The Association between Fitness and School Test Scores, Attendance, and Discipline among Mississippi Students

Geoffrey M. Hudson, PhD, CSCS
The University of Southern Mississippi
118 College Drive Box 5142
Hattiesburg, MS 39406
Geoffrey.Hudson@usm.edu

John Alvarez, PhD
Delta State University

Lindsey C Blom, EdD
Ball State University

Lei Zhang, PhD, MBA
Mississippi State Health Department

Jerome R. Kolbo, PhD, ACSW
The University of Southern Mississippi

Abstract

Between 2008 and 2010, a number of elementary and middle schools from across the state of Mississippi participated in the Health is Academic Quality Physical Education Program. As a part of the program, the schools implemented the Physical Best curriculum in their Physical Education (PE) classes. During each of the three spring semesters, the participating schools conducted fitness tests, and collected, recorded, and submitted their data through Fitnessgram software. Statistically significant correlations were found between fitness and both Language Arts and Math scores, as well as in absences. While a trend towards fitness and fewer disciplinary incidents was observed, the findings were not statistically significant. Additional analysis indicated statistically significant increases in the percentage of students in these schools that had higher Language Arts and Math scores and that achieved more Fitnessgram healthy fitness zones. Also, statistically significant decreases in absences and disciplinary incidents were observed over the three years. These findings suggest that investments in fitness and increasing the number of Mississippi students who are fit may likely result in improved test scores, fewer absences, and fewer disciplinary incidents in schools.

Introduction

A growing number of investigations have recently found a strong link between a child's fitness (irrespective of weight status) and academic performance (Blom, Alvarez, Zhang, & Kolbo, 2011; Castelli, Hillman, Buck, & Erwin, 2007; Chomitz, et al., 2009; Coe, Pivarnick, Womack, Reeves, & Malina, 2007; Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001; Eveland-Sayers, Farley, Fuller, Morgan, & Caputo, 2009; Roberts, Freed, & McCarthy, 2010; Sallis, et al., 1999; Stevens, To, Stevenson, Lochbaum, 2008; Welk, et al., 2010). Chomitz et al. (2009) found that a student's odds of passing the Math portion of the Massachusetts Comprehensive Assessment System (MCAS) increased by 38% for every increase in fitness units achieved with the Fitnessgram (Cooper Institute for Aerobic Research, 2007). Similarly, they also found a 24% increase in the odds of passing the English MCAS portion for each fitness unit achieved (Chomitz et al., 2009). Coe et al. (2006) found that higher grades were positively associated with students participating in vigorous physical activity. Additionally, Eveland-Sayers et al. (2009) found that as 1-mile run time and muscular fitness improved, so did Math scores on the Terra-Nova achievement test. Furthermore, Castelli et al. (2007) found a positive association between aerobic fitness and academic achievement and an inverse relationship between academic achievement and body mass index (BMI). In a study of elementary, middle, and high schools in Texas, Welk and colleagues (2010) also found a positive relationship between fitness and academic achievement. This study also demonstrated that students with higher fitness levels had fewer absences and fewer reported delinquency problems (Welk et al., 2010). While these cross-sectional studies have been able to demonstrate some positive associations, a longitudinal intervention performed by Sallis et al. (1999) provides some of the most compelling evidence. In the Project SPARK study, researchers found that doubling a child's time in Physical Education (PE) in the SPARK program resulted in increased academic performance (Sallis et al., 1999).

