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Regular physical activity has differential association with reduced obesity among diverse youth in the United States

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Abstract

This study examined whether daily or almost daily lower-intensity physical activity was associated with reduced obesity, among 4824 African American, Hispanic, and White youth assessed in fifth and seventh grades. Regular lower-intensity physical activity was associated with reduced obesity only among Hispanic and White males and only in seventh grade, and not among youth in fifth grade, females, or African American males or females. Findings from this study suggest that the reduced obesity risk generally attributed to physical activity may not be consistent across racial/ethnic and gender groups of early adolescents.

Keywords

adolescence, disparities, obesity, physical activity, race/ethnicity

Introduction

Although obesity has a complex etiology, programs that address childhood obesity typically target caloric expenditure, through the reduction in caloric intake and increase in physical activity. The targeting of physical activity is the hallmark of both large-scale programs with a national commitment (Let's Move!, 2011) and smaller-scale lifestyle interventions (e.g. Janicke et al., 2008; Sweat et al., 2012). However, the empirical support for these strategies may be less consistent than one would expect, given their ubiquitousness. In fact, there is mixed evidence supporting the proposition that physical activity is inversely associated with obesity in children. Whereas some studies on children and adolescents indeed have reported a beneficial relationship between increased physical activity and reduced obesity (Janssen and LeBlanc, 2010; Jiménez-Pavón et al., 2010; Norman et al., 2010), others have reported no relationship at all (Goran et al., 1997; Sallis et al., 2000; Treuth et al., 1998), and at least one study has reported a relationship between increased physical activity

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and increased obesity (Gazzaniga and Burns, 1993). Whereas differences in methodology may partially explain these mixed results, the relationship between physical activity and children's weight class has nonetheless been termed controversial by some (Goran et al., 1999; McMurray et al., 2000; Thibault et al., 2010). This study will, therefore, further examine the association between children's physical activity and obesity, and in addition, consider this association among diverse racial/ethnic groups at two points in early adolescent development.

The mixed findings on the relationship between physical activity and obesity in children are further complicated by the variability that occurs in both physical activity and obesity across race/ethnicity and gender. Physical activity is higher among male than female youth (Belcher et al., 2010; Gortmaker et al., 2012; McMurray et al., 2000) and precipitously declines during adolescence for both genders (Kimm et al., 2002). In addition to the lower prevalence of physical activity among adolescent girls, African American girls are less physically active than White girls (Kimm et al., 2002). Additionally, obesity is more than twice as frequent among African American and Hispanic compared to White children (Singh et al., 2010). Much of this disparity can be explained by the marked differences in socioeconomic resources that on average disfavor African American and Hispanic youth (Goodman, 1999; Goodman et al., 2003). However, higher socioeconomic status (SES) is differentially associated with obesity in specific racial/ethnic groups (Fradkin et al., 2014). In fact, in a study of close to 4000 African American, Hispanic, and White youth, higher SES was reported to be a risk factor among African Americans, with overweight increasing as family income rose (Alaimo et al., 2001).

Although studies have been informative as to differences in physical activity and obesity specific to race/ethnicity and gender, no study that we are aware of has examined the relationship between physical activity and obesity in childhood across groups defined by race/ethnicity, gender, *and their combination*. Furthermore, there are no studies that we know of that have examined the physical activity–obesity relationship in Hispanic youth, now the second largest racial/ethnic group in the United States. Finally, most research on physical activity in children has focused on moderate to vigorous activity, the type of physical activity that typically requires extra, purposeful effort, such as engaging in specific physical training activities or certain sports. Little attention has been paid to lower-intensity activity: activity that may be sustained over longer time and occurs regularly most days of the week (e.g. walking to and from school, bicycling in neighborhood, and outdoor play). Here, we refer to this as regular physical activity. Because regular physical activity may have been more commonly a part of children's lives in previous generations, when childhood obesity prevalence was also considerably less compared to today, it warrants further empirical examination.

