




RESEARCH ARTICLE

## Relationship Between Health Risk and School Attendance Among Adolescents

Erin E. Centeio<sup>a</sup>, Jessica Duncan Cance<sup>b</sup>, Jeanne M. Barcelona<sup>c</sup>, and Darla M. Castelli <sup>c</sup>

<sup>a</sup>Wayne State University; <sup>b</sup>Texas Department of State Health Services; <sup>c</sup>University of Texas at Austin

### 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 Progressive Aerobic Cardiovascular Endurance Run (PACER) test ( $P = .006$ ), and ran faster in the mile ( $P < .001$ ) had fewer unexcused absences compared to students who had 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.

### ARTICLE HISTORY

Received 7 January 2017  
Accepted 3 March 2017

## Background

Unexcused school absences among adolescents are a prevalent and significant problem in the United States.<sup>1,2</sup> Though any absence negatively impacts academic success,<sup>3,4</sup> unexcused absences are more strongly associated with lower academic achievement than excused absences.<sup>5</sup> Although teacher effectiveness is a primary determinant of student success, absenteeism is also associated with lower achievement in math, reading, and general knowledge.<sup>6</sup> 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.<sup>7</sup> 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 have been well studied among adults,<sup>8</sup> but little is known about the role that cardiovascular fitness, as a proxy measure of health status, may play in regards to adolescent absenteeism.<sup>9</sup> There is growing evidence of the positive benefits of physical activity on cognitive functioning and academic outcomes.<sup>10</sup> 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.<sup>11</sup> 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 (eg, 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.<sup>12</sup> Further, because healthier children exhibit greater readiness to learn,<sup>13</sup> national organizations have been highly supportive of the Whole School, Whole Community, Whole Child Approach (WSCC)<sup>14</sup> as a contemporary way of providing and aligning opportunities for children to be physically active in school. Though self-reported physical activity has been linked to lower engagement in risk behavior in adolescence,<sup>15</sup> less is known about

whether objectively measured cardiovascular fitness is related to risk-taking behavior, including skipping school or truancy.

75 Despite school reforms such as WSCC and renewed  
attention to graduation rates, school suspensions, tru-  
ancy, and “school skipping” as chronic absenteeism con-  
80 tinue to account for approximately 15% of all school  
absences.<sup>16</sup> Allensworth and Easton<sup>17</sup> discovered that  
school attendance is a better indicator of academic suc-  
cess in high school than standardized testing when a  
teenager misses 20% of the required attendance school  
85 days in the ninth grade. As such, interventions aimed at  
increasing graduation rates have placed emphasis on  
factors including attendance, behavior, and course  
passing.<sup>18</sup> This present study may help to shed light on  
the possible inclusion of whole-of-school approaches,  
whereby schools would promote a health-oriented cul-  
90 ture as part of getting adolescents to attend school.

90 Though 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 for-  
95 mula likely including student standardized testing and  
attendance as indicators of school effectiveness.<sup>19</sup> 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.  
100 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.  
105 Often health and physical education as well as perform-  
ing arts programs are eliminated so that school districts  
can work within the allocated funds. Data analyses spe-  
cifically incorporating objectively measured student  
health and its relationship to school attendance are  
110 scarce.

### Purpose

The purpose of this study was to determine the associa-  
tion between intent to be physically active, aerobic  
fitness, and school absences. A secondary aim was to  
115 control for the possible mediating effects of adolescent  
intentions to be physically active engagement as a  
determinant of physical fitness.

### Methods

120 The sample consisted of 1907 adolescents (aged 14–19;  
with an average age of  $16.37 \pm 1.17$ ) who were

attending public high school (grades 9–12) located in  
the Midwestern region of the United States. Adolescents were recruited from mandatory daily phy-  
sical education class (50 min). Passive parental consent  
and written adolescent assent were obtained from all  
125 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 indivi-  
130 dual study participant was obtained from school records  
and included all absences confirmed as excused (eg, 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 administra-  
135 tion (eg, 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.  
140 School absences data were obtained for the same ac-  
ademic year as the other measured variables in this study.