Under the pressures of ever-shrinking budgets and increased national emphasis on standardized testing, it is now commonplace for school administrators to substitute PE programs for increased time in math or language courses (Centers for Disease Control and Prevention [CDC], 2004; Pearlman, Dowling, Byuk, Cullinen, & Thacher, 2005). Despite the assumptions implied by this trend, a systematic review of literature by Murray, Low, Hollis, Cross, & Davis (2007) revealed that there is a lack of evidence that substituting time in a PE class for an academic class would negatively affect academic performance. Specifically, Welk and coauthors (2010) also found that higher fitness rates increased the odds of schools achieving exemplary/recognized school status within the state of Texas. Furthermore, longitudinal studies like Project SPARK (Sallis et al., 1999) establish that increasing PE time can potentially lead to increases in testing scores. A recent review of the literature by the CDC also strongly supports the positive relationship between school-based physical activity and academic performance (CDC, 2010). Moreover, research on the Action Schools! BC intervention in Canada demonstrated that increasing physical activity time by 47 minutes per week did not significantly affect academic performance scores (Ahamed, et al,, 2007). While this study did not demonstrate an improvement in academic performance, it is still important evidence for administrators to note that replacing time in the classroom with an extra six to seven minutes a day of physical activity did not have a negative impact on the children's academic performance. Despite numerous studies around the United States (U.S.) demonstrating a positive relationship between fitness and academics, limited research has been conducted in Mississippi. Blom et al. (2011) reported the findings of the first of three years of data on 22 Mississippi schools in 2008 that implemented the Physical Best curriculum and assessed student fitness with the Fitnessgram battery of tests. The researchers found statistically significant correlations between fitness and both Language Arts and Math Scores and in absences even after controlling for age, gender, race, and socio-economic status (SES). It should be noted that while a trend towards fitness and fewer disciplinary incidents was observed, the findings were not statistically significant. The researchers suggested that investments in fitness and increasing the number of students who were fit and were fit in more areas would likely result in improved test scores, fewer absences, and fewer disciplinary incidents (Blom et al., 2011).

Therefore, the purpose of the current study was twofold. First, the study was designed to analyze the data on the students in these same Mississippi schools during the second and third years (spring semesters of 2009 and 2010) of the Physical Best curriculum to again assess the relationship between fitness and absences, disciplinary incidents, and test scores. Secondly, the purpose was to analyze the data over the term of the project (2008, 2009, and 2010) to determine if over the three years, higher percentages of students were fit in more areas, whether Language Arts and Math scores improved, and whether absences and disciplinary incidents declined.

METHODS

Participants

In this study, fitness data were collected and analyzed on 13,311 Mississippi public school children in grades 3-8. The students were from 22 different schools between 2008 and 2010. Fitness data collected and recorded on students in these schools were then matched by the Mississippi Department of Education (MDE) with student records within the Mississippi Student Information System (MSIS). Many records were not able to be matched or had missing data that were necessary for the analysis. A final data set consisting of 6,492 students with all necessary data was produced.

Instruments

Physical fitness, standardized Language Arts and Math test scores, absences, disciplinary incidents, and socio-demographic information of gender, race/ethnicity, and SES (via lunch status) were included in the analysis. More information on each of these measures is described below.

Physical fitness data were collected through the Fitnessgram, which is a physical fitness test battery developed by the Cooper Institute (Cooper Institute for Aerobic Research, 2007). The Fitnessgram was used in tandem with the Physical Best curriculum developed by the National Association for Sport and Physical Education (NASPE). The Physical Best curriculum is a guide for best practice for developing health-related physical fitness in the K-12 physical education setting. The Fitnessgram is a commonly used means of assessment for six components of health-related fitness that includes: PACER (Progressive Aerobic Cardiovascular Endurance Run) test, curl-up endurance test, push-up endurance test, trunk lift, sit and reach, and skinfold/BMI. Under the Fitnessgram guidelines, each fitness component has a specific range of criterion-referenced standards that constitutes a healthy fitness zone. The healthy fitness zones are considered to be the minimal level of performance associated with good health or decreased risk (Welk & Meredith, 2008). Students' overall fitness level was determined by the number of healthy fitness zones they achieved on the test battery. These scores could range from zero to six healthy fitness zones achieved.

Academic achievement data (i.e., standardized Language Arts and Math scores) were collected through the second version of the Mississippi Curriculum Test (MCT2). This assessment comprises Language Arts and Mathematics and is administered annually to all Mississippi students in grades 3-8. The MCT2 has four levels of achievement, (a) minimal: students inconsistently demonstrated the content area knowledge and skills required for success at the next grade, (b) basic: students demonstrated partial mastery of the content area knowledge and skills required for success at the next grade, (c) proficient: students demonstrated solid academic performance, and (d) advanced: students demonstrated academic performance clearly beyond the requirements to be successful at the next grade (Bounds, Sewell, Kaase, & Simmons, 2007; Mississippi Department of Education, 2010). For this study, students were grouped into either a low academic achievement group (students at minimal and basic levels) or a high academic achievement group (students at proficient and advanced levels).