Consequently, this study aims to examine the association between regular physical activity and obesity in a diverse sample, including the three largest racial/ethnic groups in the United States (African American, Hispanic, and White) and both genders at two times during early adolescence (ages 10–13 years), while controlling for socioeconomic differences. We focus on this early adolescent period because children commonly adopt weight-related behaviors around this time that sustain through adolescence into adulthood (Windle et al., 2004; World Health Organization (WHO), 2004). We test the hypothesis that regular physical activity is inversely associated with obesity regardless of race/ethnicity, gender, and age in early adolescence. A secondary aim is to examine whether there are differences in obesity and regular physical activity related to race/ethnicity and gender in early adolescence. Because this is a secondary aim, we refrain from hypothesizing potential main effects differences.

Method

We used data from Healthy Passages™, a multisite community cohort study of adolescent

health and health behaviors initiated in 2004 (Schuster et al., 2012; Windle et al., 2004). Data were collected from the same cohort of youth while in fifth grade and then 2 years later when they generally were in seventh grade. Institutional review boards at each research site and Centers for Disease Control and Prevention (CDC) approved the Healthy Passages study.

Participants

Participants were recruited from public schools in (1) 10 contiguous public school districts in and around Birmingham, Alabama; (2) 25 contiguous public school districts in Los Angeles County, California; and (3) the largest public school district in Houston, Texas. Eligible schools had an enrollment of at least 25 fifth graders, representing over 99 percent of students enrolled in regular classrooms in the three areas. To ensure adequate sample sizes of non-Hispanic African American, Hispanic, and non-Hispanic White youth, we took a random sample of schools using probabilities that were a function of how closely a school's racial/ethnic mix corresponded to the site's racial/ethnic target, as detailed elsewhere (Windle et al., 2004). Information was disseminated to the fifth graders in 118 selected schools, with 11,532 students, to bring to their parents (or caregivers). Permission to be contacted was returned by 6663, of which 5147 (77%) completed at least a youth interview. Exclusion criteria included not attending a regular academic classroom or having a parent who could not complete interviews in English or Spanish. The 6 percent who were not identified by their parents as being African American, Hispanic, or White (details below) were omitted from analysis, resulting in 4824 with the unweighted (weighted) distribution of 36 percent (30%) African American, 38 percent (47%) Hispanic, and 26 percent (23%) White, 51 percent (51%) females, and youth age $M = 11.11$ years (standard deviation (SD) = .56) at the fifth-grade assessment. Additional detailed demographic information appears elsewhere (Schuster et al., 2012). The retention at the seventh-grade assessment, at age $M = 13.06$ (SD = .59), was 93 percent, resulting in 4491 participants with an essentially identical distribution across race/ethnicity and gender as at fifth grade.

Procedures

The full Healthy Passages assessment protocol was completed with a child and parent separated in private spaces at their home or another setting by two trained interviewers using both computer-assisted personal interview and computer-administered self-interview methods (Windle et al., 2004). The parent could choose whether materials were presented in English or Spanish (prepared using standard back-translation methods). The same procedures were used for the seventh-grade assessment.

Measures

Obesity. Body mass index (BMI) calculations were based on weight and standing height obtained according to standard anthropometric protocols (CDC, National Center for Health Statistics, 1998) by trained and certified interviewers. Height was measured, with the participant in bare feet or socks, to the nearest millimeter using a portable stadiometer. Weight was measured to the nearest 0.1 kg using a Tanita electronic digital scale. Sex-specific ratios of children's weight for height by age (months) were calculated according to CDC guidelines (Kuczmarski et al., 2000), with obese defined as BMI ≥ 95th percentile.

Regular physical activity. One item adapted from the PACE+ Adolescent Physical Activity Measure was used to measure weekly frequency of regular physical activity (Prochaska et al., 2000): "On how many of the past 7 days did you exercise or take part in any kind of exercise or physical activity in which you were moving for at least 60 or more minutes?" This item has shown strong test–retest reliability (intraclass correlation coefficient (ICC) = 0.72) as well as moderate correlation with accelerometer ($r = 0.37$, $p < .001$) (Prochaska et al., 2001).

