An Examination of Active Commuting by Race/Ethnicity, Income and Location

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Abstract

Introduction

Active commuting (AC; walking and biking to work) is associated with a number of positive health outcomes, low participation remains low in the USA. Our objective was to examine the multi-level influences on AC considering social determinants of health: race/ethnicity, income level and location.

Methods

We conducted a cross-sectional survey examining correlates of AC in the Mid-Atlantic region of the United States. The sample consisted of 1,310 adults over the age of 18 who were employed part- or full-time outside of the home and physically able to walk and bike. One-way ANOVAs, t-tests, and Pearson correlation analyses were run to examine the relationship between AC and influences based on the Social Ecological Model for each of the different groups (non/metro, higher/lower-income, white/black/other).

Results

There was not a significant difference in active commuting for higher income participants compared to lower income participants. Among both low and high income individuals, males were more likely to AC than females. Metro participants reported significantly more AC trips compared to non-metro participants. Blacks were least likely to AC, followed by whites, with all other racial/ethnic groups having the highest rates of AC. Variables from multiple levels were significant influencers on AC in each population.

Conclusion

The findings from this study provide insight into the multi-level influences of AC in a variety of diverse population that are often at higher risk for diseases associated with physical inactivity and obesity. This information is useful in providing a foundation for future multi-level approaches targeting AC identifying populations with which to implement AC.

Keywords

Active Commuting; Physical Activity; Diverse Populations; Travel Mode

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An Examination of Active Commuting by Race/Ethnicity, Income and Location

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ABSTRACT

Introduction: Active commuting (AC; walking and biking to work) is associated with a number of positive health outcomes, though participation remains low in the US. Our objective was to examine the multi-level influences on AC considering social determinants of health: race/ethnicity, income level and residential location.

Methods: We conducted a cross-sectional survey examining correlates of AC in the Mid-Atlantic region of the United States. The sample consisted of 1,310 adults over the age of 18 who were employed part- or full-time outside of the home and physically able to walk and bike. One-way ANOVAs, t-tests, and Pearson correlation analyses were run to examine the relationship between AC and influences based on the Social Ecological Model for each of the different groups (non/metro, higher/lower-income, white/black/other).

Results: There was not a significant difference in AC for higher income participants compared to lower income participants. Among both low and high income individuals, males were more likely to AC than females. Metro participants reported significantly more AC trips compared to non-metro participants. Blacks were least likely to AC, followed by whites, with all other racial/ethnic groups having the highest rates of AC. Variables from multiple levels were significant influencers on AC in each population.

Conclusion: The findings from this study provide insight into the multi-level influences of AC in a variety of population groups that are often at higher risk for diseases associated with physical inactivity and obesity. This information is useful in providing a foundation for future multi-level approaches targeting AC identifying populations with which to implement AC interventions.

Keywords: Active Commuting, Physical Activity, Diverse Populations, Travel Mode

INTRODUCTION

Physical activity (PA) is beneficial for preventing numerous non-communicable and largely preventable diseases including obesity, mental health disorders, certain cancers, cardio-metabolic disorders, and all-cause mortality (United States Department of Health and Human Services, 2008). Still, less than half of U.S. adults engage in the recommended levels of PA resulting in hundreds of billions of dollars lost annually in health-related productivity costs (American Heart Association, 2013).

Active commuting (AC; i.e., walking and biking to the workplace) is an alternate form of transportation emphasizing PA with well-documented and widespread benefits. In the U.S. rates of AC are exceedingly low, with 9% of trips taken by walking, 2% by public transit, and only 1% by bicycle (Alliance for Biking & Walking, 2016). Moreover, some populations (i.e., minorities and low-income populations) are largely less active than the general population, and disproportionately burdened by lifestyle-related chronic disease (Bodenheimer, Chen, & Bennett, 2009; Office of Minority Health, 2010). Thus, AC may be a valuable method to increase current PA levels and target inactivity-related chronic disease. Current research in the U.S. and worldwide shows that while leisure time PA rates are low in minority and low-income populations, these underserved populations tend to have higher rates of occupational and transportation related PA (Freeman et al., 2013; Panter, Jones, & van Sluijs, 2008; Whitfield, Paul, & Wendel, 2015). Nevertheless, while transportation and occupational PA are higher among these populations, there still remains a substantial difference in overall levels of PA.

Several studies have examined a range of influences on AC. Although extensive work has looked at demographic trends with AC (Whitfield et al., 2015), as well as the role of the physical environment (Sallis et al., 2015), less research has examined influences on AC participation, especially in subgroups of the population. Ogilvie and colleagues (2008) examined personal and environmental correlates of AC in a deprived urban population and concluded that environmental characteristics (excluding access to local amenities) had limited influence on AC in urban populations who tend not to have access to cars and thus fewer travel choice options. Previous studies have documented how low income and ethnically diverse communities/neighborhoods often have less resources to support PA and AC through programming, access to parks, or infrastructure to support walking and biking (Brazdova et al., 2015; Floyd, Taylor, & Whitt-Glover, 2009; Lovasi, Hutson, Guerra, & Neckerman, 2009; Taylor, Baranowski, & Young, 1998; Taylor, Floyd, Whitt-Glover, & Brooks, 2007). Despite these findings, there is limited evidence examining the factors that impact AC in population sub-groups. Thus, the purpose of this study is to examine multi-level influences on AC while considering race/ethnicity, income level, and location of residence.

