic/Mexican	<0.001		Hispanic/Mexican	N/A		Hispanic/Mexican	<0.001
	Other	1.000		Other	N/A		Other	1.000
African American, Black vs.	Asian only	1.000	African American, Black vs.	Asian only	N/A	African American, Black vs.	Asian only	1.000
	American Indian, Alaskan Native	1.000		American Indian, Alaskan Native	N/A		American Indian, Alaskan Native	1.000
	Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	N/A		Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	N/A		Multiracial	1.000
	Hispanic/Mexican	0.084		Hispanic/Mexican	N/A		Hispanic/Mexican	<0.001
	Other	1.000		Other	N/A		Other	1.000
Asian only vs.	American Indian, Alaskan Native	1.000	Asian only vs.	American Indian, Alaskan Native	N/A	Asian only vs.	American Indian, Alaskan Native	1.000
	Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	N/A		Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	N/A		Multiracial	1.000
	Hispanic/Mexican	1.000		Hispanic/Mexican	N/A		Hispanic/Mexican	1.000
	Other	1.000		Other	N/A		Other	1.000
American Indian, Alaskan Native vs.	Native Hawaiian, Pacific Islander	1.000	American Indian, Alaskan Native vs.	Native Hawaiian, Pacific Islander	N/A	American Indian, Alaskan Native vs.	Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	N/A		Multiracial	1.000
	Hispanic/Mexican	1.000		Hispanic/Mexican	N/A		Hispanic/Mexican	1.000
	Other	1.000		Other	N/A		Other	1.000
Native Hawaiian, Pacific Islander vs.	Multiracial	1.000	Native Hawaiian, Pacific Islander vs.	Multiracial	N/A	Native Hawaiian, Pacific Islander vs.	Multiracial	1.000
	Hispanic/Mexican	1.000		Hispanic/Mexican	N/A		Hispanic/Mexican	1.000
	Other	1.000		Other	N/A		Other	1.000
Multiracial vs.	Hispanic/Mexican	1.000	Multiracial vs.	Hispanic/Mexican	N/A	Multiracial vs.	Hispanic/Mexican	1.000
	Other	1.000		Other	N/A		Other	1.000
Hispanic/Mexican vs.	Other	1.000	Hispanic/Mexican vs.	Other	N/A	Hispanic/Mexican vs.	Other	1.000
AGE, years			**AGE, years**			**AGE, years**		
18-24 vs.	25-44	<0.001	18-24 vs.	25-44	0.120	18-24 vs.	25-44	<0.001
	45-64	<0.001		45-64	<0.001		45-64	<0.001
	≥65	1.000		≥65	<0.001		≥65	0.156
25-44 vs.	45-64	1.000	25-44 vs.	45-64	<0.001	25-44 vs.	45-64	0.006
	≥65	<0.001		≥65	<0.001		≥65	<0.001
45-64 vs.	≥65	0.036	45-64 vs.	≥65	0.006	45-64 vs.	≥65	<0.001

Note: Data were compared across categories by $\chi 2$ tests.

Table B.1.2 – Pairwise Comparisons of Demographic Factors and Active Transportation

