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ABSTRACT

Background/Purpose: The prevalence of childhood obesity and school truancy are contemporary health issues, as millions of children do not attend school, when required. The purpose of this study was to determine the association between intent to be physically active, aerobic fitness, and school absences. **Methods.** Data from 1907 adolescents from the United States were collected during physical education. Participants completed a valid theory of planned behavior survey and the FitnessGram©, with the demographic data obtained from school records. Linear regressions controlling for gender, grade, free/reduced lunch, body mass index, and intent to be physically active, were calculated. **Results.** Adolescents who had positive intentions to be physically active ($p<.001$), scored higher on the PACER test ($p=.006$), and ran faster in the mile ($p<.001$) had fewer unexcused absences compared with students who had a negative intentions and lower fitness. **Discussion.** Adolescents with higher aerobic fitness had fewer unexcused school absences, which suggests that cardiovascular health may be a valuable contributor in decreasing adolescent health and behavior risk specifically, truancy and out of school suspensions. **Translation to Health Education Practice.** Whole-of-school approaches that align physical activities and educational experiences, can help adolescents understand the benefits of physical fitness as a prevention strategy.

Keywords: exercise, physical fitness, adolescents, truancy, attendance

Relationship Between Health Risk and School Attendance Among Adolescents

Unexcused school absences among adolescents are a prevalent and significant problem in the United States.[1,2] While any absence negatively impacts academic success,[3,4] unexcused absences are more strongly associated with lower academic achievement than excused absences.[5] Although teacher effectiveness is a primary determinant of student success, absenteeism is also associated with lower achievement in math, reading, and general knowledge.[6] When adolescents are absent from school without an excuse they are less likely to succeed academically and are more likely to engage in risk behaviors when compared with adolescents who are absent with an excuse.[7] Further, because school funding in many states is determined in part by average daily attendance, unexcused absences can impact the financial resources of a school, influencing the classroom environment for all students.

Workplace absenteeism and its relationship to physical fitness and other health behaviors has been well studied among adults[8], but little is known about the role that cardiovascular fitness, as a proxy measure of health status, may play in regards to adolescent absenteeism.[9] There is growing evidence of the positive benefits of physical activity on cognitive functioning and academic outcomes.[10] Specifically, positive associations have been found between physical activity engagement and improved cardiovascular fitness leading to an increase in cognitive control of working memory and increased cognitive performance. A meta-analytic review of 59 studies from 1947 to 2009 confirmed that aerobic exercise, over muscular or resistance, had the greatest effect on children's achievement and cognitive outcomes.[11] However, most of the research on such cognitive benefits of cardiovascular fitness has neglected to account for the possible effects of physical fitness on school attendance, particularly the risk behavior of unexcused absences (e.g. skipping school), which in turn mediates academic achievement.

Adolescence is a critical time for reaping the full cognitive benefits of regular physical activity engagement due to rapid neural growth and pruning, which is a selection process preserving the most well established synaptic connections.[12] Further, because healthier children exhibit greater readiness to learn,[13] national organizations have been highly supportive of the Whole School, Whole Community, Whole Child Approach (WSCC)[14] as a contemporary way of providing and aligning opportunities for children to be physically active in school. While self-reported physical activity has been linked to lower engagement in risk behavior in adolescence,[15] less is known about whether objectively measured cardiovascular fitness is related to risk-taking behavior, including skipping school or truancy.

Despite school reforms such as WSCC and renewed attention to graduation rates, school suspensions, truancy, and "school skipping" as chronic absenteeism, continue to account for approximately 15% of all school absences.[16] Allensworth and Easton (2007)[17], discovered that school attendance is a better indicator of academic success in high school than standardized testing when a teenager misses 20% of the required attendance school days in the ninth grade. As such, interventions aimed at increasing graduation rates have placed emphasis on factors including attendance, behavior, and course passing.[18] This present study may help to shed light on the possible inclusion of whole-of-school approaches, whereby schools would promote a health-oriented culture, as part of getting adolescents to attend school.

While school attendance matters because we want all youth to maximize their potential and graduate from high school, poor attendance can also matter for school funding. On average, just under half of a school's annual budget comes from state funds, with that funding formula likely including student standardized testing and attendance as indicators of school effectiveness.[19] Simply put, the better the students perform on state academic tests and the more they attend school,

the larger the sum of money the school is likely to secure from the state. This argument presents a paradox that could cause underachieving schools that contain higher proportions of unhealthy children, to receive fewer state funds. School boards and leaders are then forced to make difficult decisions regarding how to utilize the limited funds. Often health and physical education as well as performing arts programs are eliminated so school districts can work within the allocated funds. Data analyses specifically incorporating objectively measured student health and its relationship to school attendance are scarce. As such, the purpose of this study was to determine the association between intent to be physically active, aerobic fitness, and school absences. A secondary aim was to control for the possible mediating effects of adolescent intentions to be physically active engagement, as a determinant of physical fitness.

