Disparities in Physical Activity and Sedentary Behaviors Among US Children and Adolescents: Prevalence, Correlates, and Intervention Implications

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ABSTRACT

Regular physical activity is important for health benefits among youth, but disparities exist. This paper describes disparities in physical activity participation and sedentary behaviors among youth in the United States, provides intervention implications, and offers recommendations for future research focused on reducing disparities related to levels of physical activity. Secondary analysis of national accelerometer data showed that achievement of recommended levels of physical activity ranged across subgroups from 2% to 61%. Mean hours per day spent in sedentary behavior ranged from 5.5 to 8.5. The largest disparities were by gender and age. An improved understanding of correlates may inform the design of interventions to increase physical activity in targeted subgroups. Additional theoretically based research is needed to elucidate which factors contributing to physical activity disparities are amenable to change via intervention. To eliminate

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health disparities, changes in policies that have an impact on physical activity may be necessary to promote physical activity among high-risk youth.

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INTRODUCTION

Regular physical activity is recommended for improvement of overall health and to facilitate weight control. Among children and adolescents (collectively, "youth"), physical activity also fosters optimal physical and cognitive growth and development (1). Accumulation of at least 60 min of moderate-intensity physical activity daily is recommended for youth (2). Yet data regarding achievement of the national physical activity recommendation among youth are inconsistent, with many studies finding low levels of physical activity (3) and some studies suggesting that physical activity levels are adequate (4). Physical activity levels of youth from racial/ethnic minority groups are generally found to be lower and participation in sedentary behaviors (e.g., computer/video game use, television viewing) is generally higher than among non-Hispanic Whites (5,6). Thus, it is not surprising that the prevalence of health outcomes that can be prevented or ameliorated by increases in physical activity and decreases in sedentary behaviors is above average among racial/ethnic minorities compared with non-Hispanic Whites (1).

One goal of *Healthy People 2010* is to eliminate health disparities (7). The National Institutes of Health define health disparities as " ... differences in the incidence, prevalence, mortality, and burden of diseases and other adverse health conditions that exist among specific population groups in the United States" (8). Assessing the underlying causes of disparities can provide policymakers, health care providers, health educators, public health officials, and the lay public with important information to guide the distribution of initiatives and resources to reduce or eliminate health disparities. Physical inactivity and excess sedentary behaviors among racial/ ethnic minority groups compared with non-Hispanic Whites may

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contribute to disparities in type 2 diabetes mellitus, hypertension, heart disease, stroke, and some types of cancer (9–11). Data highlighting the prevalence of overweight or obesity among youth also show higher rates among racial/ethnic minority groups compared with non-Hispanic Whites, regardless of gender (12), and these rates may be influenced by lower physical activity participation among racial/ethnic minorities. Obesity prevalence is increasing more rapidly among racial and ethnic minority youth (12). To reduce the burden of poor health outcomes among groups with the lowest levels of physical activity, a focus on decreasing physical activity-related disparities is needed.

Given the importance of understanding and eliminating health disparities to enhance public health, the purpose of this paper is to examine a variety of issues related to disparities in levels of physical activity and sedentary behaviors among youth and to consider implications for interventions that have the potential to reduce these disparities. The objectives of this paper are to: (1) describe, among US youth, disparities in physical activity patterns and sedentary behaviors using behavioral data based on accelerometer results from the National Health and Nutrition Examination Survey (NHANES) (13); (2) summarize literature on subgroup-specific correlates of physical activity that could inform interventions; and (3) provide recommendations for future research and policies focused on reducing physical activity-related disparities among US youth. The paper is organized around major sections covering each of the three objectives.

DISPARITIES IN PHYSICAL ACTIVITY AND SEDENTARY Behaviors among US Youth

Data from NHANES collected in 2003–2004 were used to describe objectively monitored physical activity and sedentary behaviors among US youth. NHANES is an ongoing, cross-sectional, national household interview survey and medical examination of a representative sample of the US population (13). Response rates to NHANES 2003–2004 were 79.3% for the survey interview and 75.6% for the medical examination.