METHODS

Design

This was a cross-sectional online survey (Qualtrics software Provo, UT) examining correlates of travel choice in adults from June to December 2011. The Institutional Review Board at Pennsylvania State University approved this study. Participants were presented with an informed consent statement at the launch of the survey. Measures of influences on the outcome variable (commuting patterns to or from work) were based on the SEM and the Theory of Planned Behavior (Ajzen, 1991; McLeroy, Bibeau, Steckler, & Glanz, 1988). The SEM allows for a comprehensive

examination of the factors that could impact AC, including individual, interpersonal, institutional, community and environment and has relevant evidence to support its use in examining active transportation Sallis et al., 2006; Sallis et al., 2015). The Theory of Planned Behavior focuses on the individual level factors of attitudes and beliefs.

Settings and Population

Recruitment for this survey took place primarily in the mid-Atlantic United States (DE, MD, NJ, OH, PA, WV) due to the proximity to the institution where the study was conducted. Using state-level data on industry, large employers in each state were targeted for recruitment, including school districts, healthcare systems, manufacturing companies, and government agencies. Individuals were eligible to participate in the study if they were over the age of 18, employed part- or full-time outside of the home, and physically able to walk and bike. The details of recruitment and response are outlined elsewhere (Bopp, Kaczynski, & Campbell, 2013).

Measurement

Travel Habits: Participants reported number of trips/week taken to and from work by walking, biking, driving, and public transit (PT). Number of walking and biking trips was summed for AC trips/week.

Individual level

Demographics: Participants reported their age, sex, racial/ethnic group, marital status, number of children, income level, and perceived health status (5-point Likert scale). Participants were dichotomized into those with higher income (HI; above 200% of the federal poverty line based on income level and family size) and lower income (LI; below 200% of the federal poverty line). Participants reported their zip code, which was coded by county and then using the US Department of Agriculture's Rural Urban Continuum (RUC) Codes were dichotomized into living in metro (RUC codes 1-3) or non-metro areas (4-9) (U.S. Department of Agriculture, 2013). Race was divided into white, black, and other, which included Hispanics of any race, Asian Americans, American Indians, Alaska Natives and those reporting multiple racial/ethnic backgrounds. Height and weight were reported from which body mass index was calculated.

Self-efficacy: Participant's confidence with their cycling skills in urban areas was assessed with a single item using a 4-point Likert scale (1=not at all confident to 4=very confident).

AC behavioral beliefs: Respondents used a 7-point Likert scale to indicate their agreement (1=completely disagree to 7=completely agree) with 13 statements about AC related to physical or mental health and other AC benefits, which was summed across all 13 items. This measure was adapted from another scale and demonstrated excellent reliability in the present study (α=0.91) (Conn, Tripp-Reimer, & Maas, 2003).

Perceived behavioral control for AC: Participants indicated their agreement using a 7-point Likert scale (1=completely disagree to 7=completely agree) with six statements about why AC is difficult (Conn et al., 2003). A total score was computed for the six items, and the scale showed good reliability (α=0.84).

Interpersonal level

Coworker and spouse AC behavior: Participants responded with using a 5-point Likert scale (1=strongly disagree to 5=strongly agree) to a question about their coworkers' AC behavior:

"Most of my coworkers walk or bike to/from work." Participants reported the number of times/week their spouse walked or biked to/from work, which was summed.

Institutional level

Worksite related: Participants were asked to report (yes/no) the number of employer supports for AC, which were summed and the perceived support of their employer for AC was assessed with a single item using a 5-point Likert scale.

Community level

Community factors: Participants reported perceived community support for AC with 5-items addressing support for bikers/pedestrians, norms around AC, maintenance of infrastructure for AC, perceived pedestrian and bicycle friendliness for AC using a 5-point Likert scale, which was summed. Perceived walk time to work was assessed and dichotomized into less than/greater than 20 minutes.

Environmental level

Barriers: Individuals used a 5-item scale to rate the extent to which they perceived the following environmental features as barriers to AC: lack of on street bike lanes, lack of off street walking and biking paths, lack of sidewalks, speed and volume of traffic along route, perceived crime along route, difficult terrain, and bad weather.

Statistical Analyses

Descriptive statistics were used to describe the sample. One-way ANOVAs, t-tests, and Pearson correlation analyses were run to examine the relationship between AC and influences based on the SEM for each of the different groups (non/metro, higher/lower-income, white/black/other). All analyses were performed using IBM SPSS version 22.0 (Aramonk, NY). Significance values were set at $p < 0.05$.

RESULTS

Characteristics of the sample (n=1310) are provided by group in Table 1. Participants were primarily white (92.1%), married (75.8%), female (68.3%), middle-aged (43.76±11.44 years), overweight (26.22±5.49 kg/m^2), and highly educated with higher incomes. On average, participants reported 1.3±3.1 AC trips/week. Differences in AC for categorical variables are presented in Table 2. Correlations with AC for continuous variables are presented in Table 3.

Table 1. Characteristics of the Sample (n=1310).

