

Physical Activities of U.S. High School Students— 2010 National Youth Physical Activity and Nutrition Survey

MinKyoung Song, Dianna D. Carroll, Sarah M. Lee, and Janet E. Fulton

Background: The 2008 Physical Activity Guidelines recommend youth participate in a variety of physical activities; however, few nationally representative studies describe the types and variety of youth activity. This study assessed the most frequently reported types and variety of activities among U.S. high school students, and examined the association between variety and meeting the 2008 Guidelines for aerobic activity (aerobic guideline). **Methods:** We analyzed data on 8628 U.S. high school students in grades 9–12 from the 2010 National Youth Physical Activity and Nutrition Survey. Types of physical activity were assessed by identifying which activities each student reported in the past 7 days. Variety was assessed by the total number of different activities each student reported. Percentage (95% CI) of students who reported engaging in each activity was assessed. Logistic regression was used to examine the association between variety and meeting the aerobic guideline. **Results:** Walking was the most frequently reported activity among U.S. high school students. On average, students reported participating in 6 different activities. Variety was positively associated with meeting the aerobic guideline. **Conclusions:** These findings support encouraging youth to participate in many physical activities and may be useful for developing interventions that focus on the most prevalent activities.

Keywords: variety, NYPANS, type, public health

Physical activity confers many health benefits for youth.¹ Accordingly, the 2008 Physical Activity Guidelines for Americans (2008 Guidelines), developed by the U.S. Department of Health and Human Services, recommends at least 60 minutes of physical activity daily for youth aged 6 to 18 years of age.² The 2008 Guidelines also recommend that youth participate in a broad range of physical activities to achieve associated health benefits and to strengthen physical skills.² For instance, bicycle riding or brisk walking are types of aerobic physical activities that increase cardio-respiratory fitness¹ while push-ups or pull-ups are muscle-strengthening activities that increase muscle and bone strength as well as neuromuscular learning.³

Two studies (National Children and Youth Fitness Study)^{4,5} were conducted in the mid-1980s to assess the most frequent physical activities among youth, but since that time there have been no national-level data available for conducting national-level analysis. The more recent studies of types and variety of activity among youth were conducted only within select groups of youth. For example, studies have been undertaken on types of activity among samples of youth from small geographic areas (and thus cannot provide state or national estimates),⁶ among girls,^{7,8} or among elementary- and

middle school-aged students.^{8–11} Variety of physical activity has been assessed only in small geographic areas.^{12,13} This study differs from previous studies also in that it examines a wider variety of youth activity. Previous studies typically focused on 10 activities^{12–14} whereas in this study we examined youth participation in 35 activities. Finally, no previous studies to our knowledge have examined the association between participation in a variety of physical activities and meeting the current youth physical activity guidelines.

This study will add to the existing literature on youth activity by being the most recent to use nationally representative data to describe types and variety of physical activity among U.S. youth and linking variety to meeting physical activity guidelines. We defined “types of physical activity” as different modes or kinds of activity such as walking, sit-ups, and swimming. “Variety of physical activity” refers to the total number of different types of physical activities a youth engages in (eg, average variety = 6 or 7). Examining the types of physical activity in which youth are engaging will aid in designing interventions that maximize the benefits of popular activities and target important activities which are underrepresented.¹⁵ Examining the variety of current physical activity is a first step toward determining whether variety is a predictor for youth meeting physical activity guidelines.

The specific objectives of this study were to 1) describe the most frequently reported types of physical activity among U.S. high school students overall and by demographic characteristics; 2) assess the variety of physical activities by demographic characteristics, body mass index (BMI), and meeting the 2008 Guidelines for aerobic activity (aerobic physical activity guideline); and 3) examine the association between the variety of reported physical activities and meeting the aerobic physical activity guideline stratified by sex.

Song (songmin@med.umich.edu) was with the Epidemic Intelligence Service and Divisions of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA, and is now with the School of Nursing, University of Michigan School of Nursing, Ann Arbor, MI. Carroll is with the Division of Human Development and Disability, Commissioned Corps, U.S. Public Health Service, Centers for Disease Control and Prevention, Atlanta, GA. Lee is with the Division of Population Health, Centers for Disease Control and Prevention, Atlanta, GA. Fulton is with the Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA.