NHANES 2003–2004 participants, including youth, were asked to wear an accelerometer (Actigraph Model 7164, Actigraph LLC;

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Ft. Walton Beach, FL, USA) for 7 days. Detailed descriptions of the accelerometer-wearing protocol and accelerometer data cleaning are available elsewhere (14). At least 1 day of valid accelerometer data were available for 2,531 participants aged 6-19 years and were used for analysis. Time spent in at least moderate-intensity physical activity was calculated using accelerometer counts per minute thresholds for age-specific criteria (15). The threshold for moderateintensity activity was four metabolic equivalents (multiples of resting metabolic rate) and for vigorous-intensity activity was seven metabolic equivalents (14). The total number of minutes per day above the age-specific criterion for moderate-intensity activity was summed; achievement of the moderate-intensity physical activity recommendation for children and youth was calculated as at least 60 min of moderate-intensity activity on at least 5 of the 7 days of monitoring (2). Sedentary behaviors were estimated as the amount of time achieving <100 counts per minute during periods when accelerometers were worn (16).

Height and weight were measured and body mass index (BMI) calculated from weight (in kilograms) divided by the square of height (in meters). Participants were classified as normal weight or overweight/obese according to cutpoints defined by the Centers for Disease Control and Prevention BMI-for-age growth charts (17). Gender, age, race/ethnicity, and socioeconomic status (SES; defined as parent-reported household income) were collected by questionnaire.

To account for the complex sampling methodology and weighting, Stata/IC 10.0 (18) was used for analysis. Prevalence estimates and 95% confidence intervals, stratified by participant demographic characteristics, were calculated to describe achievement of the physical activity recommendation. Statistically significant differences between subgroups were assumed based on non-overlapping confidence intervals. Mean and standard error were calculated to describe sedentary behaviors.

Estimated prevalence of achievement of the physical activity recommendation varied and ranged from 2% among 12–15-year-old non-Hispanic White girls to 61% among normal weight 6–11-yearold non-Hispanic Blacks. Rates of achievement of the physical activity recommendation were significantly higher among non-Hispanic Black compared to non-Hispanic White 6–11-year olds;

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among non-Hispanic Black and Mexican-American boys compared to girls at all ages and among 12–15-year-old non-Hispanic Whites; and among non-Hispanic Black normal weight compared to overweight/obese 6–11-year olds. No disparities were observed by SES (Tables 1–3).

Mean hours per day in accelerometer-assessed sedentary behaviors ranged from 5.5 among 6–11-year-old normal weight non-Hispanic Whites to 8.5 among 16–19-year-old non-Hispanic Black boys (Table 4). Although a small difference, non-Hispanic Black girls aged 6–11 years had significantly more sedentary time than non-Hispanic White girls (5.88 vs. 5.61 h per day, respectively). Among those aged 12–15 years, non-Hispanic Blacks in the middle SES group had significantly more sedentary time than non-Hispanic Whites. No other statistically significant differences were observed.

COMMENT: DISPARITIES IN PHYSICAL ACTIVITY AND SEDENTARY BEHAVIORS

A notable and surprising finding was that achievement of the physical activity recommendation was significantly higher among non-Hispanic Blacks compared to non-Hispanic Whites in the youngest age group. This pattern was also observed in other age groups, although it did not reach statistical significance. In evaluating disparities by race/ethnicity, we expected to see a higher prevalence of achievement of the physical activity recommendation among non-Hispanic Whites compared to racial/ethnic minorities, as has been reported relatively consistently in other studies (5.6). The discrepancy could be explained by the objectively measured physical activity in NHANES, compared to the self-report surveys used in previous studies (5,11). Accelerometers generally capture all domains of activity (e.g., transportation, household, school/work, leisure activities), as opposed to the mainly leisure and sports activities assessed by self-reports. Previous research suggests that self-report surveys may not accurately capture the types of physical activity in which minority adults participate, thus underestimating physical activity participation (19), which could also hold true for minority youth. It is also possible that, because of a national focus on eliminating health disparities related to racial/ethnic differences (1), minority groups have responded positively and are now truly

