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The Modifying Effects of Race/Ethnicity and Socioeconomic Status on the Change in Physical Activity From Elementary to Middle School

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A B S T R A C T

Purpose: Youth physical activity (PA) levels differ by race/ethnicity and socioeconomic status (SES). It is well established that various multilevel factors may influence changes in PA. The present study examined whether the association between the change in individual, interpersonal, and environmental factors and the change in PA is modified by race/ethnicity or SES.
Methods: This study followed 643 youths and their parents from suburban and rural South Carolina participating in the Transitions and Activity Changes in Kids (TRACK) Study in 2008–2009 and 2010–2011. We assessed total PA in youth using accelerometry and categorized youth and parent survey data into blocks based on the socioecological model. Multivariate regression growth curve models evaluated whether the association between change in independent variables and change in PA was modified by race/ethnicity or SES.
Results: PA declined from fifth to seventh grade among all racial/ethnic and SES groups. Associations between the range of variables and change in PA were modified by race/ethnicity but not SES. Blacks did not share any common predictors of change in PA with whites or Hispanics. However, child-reported number of active friends was associated with total PA, and enjoyment of PA was associated with change in PA among both whites and Hispanics. Significant interactions by time varied by racial/ethnic group.
Conclusions: The factors that influence changes in youth PA vary by race/ethnicity but not SES. These findings reinforce the complex nature of addressing PA behavior in diverse samples and further support the need for culturally appropriate interventions to promote PA in youth.

IMPLICATIONS AND CONTRIBUTION

This study examined a wide array of multilevel factors on the change of physical activity in youth. Significant differences by race/ethnicity existed, further supporting the need to address specific needs of populations and not a one-size-fits-all method of behavioral change in youth.

Conflicts of interest: The authors have no conflicts of interest to disclose.
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Regular physical activity (PA) is essential for lifetime health and wellness as it lowers the risk of multiple chronic health conditions [1]. In youth, PA promotes cardiorespiratory fitness [2] and cognitive development [3] and decreases anxiety and depression [2]. Although the health benefits of PA are well established, the majority of U.S. youth do not meet the public

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health recommendations of at least 60 minutes of daily moderate- or vigorous-intensity PA (MVPA). Unfortunately, longitudinal studies have shown that PA levels during childhood tend to decrease as children age [4], and PA patterns in adolescence may extend into adulthood [5], further emphasizing the importance of increasing (or at least maintaining) PA in youth.

In an effort to better understand PA behavior, studies have examined individual (e.g., self-efficacy), interpersonal (e.g., social support), and environmental (e.g., PA equipment at home) factors that influence the decline in PA in youth [6,7]. These factors may be further influenced by sociodemographic dynamics, such as race/ethnicity and socioeconomic status (SES). Black youth spend more time engaged in MVPA than white and Hispanic youth [8], yet also spend the most time involved in sedentary behaviors [9]. Furthermore, studies have identified differences by race/ethnicity in factors that influence PA participation. One cross-sectional study found that perceived transportation barriers were related to PA in Hispanic girls, whereas social support for friends was among the factors related to PA in black and white girls [10]. Pate et al. [11] examined declines in PA from sixth to eighth grade and found black girls declined more than white or Hispanic girls. These racial/ethnic differences may be rooted in social factors such as racial discrimination—interpersonal racial discrimination, which can manifest as emotional distress due to increased psychological stress and increase the risk of unhealthy behaviors including physical inactivity, or institutional racial discrimination from residential segregation, which may restrict access to quality PA resources [12].

Another social factor associated with race/ethnicity is SES. At present, the understanding of how SES is related to cross-sectional and longitudinal PA in youth is less clear but may be related to access [12,13]. SES has a broad spectrum of proxy definitions, including commonly used parent education and poverty index, a more objective measure developed from Census or neighborhood-level data. It is hypothesized that these social factors influence access to health care resources, which can reduce engagement in healthy behaviors [12]. A recent systematic review of 62 studies from across the world found no apparent uniform association or effect of SES on PA in adolescence [14]. However, six of the seven studies from the United States found proxies of SES to be statistically significantly associated with various measures of PA behavior. A more recent study of a nationally representative sample of U.S. youth that was not included in the systematic review demonstrated that youth of parents with only a high school education are less physically active than youth of college-educated parents, and the gap by SES is growing [15].

To guide the development of interventions designed to increase PA in youth, researchers and health professionals need to better understand the role race/ethnicity and SES play in influencing multiple levels of factors associated with PA. To our knowledge, no study has examined which factors are related to the decline in PA across race/ethnicity and SES in a sample of U.S. adolescents. Therefore, the first aim of the present study was to examine in a diverse sample of youth whether race/ethnicity or SES differences existed in total PA and the change in PA from fifth to seventh grade. The second aim was to determine the modifying effects of race/ethnicity and SES on parent- and child-reported individual, interpersonal, and environmental factors that may influence the change in PA from elementary to middle school. We hypothesized that these relationships will vary by race/ethnicity and SES, which will provide additional insight into the documented differences in PA among youth.