Methods

Survey Design

The 2010 National Youth Physical Activity and Nutrition Study (NYPANS) was a school-based study conducted by the Centers for Disease Control and Prevention (CDC). The study employed a 3-stage cluster sample design to obtain cross-sectional data representative of public- and private-school students in grades 9 to 12 in all 50 states and the District of Columbia. During a regular class period in the spring of 2010 students completed an anonymous, 120-item, self-administered paper-and-pencil questionnaire designed to measure behaviors and behavioral determinants related to physical activity and nutrition. The survey was administered by trained personnel who also measured students' height and weight using a standard protocol. The school response rate was 82%, the student response rate was 88%, and the overall response rate was 73%. CDC's and the study contractor's (ICF Macro) Institutional Review Boards approved the protocol for the NYPANS.

Types and Varieties of Physical Activity. The NYPANS survey included a list of 35 physical activities for which students were asked, "For each of the following activities, please mark on how many of the past 7 days you did this activity. Think about activities you did before and after school, in the evenings, and on the weekends, by yourself or with others. Do not include PE or gym class. Include activities you did just for fun or in competition." Response choices ranged from 0 to 7 days. The varieties of physical activities were assessed in 2 ways: 1) *Average variety*—the sum of the number of different activities reported by each student (range 1 to 35; those with no activity were excluded from the analysis) divided by the number of students; and 2) *Categories of variety*—grouping the number of different activities reported by each student into 5 categories: 1–2, 3–4, 5–6, 7–8, and 9+.

Meeting the Aerobic Physical Activity Guideline. To assess meeting the aerobic physical activity guideline,² students were asked, "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)" This question has been used in the Youth Risk Behavior Surveillance System (<http://www.cdc.gov/healthyyouth/yrebs/>) since 2007. Response choices ranged from 1 to 7 days (NYPANS inadvertently did not include a "zero days" response to the aerobic question. Discussion of this limitation can be found in a previous study¹⁶). Students who selected 7 days as the response option were characterized as having met the aerobic physical activity guideline.

Body Mass Index. BMI [weight (kg)/height (m²)] was calculated for each student using height and weight measurements taken by trained study personnel using a standardized protocol. Participants were categorized into 3 BMI groups [underweight/normal weight (< 85 percentile), overweight (≥ 85 and < 95 percentile), and obese (≥ 95 percentile)] according to sex- and age-specific reference data from the 2000 CDC growth charts.¹⁷

Demographic Characteristics. Participants were categorized by sex and grade (9th, 10th, 11th, and 12th). The race/ethnicity of the participants was categorized into 5 groups (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic other, and

non-Hispanic multi). Because the number of students from non-Hispanic other and non-Hispanic multi groups was too small for meaningful analysis, race/ethnicity is presented only for non-Hispanic White, non-Hispanic Black, and Hispanic students (who might be of any race).

Analytic Sample

Our main variable of interest for this analysis was the types of activities reported by students. The number of NYPANS participants available for analysis was 11,429. We excluded students who reported no participation in any of the 35 different physical activities listed ($n = 267$), and students who had missing responses for 10% or more of the 35 activities measured (ie, 4 or more of the activities listed; $n = 1109$). Since another variable of interest was meeting the aerobic activity levels recommended in the *2008 Guidelines*,² we excluded students from the sample for whom a determination of meeting the aerobic physical activity guideline could not be made due to missing data ($n = 101$). Students with missing BMI ($n = 1138$) or demographic (sex, grade in school, race/ethnicity) data ($n = 186$) were also excluded. The final analytical sample included 8628 (75.5%) U.S. high school students in grades 9 to 12.

Statistical Analysis

For each of the 35 physical activities included in the NYPANS, we calculated the percentage and 95% confidence interval (CI) of U.S. high school students who reported engaging in the activity in the 7 days before the survey. The activities were rank ordered by percentage of participation from highest to lowest for the overall sample, for boys and girls separately, and for race/ethnicity categories within each sex grouping. We then assessed the average variety of physical activity by sex, grade, race/ethnicity, BMI category and by meeting the aerobic physical activity guideline. We used *t*-tests to assess pairwise subgroup comparisons and orthogonal polynomial contrasts to test for linear and quadratic trends by grade and BMI category. Lastly, we examined the association between category of variety and meeting the aerobic physical activity guideline by sex in unadjusted and adjusted models controlling for grade, race/ethnicity, and BMI category. Using logistic regression we calculated the odds of meeting the aerobic physical activity guideline. Linear and quadratic trends for variety of physical activity, grade and BMI categories were assessed using orthogonal polynomial contrasts. Statistical significance was determined at $P < .05$. All analyses were performed using SAS callable SUDAAN, version 10.0.1 software (Research Triangle Institute, Research Triangle Park, NC) and all estimates were weighted to provide national estimates.

