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Physical Activity and Academic Performance Among Adolescents in Low-SES Schools

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ABSTRACT

Background: Physical fitness and activity (PA) are related to academic performance, yet little is known about these relationships among Hispanic adolescents in low–socioeconomic status (SES), urban communities. **Purpose**: To evaluate the relationship of objectively measured PA and academic performance (AP) among Hispanic adolescents in one urban school district. **Methods**: One hundred sixty students were recruited from 6 Title I schools. Participants were instructed to wear a GT3X accelerometer for 5 weekdays. The district provided demographic and academic scores. **Results**: Pearson correlations yielded a weak and negative relationship existing between PA and AP, and the linear regression indicated that our predictor variables explained 15.2% of the variance, R^2 = 0.152, F(7,144) = 2.352, P < .001. Only the very vigorous PA intensity had a significant, negative effect on the relationship between PA and AP (β = −1.241, p = .04). **Discussion**: Despite the positive findings in previous research regarding PA and AP, our data suggest that in urban schools, the benefits of chronic PA may be secondary to the effects of SES and time spent engaged with academics with regards to AP. **Translation to Health Education Practice**: Efforts to address inequalities should be embedded in health education lessons and physical activity programs for adolescents.

A AJHE Self-Study quiz is online for this article via the SHAPE America Online Institute (SAOI) http://portal.shapeamerica.org/trn-Webinars

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Background

In experimentally designed research studies, the trait of physical fitness (PF) has been associated with academic performance (AP),[1] because multiple interventions have evidenced a relationship among youth.[2–5] Though positive, the correlations have been small to moderate and occasionally contradictory because few studies control for mediating and moderating factors that may influence the relationship between PF and AP. Further, the strength of such relationships varies by academic subject matter, with the most robust findings linked to math and reading, compared to science and social studies.

Previous research examining the behavior of physical activity (PA) participation and its relationship with AP is also generally positive. Unlike the PF/AP relationship, a closer examination of the PA/AP relationship reveals disparities in the potency and consistency of these associations. In a 2015 review of the literature by Esteban-Cornejo et al,[6] half of the studies confirmed a positive correlation between PA and AP, though the remaining studies exhibited a nonsignificant or negative effect. The authors believe that there may be multiple explanations for these inconsistencies, which we would like to address in this present study: (*a*) physical activity was not objectively measured, (*b*) effects may differ by gender,[7,8] and (*c*) sample populations were largely made up of Caucasians from middle or higher income communities. Though most studies reveal positive benefits, to date no single study has evaluated the PA/AP relationship among Title I schools where students are from low–socioeconomic status (SES) households and are predominantly Hispanic. Because of the disproportionate co-occurrences of low academic performance,[9,10] low fitness,[11,12] and elevated sedentary behaviors[13] among adolescents in these settings, this research is both timely and warranted for contextualizing adolescent academic performance with regards to regular participation in PA.

Factors influencing academic performance

The quality and quantity of structured PA have been linked, both independently and collectively, to different types of outcomes for both PF (eg, aerobic fitness,

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strength, and body composition) and AP (eg, standardized testing, grades). Erickson and Karlsson[14] increased time in physical education from 2 sessions per week to daily classes for 129 Swedish children and found improved motor skills, math, reading, and writing test performance compared to control students (n = 91) who only experienced physical education 2 days per week. Among a group of Australian school-aged children, Teldford[15] found that those who participated in physical education that was taught by a specialist had slightly lower body mass indexes (BMIs) and higher scores in math and writing but not on reading standardized assessments.

Esteban-Cornejo et al[16] collected objectively measured PA in a study involving 1700 Spanish adolescents and observed that total PA had a weak, negative relationship with academic grades, after controlling for mediating variables such as fitness. Stratification of these data by PA intensity also revealed nonsignificant findings. Similarly, cohorts in Finland,[17] the United Kingdom,[18] and Holland[19] discovered similar nonsignificant findings relating objectively measured PA with academic outcomes. The incongruence between objectively measured and self-reported PA raises questions about the methodology and cultural context of previous investigations. For example, Syväoja et al[17] found no relationship between objectively measured PA and AP but a significant relationship when a PA recall was used. Moreover, the trend of null PA/AP associations among international adolescents piques our interest as to how this relationship might fair among non-Caucasian students within the United States.