Academic behavioral data were collected through reports generated by Mississippi Department of Education (MDE) on absences and disciplinary actions on each student in K-12. For this study, absence was measured by the number of days students were absent over the course of a year and categorized into three groups: few (0-3 absences), often (4-7 absences), and frequent (8 or more absences). Data on disciplinary incidents are reported similarly to absences. In this study, either In-School Suspensions or Out-of-School Suspensions were categorized into two groups: students with at least one reported suspension or those with no reported suspension.

Socio-demographic data ([SES]; i.e. race/ethnicity) were recorded and coded exactly as provided by the MDE. Based on whether or not students were qualified for free or reduced price lunch, three groups (i.e., free lunch, reduced price lunch, and paid lunch) determined their SES.

Procedures

This study received Institutional Review Board approval through the Human Subjects Committee at The University of Southern Mississippi (USM). Due to the sensitive nature of using and merging student records, a Memorandum of Understanding (MOU) regarding the protection of the data was established between MDE and USM. All data were handled electronically and were password protected.

During spring semesters 2008, 2009, and 2010, over 20 elementary and middle schools from across the state of Mississippi received funding from the Bower Foundation as part of the Health is Academic Quality Physical Education Program. As part of their funding, each school received the Physical Best Curriculum and the Fitnessgram testing battery with reporting software. Each of the schools sent representatives to training sessions in which they received training on the implementation of Physical Best curriculum and the use of the Fitnessgram software by certified trainers. During the spring semesters of 2008, 2009, and 2010, schools were able to implement the curriculum in their PE classes. They also conducted the fitness tests, and collected, recorded, and submitted their data through the Fitnessgram software. Test administration was handled by the PE teachers at each school under the supervision of those receiving the training to ensure that the Fitnessgram would be administered in a consistent manner.

Data Management

The participating PE teachers entered all demographic, bio-statistical, and fitness data into the Fitnessgram software as instructed in the training sessions and then exported the data directly from the software. Each case in the files included student name, date of birth, gender, grade level, and the six fitness test scores. The data file with all students' data from each school was submitted to the MDE. It was then merged with student records within the MDE MSIS, which included student information regarding race/ethnicity, lunch status (free, reduced price, or paid lunch), absences, disciplinary incidents, and Language Arts and Math test scores.

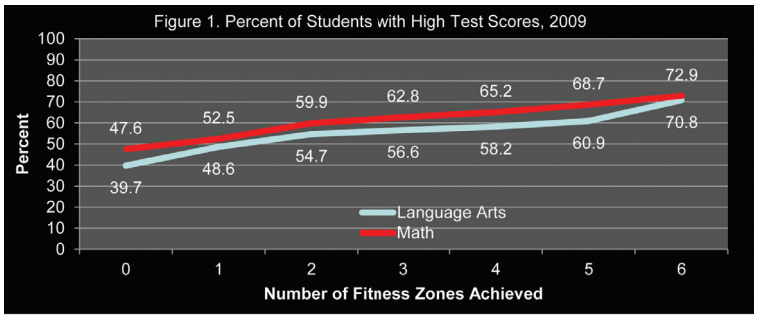
Data Analysis

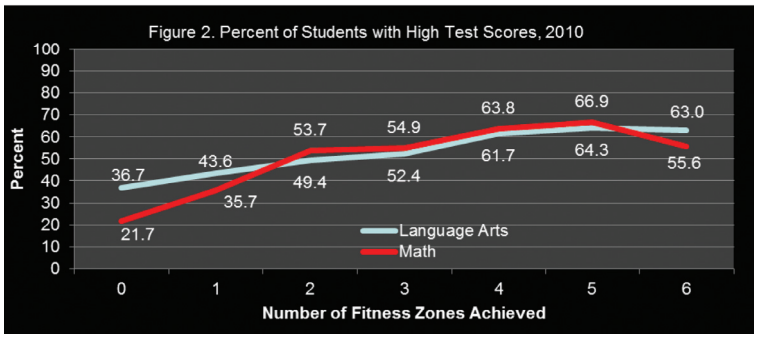
SAS 9.2 was used for all statistical analysis. Chi-square analyses were used to assess the statistical significance of observed differences in academic test scores, absences, and disciplinary incidents. Chi-square test for trend was used to investigate if the students' test scores, absences, and disciplinary incidents changed during the three years of the project (2008-2010).

