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Predictors and Patterns of Physical Activity From Transportation Among United States Youth, 2007-2016

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A B S T R A C T

Purpose: Physical activity is strongly associated with health benefits in youth, although wide disparities in physical activity persist across sex, race/ethnicity, and income. Active transportation is an important source of youth physical activity. We aimed to describe active transportation patterns for United States adolescents and young adults ages 12–25 years across sociodemographic and weight status characteristics.
Methods: Cross-sectional secondary data analyses were based on self-reported transportation-related physical activity using the National Health and Nutrition Examination Survey, 2007-2016.
Results: Of the sample (n = 8,680; population represented, N = 57,768,628), 4,300 (49.5%) were adolescents (12-17 y), and 4,380 (50.4%) were young adults (18-25 y). Male adolescents were more likely to participate in any (risk ratio [RR] = 1.3; 95% confidence interval [CI], 1.16-1.40) and daily (RR = 1.3; 95% CI, 1.06-1.63) active transportation than females. Black (RR = 1.1; 95% CI, 1.01-1.31) and Hispanic (RR = 1.2; 95% CI, 1.05-1.31) adolescents were more likely to engage in any active transportation than whites. Young adult males were more likely to participate in any (RR = 1.3; 95% CI, 1.20-1.50) and daily (RR = 1.3; 95% CI, 1.08-1.55) active transportation than females. Young adults with a lower family income, and both adolescents and young adults with a lower household education, were more likely to engage in any and daily active transportation. We also observed an inverse relationship between weight class and active transportation participation.
Conclusion: Active transportation was higher in males, minority, and lower income youth. Our study findings provide evidence for physical activity interventions, suggesting active transportation is a feasible target for low-income and minority youth to reduce physical activity disparities and support optimal health.

IMPLICATIONS AND CONTRIBUTION

Active transportation is an important physical activity source, although national youth active transportation patterns have not been reported. This study found that active transportation participation among youth was higher in males, minority and lower income youth, suggesting active transportation is a feasible target for reducing health disparities and promoting health.

Physical activity is strongly associated with health benefits in youth, including improved cardiovascular, musculoskeletal, socioemotional and mental health, and reduced risk of obesity, asthma, diabetes, and depression [1]. Developing healthy physical activity habits early in life reduces health disparities [2–5].

Conflicts of interest: The authors have no example conflicts of interest to disclose.

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However, the United States (US) is one of the lowest performing countries globally in youth physical activity attainment [6,7]. Notable declines in youth physical activity are observed in US youth with increasing age, particularly from adolescence to young adulthood, and wide disparities persist based on sex, race/ethnicity, and income [8]. For example, 49% of white youth ages 6–17 years old engage in at least 60 minutes of moderate-to-vigorous physical activity at least 5 days per week compared with just 42% of black and 45% of Hispanic youths [9]. Low-income youth are also less likely than higher income youth to participate in organized sports (70% vs. 88%) [9]. Low rates of moderate-to-vigorous physical activity in nonwhite and low-income youth predict significant disparities in youth health-related physical fitness by race and income [10].

Youth active transport, defined as walking or using a bicycle to get to and from places [7], is also in decline [11]. Active transportation is an important source of daily physical activity for youth and a significant contributor to routine youth physical activity and its associated health benefits [12,13]. Fifteen percent and 18% of total physical activity in US adolescent (12-19 y) males and females, respectively, is accounted for by active transportation [14]. Estimates from studies of European youth report similar estimates (15%–18%) of total physical activity attributable to commuting by biking and walking [15]. However, prior studies indicate that only 23% of 12- to 19-year-old US youth walk or bike at least 10 minutes continuously 5–7 days per week for transportation [7]. Also, Hispanic (28%) and non-Hispanic black (16%) youth have the highest rates of active transportation to school, compared with white youth (9%) [16], indicating that fostering safe and accessible opportunities for youth to engage in active transportation may be leveraged to reduce physical activity barriers and related health disparities [17,18].

Areas with a high proportion of minority and low-income residents, however, have low access to physical activity recreation, neighborhood walkability, and safe/well maintained active transportation routes [19,20]. In light of recent calls directed at health professionals to guide programs and policies that promote active transportation to reduce disparities [21], population-level prevalence and individual-level predictors of active transportation in US youth are needed. This study therefore aimed to describe active transportation patterns for US adolescents and young adults ages 12–25 years across individual-level sociodemographic and weight status characteristics.