Methods

Participants and setting

Participants were enrolled in Transitions and Activity Changes in Kids (TRACK), a prospective cohort study that examined PA levels in youth as they transitioned from elementary school in 2008–2009 to middle school in 2010–2011. The initial recruitment for TRACK yielded 1,083 fifth grade students in suburban and rural South Carolina. For the current analyses, we excluded students who did not report their race/ethnicity as non-Hispanic black, non-Hispanic white, or Hispanic (n = 187) and participants with missing data: accelerometry (n = 181), parent education (n = 16), or poverty index (n = 28). The final analysis sample included 643 youth (348 girls and 295 boys). The final analysis sample did not differ from the excluded sample by gender (54.5% vs. 54.1% girls), parent education (43.7% vs. 41.7% $\leq$ high school), baseline total PA (28.4 $\pm$ 4.47 vs. 27.9 $\pm$ 4.61 min/hour), or poverty index (16.5 $\pm$ 7.18 vs. 16.3 $\pm$ 6.77). The University of South Carolina Institutional Review Board approved the study protocol. Youth participants completed assent forms and parents provided consent for their child and their own participation [16].

Measures

Physical activity. We measured youth PA using the ActiGraph triaxial accelerometer (models GT1M and GT3X; Pensacola, FL). Participants wore the monitor for seven consecutive days at three different time points (fifth, sixth, and seventh grades). The accelerometer was attached to an elastic belt and worn over the right hip, anterior to the iliac crest. Participants were instructed to wear the monitor at all times except during water activities (i.e., swimming, bathing) and sleeping. The accelerometers recorded data in 1-minute intervals. We calculated time spent in sedentary, light, moderate, and vigorous PA using cut points developed by Freedson et al. [17] and total PA by summing the total minutes per day spent in light, moderate, and vigorous intensity activities [18]. Owing to the volume of total PA, this variable is presented as minute/hour. Participants who had >8 hours of wear time on at least 2 days of the week were included in the analyses.

Race/ethnicity and socioeconomic status. Youth self-reported their race, choosing from seven options including "other," and their ethnicity (Hispanic or Latino or non-Hispanic or non-Latino). We collapsed the responses from those two questions into race/ethnicity categories: non-Hispanic black (hereafter referred to as black), non-Hispanic white (hereafter referred to as white), Hispanic or Latino (hereafter referred to as Hispanic), and "other." Owing to the variability of race/ethnicity included in the "other" category, we only used the first three categories in the current analyses.

Parental education and poverty index served as proxies for SES. Parents reported the highest level of education completed from six options, ranging from attends or has attended high school to completed graduate school. The final categories were >high school and $\leq$high school degree. We used "poverty status in the last 12 months" from the American Community

Table 1
Description, definition, and means (fifth grade) of variables from youth and parent survey by race/ethnicity