Results

Nationally representative estimates in our study were based on a sample of 8628 U.S. high school students (Table 1). Approximately half of the students were girls, about 60% were non-Hispanic White, and about one-third were overweight or obese. Approximately 30% were 9th-grade students and about one-fourth were 10th-grade students. Fifteen percent of students met the aerobic physical activity guideline.

Overall, walking was the most frequently reported physical activity among U.S. high school students (82.3%), followed

Table 1 Weighted Sample Characteristics: NYPANS, 2010*

Characteristic	n	%	95% CI
Sex			
Boys	4304	50.7	49.0–52.4
Girls	4324	49.3	47.6–51.1
Grade			
9	2234	28.7	27.3–30.2
10	2171	25.3	23.8–26.8
11	2125	24.0	22.7–25.2
12	2098	22.1	20.9–23.3
Race/ethnicity			
White, non-Hispanic	3558	59.6	53.2–65.6
Black, non-Hispanic	1794	13.0	10.0–16.8
Hispanic	2630	18.7	14.6–23.8
Other, non-Hispanic	646	8.7	7.1–10.6
BMI ^a			
Underweight/normal weight	5407	63.6	61.2–65.9
Overweight	1582	17.7	16.6–18.8
Obese	1639	18.8	17.0–20.7
Meet the aerobic physical activity guideline ^b			
Yes	1246	15.0	13.4–16.8
No	7382	85.0	83.2–86.6

* Total percentages may not add up to 100% because of rounding.

^a Body mass index estimates were calculated from measured weight and height [weight (kg)/height (m²)] and classified based on sex- and age-specific reference data from the 2000 CDC growth charts.

^b Defined as performing at least 1 hour of aerobic activity daily.

Abbreviations: NYPANS, National Youth Physical Activity and Nutrition Survey; CI, confidence interval.

by running/jogging, weight lifting, basketball, and active video games (Table 2). Of the 10 most frequently reported activities for boys and girls, 7 common activities emerged for both boys and girls: walking, running/jogging, weight lifting, basketball, active video games, bike riding, and aerobics. Football, baseball, and soccer were among the top 10 reported activities for boys, while dance, swimming, and volleyball were among the top 10 reported activities for girls. For boys (79.0%) and for girls (85.6%) for all race/ethnicity groups, walking was the most frequently reported physical activity. An exception was observed among non-Hispanic Black boys, for whom basketball was reported slightly more frequently (75.6%) than walking (74.7%; Table 3). Four of the top five activities reported by boys (walking, running/jogging, weight lifting, and basketball) and by girls (walking, running/jogging, dance, and active video games) were the same for all race/ethnicity groups.

On average, U.S. high school students reported participating in 6 activities in the 7 days before the survey (Table 4). Among boys and girls, those who met the aerobic physical activity guideline reported participating in significantly more activities on average than those who did not meet the guideline. On average, in most subgroup categories boys reported participating in a significantly higher number of activities than girls. For both boys and girls, the average number of activities declined steadily from grade 9 to 12.

Students who engaged in a greater variety of activities were more likely to meet the aerobic physical activity guideline (Table 5). Significantly higher odds of meeting the aerobic physical activity guideline were found for boys who reported engaging in at least 3 activities and for girls who reported at least 5 activities.

Discussion

To date, little attention has focused on the types and varieties of physical activity in which youth engage or the extent to which their engagement is associated with achieving national physical activity guidelines. Type and variety of physical activity are both useful

Table 2 Top 10 Physical Activities* Among U.S. High School Students Overall and by Sex, NYPANS, 2010