	Income				Location				Race/ethnicity					
	Below 200% FPL (n=78)		Above 200% FPL (n=910)		Metro (n=902)		Non Metro (n=81)		White (n=941)		Black (n=33)		Other (n=48)	
Variable	**n (%)**	**Mean (SD)**	**n (%)**	**Mean (SD)**	**n (%)**	**Mean (SD)**	**n (%)**	**Mean (SD)**	**n (%)**	**Mean (SD)**	**n (%)**	**Mean (SD)**	**n (%)**	**Mean (SD)**
Individual level														
Age		40.89 (10.52)		43.68 (11.44)*		43.64 (11.52)		45.90 (10.42)		43.80 (11.46)		45.58 (9.11)		40.00 (12.49)
Sex														
Male	22 (28.6)		55 (71.4)		295 (32.8)		14 (17.5)		297 (31.7)		9 (27.3)		16 (33.3)	
Female					304 (67.2)		66 (82.5)**		640 (68.3)		24 (72.7)		32 (66.7)	
Marital Status (% Married/partnered)														
Married/partnered	53 (67.9)		682 (75)		675 (75)		60 (74.1)		711 (75.8)		20 (60.6)		33 (68.6)	
Single, divorced, widowed	25 (32.1)		227 (25)		225 (25)		21 (25.9)		227 (24.2)		13 (39.4)		15 (31.3)	
Race/ethnicity														
Non-Hispanic White	72 (92.3)		825 (91.8)		815 (91.6)		79 (97.5)							
Non-Hispanic Black	6 (7.7)		26 (2.9)		30 (3.4)		1 (1.2)							
All other racial/ethnic groups	0		48 (5.3)**		45 (5.1)		1 (1.2)							
Number of children		1.49 (1.17)		0.44 (0.76)***		0.52 (0.85)		0.51 (0.85)						
Income level														
Below 200% FPL					69 (7.9)		5 (6.5)		72 (8)		6 (18.8)		0	
Above 200% FPL					800 (92.1)		72 (93.5)		825 (92)		26 (81.3)		48 (100)*	
Education level														
High school graduate, some college	23 (29.5)		133 (14.7)		136 (15.2)		18 (22.2)		149 (15.9)		8 (24.2)		7 (14.6)	
College degree or higher	55 (70.5)		773 (85.3)***		761 (84.8)		63 (77.8)		789 (84.1)		25 (75.8)		41 (85.4)	

Body Mass Index (kg/m^2)		26.50 (5.50)		26.28 (5.47)		26.17 (5.32)		27.52 (6.22)*		26.1 (5.40)		29.79 (5.37)		25.20 (5.33) ***
Number of reported chronic diseases		0.65 (1.02)		0.83 (1.08)		0.81 (1.07)		0.86 (1.10)		0.80 (1.05)		1.06 (1.11)		0.81 (1.51)
Number of cars in the household										3.05 (0.92)		2.94 (0.96)		2.54 (1.07)**
Employment level (% employed full time)														
Employed full time	61 (78.2)		856 (94.6)		835 (93)		79 (97.5)		874 (93.4)		32 (97)		43 (89.6)	
employed part time	17 (21.8)		49 (5.4)***		63 (7.0)		2 (2.5)		62 (6.6)		1 (3)		5 (10.4)	
Perceived health status (range 1-5)		3.44 (0.85)		3.70 (0.80)**		3.69 (0.80)		3.44 (0.82)**		3.69 (0.80)		3.34 (0.79)		3.70 (0.88)
Self efficacy for bicycling skills (range:1-4)		3.00 (1.03)		2.90 (1.09)		2.92 (1.09)		3.00 (1.00)		2.93 (1.06)		2.35 (1.34)		2.97 (1.15)
AC health behavioral beliefs score (range:13-91)		43.18 (7.11)		44.15 (7.97)		44.17 (7.75)		43.16 (10.07)		44.81 (7.95)		43.97 (6.96)		42.15 (8.32)
Perceived behavioral control for AC (range: 7-42)		20.94 (7.23)		20.77 (8.45)		20.93 (8.39)		19.04 (7.89)		20.51 (8.14)		22.03 (7.93)		24.34 (10.72) **
AC trips to work times/week		0.98 (2.55)		1.65 (3.46)		1.69 (3.49)		0.25 (1.32)***		1.45 (3.26)		0.76 (2.61)		4.06 (4.88)**
Driving to work times/week		8.46 (3.22)		7.85 (3.76)		7.81 (3.79)		9.15 (2.36)**		8.07 (3.58)		8.54 (3.75)		5.22 (4.73)***
Public transit trips/week		0.55 (1.74)		0.66 (2.05)		0.73 (2.17)		0.02 (0.22)**		0.58 (1.91)		1.21 (3.16)		1.60 (3.17)**
Interpersonal level														
Spouse AC (times/week)		0.70 (2.36)		0.99 (2.73)		1.06 (2.81)		0.25 (1.71)		0.95 (2.96)		0.31 (1.25)		2.27 (4.19)*
Perceived coworker AC (range:1-5)		1.59 (0.98)		1.49 (0.78)		1.51 (0.79)		1.38 (0.62)		1.49 (0.76)		1.45 (0.79)		1.79 (1.07)*
Institutional level														
Number of employer supports for AC (range: 0-7)		1.65 (1.77)		2.14 (1.71)*		2.14 (1.71)		1.44 (1.58)***		2.09 (1.70)		2.00 (1.90)		1.47 (1.87)