Gender

In 2016, Telford et al[20] sampled 555 children aged 8–12 years old and discovered that female students were significantly different from their male counterparts by having higher percentage of body fat, having lower cardiovascular fitness, and taking fewer total steps taken per day. The idea that adolescent females are less active and fit than adolescent males is not novel, because Telford's findings corroborated previous research.[21,22] Some studies elect to control for gender,[23] whereas other studies utilize gender as an independent variable for performance comparison.[24] Given the potential mistreatment, it was suggested by Castelli and colleagues[1] that gender be included in each analysis as a primary variable of interest.

Socioeconomic status

The role of SES, as indicated by free or reduced lunch status, has been shown to be a reliable predictor of AP.[25] Students of lower SES are less likely to achieve academically (ie, standardized testing, enroll in fewer advanced placement classes) than their peers of higher SES. Although the achievement gap is narrowing, academic success is still influenced by SES due to insufficient resources as well as an increased likelihood of health-related fitness standards falling below the healthy criteria.[25,26]

School-aged children from low-income schools are at risk for reduced PA and PF, particularly during summer break, because step counts and total PA all declined, and BMI increased over the summer when there was no access to the school facilities, equipment, or PA programs.[26] Coe et al,[9] in a cross-sectional study of 1700 third-, sixth-, and ninth-grade students, confirmed educational and fitness disparities among low-SES students, with low SES being the most robust predictor in the relationship between fitness and academic achievement. In 2014 it was recommended that future studies focus on schools and communities that are traditionally underserved.[1]

Purpose

The purpose of this study was to evaluate the relationship of objectively measured PA and AP among Hispanic adolescents in one urban school district. The findings should contribute to Health Education by suggesting course content and experiential learning opportunities. Further, considering that a PA and AP gap exists in this country by SES and gender, this study is of interest given its potential to reduce health risk and improving educational outcomes among adolescents.

Methods

In this study, objectively measured PA was collected for a sample of adolescents who were predominantly Hispanic and female from Title I schools in a large urban school district. Measures of PA, PF, and AP were obtained as outlined below.

Study context

Multiple institutional review boards approved this study at the university, district, and individual school levels, and each participant assented and their guardians consented to participation in this study. Participants were recruited from classes providing high school graduation credit for physical education (ie, physical education, athletics, marching band, and dance classes). In the state where the study took place, there was a graduation requirement of 1 year of physical education in high school. The present investigation is a subsample of a large-scale study involving secondary students (grades 7–12, N = 806) conducted in an urban school district that serves over 83 000 students in a minority-majority U.S. city. Although all students were initially asked to wear accelerometers for 5 consecutive schooldays, it was determined that this request was not feasible for all students because of how they were receiving physical education credit (eg, students who received physical education credit for participation in athletics were not permitted to wear the device during football or soccer practice; students who received physical education credit for participation in marching band were also eliminated from the original sample because they were playing an instrument while participating in physical activity). In sum, 160 students out of 400 eligible participants (response rate 40%) provided data for this study.

Participants

Among the participating adolescents, 75% were female (M_{age} = 14.56, SD = 1.15) and 83% were Hispanic (Table 1). Measurement of BMI revealed that the average participant was overweight (M = 25.33, SD = 6.76), with scores ranging from 15.3 to 49.2. All of the participants were enrolled in Title I schools and received free or reduced lunch. The school district did not permit us to differentiate between reduced cost and free lunch recipients among our research participants.

Instruments

Although multiple instruments were used to quantify the AP, PA, and PF of the participants in this study, there were two primary data sources, with an additional protocol for securing objectively measured PA.

Table 1. Demographic data for participants.[a]

	Total sample (N = 160)
Age in years, M (SD)	14.65 (1.15)
Female, n (%)	119 (74.44)
Race/ethnicity, n (%)	
White	10 (6.3)
Hispanic	133 (83.1)
Black	14 (8.8)
Asian	1 (0.68)
Two or more ethnicities	2 (1.3)
BMI	25.33 (6.76)
Steps, M (SD)	7367.37 (2595.90)
% Sedentary time	74 (0.07)
% Light PA	18 (0.05)
% Moderate PA	7 (0.03)
%Vigorous PA	2 (0.005)
% Very vigorous PA	Less than 1
% MVPA	7 (0.37)

[a]BMI indicates body mass index; PA, physical activity; MVPA, moderate to vigorous physical activity.

