DIFFERENCES IN ACADEMIC ACHIEVEMENT IN FIT, HEALTHY, AND UNFIT 7TH GRADE STUDENTS

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ABSTRACT

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There is an abundance of research showing significant positive relationships between academic achievement and physical fitness. The purpose of this study was to examine the relationship between academic achievement and different levels of physical fitness. The participants were 283 7th grade students from a small, rural middle school in Northern California during 2011/12, 2012/13, 2014/15 academic school years. Academic achievement data came from the STAR (Standardized Testing and Reporting) test and CAASPP (California Assessment of Student Learning and Progress) test. Physical fitness data came from the FITNESSGRAM Physical Fitness Test. A MANOVA was performed on the academic achievement and physical fitness data. Using Pillai's Trace, there was not a significant difference between groups (number of fitness tests passed) and language arts and math achievement scores, $v = .012$, $F(4, 560) = .838$, $p = .502$. The results of this study do not confirm a significant positive relationship between academic achievement and physical fitness as demonstrated by prior research. Some variables that may have influenced results in the current study include higher student achievement and higher student Socio-Economic Status compared to statewide levels. The current study examined academic achievement and overall physical fitness, instead of examining

certain aspects of physical fitness that have been shown to have the strongest correlation with academic achievement. Furthermore, low physical fitness performance standards, and the cross-sectional nature of the study, may have influenced results. Further research is needed into variables that influence student achievement as well determining amounts of vigorous physical activity and levels of physical fitness needed to produce desirable results.

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INTRODUCTION

The lack of regular physical activity (PA) is a growing epidemic in the United States as well as world-wide. Physical inactivity is the fourth leading risk factor for mortality, causing an estimated 3.2 million deaths globally (World Health Organization [WHO], 2017). In the U.S., nearly half of all youth ages 12-21 are not vigorously active on a regular basis and only 17.1% of high school students meet the recommendations for physical activity (Centers of Disease Control and Prevention [CDC], 2017). Schools have been identified as the setting that had the most evidence for promoting and improving physical activity in youth (CDC).

The terms PA and physical fitness (PF) are often used interchangeably. PA is defined as any bodily movement produced by skeletal muscle that requires energy above that of a resting metabolic state (Rasberry, Lee, Robin, Laris, Russell, Coyle, Nihiser, 2011). PF is the result of PA, in which the body adapts in response to intermittent or continuous PA or physical exercise. PF is the integrated measure of most of the body functions that are involved in the performance of daily PA and physical exercise (Ortega, Ruiz, Castillo, & Sjostrom 2008). PA and PF are both measurable; however, within Physical Education, a student's PF is mainly assessed and evaluated to determine if they are meeting state or national health and fitness standards.

The health benefits of PA and physical fitness (PF) are well acknowledged and supported by research. Benefits of PA and PF include, but are not limited to: improved musculoskeletal health, several components of cardiovascular health, reduced adiposity

in overweight youth, reduction of depression and anxiety, and improved self-concept (Strong, Malina, Blimkie, Daniels, Dishman, Gutin, and Rowland, 2005). In addition to the physical and psychological benefits, there is a growing body of evidence that suggests that PA and PF may play a key role in improving cognitive function and academic performance (Castelli, Hillman, Buck, and Erwin, 2007). As John F. Kennedy once said, "Physical Fitness is not only one of the most important keys to a healthy body, it is the basis of dynamic and creative intellectual activity."

Health Benefits of Physical Activity

The health benefits of PA are abundant and well established by research. Regular PA has been proven to prevent diseases such as: cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, osteoporosis, and premature death (Warburton, Nicol, and Bredin 2006). There appears to be a parallel association between physical activity and health status, such that increases in physical activity will lead to additional improvements in health status (Warburton et al. 2006). These benefits are not limited to adults, but are also evidenced in youth and adolescence, they include: increased self-esteem, increased feeling of well-being, and lower levels of anxiety and stress (Trudeau & Shepard, 2008). Additional benefits to youth include a reduction in the risk of developing cardiovascular disease, diabetes, cancer, high blood pressure, high blood cholesterol, and diabetes in adulthood; as well as, an increased chance of being physically active and staying healthy as adults (Talema 2009, U.S. Department of Health and Human Services, 2012).

Physical Activity and Cognition

In addition to the many positive benefits of PA on the body, research has also determined that there are positive effects on the mind. Studies examining the link between PA and academic performance have found positive associations with vigorous PA (Coe, Pavarnik, Womack, Reeves, and Malina, 2006). In a meta-analysis conducted by Sibley and Etier (2003), researchers confirmed that a small but significant relationship existed between physical activity and cognitive performance in school aged-children (Castelli et al. 2007). Coe et. al also concluded from their research, that there may exist a threshold of physical activity intensity needed to positively influence academic achievement.