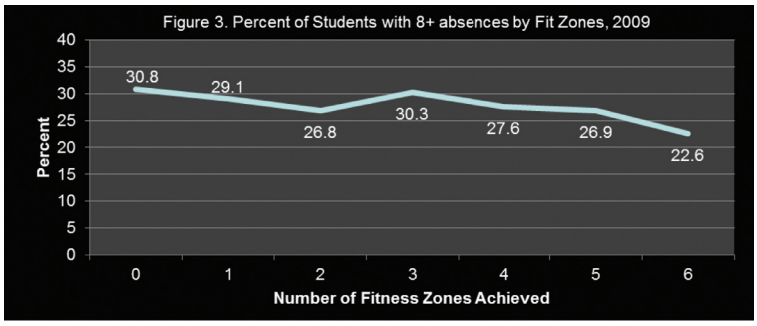
RESULTS

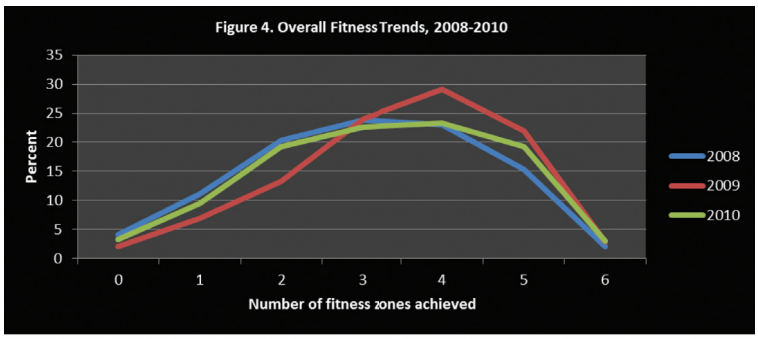
As with the findings reported by Blom et al. (2011) regarding the first year of the project (i.e. 2008), significant linear trends ($p < 0.0001$) were also observed between fitness and both Language Arts and Math scores in both 2009 and 2010. This indicates that the percent of high test scores increased with the number of healthy fitness zones achieved (Figures 1 and 2).

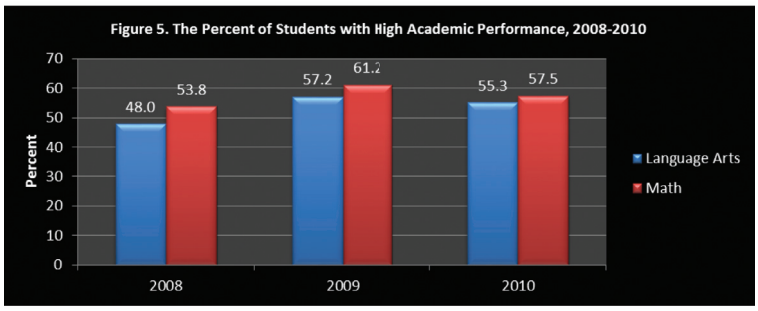
Significant relationships were also observed with the behavioral variables collected. As in 2008, significant linear trends ($p < 0.0001$) were observed between fitness and absences in 2009 (Figure