Perceived employer support for AC (range: 1-5)	2.27 (1.32)	2.48 (1.32)	2.48 (1.31)	1.91 (1.23)***	2.43 (1.31)	2.28 (1.33)	2.81 (1.35)
Community level							
Perceived community support for AC (range: 5-25)	15.32 (4.61)	16.18 (4.95)	16.23 (4.84)	14.08 (5.82)***	16.04 (4.95)	17.76 (3.91)	16.26 (5.23)
Perceived pedestrian friendliness for AC (range: 1-5)	3.08 (1.36)	3.36 (1.29)	3.39 (1.28)	2.73 (1.33)***	3.31 (1.31)	3.79 (0.96)	3.67 (1.14)*
Perceive bicycle friendliness for AC (range: 1-5)	2.95 (1.36)	3.16 (1.24)	3.19 (1.23)	2.49 (1.23)***	3.13 (1.27)	3.55 (1.09)	3.17 (1.06)
Perceived distance to work							
Less than 20 minute walk	2 (2.9)	103 (12.5)	97 (11.8)	4 (11.4)	94 (11)	4 (14.8)	9 (23.1)
Greater than 20 minute walk	67 (97.1)	722 (87.5)*	725 (88.2)	62 (93.9)	761 (89)	23 (85.2)	30 (76.9)
Environment level (range 1-5)							
Lack of on street bike lanes	3.41 (1.63)	2.91 (1.58)*	2.95 (1.57)	3.14 (1.81)	3.00 (1.59)	2.33 (1.52)	2.34 (1.54)**
Lack of off street walking/biking paths	3.34 (1.65)	2.97 (1.59)	3.00 (1.58)	3.22 (1.79)	3.05 (1.59)	2.43 (1.52)	2.51 (1.59)*
Lack of sidewalks	3.28 (1.73)	2.90 (1.61)	2.92 (1.60)	3.20 (1.77)	2.95 (1.61)	2.47 (1.59)	2.78 (1.72)
Speed and volume of traffic along route	3.47 (1.61)	3.28 (1.54)	3.30 (1.54)	3.21 (1.68)	3.30 (1.55)	3.00 (1.67)	3.29 (1.48)
Perceived crime along route	2.20 (1.41)	2.10 (1.36)	2.10 (1.36)	2.28 (1.49)	2.06 (1.33)	2.81 (1.76)	2.37 (1.42)**
Difficult terrain	2.94 (1.54)	2.91 (1.50)	2.87 (1.48)	3.30 (1.62)*	2.92 (1.50)	2.42 (1.48)	2.67 (1.56)
Bad weather	3.73 (1.27)	3.50 (1.40)	3.53 (1.38)	3.43 (1.62)	3.52 (1.39)	2.86 (1.64)	3.67 (1.39)*

Note AC: active commuting, FPL: Federal poverty line
Note: * p<.05, **p<.01, ***p<.001

Table 2. Differences in AC for Categorical Variables (n=1310)

	Income				Location				Race/ethnicity					
	Below 200% FPL (n=78)		Above 200% FPL (n=910)		Metro (n=902)		Non Metro (n=81)		White (n=941)		Black (n=33)		Other (n=48)	
Variable	**Mean (SD)**	**t or F**	**Mean (SD)**	**t or F**	**Mean (SD)**	**t or F**	**Mean (SD)**	**t or F**	**Mean (SD)**	**t or F**	**Mean (SD)**	**t or F**	**Mean (SD)**	**t or F**
Individual level														
Sex		2.93**		5.89***		6.13***		1.55		5.67***		3.06**		1.73
Male	2.24 (3.67)		2.61 (4.04)		2.70 (4.09)		0.71 (2.67)		2.33 (3.91)		2.78 (4.58)		5.75 (4.72)	
Female	0.43 (1.71)		1.19 (3.04)		1.21 (3.04)		0.12 (0.77)		1.05 (2.83)		0		3.22 (4.81)	
Marital Status (% Married/partnered)		0.63		3.06**		2.83**		2.12*		2.41***		0.15		0.9
Married/partnered	1.11 (2.86)		1.45 (3.27)		1.51 (3.33)		0.07 (0.36)		1.32 (3.14)		0.70 (2.36)		3.63 (4.59)	
Single, divorced, widowed	0.72 (1.72)		2.26 (3.90)		2.27 (3.87)		0.76 (2.48)		1.92 (3.56)		0.85 (3.05)		5.00 (5.52)	
Race/ethnicity		0.46		13.70***		14.57***		0.03						
Non-Hispanic White	0.93 (2.41)		1.54 (3.34)[a]		1.58 (3.37)[a]		0.25 (0.15)							
Non-Hispanic Black	1.67 (4.08)		0.57 (2.26)[b]		0.83 (2.73)[b]		0							
All other racial/ethnic groups	0		4.06 (4.88)[a, b]		4.33 (4.92)[a, b]		0							
Income level						1.89		0.4		-1.52		0.91		
Below 200% FPL					0.97 (2.46)		0		0.93 (2.42)		1.67 (4.08)		0	
Above 200% FPL					1.80 (3.58)		0.25 (1.38)		1.54 (3.34)		0.57 (2.67)		0	
Community level														
Perceived distance to work		0.53		5.53***		5.59***		3.44**		5.16***		3.85**		0.85
Less than 20 minute walk	0		3.51 (4.26)		3.63 (4.36)		2.55 (5.00)		3.19 (4.20)		3.75 (5.19)		6.44 (5.07)	
Greater than 20 minute walk	0.94 (2.47)		1.48 (3.35)		1.52 (3.37)		0.13 (0.80)		1.33(3.16)		0		3.90 (5.00)	

Table 3. Correlations with AC for Continuous Variables (n=1310)