Ranking	Activity	Overall		Boys			Girls		
		%	95% CI	Activity	%	95% CI	Activity	%	95% CI
1	Walking	82.3	81.1–83.4	Walking	79.0	77.2–80.7	Walking	85.6	84.1–87.0
2	Running/Jogging	71.8	69.9–73.7	Running/Jogging	73.7	71.3–75.9	Running/Jogging	69.9	67.2–72.4
3	Weight lifting	45.2	42.8–47.6	Weight lifting	62.4	60.0–64.8	Dance	52.1	48.9–55.3
4	Basketball	44.6	42.6–46.7	Basketball	57.9	55.0–60.7	Active video games	40.4	37.8–43.0
5	Active video games	40.8	38.6–43.1	Active video games	41.2	38.3–44.2	Basketball	31.0	28.6–33.5
6	Dance	33.7	31.3–36.2	Football	40.4	36.8–44.2	Aerobics	30.6	27.2–34.2
7	Bike riding	29.5	26.8–32.3	Bike riding	33.5	29.9–37.2	Weight lifting	27.5	24.3–30.9
8	Football	26.4	24.2–28.8	Baseball	26.7	23.3–30.5	Bike riding	25.3	22.9–27.9
9	Aerobics	25.8	23.1–28.6	Soccer	21.9	19.1–25.0	Swimming	24.1	20.4–28.1
10	Swimming	22.3	19.5–25.5	Aerobics	21.2	18.6–23.9	Volleyball	21.8	19.7–24.2

* Students can report participating in more than 1 physical activity.

Abbreviations: NYPANS, National Youth Physical Activity and Nutrition Survey; CI, confidence interval

Table 3 Top 5 Physical Activities* Among U.S. High School Students by Race/Ethnicity^a and Sex, NYPANS, 2010

Race/ethnicity	Boys				Girls		
	Activity	%	95% CI	Ranking	Activity	%	95% CI
White, non-Hispanic	Walking	77.8	75.9–79.7	1	Walking	87.5	85.1–89.5
	Running/Jogging	73.6	70.7–76.2	2	Running/Jogging	73.3	69.1–77.1
	Weight lifting	61.4	58.6–64.2	3	Dance	44.8	40.7–49.0
	Basketball	53.6	48.5–58.5	4	Active video games	39.0	35.5–42.7
	Active video games	38.4	34.0–43.0	5	Aerobics	35.0	30.1–40.2
Black, non-Hispanic	Basketball	75.6	70.0–80.4	1	Walking	78.2	74.5–81.5
	Walking	74.7	69.4–79.4	2	Dance	66.7	62.2–70.9
	Running/Jogging	69.8	64.7–74.4	3	Running/Jogging	55.4	50.4–60.3
	Weightlifting	65.7	60.8–70.3	4	Active video games	51.5	45.3–57.6
	Football	57.0	51.8–62.0	5	Basketball	38.6	33.6–43.9
Hispanic	Walking	83.9	79.2–87.8	1	Walking	85.3	82.2–88.0
	Running/Jogging	76.0	71.4–80.0	2	Running/Jogging	67.9	64.3–71.3
	Weight lifting	66.2	62.2–70.1	3	Dance	62.0	58.7–65.2
	Basketball	60.3	55.7–64.7	4	Active video games	36.7	32.3–41.4
	Football	48.9	45.4–52.5	5	Basketball	31.5	27.8–35.3

* Students can report participating in more than 1 physical activity.

^aSince the numbers of students from other racial/ethnic groups were too small for meaningful subgroup analysis, race/ethnicity is presented only for non-Hispanic white, non-Hispanic black, and Hispanic students (who might be of any race).

Abbreviations: NYPANS, National Youth Physical Activity and Nutrition Survey; CI, confidence interval.

Table 4 Variety* of Physical Activity (Mean, 95% CI) by Select Characteristics Among U.S. High School Students, NYPANS, 2010

	Boys		Girls		P-value [†]
	Mean	95% CI	Mean	95% CI	
Overall	6.8	6.59–7.08	6.2	6.01–6.40	<0.01
Grade					
9	7.7 ^{a,**}	7.22–8.25	7.6 ^{a,**}	7.14–8.00	0.61
10	6.7 ^b	6.26–7.08	6.2 ^b	5.85–6.47	0.04
11	6.4 ^b	5.92–6.87	5.7 ^c	5.34–6.02	0.01
12	6.3 ^b	6.05–6.59	5.1 ^d	4.78–5.40	<0.01
Race/ethnicity					
White, non-Hispanic	6.6 ^a	6.34–6.91	6.2	5.86–6.52	0.03
Black, non-Hispanic	6.7 ^a	6.21–7.13	5.8	5.40–6.13	<0.01
Hispanic	7.6 ^b	7.18–8.09	6.3	5.80–6.75	<0.01
BMI [§]					
Underweight/Normal weight	6.9	6.58–7.15	6.2	5.92–6.49	<0.01
Overweight	7.1	6.72–7.45	6.4	5.89–6.82	<0.01
Obese	6.5	5.90–7.02	6.1	5.59–6.57	0.36
Met the aerobic physical activity guideline [¶]					
Yes	8.2 ^a	7.78–8.66	8.2 ^a	7.57–8.82	0.94
No	6.5 ^b	6.17–6.74	6.0 ^b	5.83–6.22	<0.01

* The sum of the number of different activities reported by each student divided by the number of students.