Health Benefits of Physical Fitness

The effects of PF on health outcomes and the prevention of disease is like PA in relation to mortality; however, PF is a stronger predictor of positive health outcomes (Warburton et al. 2006). There are a variety of health benefits associated with physical fitness. Being physically fit, reduces the risk of: cardiovascular disease, colon cancer, diabetes, obesity, and premature death (Strong et al. 2006). Additionally, bone and musculoskeletal function improve, as do psychological variables, including depression, anxiety, stress, and self-confidence (Strong et al. 2006).

Physical Fitness and Cognition

There is an abundance of research that shows a strong positive effect of PF on cognition in adults, including a reduction in risk for age-associated neurodegenerative disorders (Hillman, Erickson, and Kramer, 2008). Recently, there is an increased interest in examining the relationship between PF and academic performance in youth, as schools are under more pressure to increase students' academic achievement as measured by standardized tests (Coe et. al 2006). Most of the studies have shown that there is a small positive correlation between PF and academic performance, including the California Department of Education study in 2001, which found a positive correlation between fitness test scores from the *Fitnessgram* Physical Fitness Test and reading and mathematics scores from the Stanford Achievement Test (Castelli et al. 2007).

Although, there is evidence of a positive relationship between PF and cognition, the exact mechanisms of how are not completely understood (Castelli et. al 2007). Castelli et. al, also found that fit children exhibit a greater allocation towards working memory. Furthermore, a study examining aerobic fitness with neurocognitive function, Hillman, Castelli, and Buck (2005) found that aerobic fitness was also positively associated with neuroelectric function, and highly fit pre-adolescent children had faster cognitive processing speed compared to the other components of physical fitness such as muscular strength, flexibility, and body composition.

Physical Activity Recommendations and Adherence

The World Health Organization (WHO) recommendations for PA in youth, include 60 minutes of moderate-to-vigorous-physical activity (MVPA) daily. In the

United States, public school systems play a key role in providing PA to children and youth, in which 95% are enrolled (CDC 2013). According to research, only 42% of U.S. children and 6-8% of adolescence are adhering to this recommendation (Troiano, Berrigan, Dodd, Masse, Tilet, & McDowell, 2008). Additionally, only 29% of high school students participated in PA for 60 minutes per day in each of the last 7 days prior, according to a survey (U.S. Department of Health and Human Services 2012). The typical school day lasts 6 to 7 hours in duration, which makes it the ideal setting in order provide PA opportunities for students. The Centers for Disease Control and Prevention has come up with the "Comprehensive School Physical Activity Program", that includes school children getting most, if not all, of the recommended 60 minutes of PA in school, one of which is through a quality Physical Education program.

Physical activity in physical education

In California, the Education Code requires school children between Kindergarten to Sixth grade participate in not less than 200 minutes of Physical Education every 10 days, and from Seventh grade to Twelfth grade, the requirement is not less than 400 minutes every 10 days (cde.ca.gov). The recommendations from the National Association for Sports and Physical Education (NASPE) is that students should be engaged in MVPA at least 50% of the time that they are in Physical Education class. A 2006 study of School Health Policies and Programs found that the total amount of active time spent in a typical physical education period was 35.6 minutes among all required physical education classes or courses (Lee, Burgeson, Fulton, & Spain, 2006). Lee et al. (2006) also found that elementary students spent 34.9 minutes of total time being active in physical

education classes, 39.7 minutes among middle school courses, and 44.6 minutes among high school courses. In another study by Coe et. al (2006), found that 6th grade students from a public school in Michigan only averaged 19 minutes of MVPA in a 55-minute class period.

Numerous studies have found positive significant connections between PA and PF, and academic achievement (Coe et. al 2006). While there is abundant research recognizing the benefits of PA and PF for school children, schools continue to reduce or eliminate opportunities for PA and PF due to increasing demands to improve student achievement (Van Dusen, Kelder, Kohl, Ranjit, & Perry, 2011). The purpose of this study was to further investigate the relationship between academic achievement and physical fitness. Based on previous research, the hypothesis was that there would be a positive significant relationship between academic achievement and PF.

METHODS

Participants

The collective data for this research came from a small public middle school situated in rural Northern California. Student population across grades 6, 7, and 8 is approximately 300, with the data for this study representing 283 7th grade students during the 2011/12, 2012/13, and 2014/15 academic school years. All 7th grade students, except for students with an IEP that limited their participation in test, were assessed. Diversity of student population was 52% White, 46% Hispanic, 1% Asian. Of the student population, 34% of students qualified for free-or-reduced lunch and 11% are classified as English Language Learners.