	Ν	Prevalence	95 % CI	Ν	Prevalence	95 % CI	Ν	Prevalence	95% CI
		Non-Hispa	nic Black		Non-Hispa	nic White		Mexican A	merican
Overall	276	50.4%	(45.3, 55.6)	217	39.9%	(34.8, 44.9)	256	41.3%	(35.7,47.0)
Genaer Boys Girls	132 144	57.4% 43.3%	(52.6, 62.3) (34.5, 52.0)	101 116	45.8% 33.9%	(37.0, 54.6) (29.0, 38.8)	118 138	51.8% 30.2%	(45.4, 58.2) (24.6, 35.8)
SES \$0-24,999	112	\$1.9%	(45.8, 58.0)	43^{\dagger}	36.4%	(27.8, 45.0)	94	39.7%	(35.3, 44.0)
\$25,000-54,999 ≥\$55,000	79 64	50.9% 48.5%	(44.3, 57.6) (38.4, 58.6)	61 108	40.8% 41.3%	(27.8, 53.8) (35.3, 47.2)	109 41 [†]	49.1% 31.4%	(39.7, 58.5) (19.7, 43.1)
<i>BMI</i> Normal weight Overweight/obese	163 112	60.8% 36.4%	(56.7, 65.0) (30.0, 42.8)	137 79	44.5% 31.8%	(36.0, 53.0) (24.9, 38.7)	149 106	46.8% 33.3%	(38.4, 55.2) (26.3, 40.2)

Non-Hispanic Bla. Overall 312 11.4% $(6.9, 1)$ Overall 312 11.4% $(6.9, 1)$ Gender 175 18.3% $(11.2, 6)$ Boys 137 4.0% $(1.6, 6)$	ispanic Black % (6.9, 15.9) % (11.2, 25.5) % (1.6, 6.4)		Prevalence	95% CI	Ν	Prevalence	95 % CI
$\begin{array}{c ccc} Overall & 312 & 11.4\% & (6.9, 1) \\ Gender & & & \\ Boys & & 175 & 18.3\% & (11.2, \\ Girls & & & 137 & 4.0\% & (1.6, \ell) \\ \end{array}$	% (6.9, 15.9) % (11.2, 25.5) % (1.6, 6.4)	-	Von-Hispan	ic White		Mexican Aı	nerican
Genuer 175 18.3% $(11.2, 6)$ Boys 137 4.0% $(1.6, 6)$	% (11.2, 25.5) % (1.6, 6.4)	222	6.4%	(4.2, 8.7)	297	10.3%	(6.9, 13.7)
		118 104	10.0% 2.4%	(6.3, 13.6) (0.9, 3.8)	146 151	17.9% 2.9%	(12.3, 23.4) (0.9, 4.9)
553 (4.4, 1 $50-24,999$ (4.4, 1 $50-24,999$	% (4.4, I 5.0)	42. †	6.2% [†]	(0.1, 12.4)	100	10.3%	(6.4, 14.3)
\$25,000-54,999 85 14.4% (IO.I.	% (10.1, 18.6)	56	4.9%	(I.2, 8.5)	130	11.3%	(7.1, 15.5)
≥\$55,000 88 II.2% (5.5, 1	% (5.5, 17.0)	114	7.7%	(4.4, 11.0)	49^{\dagger}	9.4%	(4.4, 14.4)
BMI Normal maisher 200 20200 /	(- 0) /0)0 			/0	
Overweight/obese II5 I0.7% (8.2, 1	% (5.7, 10.5) % (8.2, 13.2)	130 86	4.5%	(4.5, 10.9) (2.4, 6.5)	194 100	9.3%	(5.6, 12.9)