Cardiovascular fitness was assessed by trained per-  
sonnel during physical education class using 2 different  
measures: (1) time to complete a one-mile run, com-  
145 pleted in September, and (2) the Progressive Aerobic  
Cardiovascular Endurance Run (PACER) test,<sup>20</sup> 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  
150 increases in speed over time. Height and weight were  
also collected to calculate body mass index (BMI) 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  
155 measure of body composition and aerobic capacity,  
among both male and female adolescents.<sup>20,21</sup>

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  
160 and reliable survey<sup>22</sup> was based on the Theory of  
Planned Behavior and contained 20 Likert scale ques-  
tions about the factors of attitudes, social norms, and  
perceived behavioral control, which was summed to  
represent an individual’s intention to be physically  
165 active. To estimate the survey reliability among this  
sample, a Cronbach’s 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.  
170

**Table 1.** Descriptive data and bivariate correlations between unexcused absences, cardiovascular fitness, and sociodemographic factors among adolescents in grades 9–12, Midwestern region of the United States ( $N = 1907$ ).<sup>a</sup>

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Number of unexcused absences	—								
2. Grade in school	0.133***	—							
3. PACER (laps)	-0.129***	0.141***	—						
4. Mile time (min)	0.163***	-0.080***	-0.687***	—					
5. Male gender	-0.015	-0.013	0.472***	-0.365***	—				
6. White race	0.000	0.001	-0.053*	0.020	-0.006	—			
7. Receipt of free/reduced lunch	0.022	0.023	0.021	-0.014	0.003	-0.248***	—		
8. Intent to be physically active	-0.089***	0.075**	0.256***	-0.229***	0.046*	-0.028	0.011	—	
9. Body mass index	0.004	0.002	-0.378***	-0.416***	-0.027	0.041*	-0.043*	-0.040	—
<i>N</i>	1900	1907	1580	1530	1907	1907	1907	1702	1782
Mean (SD) or % based on original data	4.88 (7.197)	10.46 (1.116)	35.44 (21.830)	10.17 (2.922)	50.50%	81.44%	27.37%	74.21 (12.999)	24.70 (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

<sup>a</sup>PACER indicates Progressive Aerobic Cardiovascular Endurance Run. The purpose of the PACER test is to run as long as possible, meaning that a higher score is an indication of better cardiovascular fitness.

\* $P < .05$ . \*\* $P < .01$ . \*\*\* $P < .001$ .

### Statistical analyses

Linear regression (in SPSS Ver 22; IBM Corp, Armonk, NY) was used to determine whether 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 10 data sets.<sup>23</sup>

### 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  $24.7 \pm 5.819$  and, on average, adolescents had positive intentions to be physically active. The average amount of time to run a mile was  $10.2 \pm 2.922$  min, and the average PACER score was  $34.9 \pm 21.830$  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  $4.88 \pm 7.197$  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

**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 the United States ( $N = 1907$ ).<sup>a</sup>

Variable	Unstandardized B	Standard error	<i>P</i> value
PACER laps	-0.037	0.013	.006
Time to complete one mile (min)	0.419	0.091	<.001
Grade in school	1.075	0.149	<.001
Male gender	1.484	0.388	<.001
White race	-0.016	0.427	.970
Receipt of free or reduced lunch	0.297	0.372	.425
Body mass index	-0.135	0.033	<.001
Intent to be physically active	-0.023	0.015	.111

<sup>a</sup>PACER indicates Progressive Aerobic Cardiovascular Endurance Run. The purpose of the PACER test is to run as long as possible, meaning that a higher score is an indication of better cardiovascular fitness.

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 sociodemographic factors (Table 2). Adolescents with higher PACER test scores had fewer unexcused absences compared to adolescents who had lower PACER test scores ( $B = -0.037$ ,  $P = .006$ ), and adolescents with a higher mile time had more unexcused absences compared to adolescents who completed the one-mile run in a faster time ( $B = 0.419$ ,  $P < .001$ ). 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,<sup>24</sup> 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 was examined as the outcome for 2 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.<sup>24</sup> Though 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.<sup>10</sup> 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, students with an unexcused absence are not allowed to make up the work they missed or face academic consequences for being beyond the deadline. Past research has shown that cardiovascularly fit students perform better on academic achievement tests<sup>10</sup> and are less likely to engage in risky behaviors.<sup>7</sup> 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 (eg, physical activity during leisure time,<sup>15</sup> nutrition,<sup>15</sup> and a positive attitude toward physical activity<sup>22</sup>) and the reason for unexcused absences (eg, repeated exposure to truancy,<sup>1</sup> lack of parental involvement<sup>2</sup>), 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/wssc-model.aspx> as an example). Such programs help to provide the infrastructure for daily physical activity participation, attainment of physical fitness recommendations, and the promotion of healthy eating,<sup>14</sup> which have been associated with high academic achievement<sup>9,10</sup> and readiness to learn.<sup>13</sup> Second, patterns of health risk behaviors and specifically unexcused absences track into adulthood.

As Health 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. Though 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, though 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.

### 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. Though 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 WSSC programs that involve Health Education 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 ongoing 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 noncompetitive opportunities for them to engage.