	Income				Location				Race/ethnicity					
	Below 200% FPL (n=78)		Above 200% FPL (n=910)		Metro (n=902)		Non Metro (n=81)		White (n=941)		Black (n=33)		Other (n=48)	
Variable	**r**	**p value**	**r**	**p value**	**r**	**p value**	**r**	**p value**	**r**	**p value**	**r**	**p value**	**r**	**p value**
Individual level														
Age	-0.25	0.03	-0.29	<.001	-0.3	<.001	0.19	0.09	-0.26	<.001	-0.13	0.49	-0.57	<.001
Body Mass Index (kg/m^2)	-0.16	0.17	-0.19	<.001	-0.17	<.001	-0.11	0.34	-0.17	<.001	-0.15	0.42	-0.36	0.01
Number of cars in the household	-0.27	0.02	-0.37	<.001	-0.37	<.001	-0.19	0.08	-0.34	<.001	-0.11	0.56	-0.58	<.001
Perceived health status (range 1-5)	0.06	0.62	0.19	<.001	0.18	<.001	0.04	0.75	0.19	<.001	-0.23	0.21	0.45	<.001
Interpersonal level														
Spouse AC (times/week)	0.65	<.001	0.53	<.001	0.55	<.001	-0.3	0.84	0.52	<.001	-0.07	0.81	0.66	<.001
Perceived coworker AC (range:1-5)	0.29	0.01	0.32	<.001	0.33	<.001	0.16	0.16	0.32	<.001	0.19	0.14	0.32	0.01
Institutional level														
Number of employer supports for AC (range: 0-7)	0.18	0.11	0.25	<.001	0.25	<.001	-0.03	0.83	0.24	<.001	0.19	0.29	0.4	0.01
Perceived employer support for AC (range: 1-5)	0.28	0.01	0.27	<.001	0.27	<.001	0.15	0.17	0.28	<.001	0.14	0.45	0.21	0.16
Community level														
Perceived community support for AC (range: 5-25)	0.22	0.05	0.1	0.003	0.11	0.001	0.04	0.7	0.09	0.01	0.24	0.18	0.32	0.03
Perceived pedestrian friendliness for AC (range: 1-5)	0.2	0.08	0.18	<.001	0.18	<.001	-0.06	0.59	0.18	<.001	0.13	0.48	0.28	0.05
Perceived bicycle friendliness for AC (range: 1-5)	0.19	0.08	0.16	<.001	0.16	<.001	-0.01	0.9	0.17	<.001	0.06	0.75	0.18	0.21
Environment level (range 1-5)														
Lack of on street bike lanes	-0.39	0.001	-0.31	<.001	-0.33	<.001	-0.06	0.62	-0.3	<.001	-0.24	0.19	-0.29	0.08
Lack of off street walking/biking paths	-0.41	<.001	-0.34	<.001	-0.35	<.001	-0.07	0.57	-0.33	<.001	-0.2	0.3	-0.29	0.08
Lack of sidewalks	-0.44	<.001	-0.31	<.001	-0.33	<.001	-0.07	0.58	-0.31	<.001	-0.29	0.12	-0.37	0.03
Speed and volume of traffic along route	-0.18	0.14	-0.27	<.001	-0.28	<.001	-0.07	0.55	-0.26	<.001	-0.06	0.75	-0.32	0.05
Perceived crime along route	-0.28	0.03	-0.1	0.01	-0.11	0.004	-0.01	0.95	-0.1	0.01	-0.32	0.08	-0.17	0.32
Difficult terrain	-0.22	0.07	-0.28	<.001	-0.28	<.001	-0.09	0.48	-0.27	<.001	-0.21	0.25	-0.31	0.06
Bad weather	-0.25	0.04	-0.17	<.001	-0.19	<.001	0.04	0.74	-0.17	<.001	-0.27	0.15	-0.23	0.15

Note AC: active commuting, FPL: Federal poverty line, * p<.05, **p<.01, ***p<.001

Travel Mode Choice and Influences by Income

There was not a significant difference in active commuting for HI compared to LI participants. There were no significant differences in driving or PT trips on the basis of income. Among both LI and HI individuals, males were more significantly more likely to AC than females. Among HI individuals, those who were single, those reporting living closer to work, and those in other racial/ethnic minority groups were more likely to AC. For LI individuals, positively correlated variables with AC included spousal AC, perceived coworker AC, perceived employer AC supports, and perceived community AC support. Variables negatively correlated with AC include age, number of cars in the household, lack of on street bike lanes, lack of off street walking/bicycling paths, lack of sidewalks, perceived crime along the route, and bad weather. For HI individuals, positively correlated variables include perceived health status, spousal AC, perceived coworker AC, number of employer supports for AC, perceived employer support for AC, and all community level variables. All other variables (age, number of cars and environmental barriers) were negatively correlated.

Travel Mode Choice and Influences by Location

Metro participants reported significantly more AC trips compared to non-metro participants. Metro participants were less likely to drive than those in non-metro areas. Non-metro participants were significantly less likely to take PT than metro participants. Among metro participants, males were more likely to AC than females and those who were single, those reporting living closer to work, and those identifying as being in other racial/ethnic minority groups were more likely to AC. For metro individuals, all continuous variables were significantly correlated with AC. Perceived health status, spousal AC, perceived coworker AC, number of employer supports for AC, perceived employer support for AC, and all community level variables were positively correlated with AC. All other variables (age, BMI, number of cards, perceived health status, environmental barriers) were negatively correlated. For non-metro individuals rates were higher among single individuals and those living closer to work. There were no significant correlations for non-metro individuals.

Travel Mode Choice and Influences by Race/Ethnic Group

Blacks were most likely to drive followed by whites and then all other racial groups. Blacks were least likely to AC, followed by whites, with all other racial/ethnic groups having the highest rates of AC. Those in other racial/ethnic minority groups used PT significantly more often than likely than blacks and whites. Among whites and blacks, males were more likely to AC than females. Among whites, single participants and those reporting living closer to work were more likely to AC than their counterparts. Those living closer to work were also more likely to AC among blacks. The variables that were positively correlated for higher income and metro individuals were positively correlated for whites. For other racial/ethnic minority groups, perceived health status, spousal AC, perceived coworker AC, number of employer support for AC, perceived community support for AC, and perceived pedestrian friendliness for AC were positively correlated with AC. Negatively correlated variables for this group include all other individual and interpersonal level variables, lack of sidewalks, and speed and volume of traffic along the route.