Methods

Population

We drew data from years 2007–2016 of the National Health and Nutrition Examination Survey (NHANES; n = 8,680; population represented, N = 57,768,628). These years included consistent questions about physical activity for transportation in the adolescent and young adult population. NHANES is a multistage probability sample of the noninstitutionalized United States population and allows estimates that represent the US population. NHANES includes several components; here, we use the physical examination and the in-home interview. NHANES is described in detail elsewhere [22]. We included adolescents and young adults aged 12-25 who responded to questions regarding transportation-related physical activity. This study was approved by the Duke Health Institutional Review Board.

Measures

Main outcomes. The two main outcomes included participation in any and daily transportation-related physical activity. Physical activity is measured based on self-report. Questions were asked of adolescents 12–15 years during the physical examination, without parent assistance. Those 16 years and older responded for themselves during the in-home interview. We used two questions focused on physical activity that occurs for transportation. First, individuals are asked:

The next questions exclude the physical activity at work that you have already mentioned. Now I would like to ask you about the usual way (you travel/SP travels) to and from places. For example to school, for shopping, to work. In a typical week (do you/does SP) walk or use a bicycle for at least 10 minutes continuously to get to and from places?

If the respondent indicates any activity for transportation, they are asked how many days in a typical week they walk or bicycle for at least 10 minutes continuously.

We categorized individuals as reporting any versus no transportation-related physical activity (e.g., "any active transportation", main outcome 1). Among those reporting any activity, we further assessed the number of days per week they engaged in transportation-related physical activity (e.g., "daily active transportation", categorized as 7 days per week, vs. <7 days per week, main outcome 2).

Independent variables. Race/ethnicity is based on self-report and classified as non-Hispanic white, non-Hispanic black, Hispanic, or other race/ethnicity. Income is classified based on the household's income as a ratio to the Federal Poverty Level (FPL), ranging from <100% of FPL to 500% FPL or greater. Age was categorized as adolescent (12–17 years) and young adult (18–25 years) to report findings across these age groups.

Education. For adolescents aged 12-17 years, we use two measures of education to account for both poverty status and peer influences at the school level. The first is the highest grade level of the household reference person, who is a person 18 years or older who owns or rents the dwelling unit. For adolescents, this is most commonly a parent or guardian. This is categorized as <ninth grade, high school without diploma, high school diploma, some college, and college graduate. Grade level also is included for adolescents as not high school (e.g., middle school) or high school (grades 9-12). This is primarily to capture the differences in the psychosocial factors, such as peer influences, of middle versus high school. For young adults aged 18-25 years, education represents their own education level, categorized as <ninth grade, high school without diploma, high school diploma, some college, and college graduate.

Weight status. Weight status was defined using measured height and weight to calculate body mass index (BMI) in kg/m^2. For 12- to 17-year-old participants, CDC growth charts [23] based on a historical reference population were used to define five categories: healthy weight, BMI% ≥10–<85; overweight, BMI% ≥85–<95; class I obesity, BMI% ≥95–<120th percent of the 95th BMI percentile [BMI95]), class II obesity, BMI% ≥120–<140th of BMI95, and class III obesity, BMI% ≥140th of BMI95. For those 18–25 years old, five corresponding categories were constructed: healthy weight, BMI ≥18.5–24.9 kg/m^2; overweight, 25.0–29.9;

and obesity classes I-III, defined respectively as BMI ≥30.0–34.9, 35.0–39.9, and ≥40 kg/m^2.

Season of sampling. Season of data collection was included to account for impact of seasonality on active transportation participation. Summer months were defined as May-October; non-summer months were defined as November-April.

Statistical approach

We present all results separately by age group (adolescent and young adult). We conducted bivariate analyses examining the association between the independent variables and the outcomes of any and daily active transportation, comparing differences using Pearson $\chi 2$ tests adjusted with the second-order Rao-Scott correction. We only provide the test of difference across all categories, but provide 95% confidence intervals to allow readers to consider more nuanced differences. Multivariable analyses were conducted on binary outcomes using generalized linear models with a log link to produce exponentiated coefficients (i.e., risk ratios). Model covariates included gender, race/ethnicity, weight status (i.e., healthy weight; overweight; and obesity class I, II, or III), parent education (12-17 y only), grade level (12-17 y only), participant education (18-25 y only), family income, and season of sampling. All analyses were adjusted for the complex survey design in the NHANES, including strata, primary sampling units, and probability weights, conducted using the svy commands in Stata, version 16 (StataCorp LLC). We considered 2-sided $p < .05$ to be statistically significant.