Variable	Operational definition	# of items (range)	Black	Hispanic	White
Child-reported individual variables					
Self-efficacy	Confidence to be physically active most days of the week	8 (1–5)	3.3 (.03)	3.2 (.07)	3.3 (.03)
Barriers	Barriers to physical activity	5 (1–5)	1.6 (.03)	1.6 (.05)	1.6 (.03)
Enjoyment	Enjoyment of physical activity	6 (1–4)	3.6 (.03)	3.6 (.07)	3.6 (.03)
Appearance	Motives for being physically active related to appearance	5 (1–4)	3.2 (.05)	3.1 (.09)	3.0 (.05)
Fitness	Motives for being physically active related to fitness	4 (1–4)	3.7 (.03)	3.7 (.06)	3.7 (.03)
Child-reported interpersonal variables					
Parent support	Parent support for physical activity	10 [1–5]	3.4 (.06)	3.3 (.12)	3.3 (.06)
Friend support	Friend support for physical activity	3 [1–5]	3.5 (.06)	3.4 (.12)	3.3 (.05)
# of active friends	Reported number of friends physically active on a regular basis	# reported	3.8 (.08)	3.6 (.16)	3.9 (.07)
Peer encouragement	Peer encouragement to be physically active	1 (1–5)	3.7 (.06)	3.8 (.12)	3.7 (.06)
Child-reported environmental variables					
PA equipment	Availability of physical activity equipment in home	1 (1–4)	3.1 (.06)	3.2 (.12)	3.5 (.05)
Environment	Neighborhood physical activity environment	9 (1–4)	3.0 (.04)	3.0 (.07)	2.7 (.04)
Parent-reported individual variables					
Child enjoy PA	Child enjoys physical activity	1 (1–4)	2.7 (.04)	2.7 (.09)	2.5 (.04)
Child enjoy PE	Child enjoys physical education	1 (1–5)	2.7 (.05)	2.7 (.11)	2.5 (.05)
Sports/active class participation (% yes)	# of organized sports and/or physically active classes or lessons child has participated in the past year	Yes or No	66.6%	59.7%	67.1%
Importance of child PA	How important it is for child to be physically active	1 (1–4)	3.7 (.03)	3.7 (.07)	3.6 (.03)
Parent-reported interpersonal variables					
Support for PA	Encourages child to be physically active	4 (1–5)	2.8 (.05)	2.9 (.10)	2.9 (.05)
Parent leisure time PA	How parent spends leisure time (i.e., time outside of work and free from duties and responsibilities)	4 (1–5)	2.6 (.04)	2.7 (.09)	2.4 (.04)
Parent sports	If and how often parent participates in sports	4–9 (varies)	2.0 (.05)	2.2 (.10)	2.1 (.04)
Parent enjoys PA	Parent's enjoyment of physical activity	1 (1–4)	3.4 (.05)	3.4 (.10)	3.1 (.05)
Parent-reported environmental variables					
Time to closest park	Time it takes to travel to the closest park	minutes reported	12.5 (1.1)	14.0 (2.0)	13.1 (.5)
See children outdoors	Sees other children playing outdoors in neighborhood	1 (1–4)	3.3 (.06)	3.0 (.14)	2.9 (.07)
PA equipment at home	Number of physical activity resources child has access to at home	# of checked equipment	5.0 (.13)	6.4 (.32)	7.3 (.15)
Sedentary equipment at home	Number of working TVs, VCR/DVD, computers/laptops, and/or video game consoles in home	Sum of 4 items	9.3 (.21)	8.5 (.38)	9.7 (.26)
Sedentary equipment in bedroom	Number of working TVs, computers/laptops, and/or video game consoles in child's bedroom	Sum of 3 items	1.4 (.06)	1.2 (.12)	1.2 (.06)
Rules	Parental rules related to sedentary behavior	3 (1–4)	2.3 0(.03)	2.5 (.06)	2.5 (.03)

PA = physical activity.

Survey [19], based on the Census tract of each residence to compute poverty index.

Anthropometry. Trained data collectors measured participants' height to the nearest 1.0 cm using a portable stadiometer (Shorr) and weight to the nearest .1 kg using a portable digital scale (Seca, Model 880). We calculated body mass index (kg/m^2) and determined body mass index percentiles using the Centers for Disease Control and Prevention growth charts [20].

Student and parent surveys. Self-administered youth and parent questionnaires assessed individual, intrapersonal, and environmental variables at three different time points: fifth, sixth, and seventh grades. Items on the parent survey paralleled items on the youth survey. Descriptions of each variable by race/ethnicity at fifth grade are shown in Table 1. Previous studies have used these surveys in similar populations [21–25].

Physical activity resource assessment (PARA). We used the PARA to examine the quality of the physical environment in each youth's neighborhood [26] and identified PA resources by county (schools, churches, parks/trails, and commercial facilities) using Internet search engines, yellow pages, and government Web sites. A trained data collector completed the PARA, which included assessments of features (i.e., baseball fields, sidewalks), amenities (i.e., restrooms, lighting), and incivilities (i.e., broken glass, graffiti) of each PA resource, on one occasion. We then created an index by multiplying the number of features by one minus the number of incivilities divided by seven.

Statistical analyses

We calculated means and standard deviations for all descriptive and anthropometric data, PA data, and youth and parent survey variables and used analysis of variance to examine differences in PA by race/ethnicity and SES. We then calculated Pearson product correlation coefficients for each of the youth- and parent-level variables for each race/ethnicity and SES category, separately, by grade level.

We categorized all time-varying youth and parent survey data into one of three blocks (individual, interpersonal, or environmental) and ran preliminary growth curve models using child-reported variables and then using parent-reported variables from each block. A liberal p value of .20 was used to determine which variables would be included in the final growth models.

Following the preliminary growth models, we ran two final models for each race/ethnicity group separately and calculated unconditional growth models (only time and time squared in model) to provide unadjusted, baseline models (model 1) for each of the three race/ethnicity groups. A second set of models included the time-varying youth- and parent-level variables for race/ethnicity, along with demographic variables (gender, parent

Table 2
Unadjusted PA levels by race/ethnicity and SES

Variable	Grade	Total PA (min/hr ± SE)	*p* values for variable × time interaction		
Race/ethnicity			Race/ethnicity	Time	Race/ethnicity × time
Black (n = 275; 43.1%)	5th	**29.1 ± .27**[a]	.0381	<.0001	.0782
	6th	**24.7 ± .28**[a]			
	7th	22.7 ± .29			
Hispanic (n = 72; 11.1%)	5th	27.9 ± .54			
	6th	24.2 ± .55			
	7th	23.0 ± .57			
White (n = 296; 45.8%)	5th	27.8 ± .26			
	6th	24.0 ± .27			
	7th	22.4 ± .28			
Parent education	Grade	Total PA (min/hr ± SE)	Parent education	Time	Parent education × time
≤High school (n = 295; 42.8%)	5th	28.7 ± .27	.0540	<.0001	.9781
	6th	24.7 ± .28			
	7th	22.9 ± .29			
>High school (n = 392; 57.3%)	5th	28.1 ± .24			
	6th	24.0 ± .24			
	7th	22.4 ± .25			
Poverty index[b]	Grade	Total PA (min/hr ± SE)	Poverty index	Time	Poverty index × time
	5th	23.3 ± .18	.9287	<.0001	.2207
	6th	24.3 ± .19			
	7th	22.7 ± .19			