Walker			Biker			Walk or Bike		
EDUCATION		p-value	**EDUCATION**		p-value	**EDUCATION**		p-value
<High School vs.	High School or GED	<0.001	<High School vs.	High School or GED	1.000	<High School vs.	High School or GED	<0.001
	Some College or Associates Degree	0.220		Some College or Associates Degree	1.000		Some College or Associates Degree	0.220
	Bachelor's Degree	<0.001		Bachelor's Degree	0.030		Bachelor's Degree	<0.001
	Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001
High School or GED vs.	Some College or Associates Degree	<0.001	High School or GED vs.	Some College or Associates Degree	1.000	High School or GED vs.	Some College or Associates Degree	<0.001
	Bachelor's Degree	<0.001		Bachelor's Degree	<0.001		Bachelor's Degree	<0.001
	Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001
Some College or Associates Degree vs.	Bachelor's Degree	<0.001	Some College or Associates Degree vs.	Bachelor's Degree	<0.001	Some College or Associates Degree vs.	Bachelor's Degree	<0.001
	Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001		Graduate or Professional Degree	<0.001
Bachelor's Degree vs.	Graduate or Professional Degree	<0.001	Bachelor's Degree vs.	Graduate or Professional Degree	0.380	Bachelor's Degree vs.	Graduate or Professional Degree	<0.001
INCOME			**INCOME**			**INCOME**		
$0 - $24,999 vs.	$25,000 - $49,999	<0.001	$0 - $24,999 vs.	$25,000 - $49,999	0.066	$0 - $24,999 vs.	$25,000 - $49,999	<0.001
	$50,000 - $74,999	<0.001		$50,000 - $74,999	0.246		$50,000 - $74,999	<0.001
	> $75,000	1.000		> $75,000	1.000		> $75,000	1.000
$25,000 - $49,999 vs.	$50,000 - $74,999	1.000	$25,000 - $49,999 vs.	$50,000 - $74,999	1.000	$25,000 - $49,999 vs.	$50,000 - $74,999	1.000
	> $75,000	<0.001		> $75,000	<0.001		> $75,000	<0.001
$50,000 - $74,999	> $75,000	<0.001	$50,000 - $74,999	> $75,000	0.018	$50,000 - $74,999	> $75,000	<0.001
RACE			**RACE**			**RACE**		
White vs.	African American, Black	1.000	White vs.	African American, Black	0.028	White vs.	African American, Black	1.000
	Asian only	0.028		Asian only	1.000		Asian only	0.056
	American Indian, Alaskan Native	0.196		American Indian, Alaskan Native	1.000		American Indian, Alaskan Native	0.224
	Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	1.000		Multiracial	1.000
	Hispanic/Mexican	<0.001		Hispanic/Mexican	1.000		Hispanic/Mexican	<0.001
	Other	0.672		Other	1.000		Other	0.588
African American, Black vs.	Asian only	0.028	African American, Black vs.	Asian only	1.000	African American, Black vs.	Asian only	<0.001
	American Indian, Alaskan Native	0.112		American Indian, Alaskan Native	1.000		American Indian, Alaskan Native	0.056
	Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	0.056		Multiracial	0.575
	Hispanic/Mexican	<0.001		Hispanic/Mexican	0.112		Hispanic/Mexican	<0.001
	Other	0.392		Other	0.476		Other	0.140
Asian only vs.	American Indian, Alaskan Native	1.000	Asian only vs.	American Indian, Alaskan Native	1.000	Asian only vs.	American Indian, Alaskan Native	1.000
	Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	1.000		Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	1.000		Multiracial	1.000
	Hispanic/Mexican	1.000		Hispanic/Mexican	1.000		Hispanic/Mexican	1.000
	Other	1.000		Other	1.000		Other	1.000
American Indian, Alaskan Native vs.	Native Hawaiian, Pacific Islander	1.000	American Indian, Alaskan Native vs.	Native Hawaiian, Pacific Islander	1.000	American Indian, Alaskan Native vs.	Native Hawaiian, Pacific Islander	1.000
	Multiracial	1.000		Multiracial	1.000		Multiracial	1.000
	Hispanic/Mexican	1.000		Hispanic/Mexican	1.000		Hispanic/Mexican	1.000
	Other	1.000		Other	1.000		Other	1.000
Native Hawaiian, Pacific Islander vs.	Multiracial	1.000	Native Hawaiian, Pacific Islander vs.	Multiracial	1.000	Native Hawaiian, Pacific Islander vs.	Multiracial	1.000
	Hispanic/Mexican	1.000		Hispanic/Mexican	1.000		Hispanic/Mexican	1.000
	Other	1.000		Other	1.000		Other	1.000
Multiracial vs.	Hispanic/Mexican	1.000	Multiracial vs.	Hispanic/Mexican	1.000	Multiracial vs.	Hispanic/Mexican	1.000
	Other	1.000		Other	1.000		Other	1.000
Hispanic/Mexican vs.	Other	1.000	Hispanic/Mexican vs.	Other	1.000	Hispanic/Mexican vs.	Other	1.000
AGE, years			**AGE, years**			**AGE, years**		
18-24 vs.	25-44	0.012	18-24 vs.	25-44	1.000	18-24 vs.	25-44	0.072
	45-64	<0.001		45-64	1.000		45-64	<0.001
	≥65	0.144		≥65	<0.001		≥65	1.000
25-44 vs.	45-64	0.024	25-44 vs.	45-64	1.000	25-44 vs.	45-64	0.192
	≥65	0.594		≥65	<0.001		≥65	<0.001
45-64 vs.	≥65	<0.001	45-64 vs.	≥65	<0.001	45-64 vs.	≥65	<0.001

Note: Data were compared across categories by $\chi 2$ tests.