Academic performance

Variables including grades by subject matter and mid-year benchmarks testing, categorized as pass/fail of a learning outcome, were provided by the school district. Annual state-level academic achievement tests would not be available until October 1 of the following academic year and therefore were excluded from the analysis. As such, AP was determined by computing a core grade point average (GPA) from student final grade averages for English, math, science, and social studies class. Due to the individuality of secondary student schedules, these scores were first organized by subject matter. Scores in mathematics included student achievement in algebra, algebra II, geometry, precalculus, or calculus. English language arts grade scores included English I, II, III, or IV. Social studies included geography, world history, and U.S. history I or II. Science grades included integrated physics and chemistry, biology, chemistry, physics. Because these classes are vertically aligned in a typical district, they have been shown to have reliable predictive power for AP in the related courses. In addition to subject grades, these 4 subject areas were combined and averaged into a core GPA without the added variability of student elective classes.

Physical fitness measurement

As required by a state mandate, the physical fitness of all students was assessed at the beginning (first 6 weeks of the fall semester) and conclusion (final 6 weeks of the spring semester) of the academic year using the FitnessGram (Cooper Institute; Dallas, TX). The battery of tests is a widely used PF assessment that includes assessments of the parameters of health-related fitness: (*a*) Progressive Aerobic Cardiovascular Endurance Run, a multistage shuttle run (cardiovascular endurance); (*b*) BMI; (*c*) push-up test (muscular strength); (*d*) curl-up (muscular endurance); and (*e*) shoulder stretch or prone trunk extension (flexibility). These tests have been validated with criterion norms for fitness.[27,28]

Procedures

The participants were asked to wear an accelerometer (GT3x accelerometer; Actigraph TM, LLC, Pensacola, FL) for 5 consecutive school days (ie, Monday morning through Friday afternoon). Students were instructed to wear the device during all waking hours, except during bathing. The devices have been previously used in studies of adolescent PA and have been found to be valid and reliable measuring devices.[29] At the end of the school week, the participants returned the accelerometers. If an individual had recorded less than 10 hours of wear time per day over at least 4 days, he or she was asked to wear the accelerometers again the following week to meet the minimum criteria for inclusion.

Accelerometer data were downloaded to Actilife software (Ver 6.1, Actigraph TM), validated for completeness, and scored utilizing the Freedson cut points.[30] Sedentary (0–99), light (100–1951), moderate (1952–5724), vigorous (5275–9498), and very vigorous (>9499) were used to determine moderate to vigorous physical activity (MVPA) classifications, which has been validated for use with this age population.[31]

Academic measures were provided by the district and included numeric (0–100) grades for all enrolled classes for semesters 1 and 2. Because of the variability of academic schedules, data analysis was limited to the core courses required for graduation (English language arts, math, science, and social studies). The number of courses that were taken as Advanced Placement served as a control variable in the final analysis. Three values included in the final analysis were GPA on core courses, GPA by subject, and the number of core classes that were taken as Advanced Placement courses. Further, the mean Progressive Aerobic Cardiovascular Endurance Run and BMI scores of the fall and spring were included in the analysis as control variables. After these data were confirmed for completeness and accuracy, a database of PA and AP data was compiled in SPSS and 20% of the data points were audited by a peer member of the research team.

Data analysis

The daily average of the percentage of time spent on PA was calculated from the 4 10-hour minimum sampled days. Because the directionality of the hypothesis was unknown, a 2-tailed Pearson's bivariate correlation was run to initially identify any potential associations. Following the exploratory bivariate correlations, significant and near-significant variables were entered a linear regression to determine whether predictive variables could be identified. Significance was set at less than .05, and these values were used to inform potentially significant values for analyzing with linear regression.