Response options ranged from 0 to 7 days. To obtain an indication of engagement in regular physical activity, that is, on at least 5 days in the week as recommended for this age group (Butcher et al., 2008), responses were dichotomized into regular (*5–7 days/week*) and non-regular (*<5 days/week*) physical activity.

Race/ethnicity. The parent was asked which one or more of seven racial/ethnic categories describe the child. The child was classified as Hispanic if so indicated regardless of other racial/ethnic indication. Children not categorized as Hispanic were classified as non-Hispanic African American, non-Hispanic White, or other (6%, which being of insufficient prevalence was excluded from analysis).

SES. Parent report of highest year of education completed in the household was used to index SES because it is the most stable indicator of SES (Williams and Collins, 1995) and is considered best for use with members of racial/ethnic minority groups, who do not receive the same financial gains for equivalent years of education as do Whites (Kaufman et al., 1997; Williams, 1999). Response was made among seven categories (*≤eighth grade, some high school, high school graduate, General Educational Development (GED), some college, 4-year college degree, >4-year college degree)*, but for purposes of these analyses, *high school graduate* and *GED* were aggregated.

Data analysis

All analyses were performed using the SPSS complex sampling module with weighted data to adjust for design and nonresponse weights, stratification by site, and clustering of participants within schools (see Windle et al., 2004, for details). In addition, longitudinal weights were applied that fully accounted for attrition from the fifth- to seventh-grade assessment. The analysis sample consisted of youth who provided data on all variables of interest (obesity, physical activity, SES, race/ethnicity, gender) at both the fifth- and seventh-grade assessments. The general analysis approach relied on cross tabulations to estimate prevalences and logistic regression to estimate associations between physical activity and obesity in different groups. Odds ratios (ORs) were always tested with 95 percent confidence intervals (CIs).

The *primary aim* was addressed by one set of crosstab and logistic regression analyses that tested differences in obesity prevalence at regular versus non-regular physical activity levels within subgroups of race/ethnicity and gender, repeated at two ages in early adolescence. SES was included as a covariate in these analyses. However, to provide a context for these results, we first report a set of analyses that addressed the *secondary aim* regarding the prevalence of obesity and regular physical activity among racial/ethnic and gender groups, again repeated at two ages and controlling for SES. Whereas prevalences for all subgroups are provided in Table 1, because this is not the primary aim, we only present here the test statistics comparing across racial/ethnic groups within the same gender.

Results

Secondary aim: prevalence of obesity and regular physical activity

As shown in Table 1 and Figure 1, at both the fifth- and seventh-grade assessments, African American females had a higher obesity prevalence than White females (fifth-grade OR = 2.28, 95% CI (1.40–3.72); seventh-grade OR = 2.20, 95% CI (1.31–3.69)), whereas Hispanic and African American males had a higher obesity prevalence than White males (Hispanic fifth-grade OR = 2.80, 95% CI (1.66–4.71); seventh-grade OR = 2.66, 95% CI (1.61–4.42); African American fifth-grade OR = 1.76, 95% CI (1.04–2.98); seventh-grade OR = 1.89, 95% CI (1.18–3.03)). There were no other significant differences in obesity among racial/ethnic groups within same-gender groups at fifth or seventh grade.

As also shown in Table 1 and Figure 2, there were no significant racial/ethnic differences in

Table 1. Obesity, physical activity, and socioeconomic prevalences (weighted %).

	(Weighted *N*)[a]	Obese (≥95th percentile BMI)	Regular physical activity (5–7 days/week)	Higher SES (≥college degree)
Fifth-grade assessment[b]	(3817)	26.0	24.5	29.2
Female[b]	(1877)	24.4	22.5	26.8
African American	(575)	31.6	19.6	21.5
Hispanic	(883)	23.9	23.0	8.8
White	(419)	15.4	25.4	71.9
Male[b]	(1940)	27.7	26.5	31.6
African American	(609)	25.7	27.7	25.7
Hispanic	(831)	36.1	24.4	11.0
White	(500)	16.0	28.6	72.9
Seventh-grade assessment[b]	(3801)	23.7	33.1	29.5
Female[b]	(1871)	23.7	28.6	27.2
African American	(571)	30.6	32.0	22.6
Hispanic	(886)	23.8	20.9	10.0
White	(414)	13.9	40.4	70.4
Male[b]	(1930)	23.8	37.4	31.8
African American	(598)	22.9	40.7	27.1
Hispanic	(841)	30.8	27.8	11.2
White	(491)	12.8	50.0	72.6