[†] P-value for difference between boys and girls.

[§] Body mass index estimates were calculated from measured weight and height (weight [kg]/height [m²]) and classified based on sex- and age-specific reference data from the 2000 CDC growth charts.

[¶] Defined as performing at least 1 hour of aerobic activity daily.

** Linear trend P < .05.

^{a,b,c,d} Different letters represent significantly different estimates at P < .05.

Abbreviations: CI, confidence interval; NYPANS, National Youth Physical Activity and Nutrition Survey.

Table 5 Prevalence*, Odds Ratios, and 95% CI of Meeting the 2008 Guidelines^a for Aerobic Activity, NYPPANS, 2010

Characteristics	Boys						Girls					
	Meet aerobic guideline (%)			Adjusted ^b			Unadjusted			Adjusted ^b		
	Meet aerobic guideline (%)	Odds ratio	95% CI	Odds ratio	95% CI	95% CI	Meet aerobic guideline (%)	Odds ratio	95% CI	Odds ratio	95% CI	
Physical activity variety ^c												
1-2	9.8	1.00	1.00	1.00	1.00	1.00	3.2	1.00	1.00	1.00	1.00	
3-4	15.5	1.69	1.09-2.63	1.70	1.11-2.61	1.00	5.0	1.58	0.88-2.85	1.59	0.88-2.87	
5-6	21.1	2.45	1.50-4.01	2.51	1.56-4.02	1.00	7.6	2.47	1.52-4.01	2.31	1.44-3.70	
7-8	21.7	2.55	1.52-4.28	2.50	1.49-4.19	1.00	12.1	4.14	2.35-7.28	3.96	2.24-7.01	
9+	30.9	4.12	2.33-7.28	4.12**	2.47-6.86	1.00	13.6	4.76	2.87-7.89	4.33**	2.64-7.10	
Grade												
9	25.0	1.49	1.10-2.03	1.39	0.99-1.93	1.00	11.3	1.71	1.09-2.66	1.30	0.82-2.06	
10	22.4	1.29	0.96-1.75	1.27	0.90-1.79	1.00	8.3	1.23	0.84-1.80	1.09	0.73-1.61	
11	19.2	1.07	0.70-1.63	1.08	0.70-1.67	1.00	5.9	0.88	0.56-1.37	0.80	0.50-1.27	
12	18.2	1.00	1.00	1.00	1.00	1.00	6.7	1.00	1.00	1.00	1.00	
Race/ethnicity												
White, non-Hispanic	24.2	1.27	0.96-1.69	1.30	0.97-1.76	1.00	9.0	1.30	0.80-2.11	1.22	0.72-2.07	
Black, non-Hispanic	20.1	1.00	1.00	1.00	1.00	1.00	7.2	1.00	1.00	1.00	1.00	
Hispanic	17.8	0.87	0.56-1.34	0.81	0.52-1.26	1.00	5.2	0.72	0.42-1.23	0.67	0.38-1.17	
BMI ^d												
Underweight/normal weight	23.5	1.98	1.28-3.07	1.88	1.16-3.04	1.00	8.1	1.26	0.83-1.91	1.22	0.77-1.93	
Overweight	21.9	1.81	1.14-2.85	1.70	1.01-2.87	1.00	10.1	1.59	0.93-2.73	1.55	0.88-2.74	
Obese	13.4	1.00	1.00	1.00	1.00	1.00	6.8	1.00	1.00	1.00	1.00	

* Estimates are weighted to account for survey nonresponse and oversampling of certain populations.

** Linear trend $P < .05$.

^a Defined as performing at least 1 hour of aerobic activity daily.

^b Adjusting for demographic (grade, race/ethnicity), BMI category, and meeting the aerobic guideline.

^c Total number of different activities reported by each student.