Methods

The sample consisted of 1907 adolescents (aged 14-19; with an average age of 16.37±1.17) who were attending public high school (grades 9-12) located in the Midwestern region of the United States. Adolescents were recruited from mandatory, daily physical education class (50 minutes). Passive parental consent and written adolescent assent were obtained from all participants. The final student response rate was 98%. Study procedures were approved by the Institutional Review Board of the study's principal investigator.

Measures

The annual number of school absences for each individual study participant was obtained from school records and included all absences confirmed as excused (e.g., had a dentist appointment and the office confirmed the appointment; went on a college visit) as well as absences not considered to be excused by the school administration (e.g., unverified by documentation; out of school suspension; "not feeling well today", but did not go to see a physician; and missed school

without any reason). Designated school attendance officers confirmed these data, by calling a guardian for each student absence. The school absences data were obtained for the same academic year as the other measured variables in this study.

Cardiovascular fitness was assessed by trained personnel during physical education class using two different measures: (1) time to complete a one-mile run, completed in September and (2) the Progressive Aerobic Cardiovascular Endurance Run (PACER) test,[20] a test of aerobic capacity, measured in January. The PACER test objective is to run as long as possible back and forth across a 20-m space at a specified pace, which increases in speed over time. Height and weight were also collected, to calculate Body Mass Index and determine the relative estimation of aerobic capacity and to use as control variable, because there is evidence of a negative relationship between BMI as a proxy measure of body composition, and aerobic capacity, among both male and female adolescents.[20,21]

Data on participant intentions to be physically active were collected in September and January and served as a control variable ($\alpha = p < .01$). The valid and reliable survey, [22] was based on the theory of planned behavior and contained 20 Likert scale questions about the factors of attitudes, social norms, and perceived behavioral control, which was summed to represent an individual's intention to be physically active. To estimate the survey reliability among this sample, a Cronbach alpha level of .89 was calculated. Sociodemographic factors (grade in school, gender, race, eligibility for free or reduced lunch, and BMI) were included in the analyses.

Statistical Analyses

Linear regression (in SPSS V22) was used to determine if either of the cardiovascular fitness measures was associated with the total annual number of absences, controlling for the other cardiovascular fitness measure as well as the intention to be physically active and

sociodemographics. Missing data ranged from 0% to nearly 18% (Table 1), so results were based on multiple imputation methods with ten datasets.[23]

Results

The sample was evenly split by gender, predominately White (81%), and a little less than a third of the participants were eligible for free or reduced lunch (Table 1). The mean BMI was 24.7 ± 5.819 and, on average, adolescents had positive intention to be physically active. The average amount of time to run a mile was 10.2 ± 2.922 minutes, and the average PACER score was 34.9 ± 21.830 laps. Although the health classification of BMI is determined by both gender and age, the aggregated BMI was considered to fall within the range of "healthy". All BMI classifications were demonstrated in this sample, including underweight, healthy weight, overweight, and obese. The same can be said for the aerobic capacity data across both measures, with individual participants being identified as falling in the Healthy Fitness Zone, Need Improvement, and Needs Improvement - High Risk.

Adolescent participants had 4.88 ± 7.197 unexcused school absences in the school year, which did not include the number of absences that were justified and confirmed as excused. Looking at the bivariate relationships, higher grade in school, unhealthier cardiovascular fitness (both lower PACER score and higher mile time), and lower intentions to be physically active were all significantly associated with a greater number of unexcused absences.

Both measures of cardiovascular fitness were associated with the total annual number of unexcused absences, controlling for intentions to be physically active and socio-demographic factors (Table 2). Adolescents with higher PACER test scores had fewer unexcused absences compared with adolescents who had a lower PACER test scores (B=-.037, p=.006) and adolescents with a higher mile time had more unexcused absences compared with adolescents who completed

the one-mile run in a faster time (B=.419, p<.001). In sum, the adolescents with higher aerobic capacity were more likely to attend school.

Discussion

There is extensive evidence that cardiovascular fitness improves health outcomes in adolescents,[24] but the relationship with behavioral outcomes has been less researched. This study sought to determine whether objectively measured cardiovascular fitness, as potentially mediated by their intent to be physically active, was related to absences in a sample of high school students.

The number of absences, and of greater interest unexcused absences, were examined as the outcome for two primary reasons. First, unexcused absences have been shown to be an indicator of adolescent risk behaviors such as substance use and risky sexual behaviors, possibly due to an underlying propensity for risk-taking behavior.[24] While more research is necessary, it is known that cardiovascular fitness is related to the speed and accuracy of information processing as an example of an executive function, in both children and young adults.[10] What remains unclear are the underlying mechanisms facilitating such relationships. Second, it was also important to look at unexcused absences because they have a significant impact on the academic achievement of students. When a student is not in school, learning time is lost. No program can be effective if the adolescent does not attend. Further, in most schools, if a student has an unexcused absence they are not allowed to make up the work they missed or face academic consequences for being beyond the deadline. Past research has shown that cardiovascular fit students perform better on academic achievement tests,[10] and are less likely to engage in risky behaviors.[7] This study adds to this literature by showing that cardiovascular fitness could also promote academic achievement among adolescents by minimizing the potentially reduced opportunities to learn resulting from school absences, which in turn reduces engagement in risky health behaviors.