Results

Table 1 displays a description of the sample population for adolescents and young adults, and represents the US population of 12–25 year olds. The sample (n = 8,680) included 4,300 adolescents (12-17 y) and 4,380 young adults (18-25 y) who participated in NHANES and responded to questions about physical activity.

The percentage of individuals participating in any active transportation for both adolescents and young adults (Table 2) was higher among males, race/ethnicity minorities, and lower income participants. Among adolescents, engagement in any active transportation in a typical week was more common among Hispanics, blacks, those residing in households with lower education level, and youth not in high school. Weight status was not significantly associated with more engagement in any active transportation for adolescents. For young adults, engagement in any active transportation was more common among individuals who self-identify race/ethnicity as "other", participants with a healthy weight BMI, and college graduates.

Daily participation in active transportation (Table 2) for adolescents was significantly higher in males and, for young adults,

Table 1
Weighted population description, for adolescents and young adults

Variable	Adolescents (12-17 y) n = 4,300		Young adults (18-25 y) n = 4,380	
	Weighted proportion, %	95% CI	Weighted proportion, %	95% CI
Gender				
Male	50.6	48.5, 52.6	50.2	48.5, 52.0
Female	49.5	47.4, 51.5	49.8	48.1, 51.5
Race/ethnicity				
White	58.0	53.6, 62.3	58.8	54.6, 62.8
Black	14.1	11.9, 16.7	13.6	11.4, 16.1
Hispanic	19.9	16.8, 23.3	19.2	16.3, 22.6
Other[a]	8.1	6.8, 9.5	8.4	7.0, 10.0
Weight status[b]				
Healthy weight	63.9	61.8, 65.8	49.8	47.1, 52.4
Overweight	16.2	14.9, 17.6	25.1	23.3, 27.0
Class I obesity	12.7	11.3, 14.2	13.1	11.7, 14.6
Class II obesity	4.7	3.9, 5.6	6.4	5.4, 7.5
Class III obesity	2.6	2.0, 3.3	5.7	4.8, 6.8
Education[c]				
<9th grade	7.5	6.4 8.9	5.7	4.8, 6.9
HS without diploma	12.1	10.7, 13.8	11.4	10.0, 13.0
HS only	20.6	18.4, 23.0	22.5	20.1, 25.1
Some college	31.9	29.5, 34.4	35.4	31.8, 39.1
College graduate	27.8	24.8, 31.2	25	22.1, 28.1
Family income, FPL, %				
<100	20.6	18.3, 23.0	28.8	25.5, 32.4
≥100 & <200	23.3	21.2, 25.5	24.3	22.4, 26.4
≥200 & <300	16.6	14.7, 18.6	15.3	13.8, 16.9
≥300 & <400	13.2	11.2, 15.4	10.3	8.7, 12.2
≥400 & <500	8.5	7.0, 10.3	7.2	5.9, 8.8
500	18.0	15.5, 20.7	14.1	11.9, 16.5
Season of sampling				
Non-summer (November-April)	44.1	38.2, 50.2	47.0	40.7, 53.5
Summer (May-October)	55.9	49.8, 61.8	53.0	46.5, 59.3

BMI = body mass index; CI = confidence interval; HS = high school; FPL = Federal Poverty Level.
[a] Asian was included in Other. Asian was oversampled after 2010 surveys.
[b] Weight status for adolescents (12-17 y) was classified based on BMI percentiles from CDC growth charts. Corresponding classifications for the young adults (18-25 y) were created from raw BMI classifications.
[c] Education for adolescents (12-17 y) is described by the highest education level of a household reference person (someone 18 years or older). For young adults, education level represents their own education level.