PA = physical activity; SE = standard error; SES = socioeconomic status.
[a] Significant differences between black and white ($p < .05$).
[b] Poverty index is a continuous variable and based on the poverty status in the last 12 months based on the Census tract of each child's place of residence; this item appeared in the American Community Survey.

education), time, and interaction terms for the time-varying variables by time (model 2). Nonsignificant interactions were deleted and models were rerun.

For ease of interpretation, we centered the continuous variables by subtracting race/ethnicity-specific grand means of the variable and coded time as 0, 1, and 2. All models had two random statements, school and youth nested within school. We modeled the intercept and slope (i.e., time) as random effects and used an unstructured covariance matrix for all models. We estimated goodness of fit for each model using three statistics: deviance, Akaike information criteria, and Bayesian information criteria; lower values indicated better fit. We also estimated variance components for each model. To further explore significant interaction terms, we categorized time-varying variables into tertiles and reran the models to estimate PA over time.

Following the conditional growth curves run for each race/ethnicity, we ran a final model to confirm the results of the race/ethnicity-specific analyses. For the final model, we included any variable found to be significant in the preliminary models in each of the models stratified by race/ethnicity. We modeled both initial total PA and change in PA from fifth to seventh grade as outcomes and adjusted for gender, parent education, poverty index, and school as a random effect. We completed all analyses in 2015–2016 using SAS 9.4 (SAS Inc., Cary, NC).

Results

Table 2 presents unadjusted total PA levels by race/ethnicity and SES. Minutes/hour of total PA declined from fifth to sixth grade and remained stable from sixth to seventh grade among all racial/ethnic and SES groups. When examining the interactions of race/ethnicity and parent education (a proxy measurement of SES) with time, only race/ethnicity × time was statistically significant. Specifically, black youth had higher levels of PA than white youth at fifth grade (29.1 ± .27 vs. 27.8 ± .26 minute/hour, respectively) and at sixth grade (24.7 ± .28 vs. 24.0 ± .27 minute/hour, respectively); there were no differences between Hispanic youth and the other two racial/ethnic groups. Poverty index (another proxy for SES) varied between racial/ethnic groups; a greater percentage of blacks (19.2%) were in poverty than whites (15.4%; $p < .001$) or Hispanics (14.1%; $p = .004$). However, poverty index × time interaction was nonsignificant. Given the lack of statistically significant differences among both parent education and poverty index, growth curve analyses focused on race/ethnicity and adjusted for SES.

Table 3 presents results of the growth curve models adjusted for gender, SES, and school as a random effect. Among black youth, total PA was positively associated with parent report of child's enjoyment of physical education, parental support for their child's PA, parental sport participation, and PARA neighborhood index. Variables related to change in PA in black youth were self-efficacy, PA equipment, and parental sports participation. Figure 1 depicts a visual representation of interactions modeling change in PA by comparing the highest and lowest tertiles. Black youth with the highest level of self-efficacy had higher total PA in grade 7 and experienced less of a decline from fifth to seventh grade compared with blacks with the lowest level of self-efficacy (Figure 1A). Black youth with the highest access to home PA equipment had lower PA in grade 7 and experienced a steeper decline between fifth and seventh grade than black youth with lowest access (Figure 1B), and black youth whose parents reported the highest amount of sport participation reported greater total PA in fifth grade but experienced a steeper decline in total PA than black youth with parents who reported the lowest amount of sport participation (Figure 1C).

Table 3
Adjusted models for total PA in fifth grade and change in PA from fifth to seventh grades by race/ethnicity[a]