Results

Despite having physical education every other day, very low percentages of 1% to 19% of a weekday were spent on MVPA. The calculation of Pearson correlations revealed weak, negative relationships between the portion of time by PA intensity (sedentary, light, moderate, vigorous, very vigorous) and AP, particularly for math (Table 2). A multiple linear regression was employed to quantify the variance that objectively measured PA accounts for among student AP. The results of the regression indicated that our predictor variables explained 15.2% of the variance, $R^2 = 0.152$, $F(7,144) = 2.352$, $P < .001$; however, only one of the PA intensities had a significant effect on the relationship between PA and AP. The variables total daily steps ($\beta = 0.001$, $P = .317$) as well as portion of time spent on sedentary ($\beta = 0.007$, $P = .414$), light ($\beta = -0.008$, $P = .705$), moderate ($\beta = -0.104$, $P = .258$), and vigorous ($\beta = -0.129$, $P = .573$) physical activity did not meet statistical significance. The amount of time spent on very vigorous PA ($\beta = -1.241$, $P < .05$) was the only predictor that reached significance, thus indicating that the relationship between AP and PA in this population is null and trending to negative with increasing time at greater PA intensities.

Discussion

Our results provide evidence of a null to negative relationship between PA and AP among adolescents. Of immediate concern is the lack of even short bouts of PA in the vigorous and very vigorous classifications, given the potential health consequences. This study extended the existent body of literature to include

Table 2. Pearson's correlations for academic performance and physical activity ($N = 160$).[a]

Variables	1	2	3	4	5	6	7	8	9
1. English	—								
2. Math	0.644**	—							
3. Science	0.684**	0.672**	—						
4. Social studies	0.685**	0.610**	0.667**	—					
5. Sedentary (% time)	0.075	0.173*	0.070	0.002	—				
6. Light PA (% time)	0.065	0.019	0.119	.030	0.076	—			
7. Moderate PA (% time)	−0.068	−0.181*	0.050	−0.070	−0.084	−0.403**	—		
8. Vigorous PA (% time)	0.05	−0.175*	0.025	−0.084	−0.070	−0.270**	0.227**	—	
9. Very vigorous PA (% time)	−0.113	−0.260	−0.167*	−0.083	−0.192*	−0.092	0.057	0.137	—

[a]PA indicates physical activity.
*Significant at .05 level.
**Significant at .01 level.

students of Hispanic ethnicity and lower SES. It was hypothesized initially that the lower AP and higher rates of inactivity among these students might produce novel findings regarding PA and AP relationship. What emerged were surprise findings, especially about the needs of female Hispanic students enrolled in schools classified as *academically unacceptable* and having a Title I designation. The negative, nonsignificant relationship between PA and AP may suggest that time spent in PA may take away from academic learning time; however, given the potential health benefits, an alternative argument could be supported. Adolescent participation in PA of moderate to very vigorous intensities is likely essential for one to maximize one's academic potential.

In a population of female Hispanic students, both school (eg, quality of the physical education program, few PA opportunities across the school day, lack of school resources to support achievement of the learning standards, potential clustering of risk factors in a non-health-oriented climate at lower SES and lower performing schools) and individual factors (eg, clustering of personal risk factors, reading below grade level, lack of early childhood education) influence the relationship between PA and AP.

School factors possibly influencing the PA and AP relationship

The findings of this study demonstrated that participation in some PA could not overcome the effects of SES and potentially suboptimal learning experiences or lack of student engagement in the classroom. It is likely within the context of a school that struggles for the students to reach state academic achievement goals are a result of a multilayered, clustering of factors. Future studies must directly measure mediating and moderating factors of the PA and AP relationship.

There are numerous school factors (ie, the requirement of 1 year of physical education, block scheduling of classes causing longer sedentary time and decreased opportunities for PA, and internal pressures to produce academically acceptable outcomes at schools with a history of not meeting standards). The state in which this study was conducted has a mandate of 1 year of physical education during high school for graduation credit. There are several waivers and alternative ways to acquire the one credit for high school physical education; for example, participation in (*a*) marching band, (*b*) ROTC, (*c*) high school athletics, and (*d*) online physical education. Particularly unique is the use of online submission of PA participation, to secure physical education credit. Little oversight and accountability are included in this program. Only study replication with a similar sample could reveal such possible influences.

Lack of school resources

Each school in this study was in an urban setting and had a recent history of failing to meet adequate yearly progress in state testing and subsequently have spent a considerable focus of their education on remediation and a test-retaking strategy to close their achievement gaps in academics. Moreover, though these students were all enrolled in physical education, the school staff was unable to answer questions about why some ninth-grade students were not enrolled in physical education.