SES: socioeconomic status; BMI: body mass index.
SPSS complex sampling results for dichotomous variables expressed as weighted %. Assessments conducted in fifth and seventh grades with the same participants.
[a]Weighted *N* based on sampling plan specific to each assessment.
[b]Aggregated racial/ethnic proportions in this sample are not representative of US population distribution.

regular physical activity prevalence for either gender at the fifth-grade assessment. At seventh grade, Hispanic females and males had a significantly lower prevalence of regular physical activity compared to their White gender counterparts (female OR = 0.45, 95% CI (0.31–0.65); male OR = 0.55, 95% CI (0.38–0.79)). There were no other significant differences in regular physical activity among racial/ethnic groups within same-gender groups at seventh grade.

Primary aim: associations between obesity and regular physical activity

Obesity prevalences at regular and non-regular physical activity levels and corresponding ORs are presented in Table 2 for overall sample and gender groups at both assessments. Among the sample as a whole in fifth grade, disregarding race/ethnicity and gender, there was no significant difference in obesity prevalence between youth of regular versus non-regular physical activity ($p = .96$). At the seventh-grade assessment, youth with regular physical activity had a lower prevalence of obesity than youth with non-regular physical activity (20% vs 26% obesity, OR = 0.77, 95% CI (0.64–0.94)). Among females at both fifth and seventh grades, as well as males at fifth grade, there was no significant difference in obesity prevalence between youth reporting different levels of regular physical activity. At seventh grade, males with regular physical activity had a lower prevalence of obesity than males with non-regular physical activity (18% vs 28% obesity, OR = 0.62, 95% CI (0.48–0.80)).

Obesity prevalences at regular and non-regular physical activity and corresponding ORs are presented in Table 2 for racial/ethnic and gender subgroups and depicted graphically