^d Body mass index estimates were calculated from measured weight and height (weight [kg]/height [m²]) and classified based on sex- and age-specific reference data from the 2000 CDC growth charts. Abbreviations: NYPPANS, National Youth Physical Activity and Nutrition Survey; CI, confidence interval.

variables to measure. As noted in the introduction, assessing levels of participation by *type* may be instructive for designing interventions that take advantage of youth preferences to match youth with activities they most enjoy.¹⁵ Assessing *variety* is an important step in determining whether youth who engage in a varied set of physical activities are more likely to meet the current youth physical activity guidelines.²

This study provides a cross-sectional view of types and varieties of physical activity in U.S. youth; these findings can inform future studies that examine youth physical activity longitudinally. Ultimately, the findings of this study will help researchers develop interventions tailored to the preferred activities among high school students. Interventions based on youth preferences will help youth establish and maintain their active lifestyles throughout adolescence into adulthood.^{15,18–20}

Our finding (using a national sample) that walking is the most frequently reported physical activity is consistent with previous studies of selected samples of youth.^{7,21,22} In a longitudinal study of adolescents of both sexes from 7th to 11th grade,²² walking was the most frequently reported physical activity (ranging from 82% to 97%). In studies of girls,^{7,21} walking was identified as the most frequently reported activity among girls in grades 8 through 12. No studies have investigated the reasons why walking is the most prevalent activity. However, we speculate that some of the primary reasons are that: it serves as a common way for adolescents to move from place to place; it does not require special equipment, facilities, or training;²³ and it entails a relatively low risk of injury.^{24,25}

Examination of our findings by subgroups reveals interesting consistencies between this study and previous studies of types of physical activity. For example, our study is consistent with earlier ones showing that although walking is a common activity among boys and girls, boys tend to participate more in team activities (eg, football, basketball, soccer), while girls tend to participate more often in noncompetitive or individual activities (eg, dancing, bicycling).^{11,12,15,21,26} Also consistent with previous studies^{6,26} is our finding that basketball was reported among non-Hispanic Black boys and girls more frequently than in other racial/ethnic groups. Our finding that physical activity preferences differ by sex and race/ethnicity suggests the importance of tailoring physical activity interventions to specific sexes or racial/ethnic youth groups, especially in designing a study of ethnically diverse populations.

There are similarities between the findings of this study and those of others that examined the variety of physical activities in youth. In our study, youth reported on average 6.5 activities, a finding that is similar to the 7.1 activities reported in a previous study of adolescents.¹³ However, the earlier study¹³ was conducted in 1990 in a local area, and with young students (12–15 years) while the 2010 study was conducted 2 decades later, used a national data set, and examined students aged 14 to 18 years. As such, the 2 studies may not be directly comparable. Previous studies^{12–14} also support our finding that the varieties of physical activity decrease as adolescents become older; specifically, those other studies showed a decrease by approximately 50% from mid-adolescent to late-adolescent years.^{13,14} A related earlier study¹³ reported that a decrease in the total extent of physical activity may reflect a decrease in the *variety* of reported physical activity rather than a decrease in the *time* spent on specific activities as adolescents get older. Our findings are consistent with that study, in that we show a positive association between the variety of physical activity and numbers of students who meet the aerobic physical activity guide-

line. Together, the previous study and the present one offer support for the *2008 Guidelines*,² which recommend that youth should be encouraged and supported to engage in a variety of age-appropriate and enjoyable physical activities.

Limitations

The current study has 2 major limitations. First, this study relied on self-reported data, which may be influenced by recall bias or social-desirability bias. These biases can result in either over or underestimation of types or variety of physical activity. However, other measures (which are able to capture types and variety of physical activity) such as direct observation and physical activity log are logistically impractical for population-based studies. Second, we examined only data reported during the 7 days before the survey; and these dates might have been influenced by seasonality bias since the NYPANS was conducted during the spring, while most data had been collected during the colder months of February and March when physical activity is generally lower.^{27,28}

Public Health Implications

Our findings have 2 major public health implications. First, promoting walking may be an efficient way to improve physical activity among U.S. adolescents. Although few studies have examined the health benefits of walking for youth, as discussed earlier walking is an easily accessible activity that requires no special equipment or training, and can be done alone or with others.²⁹ Further studies are needed that examine the effects of intensity and duration of walking, as well as the effects of modifying ‘built environments’ (eg, creating neighborhoods, streets, and outdoor spaces that encourage walking) to help realize those benefits. Second, encouraging participation in a variety of physical activities for U.S. high school students could prevent the age-related decline of physical activity and may help maintain the number of students who meet the *2008 Guidelines* for physical activity as they get older. Encouraging variety may also provide youth with recovery time, which would help to decrease the risk of overuse injuries. It may also help increase activity levels by reducing the boredom of repeated activities.^{30–32} Promoting variety in physical activity by providing youth with opportunities to participate in different types of physical activities may help students develop more muscle groups and motor skills.^{2,33} This goal can be achieved in either school-based or nonschool based settings. In school settings, enhancing the variety of activities can be targeted in physical education classes and/or during activity breaks (including recess and physical activity within the classroom). In nonschool based settings (eg, family and home, community, and primary care), making exercise equipment available and accessible, providing family-based fitness programs, and educating family members at primary care about the importance of variety in physical activity may be emphasized.