Fixed effects	Black children (n = 275)		White children (n = 296)		Hispanic (n = 72)	
	Total PA	Δ in total PA	Total PA	Δ in total PA	Total PA	Δ in total PA
Intercept	**27.79 (.72)*****		**25.88 (.65)*****		**26.98 (1.44)*****	
Time	**−5.84 (.58)*****		**−4.70 (.48)*****		**−5.49 (.83)*****	
Time × time	**1.35 (.27)*****		**.99 (.23)*****		**1.55 (.39)*****	
Gender	**3.26(.43)****		**1.25 (.41)****		1.62 (.92)	
Parent education	.88 (.42)*		.49 (.42)		1.61 (.92)	
Poverty index	−.04 (.03)		.02 (.03)		−.06 (.08)	
Child-reported variables						
Self-efficacy	.21 (.44)	**.88 (.34)***				
Barriers			.67 (.49)	**−1.07 (.42)***		
Enjoyment			.42 (.43)	**−.83 (.34)***	−.40 (.67)	**1.11 (.48)***
# of active friends			.26 (.12)*		**.53 (.23)***	
PA equipment	.32 (.21)	**−.62 (.16)*****				
Parent-reported variables						
Child enjoys PA			1.07 (.24)***			
Child enjoys PE	**.45 (.19)***					
Child sport/active class participation			1.16 (.36)**			
Support for PA	**.62 (.22)****					
Sport participation	**.73 (.32)***	**−.67 (.24)****				
See children outdoors					**1.04 (.40)***	**−.88 (.28)****
Objective variable						
PARA index	**.02 (.01)***					

$^{*}p < .05$; $^{**}p < .01$; and $^{***}p < .001$.
Goodness of fit metrics: deviance = 3489.5; AIC = 3529.5; BIC = 3549.5.
PA = physical activity; PARA = physical activity resource assessment.
[a] All models are adjusted for gender, parent education, poverty index, and school as a random effect; time-varying variables are centered for ease of interpretation. Only time-varying child-level and parent-level variables with a p value < .20 were retained for each race/ethnicity category.

Among white youth, total PA was positively associated with child-reported number of active friends, parent-reported child enjoyment of PA, and parent-reported child sport participation. Barriers to PA and enjoyment of PA were associated with change in PA. White youth who reported the greatest amount of barriers to PA in fifth grade had lower total PA in grade 7 compared with white youth with the least PA barriers (Figure 2A). White youth with the highest level of PA enjoyment reported lower PA in grade 7 than those with the lowest level of PA enjoyment (Figure 2B).

Among Hispanic youth, total PA was positively associated with child report of number of active friends and parent report of seeing other children outdoors. Factors associated with change in PA were child report of PA enjoyment and parent report of seeing children outdoors. Hispanic youth with the lowest level of PA enjoyment reported more total PA in fifth grade, but lower total PA in seventh grade than Hispanic youth with the highest level of enjoyment (Figure 3A). Hispanic youth with parents who reported seeing the most number of children outdoors had greater total PA in fifth grade but lower PA in grade 7 compared to youth with parents who saw the fewest number of children outdoors (Figure 3B).

Discussion

In the present study, race/ethnicity, but not SES, modified the association between various multilevel factors previously found to be associated with youth PA and change in PA. We hypothesized that both race/ethnicity and SES would modify these relationships and help to explain the PA differences often reported among these subgroups. However, in our diverse sample of elementary school youth, SES was not statistically significant in influencing PA as children transitioned to middle school. This may be due to a combination of factors: lower relevancy of SES to influence PA in youth compared with adults and the operationalization of SES. SES clearly plays a significant role in impacting PA in adults [27], particularly through access [12,13], but decisions that adolescents make (even in relation to PA) may be driven more by individual factors, such as intrinsic motivation, personal interest, or peer influence, than parental education or income [14]. This shift in decision-making coupled with the operationalization of SES may have resulted in null findings. SES is composed of social and economic status [28], and although the present study used both an individual- and a community-level variable to define SES, it used the SES proxies as separate variables and not a composite. An SES measure that combines several aspects of SES may be more robust [14]. An SES composite commonly used is maternal education and family income reduced to an income-to-needs index based on federal poverty level for family size. Studies that used this composite measure may be more sensitive, and some have yielded statistically significant differences between SES and PA [4,29].

Despite the lack of significant findings with SES, race/ethnicity did influence the relationship between multiple levels of PA correlates and predictors with total PA and change in PA, respectively. The study found unique differences between the three racial/ethnic groups—distinct findings that preclude comparisons of the groups and warrant discussion of each racial/ethnic group separately.

Among black youth, variables associated with total PA and predictors for change in PA, with the exception of parental sport participation, were not the same. Specifically, total PA was positively associated with parent report of youth's enjoyment of PE, parental support for their youth's PA, and PARA neighborhood index, while change in PA was predicted by PA self-efficacy and home PA equipment. These findings suggest that selected