Although it is clear that many variables may contribute to both the attainment of physical fitness (e.g., physical activity during leisure time[15], nutrition[15], and a positive attitude toward physical activity[22]) and the reason for unexcused absences (e.g. repeated exposure to truancy[1], lack of parental invovlement[2]) the findings from this study shed light on possible considerations for schools and health education programs. First, health educators and physical activity leaders should access free resources about the implementation of comprehensive and coordinated school health programming and the WSSC approach (see http://www.ascd.org/programs/learning-and-health/wscc-model.aspx as an example). Such programs help to provide the infrastructure for daily physical activity participation, attainment of physical fitness recommendations, and for the promotion of healthy eating[14], which have been assoicated with high academic achievement[9,10] and readiness to learn[13]. Second, patterns of health risk behaviors and specifcially unexcused absences track into adulthood. As educators and health promoters, a critical time to address such patterns of risk behavior is through formal education and positive reinforcement in the school setting, where adolescents can rehearse making healthy choices in a supportive environment.

There were both significant strengths and limitations of this study. While the study is based on a large sample of students homogenous in their exposure to in-school, mandatory, daily physical education, generalizability to other samples may be limited. This study significantly adds to the literature by including objective measures of fitness and school records to determine the demographics and number of absences. However, one potential limitation is that a student who is missing one class, such as leaving school early without permission, was coded the same as a student missing an entire day of classes. Finally, while the study included relevant sociodemographic and behavioral covariates that could be confounders in the relationship between

cardiovascular fitness, intentions, and absences, more research is needed to disentangle the causality of the association.

Implications and Translation to Health Education Practice

This study supports the importance of cardiovascular fitness because adolescents in high school with higher cardiovascular fitness were less likely to have unexcused school absences. While more research is needed to determine the causal pathways of this association, the results suggest that cardiovascular health plays a role in decreasing adolescent risk behavior, quantified as "skipping school" and out of school suspension. The implementation of WSCC programs that involve health and physical education teachers, classroom teachers, student leaders, parents, and other members of the community, may generate a comprehensive promotion of regular physical activity and healthy eating that contributes to on-going efforts to increase school attendance, graduation rates, and school funds received from the state. Such comprehensive efforts are necessary to increase opportunities to be physically active and engage in corresponding educational experiences that can help adolescents understand the benefits of physical fitness as a prevention strategy. If adolescent intentions to be physically active are positive, then we as health educators should provide competitive and non-competitive opportunities for them to engage.

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Table 1. Descriptive data and bivariate correlations between unexcused absences, cardiovascular fitness, and sociodemographic factors among adolescents in grades 9-12, Midwestern region of USA, (N=1,907)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Number of unexcused absences	--								
2. Grade in school	.133***	--							
3. PACER (laps)	-.129***	.141***	--						
4. Mile time (min)	.163***	-.080***	-.687***	--					
5. Male gender	-.015	-.013	.472***	-.365***	--				
6. White race	.000	.001	-.053*	.020	-.006	--			
7. Receipt of free/reduced lunch	.022	.023	.021	-.014	.003	-.248***	--		
8. Intent to be physically active	-.089***	.075**	.256***	-.229***	.046*	-.028	.011	--	
9. Body Mass Index (BMI)	.004	.002	-.378***	-.416***	-.027	.041*	-.043*	-.040	--
N	1900	1907	1580	1530	1907	1907	1907	1702	1782
Mean (SD) or % based on original data	4.88	10.46	35.44	10.17	50.50%	81.44%	27.37%	74.21	24.70
	(7.197)	(1.116)	(21.830)	(2.922)				(12.999)	(5.819)
Range	0-78	9-12	2-97	5.12 – 25.52				23-100	14-55
Multiple imputation Mean or %	4.88	10.46	34.94	10.26	50.50%	81.44%	27.37%	74.17	24.71

*p<.05, **p<.01, ***p<.001

Note: The purpose of the Progressive Aerobic Cardiovascular Endurance Run (PACER) test is to run as long as possible, meaning that a higher score is indication of better cardiovascular fitness.

Table 2. Cardiovascular fitness and sociodemographic factors associated with the past year total number of unexcused absences among adolescents in grades 9-12, Midwestern region of USA, (N=1,907)

Variable	Unstandardized B	Standard Error	p-value
PACER laps	-.037	.013	.006
Time to complete one mile (minutes)	.419	.091	<.001
Grade in school	1.075	.149	<.001
Male Gender	1.484	.388	<.001
White Race	-.016	.427	.970
Receipt of Free or Reduced Lunch	.297	.372	.425
Body Mass Index	-.135	.033	<.001
Intent to be physically active	-.023	.015	.111

Note: The purpose of the Progressive Aerobic Cardiovascular Endurance Run (PACER) test is to run as long as possible, meaning that a higher score is indication of better cardiovascular fitness.