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Table 3: Estimated popper day for 5 out of 7 σ	ulatio days),	n prevalence of for 16–19-year	achievement o -old youth; Na	f the m ational	oderate-inten Health and N	sity physical act Jutrition Exami	civity* 1 nation	ecommendati Survey, 2003-	on (≥60 min •2004
	Ν	Prevalence	95% CI	Ν	Prevalence	95 % CI	Ν	Prevalence	95% CI
		Non-Hispani	ic Black		Non-Hispan	ic White		Mexican An	ıerican
Overall Condor	297	8.5%	(6.0, 10.9)	238	7.1%	(3.5, 10.8)	250	8.6%	(6.4, 10.9)
Girls Girls	159 138	13.7% 3.5%	(9.5, 17.9) (1.6, 5.3)	113 125	8.7% 5.6%	(3.9, 13.6) (1.7, 9.5)	137 113	12.3% 4.6%	(9.7, 14.9) (1.5, 7.7)
SES \$0-24,999	126	10.0%	(4.8, 15.3)	63	16.2%	(6.9, 25.5)	90	11.0%	(7.2, 14.9)
\$25,000-54,999 ≥\$55,000	76 72	7.7% 7.5%	(2.7, 12.6) (2.1, 13.0)	52 107	7.1% 3.7%	(2.5, 11.7) (1.7, 5.7)	$\begin{array}{c} 9_{\mathrm{I}} \\ 43^{+} \end{array}$	5.9% 9.2%	(3.0, 8.8) (2.9, 15.4)
BMI Normal weight Overweight/obese	180 110	10.1% 6.3%	(7.1, 13.1) (3.4, 9.3)	158 78	8.0% 5.4%	(3.4, 12.6) (1.8, 9.1)	147 103	9.0% 8.2 <i>%</i>	(6.1, 11.9) (1.4, 14.9)
* Physical activity assessed for 7 days. * Fewer than 50 observati	l by Act ons in ;	tigraph (Actigrapl a cell, estimate m	1, LLC; Ft. Waltc ay be unstable.	on Beach	ι, FL) Model 71	64 accelerometer	over the	right hip on an	elasticized belt

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			A	ge		
	6-11	years	12-15	years	16–19	years
	Mean	SE	Mean	SE	Mean	SE
Non-Hispanic Black <i>Gender</i>	5.90	0.17	7.77	0.20	8.34	0.26
Boys	5.93	0.18	7.66	0.23	8.46	0.25
Girls	5.88 [‡]	0.17	7.90	0.16	8.20	0.26
SES						
\$0-24,999	5.80	0.19	7.67	0.21	8.35	0.25
\$25,000-54,999	6.00	0.15	7.89^{\ddagger}	0.20	8.42	0.28
≥\$55,000	5.96	0.17	7.77	0.19	8.26	0.24
BMI						
Normal weight	5.75	0.17	7.72	0.21	8.42	0.24
Overweight/obese	6.13	0.17	7.84	0.18	8.23	0.27
Non-Hispanic White <i>Gender</i>	5.63	0.14	7.18	0.19	7.95	0.23
Boys	5.64	0.17	6.92	0.21	7.79	0.25
Girls	5.61	0.12	7.51	0.16	8.10	0.20
SES						
\$0-24,999	5.60 [§]	0.16	$6.86^{\$}$	0.18	8.08	0.24
\$25,000-54,999	5.51	0.13	7.30	0.17	7.73	0.27
≥\$55,000	5.70	0.14	7.25	0.20	7.99	0.20
BMI						
Normal weight	5.50	0.14	7.12	0.18	8.03	0.21
Overweight/obese	5.83	0.15	7.28	0.20	7.81	0.26
Mexican American <i>Gender</i>	5.86	0.16	7•74	0.16	7.64	0.24
Boys	5.70	0.17	7.57	0.17	7.43	0.22
Girls	6.00	0.16	7.90	0.15	7.89	0.26

Table 4: Adjusted* amount of time (hours per day) spent in sedentary behaviors[†], by subgroup; National Health and Nutrition Examination Survey, 2003-2004

			A	ge		
	6-11	years	12-15	years	16–19	years
	Mean	SE	Mean	SE	Mean	SE
SES						
\$0-24,999	5.97	0.17	7.75	0.16	7.61	0.21
\$25,000-54,999	5.64	0.15	7.81	0.15	7.59	0.25
≥\$55,000	6.18 [§]	0.18	$7 \cdot 55^{\$}$	0.17	7.82 [§]	0.27
BMI						
Normal weight	5.71	0.17	7.76	0.16	7.69	0.24
Overweight/obese	6.07	0.14	7.70	0.16	7.58	0.24

Table 4 (continued)

* Models were adjusted for gender, age group, race/ethnicity, SES, BMI.