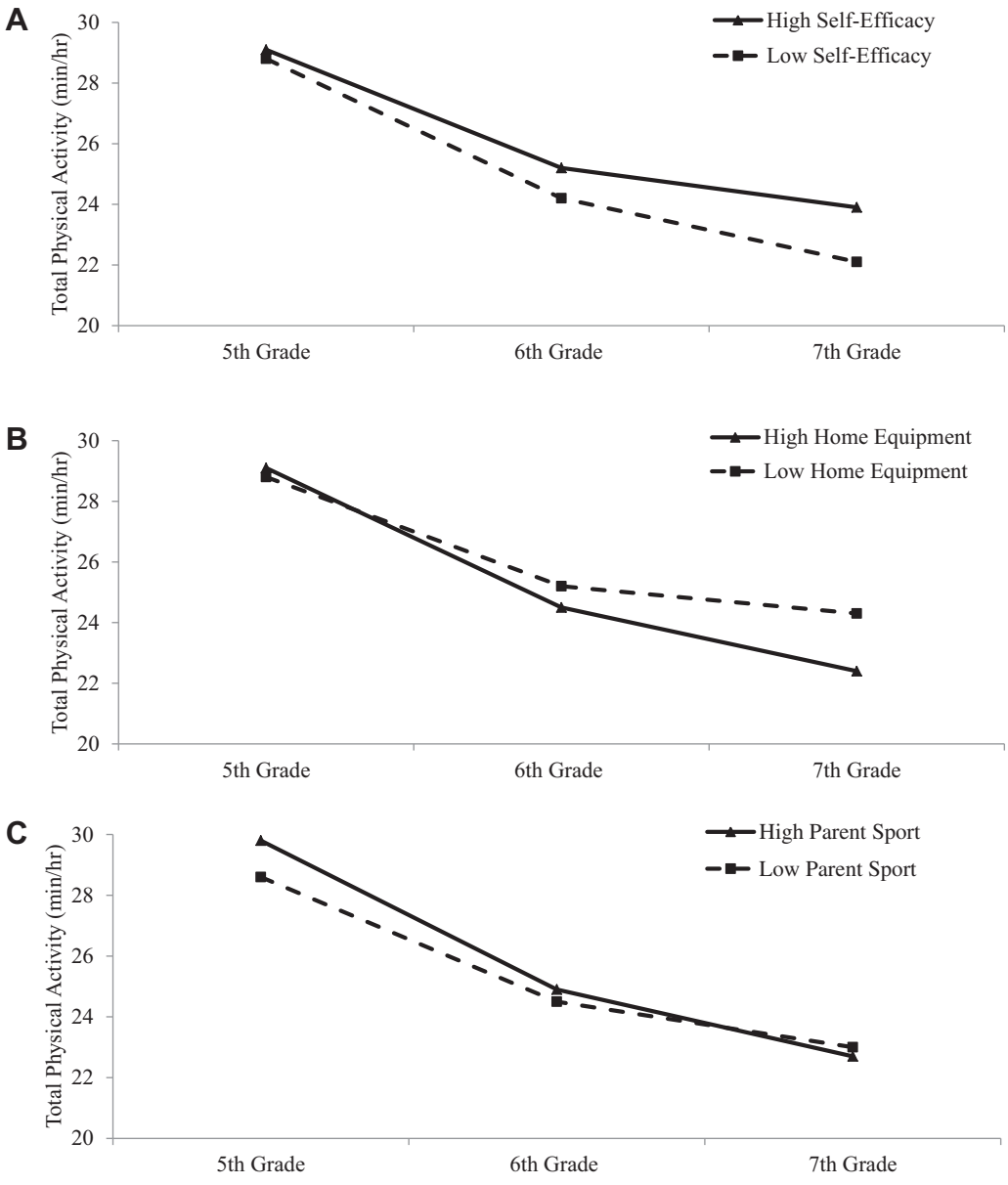

Figure 1. Interactions of time-varying child-reported (A) self-efficacy, (B) home equipment, and (C) parent-reported sport participation with changes in PA across fifth, sixth, and seventh grade black children (n = 275). (A) Fifth grade: high, n = 111; low, n = 85; sixth grade: high, n = 75; low, n = 75; seventh grade: high, n = 89; low, n = 115. (B) Fifth grade: high, n = 68; low, n = 69; sixth grade: high, n = 81; low, n = 63; seventh grade: high, n = 126; low, n = 143. (C) Fifthsl grade: high, n = 117; low, n = 100; sixth grade: high, n = 66; low, n = 69; seventh grade: high, n = 92; low, n = 106. "High" refers to the top tertile and "low" to the bottom tertile.

individual and environmental variables may be important for black youth at both the start of elementary school and as they advance to middle school. However, interpersonal variables appear to be more related to black youth's PA at a younger age. Younger black youth may not have the same level of autonomy as older youth, and they may be dependent on social support to positively impact PA. Unfortunately, very few studies have examined predictors or correlates of PA in black youth. In one study, Kelly et al. [10] conducted a cross-sectional examination of sixth grade black girls and found peer and teacher social support to be important correlates for PA. The complex findings of the present study, coupled with the lack of literature targeting PA behavior in black youth, support the need for more longitudinal studies to examine a wide range of variables across levels of the social ecological model to better understand how, what, and why PA is affected in this vulnerable population.