DISCUSSION

This is one of the first studies to examine multi-level influences of AC by different racial/ethnic groups, income levels or residential location, factors which are associated with lower rates of PA and subsequently poorer health. Our analyses revealed no significant differences in AC patterns on the basis of income; however, results showed those in non-metro areas (e.g., rural areas) were less likely to AC than those living in metro areas. Moreover, those in other racial/ethnic minority groups were more likely to AC than their white and black counterparts. We found that variables within each level of the SEM provided some level of influence on AC in these sub-populations that often differed from AC influences in the general population. Parallel to our results, Pucher, Buehler, Merom, and Bauman (2011) examined rates of walking and cycling in the U.S. They found that walking and biking were greater among those with higher education and that those in rural areas were less likely to walk and bike. Additionally, Bopp, Kaczynski, and Besenyi (2012) examined influences on AC to work among adults and found similar rates of walking between whites and minorities, but greater rates of bicycling among minorities and greater rates of driving among whites.

At the individual level of the SEM, results showed males were significantly more likely to AC than females for all groups except those living in non-metro areas and those in other racial/ethnic minority groups. Multiple studies have examined the differences in rates of AC by gender and found that males consistently AC more than females (Bopp et al., 2012; Bopp et al., 2013; Edmond, Tang, & Handy, 2009; Heesch & Sahlqvist, 2013; Heinen, Van Wee, & Maat, 2010; Pucher, Buehler, & Seinen, 2011; Twaddle, Hall, & Bracic, 2010; Whitfield, Paul, & Wendel, 2015). Alternatively, Abel, Graf, and Niemann (2001) coined the term "gender bias" which postulates than men are more likely to participate in exercise, physical activity, and sporting behaviors while women are more likely to participate in transportation-based PA. Furthermore, women may have lower self-efficacy for certain types of AC (i.e., bicycling). While our data showed no differences for bicycling SE or AC health behavioral beliefs, we did see that those in other/ethnic minority groups had significantly higher perceived behavioral control for AC, which may explain the higher rates of AC in this group. These attitudes and beliefs could serve as the target of a behavior-change intervention specifically targeting women.

Of HI individuals, those in all other racial/ethnic groups were more likely than whites and blacks to AC. This may relate to access to resources (e.g., having a car, living in metro areas). Research shows that younger individuals have higher rates of AC compared to older individuals (2011). Altogether, results from our individual level analyses suggest that certain populations and subgroups of the population are deserving of tailored approaches through targeted intervention strategies.

At the interpersonal level, spousal AC and perceived coworker AC were significantly correlated with AC rates for those in metro areas, in whites and those in other racial/ethnic minority groups, despite income level. The strong influence of social support and social dynamics on PA and AC is well documented in the literature (Guell, Panter, Jones, & Ogilvie, 2012; Simons et al., 2013). Social support networks are an effective and recommended intervention strategy for changing PA behavior. Bopp, Kaczynski, and Campbell (2013) suggested that other community-level strategies could be translated to social-support based AC interventions, however, current research is limited among interventions specifically targeting spousal or coworker support. Further investigation is warranted into social and cultural norms surrounding AC.

At the institutional level, HI individuals and those in non-metro areas were more likely to more employer supports for AC. Number of employer supports for AC was moderately correlated with AC in HI individuals, individuals living in metro areas, whites, and those in other racial/ethnic minority groups. Perceived employer support for AC was moderately correlated with AC in both HI and LI individuals, those living in metro areas, and whites. Kaczynski, Bopp, and Wittman (2010) examined the association of workplace supports with AC and found the presence of both physical and cultural supports in the workplace is related to more AC behaviors, especially among women. This, however, does not explain the low rates of AC among non-metro participants in the present study. These interpersonal and institutional level results suggest that in order to improve rates of AC among various populations, social support and cultural norm constructs toward AC should be targeted to see improvement in rates of AC.

At the community level, a greater percent of LI individuals as compared to HI individuals perceived living more than a 20 minute walk from work (roughly the equivalent of one mile), resulting in a greater likelihood for the presence of certain AC barriers. This variable was a significant influence on AC for all populations with the exception of LI individuals and those in other racial/ethnic groups. Previous research shows that living closer to an individual's destination increases the likelihood that they will actively commute (Shannon et al., 2006). The lack of significance found in LI individuals and those in other racial/ethnic minority groups may be because despite their location, AC may be their main form of travel due because of its low-cost nature.

Perceived pedestrian and bicycle friendliness and perceived community supports for AC were higher among metro participants compared to non-metro participants, which may explain higher rates of AC among metro participants. Perceived community supports for AC were significantly correlated with AC for all populations with the exception of those living in non-metro areas and blacks. Community supports for AC may not relate to AC in these populations simply because rates of AC are so low. Despite the lack of influence of community supports for AC in these underserved populations, other research has suggested that low-income and ethnically diverse communities tend to have poor AC infrastructure (Ogilvie et al., 2008). Improving this infrastructure and environmental accommodations may result in even higher rates of AC among these groups. Rodriguez and Joo (2004) showed that aspects of the physical environment (i.e., sidewalk availability, residential density, presence of walking and bicycling paths, topography) were significant in explaining travel mode choice beyond traditional travel decision criteria (e.g., time). Further studies in adults and children agree with these results as it relates to PA (Humpel, Owen, & Leslie, 2002; Sallis, Prochaska, & Taylor, 2000).