In the urban setting, there were few opportunities for active transportation to and from school. The schools in this study attended low-SES schools located less than 1 mile from major highways and, as such, most students are bused to closed and secure campuses. Additionally, there was little green space and few informal opportunities for PA.

Individual factors possibly influencing PA and AP relationship

The proxy health status, measured as BMI and aerobic capacity, and lack of PA opportunities may both be influential. For those students enrolled in physical education, this was the last time they will formally be offered opportunities to participate in PA. The block schedule in these secondary schools limited the number of opportunities to participate in even light and moderate PA during the school day. Within these schools, a coordinated school health model was supposed to be integrated, but the block scheduling (ie, long academic periods) limited the number of informal opportunities for PA.

Half of the participants in this sample were overweight or obese. When BMI is coupled with sedentary behaviors and few opportunities to participate in MVPA, the prevalence of risk factors increases. Schools, and particularly physical and Health Education programs, need to offer targeted instruction focused on protective health factors and other behavioral change mechanisms such as self-regulation and goal setting. The adolescent females in this study had few opportunities to be physically active (ie, physical education every other day for one semester) and even fewer chances to engage in PA at high intensity because these students have not been involved in school athletic teams or PA clubs.

Other individual factors

At the individual level, factors such as engagement in academic lessons, completion of homework, parent involvement, steps per day, school attendance, and study habits might explain the findings in this study. All of these variables are beyond the scope of this study but should be considered possible confounding variables that plausibly contributed to the results of this investigation.

Delimitations and limitations. This study is not without its advantages and disadvantages. The idea of objectively measured PA among a predominantly female Hispanic population in an urban setting is novel and was a strength of this study. Additional strengths were the recruiting participants from Title I schools and schools classified as making unacceptable educational progress. Often researchers cannot gain access to such settings. The study was limited by several confounding variables that were beyond the control of the researchers. Notably, the researchers were not permitted to obtain an individual participant's SES (ie, reduced or free lunch status) and classroom engagement in learning. The researchers were initially seeking a representative sample of the school student body, but an additional limitation of this study was that the sample was 74.4% female. This was because more males receive credit for physical education through sport participation than females and they were not permitted to wear the accelerometers during practice. Although this enrollment was reflective of general physical education classes at the schools in this study, it is not indicative of the campus populations.

Translation to Health Education Practice

PA intensity should be objectively measured and tracked, because time spent in vigorous to very vigorous intensities may influence AP. Despite the importance of PA intensity, the current study demonstrated that participation in PA in and of itself could not overcome other factors related to AP. In part AP could also be influenced by grit and school attendance, because these factors have been previously implicated as better measures of protective factors among female Hispanic adolescents.[32] The schools in this study are an ideal target for a Comprehensive School Physical Activity Program intervention because truancy, the building of human capacity, and PA could be addressed simultaneously during health and physical education classes as well as within an afterschool program that extends from before school and into the community on the weekends.

Application of the whole school, whole community, and whole child approach could create better alignment, integration, and collaboration between educational outcomes and student health. The foundation of a Comprehensive School Physical Activity Program is physical education, because this program is the only educational experience purposely linked to physically active learning outcomes. Other points of intervention include before/after school programs, PA during the schoolday (ie, recess, activity breaks in classroom settings), staff involvement (ie, both as a model and as a participant in healthy decision making), and community and parent engagement. Although many national organizations endorse this model, little is known about the learning outcomes resulting from participation in physical education as well as some of the alternative settings where opportunities for physical activities can be provided.

It would be shortsighted to believe that a PA program in and of itself would be enough to improve AP; however, providing opportunities for participation in MVPA could serve as the first step in the process of reform. As part of the coordinated school health mandate, and even with limited resources, urban schools could provide adolescents with PA opportunities as part of improving health and addressing the needs of the whole child. It is important to note that this need is both pervasive and habitual, and there is little evidence that a 1-year PA intervention would have an impact or be sustainable.

In sum, urban settings reduce the number of formal PA opportunities for female Hispanic students and, as such, require intervention and rethinking how, even with limited resources, the daily school schedule and before and after school programming could contribute to improved AP.

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