Table 2
Percentage of individuals reporting any[a] and daily use of active transportation by gender, race/ethnicity, weight status, education, income, and seasonality

Variable	Any				Daily			
	Adolescents (12-17 y) n = 4,300		Young adults (18-25 y) n = 3,978		Adolescents (12-17 y) n = 2,010		Young adults (18-25 y) n = 1,628	
	Percentage, %	*p* value	Percentage, %	*p* value	Percentage, %	*p* value	Percentage, %	*p* value
Gender								
Male	48.3	<.001	41.2	<.001	25.9	.009	32.0	.09
Female	37.8		33.6		19.2		26.8	
Race/ethnicity								
White	39.8	<.001	35.0	.003	23.1	.14	28.8	.38
Black	47.2		42.7		27.7		34.4	
Hispanic	48.7		36.4		20.7		27.8	
Other[b]	46.0		48.8		20.4		30.8	
Weight status[c]								
Healthy weight	42.5	.49	41.6	.001	25.6	.01	33.8	.009
Overweight	42.0		34.3		19.5		25.9	
Class I obesity	46.6		35.8		14.9		23.1	
Class II obesity	47.4		30.3		21.9		17.4	
Class III obesity	40.7		30.1		28.0		24.0	
Education[d]								
<9th grade	50.1	.008	37.1	<.001	18.9	.001	33.7	.15
HS without diploma	49.6		37.2		30.0		34.0	
HS only	42.5		25.3		29.1		21.2	
Some college	42.7		41.3		22.1		30.6	
College graduate	38.9		43.0		16.5		30.6	
Grade level								
Not HS	46.5	<.001	NA	NA	21.2	.05	NA	NA
HS (9-12 grade)	38.7		NA		25.8		NA	
Family income, FPL, %								
<100	50.2	.002	47.9	<.001	28.9	.08	37.1	.01
≥100 & <200	48.2		37.4		21.8		22.4	
≥200 & <300	41.7		31.5		24.4		33.8	
≥300 & <400	36.6		32.4		22.6		24.1	
≥400 & <500	37.9		25.9		18.1		21.5	
500	38.2		30.3		17.5		23.1	
Season of sampling								
Non-Summer (November-April)	40.2	.076	39.2	.36	21.6	.33	28.4	.47
Summer (May-October)	45.4		35.9		24.0		31.0	

BMI = body mass index; HS = high school; FPL = Federal Poverty Level.
N Missing, Any: Adolescents Weight Status = 40; Adolescents Household Reference Person = 102; Young Adults Weight Status = 57; Young Adults Education = 400.
N Missing, Daily: Adolescents Weight Status = 15; Adolescents Household Reference Person = 50; Young Adults Weight Status = 15; Young Adults Education = 169.
[a] Any active transportation is defined as whether the sampled individual walks or uses a bicycle for 10 continuous minutes to get to or from a place in a typical week.
[b] Asian was included in Other. Asian was oversampled after 2010 surveys.
[c] Weight status for adolescents (12-17 y) was classified based on BMI percentiles from CDC growth charts. Corresponding classifications for the young adults (18-25 y) were created from raw BMI classifications.
[d] Education for adolescents (12-17 y) is reported both as the highest education level of a household reference person (someone 18 years or older) and as the grade level of the adolescent. For young adults, the reported education level represents their own education level.

those with a lower family income. Daily participation in active transportation was highest among adolescent youth with class III obesity, youth in a household with a reference person education of high school without a diploma, and youth reporting a grade level of high school. Also shown in Table 2, young adult engagement in daily active transportation was highest for those with a healthy weight BMI. Education level and gender were not associated with young adult engagement in daily active transportation and family income was not associated with adolescent engagement in daily active transportation. Race/ethnicity was not associated with daily active transportation for either adolescents or young adults. Neither any nor daily active transportation in either age group differed significantly across season of sampling.

Multivariable estimates for likelihood of adolescent (12-17 y) active transportation based on sociodemographics and weight status

Multivariable estimates for likelihood of adolescent active transportation (accounting for gender, race/ethnicity, weight status, parent education, grade level, family income, and season of sampling) are presented in Table 3. For adolescent participants, males were more likely than females to participate in any (risk ratio [RR] = 1.3; 95% confidence interval [CI], 1.16-1.40) and daily (RR = 1.3; 95% CI, 1.06-1.63) active transportation. Black (RR = 1.1; 95% CI, 1.01-1.31) and Hispanic (RR = 1.2; 95% CI, 1.05-1.31) adolescents were more likely to engage in any active transportation compared to whites. Weight status and household education level were not associated with any active transportation. However, adolescents enrolled in high school (RR = .8; 95% CI, .76-.95) versus not in high school were less likely to engage in any active transportation. Also, adolescents sampled in the period May-October were more likely to engage in any active transportation than those sampled during November-April (RR = 1.2; 95% CI, 1.06-1.42).