At the environmental level, lower income individuals were more likely to cite lack of on street bike paths and non-metro participants were more likely to cite difficult terrain as impacting travel mode choice. This may explain the higher AC rates among HI individuals compared to lower income individuals. Those in other racial/ethnic minority groups were less likely to cite lack of on street bike paths and lack of off street walking/bike paths, which may also explain their higher rates of AC. However, those in the same group were more likely to cite perceived crime along their route and bad weather as influencing their travel mode choice. When results were examined within each group they revealed that environmental influences were extremely important for HI individuals, those living in metro areas, and whites with each variable being significantly correlated with AC. In LI participants, all environmental factors besides speed and volume of

traffic along the route and difficult terrain were correlated with AC. In terms of race, for other racial/ethnic minority groups, lack of sidewalks and speed and volume of traffic along the route were the only significant correlations with AC. Taylor et al. (YEAR) examined the relationship between environmental justice, obesity, and PA and found that underserved populations have considerable environmental challenges to overcome (i.e., environmental barriers) to be physically active. By addressing these community level and environmental justice disparities we may be able to see drastic improvements in PA and AC in underserved groups. Additionally, policy level tactics like improving urban design and implementing mixed-land use zoning within communities may result in further improvements in rates of AC.

The examination of AC behavior for different sub-groups of the population provides valuable insight for practitioners interested in providing education and encouragement to promote walking and biking to work. By considering factors at the individual, interpersonal, institutional, community and environmental levels, there are many targetable influences on AC participation for different groups. These influences can inform intervention strategies, environmental or policy changes and have the potential for shifts in population-level AC participation and can be guided using tools outlined by entities such as the Task Force for Community Preventive Services, Complete Streets, or the League of American Bicyclists' Bicycle Friendly America campaign (League of American Bicyclists, 2013; Smart Growth America & Coalition, 2016; Task Force on Community Preventive Services, 2002). These approaches can be tailored to meet the needs and influences for the sub-populations outlined in the current study.

Despite the implications of the findings presented here, this study is not without limitations. The cross-sectional design, convenience sample, and use of self-report measures limit the generalizability of the data, the ability to interpret the data, and the ability to make causal connections. Also, this study was geographically limited which may present some challenges when considering factors such as weather or seasonality. Further studies should attempt to use more objective forms of assessing travel habits, including using accelerometers or travel diaries as well as using stronger study designs with a broader geographic area.

Perhaps the greatest limitation of the current study is the lack of diversity within the sample and the merging of multiple racial groups into a single "other" category further limited generalizability. The sample was also highly educated with a high income, limiting our interpretation of the findings. This methodological challenge significantly limits the ability to extrapolate our results to a larger population considering race/ethnicity, income level and residential location. Further research in this area should work to target more diverse participants through partnerships with community organizations, local government, employers and groups that serve these populations. This would allow for recruitment of a much more diverse sample to truly understand the influences on travel mode choice and the relationship with some of the social determinants of health.

CONCLUSION

These limitations notwithstanding, this study provides good insight into the multi-level influences on AC in a wide range of populations. The findings from this study provide a foundation for future multi-level approaches targeting AC as our results offer information on a variety of multifaceted influences on AC behavior. Diverse and traditionally overlooked populations are often at higher risk for diseases associated with physical inactivity and obesity, thus, this

information is potentially useful in identifying populations with which to implement AC interventions.

REFERENCES

Abel, T., Graf, N., & Niemann, S. (2001). Gender bias in the assessment of physical activity in population studies. *Sozial-und Präventivmedizin, 46*, 268-272.

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes, 13*, 179-204.

Alliance for Biking & Walking. (2016). Bicycling and walking in the United States 2016 Benchmarking Report (pp. 198). Washington DC: Alliance for Biking & Walking.

American Heart Association. (2013). The Price of Inactivity. Retrieved from http://www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/FitnessBasics/The-Price-of-Inactivity_UCM_307974_Article.jsp

Bodenheimer, T., Chen, E., & Bennett, H. D. (2009). Confronting the growing burden of chronic disease: can the US health care workforce do the job? *Health Affairs, 28*, 64-74.

Bopp, M., Kaczynski, A. T., & Besenyi, G. (2012). Active commuting influences among adults. *Prev Med, 54*, 237-241. doi:S0091-7435(12)00037-0 [pii]10.1016/j.ypmed.2012.01.016

Bopp, M., Kaczynski, A. T., & Campbell, M. E. (2013). Social Ecological Influences on Work-Related Active Commuting Among Adults. *Am J Health Behav, 37*, 543-554.

Bopp, M., Kaczynski, A. T., & Wittman, P. (2011). Active commuting patterns at a large, midwestern college campus. *J Am Coll Health, 59*, 605-611. doi:10.1080/07448481.2010.518327

Brazdova, Z. D., Klimusova, H., Hruska, D., Prokopova, A., Burjanek, A., & Wulff, K. R. (2015). Assessment of Environmental Determinants of Physical Activity: a Study of Built Environment Indicators in Brno, Czech Republic. *Cent Eur J Public Health, 23 Suppl*, S23-29. doi:10.21101/ cejph.a4133

Conn, V. S., Tripp-Reimer, T., & Maas, M. L. (2003). Older women and exercise: theory of planned behavior beliefs. *Public Health Nurs, 20*, 153-163.