[†]Sedentary behaviors assessed by Actigraph (Actigraph, LLC; Ft. Walton Beach, FL) Model 7164 accelerometer over the right hip on an elasticized belt for 7 days. Sedentary behaviors was estimated as the amount of time accumulated below 100 counts per minute during periods when the monitor was worn.

[‡]Non-Hispanic Black significantly different from non-Hispanic White (P < 0.05).

[§]Fewer than 50 observations in a cell, estimate may be unstable.

engaging in physical activity at higher levels than non-Hispanic Whites. Present findings are inconsistent with findings of higher rates of poor health outcomes associated with low levels of physical activity in racial/ethnic minority groups compared to non-Hispanic Whites (9,11). However, if a population-level change in physical activity has occurred recently, sufficient time may not have elapsed to observe changes in health outcomes associated with physical activity.

The largest disparities in achievement of the physical activity recommendation were observed by gender, which has been previously documented (5). There was also a marked decline in physical activity as age increased regardless of race/ethnicity, gender, SES, or weight status. No major differences in achievement of the physical activity recommendation were observed by weight status. Because previous cross-sectional studies of physical activity by weight status have been inconsistent (20), present findings of few differences are not surprising. whitt-glover et al \cdot activity disparities among youth 5319

The lack of differences in sedentary behaviors across racial/ethnic groups is inconsistent with other national studies, which show higher levels of television viewing by racial/ethnic minorities (21,22). Although earlier studies consistently showed that overweight and obese youth watched more television than healthy-weight youth (22,23), present findings also suggest that total sedentary time may not be related to weight status. Again, these findings could be explained by the accelerometer providing a more accurate estimate of total sedentary time across all domains and settings compared to self-report methods. Many hours of sitting in school across all subgroups could also have obscured differences between groups in non-school sedentary behaviors. Potential disparities in specific sedentary behaviors, including television watching, should be further examined using appropriate objective measures.

CORRELATES OF PHYSICAL ACTIVITY IN SUBGROUPS OF YOUTH

An understanding of correlates of behavior is important for explaining disparities in physical activity participation. Based on ecological models, main categories of correlates include demographic; behavioral; psychological, cognitive, and emotional; social and cultural; and environmental (objective and perceived). An improved understanding of correlates may inform the design of interventions to increase physical activity in targeted subgroups (e.g., what works for girls may not work for boys). Examining mean differences in correlate variables may provide additional information that could explain disparities in behavior. For example, perceived athletic coordination may be correlated with physical activity among both normal weight and overweight youth (24), but lower mean levels of coordination among overweight youth could help explain physical activity disparities. Comprehensive reviews of physical activity correlates in youth have been conducted for articles published in English prior to 2000 (25–27). We identified additional papers published since 2000, and these papers are summarized below.

Only three studies since 2000 (28–30) have compared physical activity correlates among youth by racial/ethnic groups. Collectively, these data showed that encouragement by parents to be active,

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reported enjoyment of physical education classes, self-efficacy, perceived behavioral control, and participation in sports teams were positively associated with physical activity participation. Selfreported television viewing was inversely associated with physical activity participation, and more strongly correlated with physical activity among Blacks compared to other racial/ethnic groups. Social cognitive theory variables, including self-efficacy, tended to be more strongly associated with physical activity among non-Hispanic Whites compared to other racial/ethnic groups, whereas enjoyment and parental encouragement tended to be more strongly associated with physical activity among Blacks.

Six studies published since 2000 (31–36) investigated genderspecific physical activity correlates. Studies included a wide variety of correlates that were associated with physical activity, including modeling and support from family and friends, perceived enjoyment and benefits of physical activity/physical education, and perceived barriers to physical activity. No consistent pattern emerged across studies when comparing gender-specific physical activity correlates.

Two studies published since 2000 (24,30) examined physical activity correlates by weight status (i.e., normal weight vs. overweight/obese). Only one identified differences in correlates by weight status and reported that, for vigorous-intensity physical activity, the single significant correlate for physical activity for overweight boys and girls was greater athletic coordination ($R^2 = 0.49$ for overall model, P < 0.0001) (24). For non-overweight youth, greater family support, greater peer support, greater athletic coordination, and fewer barriers were positively associated with physical activity ($R^2 = 0.27$ for overall model, P < 0.0001) (24).