Race/ethnicity was not associated with daily active transportation among adolescents. Adolescents with overweight (RR = .7; 95% CI, .53-.97) or class I obesity (RR = .6; 95% CI, .43-.81) were less likely to participate in daily active transportation

Table 3
Generalized linear model of likelihood of any[a] and daily active transportation for adolescents (12-17 y) based on gender, race/ethnicity, weight status, education, income, and seasonality

Variable	Any				Daily			
	RR	95% CI		*p* value	RR	95% CI		*p* value
Gender								
Female	1	[Reference]		NA	1	[Reference]		NA
Male	1.27	1.16	1.40	.00	1.32	1.06	1.63	.01
Race/ethnicity								
White	1	[Reference]		NA	1	[Reference]		NA
Black	1.15	1.01	1.31	.04	1.02	.82	1.28	.84
Hispanic	1.17	1.05	1.31	.01	.81	.63	1.04	.10
Other[b]	1.13	.96	1.32	.13	.87	.62	1.23	.44
Weight status[c]								
Healthy weight	1	[Reference]		NA	1	[Reference]		NA
Overweight	.97	.88	1.08	.62	.72	.53	.97	.03
Class I obesity	1.07	.91	1.25	.40	.59	.43	.81	.00
Class II obesity	1.07	.90	1.27	.45	.79	.51	1.22	.27
Class III obesity	.88	.67	1.16	.36	.85	.46	1.55	.59
Parent education[d]								
HS only	1	[Reference]		NA	1	[Reference]		NA
<9th grade	1.09	.93	1.27	.30	.65	.45	.92	.02
HS without diploma	1.11	.97	1.27	.12	.98	.74	1.29	.86
Some college	1.05	.91	1.21	.52	.77	.58	1.03	.08
College graduate	1.00	.85	1.18	1.00	.60	.38	.95	.03
Grade level								
Not HS	1	[Reference]		NA	1	[Reference]		NA
HS (9-12 grade)	.85	.76	.95	.00	1.17	.96	1.14	.12
Family income, FPL, %								
500	1	[Reference]		NA	1	[Reference]		NA
<100	1.18	.96	1.45	.11	1.42	.94	2.15	.09
≥100 & <200	1.15	.94	1.41	.18	1.08	.71	1.66	.71
≥200 & <300	1.06	.86	1.32	.58	1.26	.75	2.10	.38
≥300 & <400	.91	.72	1.14	.41	1.07	.62	1.85	.81
≥400 & <500	.96	.74	1.25	.77	.89	.45	1.74	.73
Season of sampling								
Non-summer (November-April)	1	[Reference]		NA	1	[Reference]		NA
Summer (May-October)	1.22	1.06	1.42	.01	1.10	.89	1.35	.38

BMI = body mass index; CI = confidence interval; HS = high school; FPL = Federal Poverty Level; NA = not applicable; RR = risk ratio.
[a] Any active transportation is defined as whether the sampled individual walks or uses a bicycle for 10 continuous minutes to get to or from a place in a typical week.
[b] Asian was included in Other. Asian was oversampled after 2010 surveys.
[c] Weight status for adolescents (12-17 y) was classified based on BMI percentiles from CDC growth charts. Corresponding classifications for the young adults (18-25 y) were created from raw BMI classifications.
[d] Education for adolescents (12-17 y) is reported both as the highest education level of a household reference person (someone 18 years or older) and as the grade level of the adolescent.

compared to healthy weight adolescents. Youth with a highest household education level of less than ninth grade (RR = .7; 95% CI, .45-.92), and college graduates (RR = .6; 95% CI, .38-.95) were less likely than households with high school only to engage in daily active transportation. Grade level was not associated with daily active transportation and family income was not associated with any or daily active transportation among adolescents.