Conclusions

This study found that walking was the most frequently reported physical activity among U.S. high school students and that participation in a broad range of activities was associated with meeting the aerobic physical activity guideline. Our findings suggest that incorporating walking into physical activity interventions as an easily accessible and cost-effective form of physical activity may capture youths’ physical activity preferences. Our findings also suggest that introducing a variety of activities at an earlier age

may increase levels of physical activity. Creating or enhancing access to environments for walking, and developing or modifying programs to encourage a variety of physical activities may help increase the number of youth who meet the current aerobic physical activity guideline.

References

1. Physical Activity Guidelines Advisory Committee. *Physical activity guidelines advisory committee report, 2008*. Washington, DC: US Department of Health and Human Services; 2008.
2. U.S. Department of Health and Human Services. *2008 physical activity guidelines for Americans*. Washington, DC: US Department of Health and Human Services; 2008.
3. McCambridge TM, Stricker PR. Strength training by children and adolescents. *Pediatrics*. 2008;121(4):835–840. [PubMed doi:10.1542/peds.2007-3790](#)
4. Ross JG, Pate RR. The National Children and Youth Fitness Study II: a summary of findings. *J Phys Educ, Recreat Dance*. 1987;58:51–56. [doi:10.1080/07303084.1987.10604374](#)
5. Ross JG, Gilbert GG. The National Children and Youth Fitness Study: a summary of findings. *J Phys Educ, Recreat Dance*. 1985;56(15):45–50. [doi:10.1080/07303084.1985.10603683](#)
6. Sallis JF, Zakarian JM, Hovell MF, Hofstetter CR. Ethnic, socioeconomic, and sex differences in physical activity among adolescents. *J Clin Epidemiol*. 1996;49(2):125–134. [PubMed doi:10.1016/0895-4356\(95\)00514-5](#)
7. Pate RR, Dowda M, O'Neill JR, Ward DS. Change in physical activity participation among adolescent girls from 8th to 12th grade. *J Phys Act Health*. 2007;4(1):3–16. [PubMed](#)
8. Pate RR, Sallis JF, Ward DS, et al. Age-related changes in types and contexts of physical activity in middle school girls. *Am J Prev Med*. 2010;39(5):433–439. [PubMed doi:10.1016/j.amepre.2010.07.013](#)
9. Harrell JS, Gansky SA, Bradley CB, McMurray RG. Leisure time activities of elementary school children. *Nurs Res*. 1997;46(5):246–253. [PubMed doi:10.1097/00006199-199709000-00002](#)
10. Harrell JS, Pearce PF, Markland ET, Wilson K, Bradley CB, McMurray RG. Assessing physical activity in adolescents: common activities of children in 6th–8th grades. *J Am Acad Nurse Pract*. 2003;15(4):170–178. [PubMed doi:10.1111/j.1745-7599.2003.tb00259.x](#)
11. Hovell MF, Sallis JF, Kolody B, McKenzie TL. Children's physical activity choices: a developmental analysis of gender, intensity levels, and time. *Pediatr Exerc Sci*. 1999;11(2):158–168.
12. Bradley CB, McMurray RG, Harrell JS, Deng SB. Changes in common activities of 3rd through 10th graders: the CHIC Study. *Med Sci Sports Exerc*. 2000;32(12):2071–2078. [PubMed doi:10.1097/00005768-200012000-00017](#)
13. Aaron DJ, Storti KL, Robertson RJ, Kriska AM, LaPorte RE. Longitudinal study of the number and choice of leisure time physical activities from mid to late adolescence: implications for school curricula and community recreation programs. *Arch Pediatr Adolesc Med*. 2002;156(11):1075–1080. [PubMed doi:10.1001/archpedi.156.11.1075](#)
14. Dovey SM, Reeder AI, Chalmers DJ. Continuity and change in sporting and leisure time physical activities during adolescence. *Br J Sports Med*. 1998;32(1):53–57. [PubMed doi:10.1136/bjism.32.1.53](#)