Unequal access to activity-friendly environments may help explain socioeconomic and racial/ethnic disparities in physical activity among youth from low-income and racial/ethnic minority populations (37,38). Several studies have reported positive associations of the presence of stores, pleasant neighborhood aesthetics (39), and sidewalks (40–43) with active commuting to school and overall physical activity (44) among youth. Similarly, adolescents with access to public parks (45) and public and commercial recreation facilities (37,38) generally have higher levels of physical activity, although there is some indication that crime and perceptions of whitt-glover et al \cdot activity disparities among youth 5321

unsafe conditions are significant barriers to physical activity among adolescents (46–49).

We found few studies that reported environmental correlates of physical activity for subgroups of youth. A study by Gordon-Larsen et al. (37) is the only one to demonstrate that disparities in availability of recreation facilities partially explain racial/ethnic and socioeconomic disparities in reported physical activity and overweight status among adolescents. Gordon-Larsen et al. (37) found that census block groups (usually small land areas (50)) with higher concentrations of non-college-educated and minority populations were less likely to have one or more recreation facilities. Relative odds of overweight status among youth (BMI≥95th percentile on CDC growth curves (51)) decreased when one or more facilities were available, and odds of achieving five sessions of moderate-tovigorous physical activity per week increased with the availability of one or more facilities. Additional studies indicate that disparities in reported physical activity by subgroups among adolescents (particularly SES and race/ethnicity) may be attributed to fewer available recreation facilities in low-SES and racial/ethnic minority areas (38,52). Other national studies show that fewer commercial and public recreation opportunities are also available in low-income and racial/ethnic minority areas (53,54).

Size and quality of recreation facilities may be even more important than mere availability of recreation facilities (48). Unfortunately, findings from regional or local area studies are inconsistent. A study of selected census tracts (50) in three regions of the United States (i.e., Maryland, New York, and North Carolina) found that density of private recreation facilities was greater in census tracts that were >60% White and had the wealthiest populations than racial/ethnic minority and low-income tracts, although parks were equitably distributed (55). By contrast, a similar study of 833 census blocks in Maryland found that, in census blocks that were mostly minority (71%-100% non-White), the census blocks with the smallest parks and the lowest mean number of parks per block were composed of primarily of non-White, highincome residents (56). Estabrooks et al. (57) found no differences in the number of "pay-for-use" facilities among SES groups, but high-SES neighborhoods had greater numbers of total facilities and "free-for-use" facilities. Wolch et al. (58) assessed park acreage

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per 1,000 children in Los Angeles and found census tracts that were at least 75% Black and 75% Latino had less acreage compared to census tracts where the majority of the population was White. Census tracts with a median income of less than \$20,000 had less park acreage per 1,000 children than tracts with a median income of \$40,000 or more. A study in Boston found that the proportion of youth living in poverty was negatively correlated with proximity to playgrounds (59). The study also demonstrated the importance of measuring quality and availability of physical activity facilities: race was not significantly correlated with distance to playgrounds, but proportion of Black residents was significantly associated with worse playground safety (related to construction and maintenance).

Although most studies reported fewer available physical activity resources in disadvantaged and mostly minority areas, some studies produced different results. In Melbourne, Australia, Timperio *et al.* (60) compared availability of open space with varying levels of access by SES and found no disparity. Ellaway *et al.* (61) found a greater number of play areas per 1,000 population (and per 1,000 child population) in disadvantaged areas in Glasgow, Scotland. Similar findings were reported by Nicholls (62), Lindsey *et al.* (63), and Talen (64), who found greater access to parks and trails among racial/ethnic minorities in US cities.

Even fewer studies have examined racial/ethnic and income disparities associated with urban form and perceptions of crime and safety. A recent study by Zhu and Lee (65) demonstrated the importance of such studies. They documented disparities in environments that support active commuting to school. Although high poverty and predominantly Hispanic school attendance areas had highly walkable streets (based on objective measures), these areas also exhibited greater risks from traffic crashes, more crime, less favorable levels of maintenance, and fewer amenities and aesthetic features conducive to walking and outdoor leisure. In their analysis of adolescent physical activity patterns, Gordon-Larsen et al. (47) reported both that the highest percentage of White adolescents lived in low-crime areas (46.9%) while the highest percentage of Blacks (58.1%) and Hispanics (41.5%) lived in highcrime areas, and that crime was negatively associated with physical activity. Findings from such studies are consistent with

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reports showing that racial/ethnic minorities generally rate their neighborhoods as less pleasant and less safe for physical activity than White respondents (66–68).