Edmond, C., Tang, W., & Handy, S. (2009). Explaining Gender Difference in Bicycling Behavior. *Transportation Research Record, 2125*, 16-25. doi:10.3141/2125-03

Floyd, M. F., Taylor, W. C., & Whitt-Glover, M. (2009). Measurement of park and recreation environments that support physical activity in low-income communities of color: highlights of challenges and recommendations. *Am J Prev Med, 36*(4 Suppl), S156-160. doi:S0749-3797(09)00017-8 [pii]10.1016/j.amepre.2009.01.009

Freeman, L., Neckerman, K., Schwartz-Soicher, O., Quinn, J., Richards, C., Bader, M. D., . . . Konty, K. (2013). Neighborhood walkability and active travel (walking and cycling) in New York City. *Journal of Urban Health, 90*(4), 575-585.

Guell, C., Panter, J., Jones, N. R., & Ogilvie, D. (2012). Towards a differentiated understanding of active travel behaviour: using social theory to explore everyday commuting. *Soc Sci Med, 75*, 233-239. doi:10.1016/j.socscimed.2012.01.038S0277-9536(12)00170-0 [pii]

Heesch, K. C., & Sahlqvist, S. (2013). Key influences on motivations for utility cycling (cycling for transport to and from places). *Health Promot J Austr, 24*, 227-233. doi:10.1071/HE13062

Heinen, E., Van Wee, B., & Maat, K. (2010). Commuting by Bicycle: An Overview of the Literature. *Transport Reviews, 30*, 59-96.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity. A review. *Am J Prev Med, 22*, 188-199.

Kaczynski, A. T., Bopp, M. J., & Wittman, P. (2010). Association of workplace supports with active commuting. *Prev Chronic Dis, 7*(6), A127. doi:A127 [pii]

League of American Bicyclists. (2013). Building A Bicycle Friendly America. Washington DC: League of American Bicyclists.

Lovasi, G. S., Hutson, M. A., Guerra, M., & Neckerman, K. M. (2009). Built environments and obesity in disadvantaged populations. *Epidemiol Rev, 31*, 7-20. doi:10.1093/epirev/mxp005

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15*, 351-377.

Office of Minority Health. (2010). The National Plan for Action: Changing Outcomes - Achieving Health Equity. Washington, DC: U.S. Department of Health and Human Services.

Ogilvie, D., Mitchell, R., Mutrie, N., Petticrew, M., & Platt, S. (2008). Personal and environmental correlates of active travel and physical activity in a deprived urban population. *Int J Behav Nutr Phys Act, 5*, 43. doi:1479-5868-5-43 [pii]10.1186/1479-5868-5-43

Panter, J. R., Jones, A. P., & van Sluijs, E. M. (2008). Environmental determinants of active travel in youth: A review and framework for future research. *International Journal of Behavioral Nutrition and Physical Activity, 5*, 34.

Pucher, J., Buehler, R., Merom, D., & Bauman, A. (2011). Walking and cycling in the United States, 2001-2009: evidence from the National Household Travel Surveys. *Am J Public Health, 101 Suppl 1*, S310-317. doi:AJPH.2010.300067 [pii]10.2105/AJPH.2010.300067

Pucher, J., Buehler, R., & Seinen, M. (2011). Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. *Transportation Research Part A: Policy and Practice, 45*, 451-475.

Rodríguez, D. A., & Joo, J. (2004). The relationship between non-motorized mode choice and the local physical environment. *Transportation Research Part D: Transport and Environment, 9*, 151-173.

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annu Rev Public Health, 27*, 297-322.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32*, 963-975.

Sallis, J. F., Spoon, C., Cavill, N., Engelberg, J. K., Gebel, K., Parker, M., . . . Ding, D. (2015). Co-benefits of designing communities for active living: an exploration of literature. *Int J Behav Nutr Phys Act, 12*, 30. doi:10.1186/s12966-015-0188-2

Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T., & Bull, F. (2006). Active commuting in a university setting: assessing commuting habits and potential for modal change. *Transport Policy, 13*, 240-253.

Simons, D., Clarys, P., De Bourdeaudhuij, I., de Geus, B., Vandelanotte, C., & Deforche, B. (2013). Factors influencing mode of transport in older adolescents: a qualitative study. *BMC Public Health, 13*, 323. doi:10.1186/1471-2458-13-3231471-2458-13-323 [pii]

Smart Growth America, & Coalition, N. C. S. (2016). The Best Complete Streets Policies of 2016. Washington DC: Smart Growth America.

Task Force on Community Preventive Services. (2002). Recommendations to increase physical activity in communities. *Am J Prev Med, 22*(4S), 67-72.

Taylor, W. C., Baranowski, T., & Young, D. R. (1998). Physical activity interventions in low-income, ethnic minority, and populations with disability. *Am J Prev Med, 15*, 334-343.

Taylor, W. C., Floyd, M. F., Whitt-Glover, M. C., & Brooks, J. (2007). Environmental justice: a framework for collaboration between the public health and parks and recreation fields to study disparities in physical activity. *J Phys Act Health, 4 (Suppl 1)*, S50-63.

Twaddle, H., Hall, F., & Bracic, B. (2010). Latent Bicycle Commuting Demand and Effects of Gender on Commuter Cycling and Accident Rates. *Transportation Research Record Journal of the Transportation Research Board, 2190*, 28-36.

U.S. Department of Agriculture. (2013). Rural-urban continuum codes Retrieved from http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/.

United States Department of Health and Human Services. (2008). Physical Activity Guidelines for Americans. Retrieved from http://www.health.gov/paguidelines/pdf/faq.pdf.

Whitfield, G. P., Paul, P., & Wendel, A. M. (2015). Active Transportation Surveillance - United States, 1999-2012. *MMWR Surveill Summ, 64*(7), 1-17. .