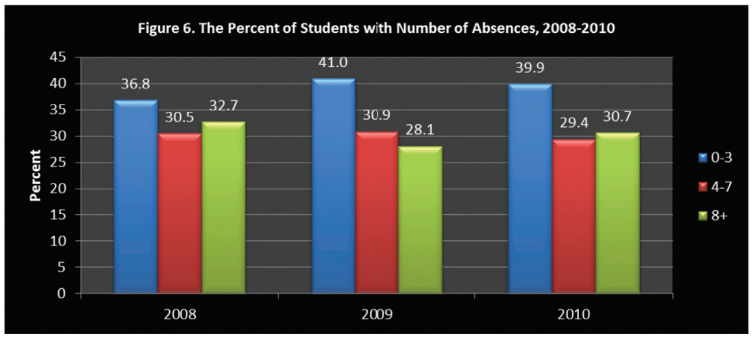


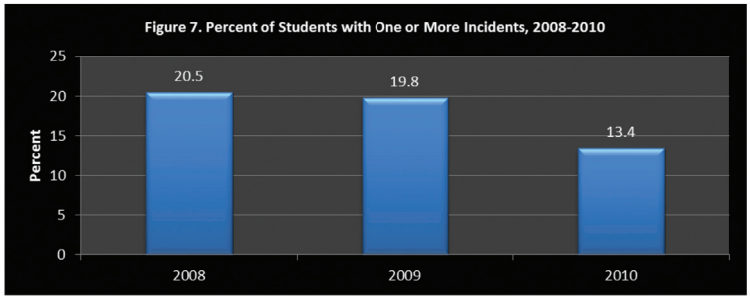


3), but not 2010. In 2009 and 2010, there was no relationship between number of disciplinary incidents and number of healthy fit zones achieved. This finding is also consistent with the data from 2008.

As for trends over the three years of the project, changes were noted in the distribution of the number of fit zones achieved. The percent of students who achieved lower numbers of fit zones decreased and the percent of students who achieved higher numbers of fit zones increased over the three year period. This change is statistically significant ($p < 0.0001$) (Figure 4). As for changes in Language Arts and Math scores, the percent of students with high performance showed an upward trend over the three years of the project. This change is statistically significant for both Language Arts ($p < 0.0001$) and Math ($p < 0.0001$) (Figure 5).

Data on behavioral parameters provided several interesting findings. Over the past three years, the percent of students with 0 – 3 absences increased, while students with 4 – 7 absences remained unchanged, and students with 8 or more absences decreased. The overall change was statistically significant ($p = 0.015$) (Figure 6). While the relationship between fitness and disciplinary incidents was not statistically significant in the analysis of each individual year, the percent of students with one or more disciplinary incidents showed a statistically significant downward linear trend ($p < 0.0001$) (Figure 7).





DISCUSSION

These findings are consistent with and support prior research within Mississippi (Blom et al., 2011) and beyond (e.g., Castelli et al., 2007; Chomitz et al., 2009; Eveland-Sayers et al., 2009; Roberts et al., 2010; Welk et al., 2010). Similar statistically significant findings over three separate years and over a three year period indicate that the relationship between fitness and academic performance is strong and provide additional confidence that these findings are worth careful consideration. These findings suggest that investments in fitness and increasing the number of students who achieve more healthy fitness zones may likely result in improved test scores, fewer absences, and fewer disciplinary incidents in schools.

The design of this study does possess limitations, however. First, since this is a cross-sectional study, it cannot be concluded that increased fitness caused improved test scores and decreased absences or disciplinary incidents. It is possible that the students that score better on both academic and fitness tests are simply more motivated to go to school, stay out of trouble and do well on tests. Secondly, with the current research design, it was not possible to track the progress of each child longitudinally over the three year period. It is also important to note that by the third year, only 16 of the original schools submitted data. It is possible that schools and the students in those schools that remained in the project were different than those that had dropped out of the project. However, it should be noted the each individual year of the project (2008, 2009, and 2010) found statistically significant findings regardless of which schools submitted data. In future studies, it would be useful to examine whether an improvement in each student's fitness would lead to similar academic improvements. Moreover, it would be valuable to determine the impact of grade level (elementary and middle vs. high school), student and parent motivation for academic success, and the modes of delivery that are used and times involved in each mode (e.g. PE class, recess, after-school programs). These findings and the limitations of this current project suggest that future studies that longitudinally track students individually over several years are warranted to better determine whether changes in fitness and academic performance, as well as absences and discipline, are causally related.

To the authors' knowledge, this study is the first of its kind to repeatedly investigate the relationship between fitness and academic performance and to do so over time in Mississippi. These results are then of great significance to teachers and administrators in Mississippi and perhaps across the nation. As previous evidence has illustrated the importance of exercise with childhood obesity, this study also illustrates that elementary and middle school students in Mississippi who are more physically fit also have higher scores in Math and Language Arts and have fewer absences. These findings could be used by physical education professionals as well as administrators in the state to combat the temptation to sacrifice PE instructional time for additional academic instruction. In doing so, it is more likely that the schools can also further aid in the reversal of the childhood obesity epidemic in the state while still maintaining and possibly improving their academic performance measures.

REFERENCES

Ahamed, Y., Macdonald, H., Reed, K., Naylor, P-J., Liu-Ambrose, T., & McKay, H. (2007). School-based physical activity does not compromise children's academic performance. Medicine & Science in Sports & Exercise, 39(2), 371-376.