### ORCID

Darla M. Castelli  <http://orcid.org/0000-0002-8862-578X>



## References

- 325 1. Flannery KB, Frank JL, Kato MM. School disciplinary responses to truancy: current practice and future directions. *J Sch Violence*. 2012;11(2):118–137.
2. Kearney CA. School absenteeism and school refusal behavior in youth: a contemporary review. *Clin Psychol Rev*. 2008;28:451–471.
- 330 3. Allensworth E, Easton JQ. *The On-Track Indicator as a Predictor of High School Graduation*. Chicago, IL: Consortium on Chicago School Research; 2005.
4. Hickman GP, Bartholomew M, Mathwig J. *The Differential Development Trajectories of Rural High School Dropouts and Graduates: Executive Summary*. Phoenix, AZ: The College of Teacher Education and Leadership at the Arizona State University at the West Campus; 2007.
- 335 5. Gottfried MA. Excused versus unexcused: how student absences in elementary school affect academic achievement. *Educ Eval Policy Anal*. 2009;31:392–415.
6. Adelman C. *The Toolbox Revisited: Paths to Degree Completion from High School Through College*. Washington, DC: U.S. Department of Education; 2006.
- 345 7. Eaton DK, Brener N, Kann LK. Associations of health risk behaviors with school absenteeism. Does having permission for the absence make a difference? *J Sch Health*. 2008;78(4):223–229.
- 350 8. Berry L, Mirabito AM, Baun WB. What's the hard return on employee wellness programs? <https://ssrn.com/abstract=2064874>. Published December 2012. Accessed January 5, 2016.
9. Castelli DM, Centeio EE, Hwang J, et al. The history of physical activity and academic performance research: informing the future. *Monogr Soc Res Child*. 2014;79(4):119–148.
- 355 10. Donnelly JE, Hillman CH, Castelli D, et al. Physical activity, fitness, cognitive function, and academic achievement in children: a systematic review. *Med Sci Sports Exerc*. 2016;48:969–1225.
- 360 11. Fedewa AL, Ahn S. The effects of physical activity and physical fitness on children's achievement and cognitive outcomes: a meta-analytic review. *Res Q Exerc Sport*. 2011;82:521–535.
- 365 12. Travis F. Cortical and cognitive development in 4th, 8th and 12th grade students: the contribution of speed of processing and executive functioning to cognitive development. *Biol Psychol*. 1998;48:37–56.
13. Basch CE. Healthier students are better learners: a missing link in school reforms to close the achievement gap. *J Sch Health*. 2011;81:593–598. 370
14. Lewallen TC, Hunt H, Potts-Datema W, Zaza S, Giles W. The whole school, whole community, whole child model: a new approach for improving educational attainment and healthy development for students. *J Sch Health*. 2015;85:729–823. 375
15. Nelson MC, Gordon-Larsen P. Physical activity and sedentary behavior patterns are associated with selected adolescent health risk behaviors. *Pediatrics*. 2006;117:1281–1290. 380
16. Balfanz R, Bridgeland JM, Horning J, et al. Building a grad nation: progress and challenge in ending the high school dropout epidemic. <https://eric.ed.gov/?id=ED556758> Updated April 2014. Accessed January 5, 2016. 385
17. Allensworth EM, Easton JQ. *What Matters for Staying on Track and Graduating in Chicago Public High Schools: A Close Look at Course Grades, Failures, and Attendance in the Freshman Year*. Chicago, IL: University of Chicago; 2007. 390
18. Balfanz R, Herzog L, Mac Iver DJ. Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: early identification and effective interventions. *Educ Psychol*. 2007;42(4):223–235. 395
19. Oliff P, Leachman M. *New School Year Brings Steep Cuts in State Funding for Schools*. Washington, DC: Center on Budget and Policy Priorities; 2011.
20. Welk GJ, Meredith MD. *Fitnessgram/Activitygram Reference Guide*. Dallas, TX: The Cooper Institute; 2008. 400
21. Minasian V, Marandi SM, Kelishadi R, Abolhassani H. Correlation between aerobic fitness and body composition in middle school students. *Int J Prev Med*. 2014;5(2):S102–S107. 405
22. Motl RW, Dishman RK, Saunders RP, et al. Examining social-cognitive determinants of intention and physical activity among black and white adolescent girls using structural equation modeling. *Health Psychol*. 2002;21:459–467. 410
23. Rubin DB. Multiple imputation after 18+ years. *J Am Stat Assoc*. 1996;91:473–489.
24. Strong WB, Malina RM, Blimkie CJ, et al. Evidence based physical activity for school-age youth. *J Pediatr*. 2005;146:732–737. 415