Among white youth in the present study, interpersonal and/or individual, but not environmental, factors were associated with total PA and change in PA. Although not longitudinal in nature, Kelly et al. found similar results—barriers and friend support, but not environmental variables, were associated with PA. [10] One longitudinal study [30] examined change in PA in a similar age group and reported peer and friend support as influencing youth PA; however, this study did not examine any

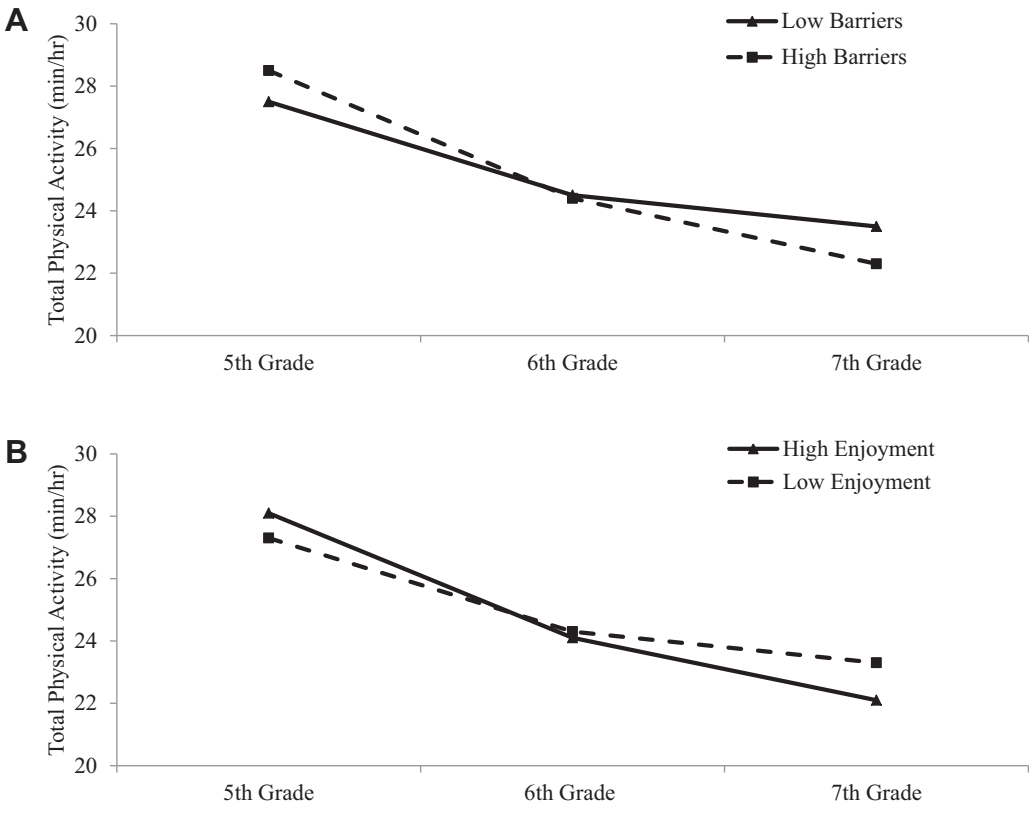

Figure 2. Interactions of time-varying child-reported (A) barriers and (B) enjoyment with changes in PA across fifth, sixth, and seventh grade white children (n = 296). (A) Fifth grade: high, n = 94; low, n = 78; sixth grade: high, n = 38; low, n = 34; seventh grade: high, n = 62; low, n = 82. (B) Fifth grade: high, n = 47; low, n = 43; sixth grade: high, n = 60; low, n = 62; seventh grade: high, n = 87; low, n = 89. "High" refers to the top tertile and "low" to the bottom tertile.

environmental variables. Similar to conclusions drawn about black youth, more research focusing on white youth that is not only longitudinal in nature but also includes a wider array and levels of variables should be conducted.

Among Hispanic youth, parents seeing other youth outdoors was associated with total PA and change in PA. In addition, the number of active friends was a correlate for total PA, and child-reported PA enjoyment influenced change in PA. Similarly, among the Hispanic subsample in the study by Kelly et al., all three levels of variables were associated with MVPA and VPA [10]. This suggests that Hispanic youth may benefit more by interventions that target all three levels—individual, interpersonal, and environmental.

Comparisons between the three racial/ethnic groups are limited in the current literature. Several studies have examined various levels of correlates [31,32] and predictors [29,33–35] of PA in similar-aged groups, and some included diverse samples but did not stratify by race/ethnicity. A large number of studies examined PA trends by race/ethnicity but did not include variables associated with the behavior [4,9,36–38]. In addition, studies to date lack consistency in the type of PA assessed when making race/ethnicity comparisons. MVPA [10,30] and VPA [10] have been previously measured, but the present study focused on total PA. Total PA includes light PA in addition to MVPA, and factors that determine total PA may be more expansive than factors that influence just MVPA. This relationship may be further exacerbated by examining changes over time and across racial/ethnic groups.