Multivariable estimates for likelihood of young adult (18-25 y) active transportation based on sociodemographics and weight status

Multivariable estimates for likelihood of young adult active transportation (accounting for gender, race/ethnicity, weight status, participant education, family income, and season of sampling) are presented in Table 4. For young adults, males were more likely to participate in any (RR = 1.3; 95% CI, 1.20-1.50) and daily (RR = 1.3; 95% CI, 1.08-1.55) active transportation than females. Young adults who identified as "Other" race/ethnicity (RR = 1.3; 95% CI, 1.05-1.49) were more likely to engage in any active transportation compared with whites. Young adults with overweight (RR = .8; 95% CI, .74-.97), class I obesity (RR = .9; 95% CI, .74-1.00) or class III obesity (RR = .7; 95% CI, .58-.95) were less likely to engage in any active transportation compared to those with a healthy weight BMI. Any level of education was associated with a higher likelihood of participating in any active transportation (RR = 1.3; 95% CI, .97-1.76 for <ninth grade, RR = 1.4; 95% CI, 1.11-1.66 for high school without a diploma, RR = 1.6; 95% CI 1.35-1.94 for some college, and RR = 1.8; 95% CI, 1.49-1.26 for college graduate) when compared to young adults reporting only high school education. Young adults with a lower family income (RR = 1.7; 95% CI, 1.21-2.26 for <100 and RR = 1.4; 95% CI, 1.07-1.70 for ≥100 and <200) were more likely engage in any active transportation compared to those with a family income of 500% FPL.

Black young adults (RR = 1.2; 95% CI, .98-1.55, $p = .07$; Table 4) were more likely to engage in daily active transportation compared with white young adults. Also, young adults with any level of overweight or obesity were significantly less likely to engage in daily active transportation compared to their healthy weight counterparts (RR = .77; 95% CI, .60-.99 for overweight, RR = .65; 95% CI, .46-.93 for class I obesity, RR = .52; 95% CI, .33-.84 for class 2 obesity, and RR = .56; 95% CI, .33-.96 for class III obesity). For daily active transportation, young adults reporting

Table 4
Generalized linear model of likelihood of any[a] and daily active transportation for young adults (18-25 y) based on gender, race/ethnicity, weight status, education, income, and seasonality

Variable	Any				Daily			
	RR	95% CI		*p* value	RR	95% CI		*p* value
Gender								
Female	1	[Reference]		NA	1	[Reference]		NA
Male	1.34	1.20	1.50	.00	1.30	1.08	1.55	.01
Race/ethnicity								
White	1	[Reference]		NA	1	[Reference]		NA
Black	1.12	.95	1.32	.17	1.23	.98	1.55	.07
Hispanic	1.02	.84	1.24	.85	1.02	.79	1.32	.89
Other[b]	1.25	1.05	1.49	.01	.98	.75	1.30	.91
Weight status[c]								
Healthy weight	1	[Reference]		NA	1	[Reference]		NA
Overweight	.85	.74	.97	.02	.77	.60	.99	.04
Class I obesity	.86	.74	1.00	.06	.65	.46	.93	.02
Class II obesity	.82	.63	1.05	.11	.52	.33	.84	.01
Class III obesity	.74	.58	.95	.02	.56	.33	.96	.04
Education[d]								
HS only	1	[Reference]		NA	1	[Reference]		NA
<9th grade	1.31	.97	1.76	.08	1.66	1.04	2.65	.04
HS without diploma	1.36	1.11	1.66	.00	1.27	.90	1.80	.18
Some college	1.62	1.35	1.94	.00	1.29	.97	1.71	.08
College grad	1.83	1.49	2.26	.00	1.29	.91	1.83	.15
Family income, FPL, %								
500	1	[Reference]		NA	1	[Reference]		NA
<100	1.72	1.21	2.26	.00	1.50	.95	2.37	.09
≥100 & <200	1.35	1.07	1.70	.01	.90	.54	1.49	.67
≥200 & <300	1.16	.90	1.49	.24	1.38	.81	2.34	.23
≥300 & <400	1.12	.84	1.48	.43	1.06	.56	2.03	.85
≥400 & <500	.80	.58	1.10	.17	1.20	.59	2.45	.61
Season of sampling								
Non-Summer (November-April)	1	[Reference]		NA	1	[Reference]		NA
Summer (May-October)	.96	.81	1.14	.64	1.15	.93	1.42	.19