B.2 WORKPLACE FACTORS PAIRWISE COMPARISONS

Table B.2 - Pairwise Comparisons of Workplace Factors and Active Commuting

Walker			Biker			Walk or Bike		
Time to Work		p-value	**Time to Work**		p-value	**Time to Work**		p-value
<10 mins	≥10-20 mins	<0.001	<10 mins	≥10-20 mins	0.106	<10 mins	≥10-20 mins	0.108
	≥20-30 mins	<0.001		≥20-30 mins	<0.001		≥20-30 mins	<0.001
	≥30 mins	<0.001		≥30 mins	<0.001		≥30 mins	<0.001
≥10-20 mins	≥20-30 mins	<0.001	≥10-20 mins	≥20-30 mins	0.792	≥10-20 mins	≥20-30 mins	0.792
	≥30 mins	<0.001		≥30 mins	<0.001		≥30 mins	<0.001
≥20-30 mins	≥30 mins	0.006	≥20-30 mins	≥30 mins	0.486	≥20-30 mins	≥30 mins	0.486
Distance to Work			**Distance to Work**			**Distance to Work**		
≤1 mile	>1-5 miles	<0.001	≤1 mile	>1-5 miles	<0.001	≤1 mile	>1-5 miles	<0.001
	≥5-10 miles	<0.001		≥5-10 miles	<0.001		≥5-10 miles	<0.001
	≥10 miles	<0.001		≥10 miles	<0.001		≥10 miles	<0.001
>1-5 miles	≥5-10 miles	<0.001	>1-5 miles	≥5-10 miles	<0.001	>1-5 miles	≥5-10 miles	<0.001
	≥10 miles	<0.001		≥10 miles	<0.001		≥10 miles	<0.001
≥5-10 miles	≥10 miles	1.000	≥5-10 miles	≥10 miles	<0.001	≥5-10 miles	≥10 miles	<0.001
Work Start Time			**Work Start Time**			**Work Start Time**		
≥6:00AM – 11:00AM	≥11:00AM – 4:00P	<0.001	≥6:00AM – 11:00AM	≥11:00AM – 4:00P	<0.001	≥6:00AM – 11:00AM	≥11:00AM – 4:00P	<0.001
	≥4:00PM – 9:00PM	1.000		≥4:00PM – 9:00PM	1.000		≥4:00PM – 9:00PM	1.000
	≥9:00PM – 1:00AM	1.000		≥9:00PM – 1:00AM	0.660		≥9:00PM – 1:00AM	0.660
	≥1:00AM – 6:00AM	0.710		≥1:00AM – 6:00AM	0.330		≥1:00AM – 6:00AM	0.330
≥11:00AM – 4:00PM	≥4:00PM – 9:00PM	1.000	≥11:00AM – 4:00PM	≥4:00PM – 9:00PM	1.000	≥11:00AM – 4:00PM	≥4:00PM – 9:00PM	1.000
	≥9:00PM – 1:00AM	0.200		≥9:00PM – 1:00AM	0.030		≥9:00PM – 1:00AM	0.030
	≥1:00AM – 6:00AM	<0.001		≥1:00AM – 6:00AM	<0.001		≥1:00AM – 6:00AM	<0.001
≥4:00PM – 9:00PM	≥9:00PM – 1:00AM	1.000	≥4:00PM – 9:00PM	≥9:00PM – 1:00AM	0.310	≥4:00PM – 9:00PM	≥9:00PM – 1:00AM	0.310
	≥1:00AM – 6:00AM	0.150		≥1:00AM – 6:00AM	0.170		≥1:00AM – 6:00AM	0.170
≥9:00PM – 1:00AM	≥1:00AM – 6:00AM	1.000	≥9:00PM – 1:00AM	≥1:00AM – 6:00AM	1.000	≥9:00PM – 1:00AM	≥1:00AM – 6:00AM	1.000

Note: Data were compared across categories by $\chi 2$ tests.

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