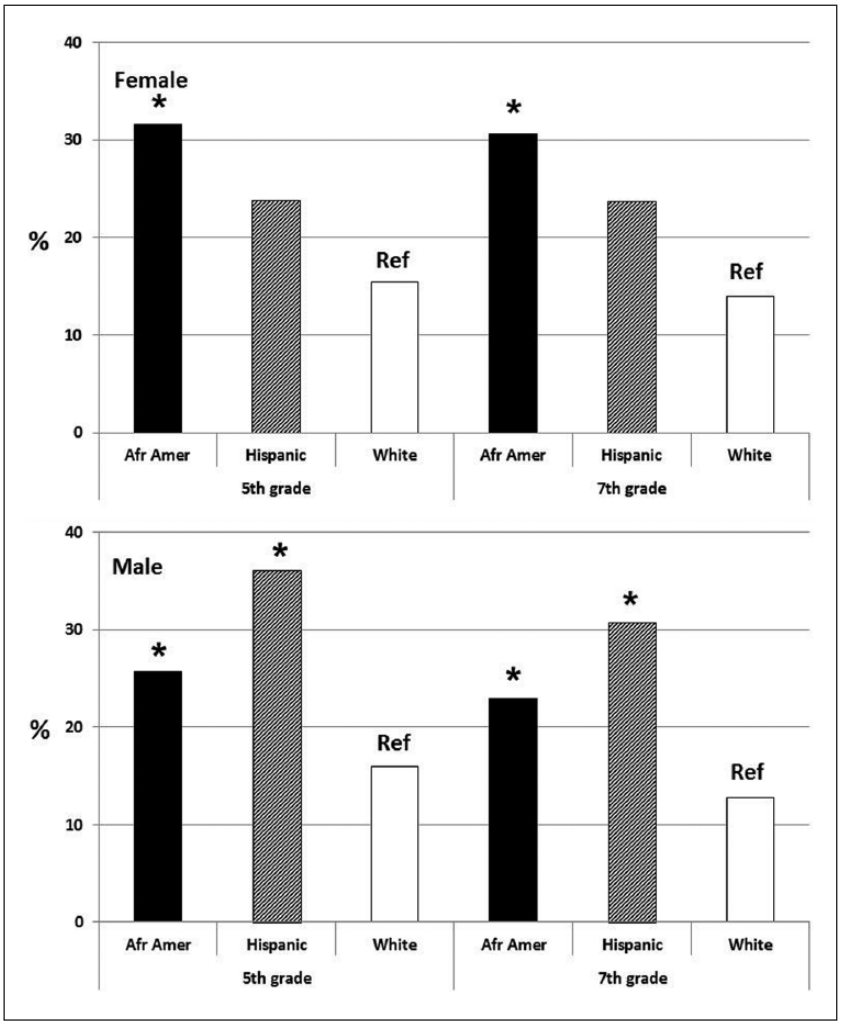

Figure 1. Obesity prevalence across race/ethnicity and gender at fifth- and seventh-grade assessments.
Afr Amer: African American; Ref: reference category = White.
Symbol "*" denotes statistically significant ($p < .05$) odds ratio (OR) as referenced to White group (Ref) in each grade; socioeconomic status included as a covariate.

in Figure 3. Among females at both fifth and seventh grades, as well as males at fifth grade, there was no significant difference in obesity prevalence between youth at different levels of regular physical activity within any racial/ethnic group. At seventh grade, however, Hispanic and White, but not African American, males with regular physical activity had a significantly lower prevalence of obesity compared to their racial/ethnic counterparts with non-regular physical activity (Hispanic: 23% vs 34% obesity, OR = 0.57, 95% CI (0.40–0.80); White: 8% vs 17% obesity, OR = 0.45, 95% CI (0.24–0.82)). To further examine for differences between racial and ethnic groups, sensitivity analysis (not shown) found statistically significant evidence of interactions of race/ethnicity with physical activity on obesity in seventh grade, which were consistent with these results.