Blom, L.C., Alvarez, J., Zhang, L., & Kolbo, J. (2011). Associations between health-related physical fitness, academic achievement and selected academic behaviors of elementary and middle school students in the state of Mississippi. ICHPER-SD Journal of Research, 6(1), 28-34.

Bounds, H.M., Sewell, B., Kaase, K., & Simmons, C. (2007). Mississippi performance level descriptors for the 2006 Mississippi language arts framework revised, 2007 Mississippi mathematics framework revised, and 2001 Mississippi science framework. Retrieved from Mississippi Department of Education website: http://www.mde.k12.ms.us/ACAD/osa/pld/Performance_Level_Descriptors.pdf

Castelli, D.M., Hillman, C.H., Buck, S.M., & Erwin, H.E. (2007). Physical fitness and academic achievement in third- and fifth-grade students. Journal of Sport & Exercise Psychology, 29, 239-252.

Centers for Disease Control and Prevention. (2004). Participation in high school physical education – United States, 1991-2003. Morbidity and Mortality Weekly Reports, 53(36), 844-847.

Centers for Disease Control and Prevention. (2010). The association

between school-based physical activity, including physical education, and academic performance. Atlanta, GA: U.S. Department of Health and Human Services.

Chomitz, V.R., Slining, M.M., McGowan, R.J., Mitchell, S.E., Dawson, G.F., & Hacker, K.A. (2009). Is there a relationship between physical fitness and academic achievement? Positive results from public school children in the Northeastern United States. Journal of School Health, 79(1), 30-37.

Coe, D.P., Pivarnik, J.M., Womack, C.J., Reeves, M.J., & Malina, R.M. (2006). Effect of physical education and activity levels on academic achievement in children. Medicine & Science in Sports & Exercise, 38(8), 1515-1519.

Cooper Institute for Aerobic Research. (2007). Fitnessgram/Activitygram Test Administration Manual (4th ed.). Champaign, IL: Human Kinetics.

Dwyer, T., Sallis, J.F., Blizzard, L., Lazarus, R., & Dean, K. (2001). Relation of academic performance to physical activity and fitness in children. Pediatric Exercise Science, 13, 225-237.

Eveland-Sayers, B.M., Farley, R.S., Fuller, D.K., Morgan, D.W., & Caputo, J.L. (2009). Physical fitness and academic achievement in elementary school children. Journal of Physical Activity and Health, 6, 99-104.

Mississippi Department of Education. (2010). Mississippi curriculum test (2nd edition): Interpretive guide. Iowa City, Iowa: Pearson, Inc.

Murray, N.G., Low, B.J., Hollis, C., Cross, A.W., & Davis, S.M. (2007). Coordinated school health programs and academic achievement: A systematic review of the literature. Journal of School Health, 77(9), 589-600.

Pearlman, D.N., Dowling, E., Byuk, C., Cullinen, K., & Thacher, A.K. (2005). From concept to practice: using the School Health Index to create healthy school environments in Rhode Island elementary schools. Preventing Chronic Diseases, Nov. V.2: Special Issue.

Roberts, C.K., Freed, B.F., & McCarthy, W.J. (2010). Low aerobic fitness and obesity are associated with lower standardized test scores in children. Journal of Pediatrics, 156(5), 711-718.

Sallis, J.F., McKenzie, T.L., Kolody, B., Lewis, M., Marshall, S., & Rosengard, P. (1999). Effects of health-related physical education on academic achievement: Project SPARK. Research Quarterly for Exercise and Sport, 70(2), 127-134.

Stevens, T.A., To, Y., Stevenson, S.J., & Lochbaum, M.R. (2008). The importance of physical activity and physical education in the prediction of academic achievement. Journal of Sport Behavior, 31(4), 368-388.

Welk, G.J. & Meredith, M.D. (Eds.). (2008). Fitnessgram/Activitygram Reference Guide. Dallas, TX: The Cooper Institute.

Welk, G.J., Jackson, A.W., Morrow, J.R., Haskell, W.H., Meredith, M.D. & Cooper, K.H. (2010). The association of health-related fitness with indicators of academic performance in Texas schools. Research Quarterly for Exercise and Sport, 81(3), S16-S23.