Instruments

Physical Fitness Test. The California State Board of Education has designated the *FITNESSGRAM* as the Physical Fitness Test (PFT) for students in California Public Schools (*cde.ca.gov).* The primary goal of the *FITNESSGRAM* is to assist students in developing lifelong habits of regular physical activity. Initially developed by Charles L. Sterling, as a physical fitness "report card" (Plowman, Sterling, Corbin, Meredith, Welk, & Morrow, 2006). The FITNESSGRAM uses Criterion Reference (CR) standards for field tests and fitness standards that meet validity and reliability tests. (Plowman et. al 2006).

The *FITNESSGRAM* PFT is required of all 3rd, 5th, 7th, and 9th graders in California between February 1 and May 30. The *FITNESSGRAM* test consists of the following six fitness areas: aerobic capacity (PACER or mile run), abdominal strength and endurance (curl-ups), upper body and endurance (push-ups, pull-ups, or flexed-arm hang), body composition (skin fold/bioelectric impedance analyzer or body mass index), trunk extensor strength and flexibility (trunk lift), and flexibility (back-saver sit & reach). Students prepared for tests throughout the school year, including a pre-test that took place in October, along with designed weekly lessons that incorporated specific training along with periodic "practice" tests. Healthy fitness standards have been established for gender and age for each test. Participants are informed of the healthy fitness standards and are encouraged to achieve their "personal best" in each of the categories of fitness that were assessed.

Standardized Testing and Reporting. In October of 1997, the Governor of California signed Senate Bill 376 authorizing the Standardized Testing and Reporting (STAR) Program (cde.ca.gov). Students in grades two through eleven were tested in three different academic area: Reading, Language, and Mathematics beginning in the Spring of 1998. The STAR consists of several key tests that are designed for student's age and individual needs. The tests include the California Standards Test (CST), California Modified Assessment (CMA), and California Alternate Performance Assessment (CAPA). The CST's are multiple choice tests in English-Language Arts, Mathematics, Science, and History-Social Science for varying grade levels.

California Assessment of Student Performance and Progress. The California Assessment of Learning Performance and Progress (CAASPP), replaced the Standardized Testing and Reporting Program on January 1, 2014 (cde.ca.gov). In 2014/2015, CAASPP administered through the online Smarter Balanced summative assessments these are comprehensive, end of year assessments of grade level learning that measure progress toward college and career readiness each test, English Language Arts/Literacy (Ela) and Mathematics is comprised of two parts: (1) a computer adaptive test and (2) a performance task; administered within a 12-week window beginning at 66 percent of the instructional year for grades three through eight.

Procedures

The PFT were given during the first two weeks in May. One test was administered per day, expect of Body Composition (BMI), which was administered on the same day. Students who missed a test due to absence, could make-up the test when they returned to school within the testing date window. Students were informed of the PFT Standards for each test.

STAR tests were administered during the Spring of 2012 and 2103 and followed the protocols set forth by California Department of Education for the administering of tests (cde.ca.gov). In 2015, student's academic performance was assessed by the CAASPP. Both tests were administered to all students except for those students with significant cognitive disabilities or students who have an IEP that indicates assessment with an alternative test.

Data analysis. Academic achievement and physical fitness data was collected from a secondary source. Using IBM SPSS statistics software, a Multivariate analysis of variance (MANOVA) test was performed on academic achievement data and physical fitness data.

Institutional Board Review. Approval of this study was obtained through Humboldt State University Institutional Review Board (IRB). The IRB process included completing the IRB application and subsequent approval. IRB number: IRB 15-225 Date: June 1, 2016

RESULTS

Descriptive Data

The data from this study came from 283 participants from the 2011/12, 2012/13, and 2014/15 academic school years. Academic achievement data came from the STAR test results in 2012 and 2013, and from the CAASPP test results in 2015. Physical fitness data is representative of 2012, 2013, and 2015 PFT scores. Data was organized by dividing participants into three groups: fit, healthy, and unfit. Students whose PFT scores met the healthy fitness standard in 5 of 6 or 6 of 6 were classified as "fit". Students whose PFT scores met 3 of 6 or 4 of 6 of the healthy fitness standards, were classified at "healthy", and students who met 0, 1, or 2 of 6 of the healthy fitness standards, were classified as "unfit".