Strengths and limitations

Limitations of the study include the self-reported nature of the independent variables, the limited assessment of SES, and the lack of generalizability of findings to the U.S. population, since the data were collected only in South Carolina. In addition, the sample size for the Hispanic youth was significantly smaller than the sample sizes for the black and white youth. However, a paucity of research has examined the change in PA, and the work that has explored this relationship used a racially homogeneous sample [33].

Despite these limitations, this study has several important strengths, including the examination of an extensive range of multilevel factors that have been hypothesized to be related to total PA and change in PA in youth, the inclusion of a diverse sample, and the utilization of objective PA measurement. Furthermore, the inclusion of both parent- and child-reported variables adds to the ability of the present study not only to examine multiple levels of PA predictors but also to assess the different viewpoints within the same study; to our knowledge, no other study has examined PA predictors in a similar manner. Another strength of this study is that data are longitudinal, with three time points included, which allows for greater examination of temporal sequence of associations. The baseline recruitment rate was 60% in fifth grade with 85% retention rate in seventh grade, which indicate good representation of the targeted population. Finally, the present study examined both total PA and change in PA during adolescence, a period marked with

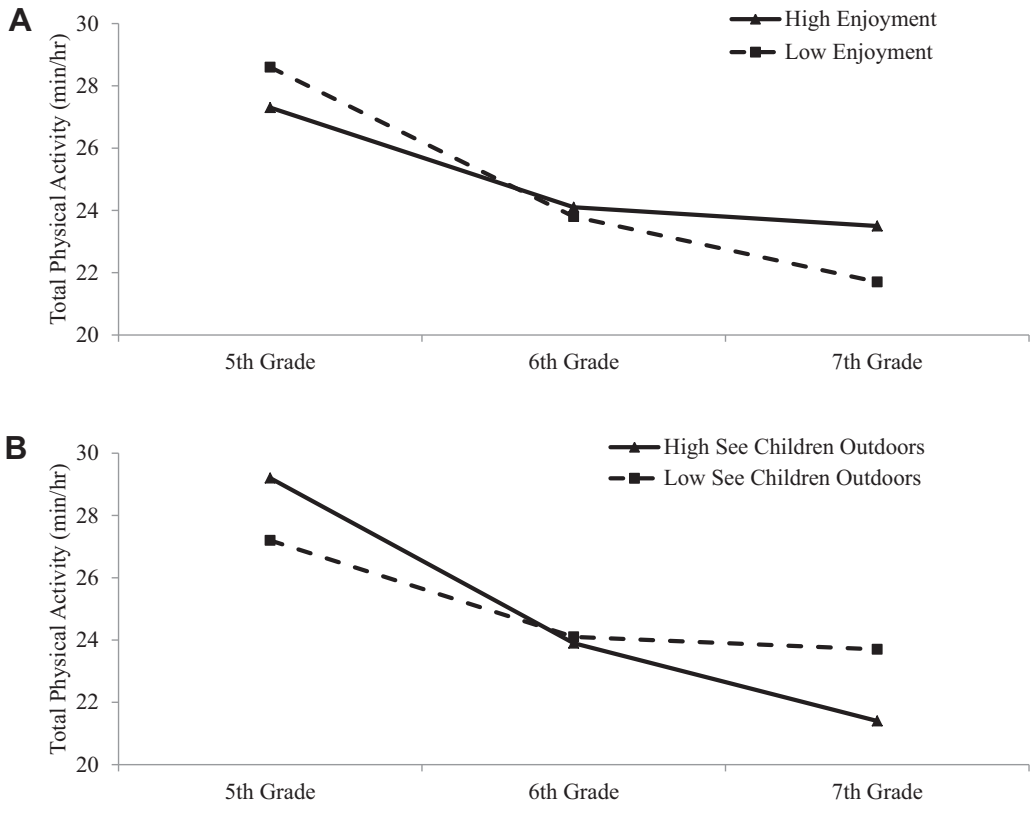

Figure 3. Interactions of time-varying parent-reported (A) child's enjoyment for PA and (B) seeing children outdoors with changes in PA across fifth, sixth, and seventh grade Hispanic youth (n = 72). (A) Fifth grade: high, n = 23; low, n = 11; sixth grade: high, n = 17; low, n = 11; seventh grade: high, n = 32; low, n = 50. (B) Fifth grade: high, n = 39; low, n = 22; sixth grade: high, n = 11; low, n = 21; seventh grade: high, n = 22; low, n = 29. "High" refers to the top tertile and "low" to the bottom tertile.

tremendous developmental and social changes but rarely examined in the literature.

Interventions targeting correlates and predictors of PA continue to be a viable way to address low levels of PA in youth. [39] The present study supports previous findings that the factors that influence changes in youth PA vary by race/ethnicity. It has been argued, although not always accepted, that interventions should be tailored to address the specific needs of populations [40]. The present study provides further support that the one-size-fits-all method of behavioral change may not be effective when working with youth from varying backgrounds. Special consideration related to the targeted population must be made when deciding which factors to target.

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