COMMENT: CORRELATES OF PHYSICAL ACTIVITY

Collectively, the data suggest that key correlates of physical activity appear to be parental involvement, enjoyment of physical education or physical activity, self-efficacy, access, and quality and location of physical activity-related resources, regardless of participant characteristics (e.g., race/ethnicity, gender). These findings have implications for programming focused on increasing physical activity in disparate subgroups, because similar correlates could be targeted for change in programs while altering the program approach to fit with the specific targeted subgroup (e.g., use of culturally appropriate music and role models for programs targeting specific racial/ethnic subgroups while focusing on similar correlates across subgroups). Additional research is needed to test this recommendation. Several studies documented that access to recreation resources was lower in low-income and mostly minority communities, which may help explain disparities in physical activity among youth. These findings suggest that interventions to create and enhance access to activityfriendly environments for children and adolescents could be effective in increasing physical activity. An important gap is the lack of research on correlates of sedentary behaviors.

INTERVENTION IMPLICATIONS

It may be argued that the present findings of few differences in physical activity and sedentary behavior among racial/ethnic minorities and low-SES subgroups (using NHANES data) suggest that there is no need for interventions targeting these groups. However, because these groups have particularly high rates of obesity and other inactivity-related diseases, as well as some evidence of reduced access to physical activity facilities, there is still a powerful health-related rationale for targeting physical activity interventions to low-income groups and communities of color. It is notable that few intervention studies have demonstrated success in increasing physical activity in high-risk demographic subgroups.

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Small sample sizes, unrepresentative samples, uncontrolled study designs, few comparable intervention and evaluation approaches, and primarily self-reported outcome measures have made identifying "evidence-based" or even "best practice" models difficult. This challenge is compounded by the tremendous heterogeneity within demographic subgroups (e.g., differences by tribal or national origin, urbanicity [that is, living in an urban environment], and acculturation within a single racial/ethnic group). This gap in the English language intervention literature reflects the daunting task of developing effective physical activity interventions in environments with the most disparities among subgroups (69).

A planned special issue of the American Journal of Health Promotion, devoted to reviews of the scientific literature on interventions among racial/ethnic minority children, adolescents, and adults, included reviews of studies published in English between 1985 and 2006 (S. Kumanyika, personal communication, August 2008). The reviews identified only 14 physical activity interventions targeting African Americans and 9 targeting Latinos, while 37 interventions targeted American Indians/Alaska Natives. It is noteworthy that only two studies – one among Latinos and the other among American Indians – targeted preschool children.

In general, sample sizes were small, and nearly all studies targeted only one racial/ethnic group, precluding comparisons in effectiveness by race/ethnicity. Intervention approaches also varied substantially. Many involved cultural adaptations (e.g., dance and music and other traditional ethnically grounded active recreational pursuits). Among African Americans, interventions have included school-based physical education enhancement, physical activity augmentation during the school day, after-school sports programs augmented by behavioral management, evening fitness center programs involving caregivers or entire families, and programs to limit television viewing. Only organized activity involvement was effective in increasing physical activity (70). Among Latinos, most studies were conducted in low-income school settings, with the remainder reporting on after-school programs. Group-, structured-, supervised-, and vigorous-intensity approaches appeared to be most effective in increasing fitness, but overall physical activity was either not measured or poorly measured. Interventions targeted to American Indians and Alaska Natives primarily involved traditional

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outdoor games and subsistence activities, walking, running, and physical education enhancement. The only reported impact in the review of strategies targeting American Indians/Alaska Natives was decreased television viewing and video game use.