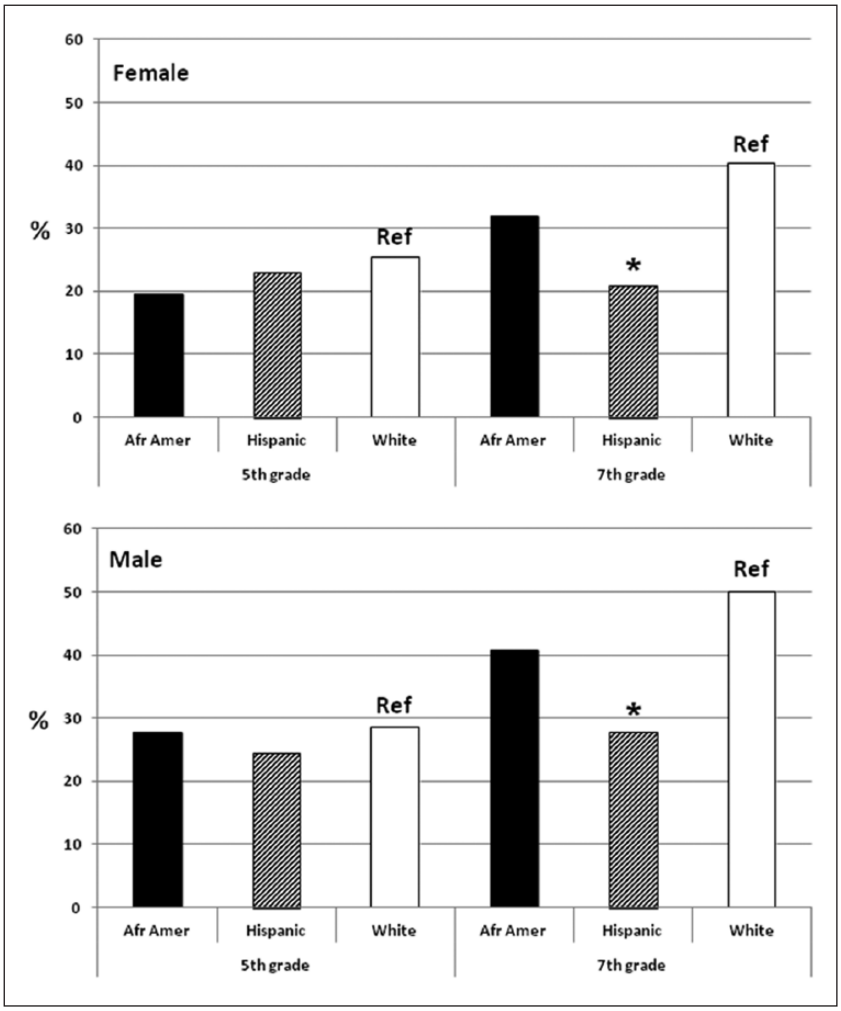

Figure 2. Regular physical activity prevalence across race/ethnicity and gender at fifth- and seventh-grade assessments.
Afr Amer: African American; Ref: reference category:.
Symbol "*" denotes statistically significant ($p < .05$) odds ratio (OR) as referenced to reference-category group (Ref) in each grade; socioeconomic status included as a covariate.

Discussion

These results show that physical activity manifested for 60 minutes a day on at least 5 days/week is associated with obesity differently across racial/ethnic groups, gender, and age during early adolescence. Of the six demographic groups examined (3 racial/ethnic × 2 gender groups) at two time points, this type of regular physical activity was significantly associated with reduced obesity risk for only Hispanic and White males and only in seventh grade. There was an absence of significant associations between regular physical activity and obesity in early adolescence for African American youth of either gender as well as for females and fifth-grade youth of any race/ethnicity. Thus, the hypothesized reduction in obesity associated with physical activity received relatively weak, and certainly not universal,

Table 2. Comparison of obesity prevalence (%) by physical activity level for racial/ethnic and gender groups at fifth- and seventh-grade assessments.

Physical activity level	Females			Males			Females[a]	Males[a]	Total sample[a]
	African American	Hispanic	White	African American	Hispanic	White			
Fifth grade									
Regular	33.1	24.2	8.8	26.3	36.7	18.4	22.7	28.2	25.7
Non-regular	31.3	23.8	17.7	25.5	35.9	15.0	24.9	27.5	26.2
OR	1.09	1.02	0.47	1.05	1.03	1.30	0.89	1.07	1.00
(95% CI)	(0.69–1.71)	(0.67–1.56)	(0.15–1.47)	(0.65–1.67)	(0.74–1.44)	(0.74–2.28)	(0.67–1.19)	(0.86–1.33)	(0.83–1.20)
Overall	31.6	23.9	15.4	25.7	36.1	16.0	24.4	27.7	26.0
Seventh grade									
Regular	28.9	27.1	10.6	22.4	22.6	8.1	22.5	17.6	19.7
Non-regular	31.4	23.0	16.2	23.2	34.0	17.4	24.2	27.5	25.7
OR	0.89	1.30	0.61	0.96	**0.57**	**0.45**	0.99	**0.62**	**0.77**
(95% CI)	(0.58–1.35)	(0.82–2.06)	(0.23–1.58)	(0.60–1.53)	**(0.40–0.80)**	**(0.24–0.82)**	(0.73–1.33)	**(0.48–0.80)**	**(0.64–0.94)**
Overall	30.6	23.8	13.9	22.9	30.8	12.8	23.7	23.8	23.7

OR: odds ratio; CI: confidence interval.
Values in bold indicate significant OR, at $p < .05$, with Regular referenced to Non-regular physical activity level, and socioeconomic status included as a covariate.
[a]Aggregated racial/ethnic proportions in this sample are not representative of US population distribution.