BMI = body mass index; CI = confidence interval; HS = high school; FPL = Federal Poverty Level; NA = not applicable; RR = risk ratio.
[a] Any active transportation is defined as whether the sampled individual walks or uses a bicycle for 10 continuous minutes to get to or from a place in a typical week.
[b] Asian was included in Other. Asian was oversampled after 2010 surveys.
[c] Weight status for adolescents (12-17 y) was classified based on BMI percentiles from CDC growth charts. Corresponding classifications for the young adults (18-25 y) were created from raw BMI classifications.
[d] For young adults (18-25 y), the reported education level represents their own education level.

less than a ninth grade education level (RR = 1.7; 95% CI, 1.04-2.65) were more likely to participate than those with only high school. Family income was not associated with daily participation in active transportation and seasonality of sampling was not associated with any or daily active transportation participation in young adults.

Discussion

Consistent with prior research on youth transportation to school [11], this study of US adolescents and young adults found a higher proportion of minority and low-income youth participate in active transportation compared with their nonminority and higher income peers. However, physical activity levels are shown in prior research studies to be lower in minority/low-income subgroups [8]. Prior studies also show that for disadvantaged populations, physical activity is a particularly important driver of cardiovascular health disparities [24], and that lower neighborhood support of physical activity is associated with higher youth obesity [25]. Given that social and structural drivers of health are critical determinants of youth physical activity participation [2,19], promoting active transportation may present an opportunity to increase physical activity and reduce youth health disparities in under resourced settings [17]. Our study findings provide key information suggesting that active transportation is a feasible target for low-income and minority youth, particularly in light of social and structural barriers to physical activity, to reduce disparities and support optimal health.

Consistent with prior reports on physical activity [8], young adults and females in this study were less likely to participate in any active transportation; however, young adults who did participate in any active transportation were more likely to engage in daily active transportation compared with their adolescent counterparts. In this sense, our data show that while young adults report less active transportation overall, when they do, they use it more frequently than adolescents. We hypothesize that young adults may be using active transportation to commute to work (vs. owning a personal vehicle), although this data set does not include information specific to this possibility. Other studies have shown that minority race/ethnicity, poverty, household vehicle ownership, safety, parental active transport, parental safety concerns, social connectedness to peers, and built environment factors (e.g. number of accessible recreation destinations, walkability, mixed land use, street connectivity) are important predictors of youth active transportation [11,26,27]. Additional follow-up studies are needed to address drivers of youth active transportation specifically among minority youth to determine whether particular factors can be leveraged to promote active transportation in this subgroup.

We also observed an inverse relationship between weight class and active transportation participation, although this may be reflective of bidirectionality (high active transportation levels would increase overall physical activity, which is associated with lower weight class). However, these findings are supported by prior literature showing a similar relationship between youth obesity and physical activity [28,29] and may suggest that active transportation interventions may help to reduce overweight and obesity among youth. There may also be confounding by participant characteristics—minority and lower income participants were more likely to engage in active transportation, yet are also more likely to have obesity. Specifically, we observed that black and Hispanic adolescents were 10% and 20%, respectively, more likely to engage in any active transportation compared to whites. Black young adults were 23% more likely to engage in daily active transportation compared to whites. Young adults with a low family income <100 and <100 and <200 of the federal poverty level also were 73% and 35%, respectively, more likely engage in any active transportation compared to those with a high family income (>500). Although prior literature shows disparities in physical activity for minority/low-income populations [16,30], our findings suggest that if active transportation neighborhood resources are made available, accessible and safe, physical activity disparities among disadvantaged subgroups may be reduced.

Based on findings from this study, minority and low-income youth who participate in active transportation do so more than their nonminority and higher-income peers. Prior research, however, has demonstrated that higher participation in active transportation by minority and low-income youth attenuates after accounting for potential confounding and mediating variables including household vehicle ownership, distance to destinations, safety, and residential density [11]. It is possible that minority and low-income youth who are actively traveling are doing so out of necessity rather than by choice. Future research should address the need for interventions to improve youth access and safety to reach and use public transportation, programs to promote youth self-efficacy pertaining to transportation system use, and expanding afterschool/community programs of interest to youth in order to incentivize transportation system use to attend these programs. Although findings in this study included many individual/household factors potential confounders, area-level built environment and psychosocial variables were not addressed in this analysis and may be driving the associations observed. Nevertheless, given that active transportation accounts for a small proportion of total physical activity in adolescents (18% and 16% for adolescent and young adults, respectively) [14], our results suggest active transportation can be leveraged to promote overall physical activity. Moreover, active transportation can be an accessible/affordable method of physical activity engagement, and therefore may represent a feasible and acceptable method to reduce youth physical activity disparities across race/ethnicity and income [25]. In this sense, active transportation may serve as an important contributor to overall physical activity particularly for high-need youth populations, and possibly an important target for activity promotion.