Test data representing academic achievement was organized using a 5-point scoring system for the STAR test. The 5-point score system corresponds to a performance level. A score of "5" is representative of advanced performance, "4" is representative of proficient, "3" is representative of basic performance, "2" is representative of below basic performance, and "1" is representative of far below basic performance.

CAASPP test data was organized using a 4-point system. The 4-point system corresponds to performance and represent the extent to which grade level standards were

met. Level "4" represents standard exceeded, level "3" represents standard met, level "2" represents standard nearly met, and level "1" represents standard not met. (cde.ca.gov)

Academic achievement data from 2012 STAR tests indicate that of 105 students tested the average ELA test score was 3.99 and the average Mathematics score was 3.92. Test results also revealed that 41% of student scores were advanced, 35% proficient, 17% basic, 3% below basic, and 4% of students scored far below basic in ELA. In Mathematics, 40% of students scored advanced, 29% scored proficient, 20% scored basic, 10% scored below basic, and 1% scored far below basic. During the same year, PFT data shows an average student score of 4.74 healthy fitness zone standards met. From the same data, 41.8% of students assessed met all 6 of the healthy fitness zone standards, 20.9% of students met 5 of 6 standards, 19.1% of students met 4 of 6 standards, 10.9% of students met 3 of 6 standards, and 6.3% of students assessed met 2 of 6 standards or below.

Data from 2013 indicates that the average ELA student score for the STAR test was 4.07 and 4.10 for Mathematics. Of the students assessed, 40% of students tested scored advanced, 34% of students scored proficient, 24% scored basic, 2% scored below basic, and 0% far below basic in ELA. In Mathematics, 41% of students assessed scored advanced, 31% scored proficient, 23% scored basic, 5% scored basic, and 0% scored far below basic. PFT data for 2013, showed an average student score of 4.02 healthy standards met. Students who met 6 of 6 healthy fitness zone standards represented 0% of students. 47.7% of students met 5 of 6 healthy fitness zone standards, 23.3% of students

met 4 of 6 healthy fitness zone standards, 17.4% of students met 3 of 6 healthy fitness zone standards, and 11.6% of students met 2 of 6 healthy fitness zone standards or less.

(Table 1) shows the average Language Arts and Mathematics scores for fit, healthy, and unfit students. Fit students represented n=164 of the students with an average Language Arts score of 3.68 and average Mathematics score of 3.52. There were n=96 students in the healthy category whose average Language Arts score was 3.40 and average Mathematics score was 3.28. Unfit students represented n=23 students and their average Language Arts score was 3.57 and average Mathematics score was 3.43.

Table 1 Descriptive statistics for Language Arts and Mathematics for fitness groups

Variables	Unfit (n = 23)	Healthy (n = 96)	Fit (n = 164)
Language Arts	3.57 (1.27)	3.40 (1.27)	3.68 (1.18)
Mathematics	3.43 (1.20)	3.28 (1.40)	3.51 (1.37)

(Figure 1) shows a bar graph of average academic achievement scores for Language Arts and Mathematics in fit, healthy, and unfit students. Fit students represented by the light bar, healthy students represented by the shaded bar, and unfit students represented by the dark bar.