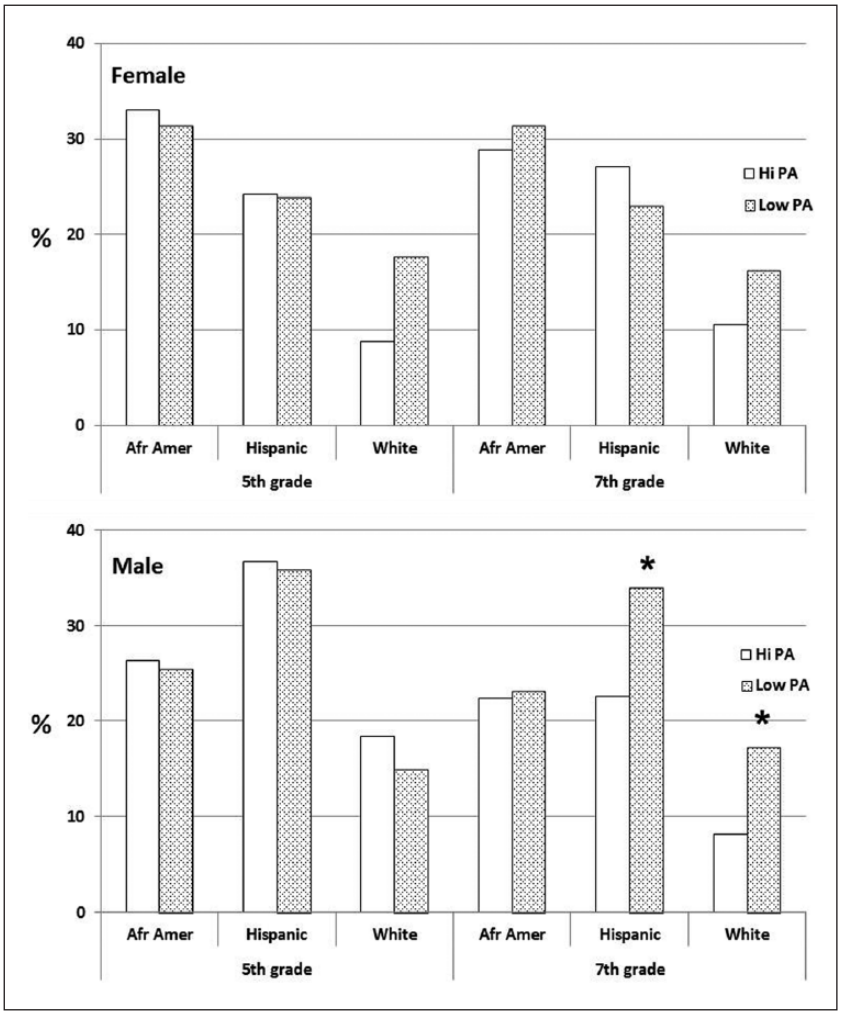

Figure 3. Obesity prevalence across regular physical activity level for racial/ethnic and gender groups at fifth- and seventh-grade assessments.
Afr Amer: African American; Hi PA: regular physical activity (5–7 days/week); Low PA: non-regular physical activity (<5 days).
Symbol "*" denotes within-groups statistically significant ($p < .05$) odds ratio (OR) comparing regular as referenced to non-regular physical activity group; socioeconomic status included as a covariate.

support in this study. Rather, these findings appear more consistent with those studies that have described the relationship between obesity and physical activity in children as "controversial" (Goran et al., 1999; McMurray et al., 2000; Thibault et al., 2010). Because SES was a covariate in the analyses, the observed relationship between regular physical activity and obesity is independent of the marked racial/ethnic differences in SES.

As a secondary aim, this study also examined differences in obesity and regular physical activity in relation to race/ethnicity and gender in early adolescence. We found that African American females and Hispanic males are at higher risk for obesity compared to their same-gender cohorts, which is consistent with prior research (Singh et al., 2010). So is the present finding of a lower prevalence of physical activity among African American youth of both

gender, as well as Hispanic females, compared to their same-gender White peers, but only in seventh grade (Kimm et al., 2002). Thus, we confirm disparities in these important health indicators.