Novel frameworks proposed in the literature suggest that funding be directed towards cross-sector collaboration and policy to improve youth physical activity with transportation measures [31]. Policy can be targeted to improve pedestrian and biking safety including bike racks at schools, traffic calming on school properties and promoting biking and walking to school [32]. In light of national reports indicating that less than 10% of students at >60% of schools actively commute to school [33], and dramatic declines in US youth active transportation to schools from 41% in 1,969% to 13% in 2001 [11], calls have been issued also to "re-normalize active transportation to school" [34]. Federally funded initiatives, including Healthy People 2030, similarly include the Safe Routes to Schools program [35] dedicated to promoting US students walking and biking to school while emphasizing the social benefits of such active transportation and addressing parental safety concerns. Improving access to well-maintained/well-lit sidewalks and bike lanes, and providing free bus passes and connectivity between sidewalks and city busses, will also facilitate more physical activity from transportation among youth [36]. Moreover, partnerships among public health professionals, transportation specialists, and local youth organizations can improve youths' and parents' awareness of safe active transportation options [17,20].

US youth active transportation may also be promoted through community-based and built environment solutions. Active transportation is not universally accessible, feasible, or amenable, particularly for high need youth, girls, and youth with obesity. [37,38] The American Academy of Pediatrics has issued policy statements calling for community designs that facilitate active transportation opportunities for youth [39]. Infrastructure spending, such as in the American Recovery and Reinvestment Act and the Surface Transportation Bill, were implemented in part to advance the nation's physical activity environment for current and future generations. Reducing the convenience of a car, and also encouraging active commuting with safer routes, are shown to be most effective for promoting uptake and maintenance of youth active commuting programs [40]. Facilitating safe active transportation to physical activity recreation sites, including addressing perceived traffic safety and crime, likewise will support this effort [41]. It is also critical to provide equitable distribution of environmental features, including neighborhood walkability, quality and accessibility of parks and playgrounds, and active transportation programs and infrastructure in order to address widening racial/ethnic and income health disparities [42]. Such efforts can offer solutions to supporting high-need youth subgroups, and particularly minority and low-income youth, to address health disparities through physical activity promotion. Of note, policy and program initiatives may inadvertently further widen youth physical activity disparities given disparate health benefits experienced by nonminority versus minority youth from neighborhood amenities (e.g. sidewalks, bike paths, trails) [43]. Future measures to reduce physical activity disparities should consider not only the presence of activity—promoting neighborhood amenities but also safety and accessibility (e.g. lighting, well maintained) of those amenities [43].

This study presents nationally representative data on US youth active transportation prevalence and patterns at a population level, drawing from 9 years of data and representing more than 57 million youth. This work reports data from NHANES, a multiwave cross-sectional study. Temporality and causality may not be inferred from findings reported here. Also, data are based on self-report, and findings may be limited due to social desirability bias. The validity of the NHANES active transportation questions has not been reported, and no information was

available from participants on their purpose for using active transportation use or home address that would permit the inclusion of neighborhood factors (distance to school or work, proximity to high-density crime, public transportation, and recreational amenities), or additional modes of active transportation (e.g., nonmotorized scooters). In addition, although the sample is nationally representative, information was not available pertaining to the urban/rural context of participants' home residences, limiting the ability to determine how this sample generalizes from an urban-rural perspective, particularly given lower rates of youth active transportation in rural settings [11].

In conclusion, just 24% of US youth ages 6–17 years old meet physical activity recommendations [7]. Findings from this study of US adolescents and young adults indicate that among youth who engage in active transportation, participation was higher in males, minorities and lower income populations, suggesting that active transportation is a feasible target for reducing health disparities and promoting optimal health. In light of inadequate physical activity among our nation's youth, designing and implementing physical activity interventions targeting active transportation aligns with Healthy People 2030 priorities and American Academy of Pediatrics objectives in support of reducing chronic disease disparities across the lifespan.

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