15. Liu JH, Sun H, Beets MW, Probst JC. Assessing Natural groupings of common leisure-time physical activities and its correlates among US adolescents. *J Phys Act Health*. 2013;10(4):470–479. [PubMed](#)
16. Centers for Disease Control and Prevention (CDC). Physical activity levels of high school students—United States, 2010. *MMWR Morb Mortal Wkly Rep*. 2011;60(23):773–777. [PubMed](#)
17. Kuczmariski RJ, Ogden CL, Guo SS, et al. 2000 CDC Growth charts for the United States: methods and development. *Vital Health Stat*. 2002;(246):1–190.
18. Wichstrom L, von Soest T, Kvaem IL. Predictors of growth and decline in leisure time physical activity from adolescence to adulthood. *Health Psychol*. 2013;32(7):775–784. [PubMed doi:10.1037/a0029465](#)
19. Telama R. Tracking of physical activity from childhood to adulthood: a review. *Obesity Facts*. 2009;2(3):187–195. [PubMed doi:10.1159/000222244](#)
20. Telama R, Yang XL, Laakso L, Viikari J. Physical activity in childhood and adolescence as predictor of physical activity in young adulthood. *Am J Prev Med*. 1997;13(4):317–323. [PubMed](#)
21. Dowda M, Pate RR, Felton GM, et al. Physical activities and sedentary pursuits in African American and Caucasian girls. *Res Q Exerc Sport*. 2004;75(4):352–360. [PubMed doi:10.1080/02701367.2004.10609168](#)
22. Belanger M, Gray-Donald K, O'Loughlin J, Paradis G, Hanley J. When adolescents drop the ball sustainability of physical activity in youth. *Am J Prev Med*. 2009;37(1):41–49. [PubMed doi:10.1016/j.amepre.2009.04.002](#)
23. Simons M, Bernaards C, Slinger J. Active gaming in Dutch adolescents: a descriptive study. *Int J Behav Nutr Phys Act*. 2012;9:118. [PubMed doi:10.1186/1479-5868-9-118](#)
24. Simpson ME, Serdula M, Galuska DA, et al. Walking trends among U.S. adults: the Behavioral Risk Factor Surveillance System, 1987–2000. *Am J Prev Med*. 2003;25(2):95–100. [PubMed doi:10.1016/S0749-3797\(03\)00112-0](#)
25. Centers for Disease Control and Prevention (CDC). Vital signs: walking among adults—United States, 2005 and 2010. *MMWR Morb Mortal Wkly Rep*. 2012;61(31):595–601. [PubMed](#)
26. Dowda M, Saunders RP, Hastings L, Gay JM, Evans AE. Physical activity and sedentary pursuits of children living in residential children's homes. *J Phys Act Health*. 2009;6(2):195–202. [PubMed](#)
27. Belanger M, Gray-Donald K, O'Loughlin J, Paradis G, Hanley J. Influence of weather conditions and season on physical activity in adolescents. *Ann Epidemiol*. 2009;19(3):180–186. [PubMed doi:10.1016/j.annepidem.2008.12.008](#)
28. Tucker P, Gilliland J. The effect of season and weather on physical activity: a systematic review. *Public Health*. 2007;121(12):909–922. [PubMed doi:10.1016/j.puhe.2007.04.009](#)
29. Lee IM, Buchner DM. The importance of walking to public health. *Med Sci Sports Exerc*. 2008;40:S512–S518. [PubMed doi:10.1249/MSS.0b013e31817c65d0](#)
30. Sherwood NE, Jeffery RW. The behavioral determinants of exercise: implications for physical activity interventions. *Annu Rev Nutr*. 2000;20:21–44. [PubMed doi:10.1146/annurev.nutr.20.1.21](#)
31. Knapik JJ, Rieger W, Palkoska F, Van Camp S, Darakjy S. United States Army physical readiness training: rationale and evaluation of the physical training doctrine. *J Strength Cond Res*. 2009;23(4):1353–1362. [PubMed doi:10.1519/JSC.0b013e318194df72](#)
32. Glaros NM, Janelle CM. Varying the mode of cardiovascular exercise to increase adherence. *J Sport Behav*. 2001;24(1):42–62.
33. Bond DS, Raynor HA, Phelan S, Steeves J, Daniello R, Wing RR. The relationship between physical activity variety and objectively measured moderate-to-vigorous physical activity levels in weight loss maintainers and normal-weight individuals. *Journal of Obesity*. 2012;2012:1–6.