The finding that regular, daily, or almost daily physical activity is not consistently associated with reduced obesity is counter to the expectation that healthy weight in children is in part related to energy expenditure. Although the etiology of obesity is complex, this expectation has been fostered by weight management approaches built on reducing children's obesity through improved quality of diet and quantity of physical activity. With regard to activity, our findings suggest that this approach may not be as well founded as desired, at least for some groups of children for whom obesity appears not to be associated with regular physical activity (60 minutes on at least 5 days/week). Indeed, another study of the Healthy Passages cohort found that days per week of vigorous exercise did not predict either exit from or entry into obesity from fifth to tenth grade (Schuster et al., in press). These findings may bring into question the universal utility of healthy weight promoting public programs (e.g. Let's Move!, 2011) built solely upon platforms of reducing unhealthy weight through "improving children's diet and increasing exercise." One might wonder whether programs such as these are sufficient or whether they may be under-serving racial/ethnic and gender subgroups of particularly high risk (e.g. African American females).

Whereas other studies have examined the relationship between physical activity and obesity focusing on higher levels of activity (moderate to vigorous), our study is the first that we are aware of that has focused on lower-intensity regular physical activity to reflect everyday activity in children. It may be that this level of physical activity was not of sufficient intensity to reduce obesity, despite being reported to occur for at least 60 minutes on at least 5 days a week. This may imply that intensity rather than duration of activity is more relevant to weight status. Further research is certainly needed to identify at what intensity, duration, and regularity physical activity become associated with reduced obesity. However, our findings are consistent with at least one recent meta-analysis on the efficacy of school-based physical activity and nutritional education interventions in reducing the BMI of children and adolescents (Guerra et al., 2014). This review of 38 studies found that school-based physical activity and nutritional education interventions offered no statistically significant benefits of BMI reduction in children. These findings further support the position that the common approach to weight management focused solely on improving children's diet and activity may not be sufficient (Schwartz and Brownell, 2010).

This study aimed to examine the association between physical activity and obesity with a sample balanced for race/ethnicity and gender in early adolescence. Previous studies have examined racial/ethnic and gender differences in obesity (Singh et al., 2010) and physical activity (Kimm et al., 2002). However, surprisingly, ours is the first we are aware of that examined the association between physical activity and obesity in adolescence where race/ethnicity and gender were examined in combination. In addition, we examined these relationships at two points in early adolescent development, in fifth and seventh grades. Not finding any relationship between regular physical activity and obesity for any groups examined in fifth grade points to a hypothesis that this association may manifest in some segments of youth—Hispanic and White males only—not until sixth or seventh grade, at about ages 11–13 years. It is conceivable that the introduction of sports in schools around this time, probably more so for males than females, may play a role in this developmental observation.

Among limitations in this research is that causality cannot be determined from these correlational findings. Also, because the Hispanic portion in the study has familial roots primarily in Mexico and to a lesser extent Central America and because of the heterogeneity within this ethnic group, findings should not be generalized to Hispanics with other origins. Additionally, the validity of young adolescents self-reporting

their physical activity may be of concern. When compared to objectively measured physical activity (e.g. by accelerometer), adolescents appear to over-report weekly physical activity (Slootmaker et al., 2009). There may also be variability of self-reporting across gender, because adolescent females appear to over-report activity at a slightly higher rate than males (Slootmaker et al., 2009). Although this would likely not be feasible in large-sample studies such as ours, further research into the role of physical activity in obesity in youth should include more objective measurements.

Furthermore, in lieu of the differential association between regular physical activity and obesity across groups in this as well as other studies, future research should consider additional modifiable influences on obesity. Variables such as parenting style, child's self-esteem and quality of life, and family structure are just a few potential moderators that are understudied as to their influence on obesity among youth. In addition, environmental resources should be considered, such as the availability of activity-promoting after-school programs such as sports, gymnastics, swimming, and dance, and how the built environment encourages, or not, engaging in physical activity. In examining these influences, research should assess these and other variables within racial/ethnic and gender subgroups, under the assumption that these mechanisms vary across such groups. Whereas the prospect of separate analyses within specific racial/ethnic and gender subgroups may be challenged by statistical power requirements, this approach is needed in the assessment of weight-risk mechanisms in the United States if we wish to gain a higher understanding of the complexities of weight risk among youth.

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