Several studies provided examples of interventions targeting disparate groups through dissemination of programs in low-income schools. An evaluation of the Child and Adolescent Trial for Cardiovascular Health (CATCH) evidence-based physical activity and nutrition intervention in schools with predominantly lowincome Latino children demonstrated that fewer boys and girls exposed to the intervention became overweight or at-risk for overweight 2 years later (in grades 3-5) (71). Since the physical education component of CATCH was found to be the most sustainable of all program elements (72), the study suggests that activity-focused physical education may be an effective intervention for improving physical activity participation among children in elementary school. A minimal-intensity physical activity promotion approach separate from physical education delivery, Take 10!, developed in predominantly African-American schools, has also been documented to engage children in meaningful amounts of moderateto-vigorous physical activity through short sessions, as an integral part of the school curriculum (73,74).

POLICY AND INTERVENTION IMPLICATIONS

To eliminate health disparities, changes in policies that affect physical activity may be another necessary component in efforts to promote physical activity among high-risk youth. Definitive evidence of effective policy and programmatic strategies to eliminate disparities is not yet available. The sparse youth-focused intervention findings published to date have mainly involved structured schoolbased physical activity promotion and approaches to reducing television viewing. School-based physical activity represents a much greater proportion of total physical activity among children in racial/ ethnic minority and/or low-income communities than in other communities (1). Such structured group exercise intervention approaches as Take 10! and the physical education component of CATCH, which are relatively easy and inexpensive to implement in low-resource settings, may be particularly useful in addressing

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disparities (1). For example, in California, recent statewide crosssectional examination of the status of school-based policies and participation related to physical education and physical activity found that students in low-resource schools were moderately or vigorously active for only about 4–6 min of a typical 30-min physical education class (75). Few elementary schools had full-time physical education specialists on staff, and most in low-income areas had none. Despite the existence of physical education requirements in California and 47 other states, these mandates are rarely enforced or sufficiently funded because government priorities for student performance on standardized tests compete for students' time. Even if additional physical education minutes were legislatively mandated immediately, this mandate would not likely result in substantial increases in moderate-to-vigorous physical activity among lowincome children without attention to physical education quality improvements and accountability for adherence to the mandate. For many of the correlates of physical activity, it is not clear what policy implications are present. To clearly identify policies and agents for change as they relate to correlates of physical activity, we recommend the approach to community input illustrated by Taylor et al. (76).

CONCLUSIONS AND RECOMMENDATIONS

Disparities in physical activity participation exist, but it is not clear which population subgroups experience the greatest disparities. Previous research based on self-reports indicated the greatest disparities in physical activity participation were between racial/ ethnic subgroups. However, our secondary analysis of objectively monitored physical activity data from a national survey indicates the greatest disparities in physical activity among youth are by gender and age. Regardless of where disparities are greatest, correlates related to physical activity appear to be similar across youth population subgroups. In addition, secondary data analysis showed that, regardless of the subgroup studied, achievement of the physical activity recommendation was low and time spent in sedentary behaviors was high.

Additional theoretically based research is needed to clearly elucidate which factors contributing to disparities in physical activity

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are amenable to change via intervention. Studies are needed to document the extent of racial/ethnic and income disparities in features in the built environment that are relevant to physical activity, and to illuminate how such disparities shape patterns of physical activity among youth. There is also a need to develop and adopt measures that facilitate comparisons across different types of physical activity resources and different geographic and politicaljurisdictional contexts (56). Better definition of how subgroups are identified by race/ethnicity, income, gender, or weight status is needed. Future research should account for developmental differences; intensity and type of physical activity (e.g., light-, moderate-, and vigorous-intensity; aerobic, strength, flexibility); context (e.g., sports, recreation, transportation); and setting (e.g., community playground, neighborhood street, fitness facility, school).

Combined, the information presented above suggests that interventions focused on girls, on maintaining physical activity participation as age increases, and on improving safety and access to recreational facilities may be critical for eliminating disparities in youth physical activity and, possibly, obesity and other health outcomes. Because achievement of the physical activity recommendation was low within all subgroups, it is important to continue to implement and test population-wide approaches for increasing physical activity and improving health among youth. Finally, additional studies to guide policy and programmatic prescriptions should recognize differences in utilization between public or nonprofit vs. commercial facilities, regional differences, and interactions between race/ethnicity, SES, gender, and weight status.

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