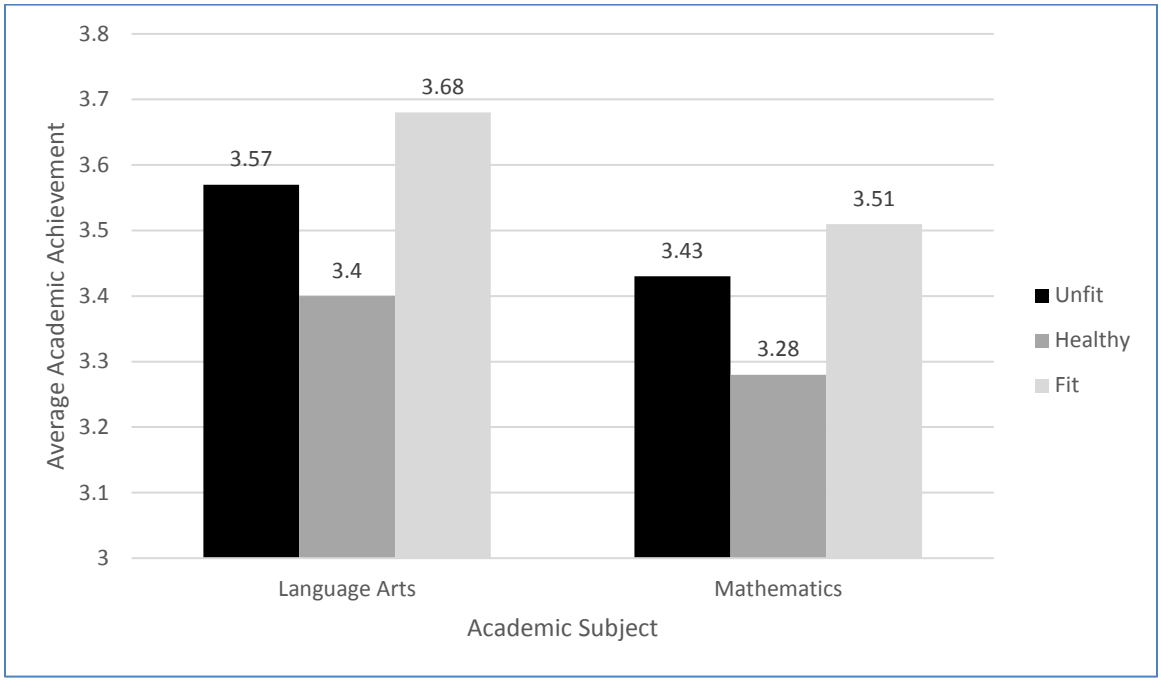

Figure 1.

There were four outliers (z = -2.10, -2.23, -2.07, -1.99) identified in the data set within Language Arts, however, a sensitivity analysis was conducted and determined that outliers would be retained. Tests of multivariate assumptions found a violation of multivariate normality (K-S $\leq$ 0.05) within all groups for both Language Arts and Mathematics scores but equality of covariance matrices (Box's M = 7.16, p = .321) was not violated. Using Pillai's Trace, there was not a significant difference between groups (number of fitness tests passed) and language arts and math achievement scores, ν = .012, F(4, 560) = .838, p = .502.

DISCUSSION

Results from the present study show that there were not significant differences between academic achievement and physical fitness in 7th grade students. Of the 283 participants in this study, 164 were classified as "fit", 96 were classified as "healthy", and 23 were classified as "unfit" based on the number of fitness standards met. The average language arts achievement score was 3.68 in "fit" students, 3.4 in "healthy" students, and 3.57 in "unfit" students. In mathematics achievement, the average score was 3.51 in "fit" students, 3.28 in "healthy" students, and 3.43 in "unfit" students. Although "fit" students scored the highest in both language arts and mathematics achievement tests compared to "healthy" and "unfit" students, differences were not statistically significant.

Previous research has shown that there is a significant positive relationship between academic achievement and physical fitness. The Department of Education study in 2001, found a positive correlation between fitness test scores from the *FITNESSGRAM* PFT and reading and mathematics scores from the Stanford Achievement Test (Castelli et. al, 2007). In another study by Castelli et. al, found that physical fitness was positively related to academic achievement in 259 third and fifth grade students. Finally, research done by Chomitz et. al (2009), found a significant positive relationship in Mathematics achievement and English achievement, and increasing levels of physical fitness among diverse, urban school children.

Research has also shown that there are significant positive benefits of vigorous PA and cognitive function (Coe et. al 2006). Coe et. al, also found that students who

performed vigorous PA had significantly higher grades than students who performed no vigorous PA, or moderate PA. Coe et al. concluded from their research, that there may exist a threshold of PA that is required to produce desirable effects. In other research on associations of PA and academic achievement, found that 50.5% of associations were positively related, 48% of associations were not significant, and only 1.5% demonstrated a negative association (Rasberry et al. 2011).

There are many possible explanations why the results from the current study do not correspond to previous research that shows a significant positive relationship between academic achievement and physical fitness. First, the middle school from which the data came from, is unique from other middle schools in California. Academic achievement data from 2011-12 academic school year, shows that 73.2% of students assessed from the subject school scored Proficient or Advanced in English-Language Arts. Data from the State of California, shows that 57.2% of students statewide scored Proficient or Advanced in English-Language Arts. In Mathematics, student data from subject school revealed that 59.9% of students scored Proficient or Advanced compared to 51.5% of students statewide that scored Proficient or Advanced. Physical fitness data shows similar findings. In the subject school, 41.8% of 7th grade students met 6 of 6 healthy fitness standards. Data from the State of California, shows that 31.9% of 7th grade students statewide met 6 of 6 healthy fitness standards. It is apparent that data from the subject school and statewide data show significant differences in student achievement which may have impacted results of study.

Another variable that may have influenced results include Socio-Economic status (SES). Higher SES has been shown to be a general indicator of higher academic achievement and is also an indicator of better health (Grissom 2005). Also, achievement of children in affluent suburban schools was significantly and consistently higher than that of children in "disadvantaged" urban schools (Sirin, 2005; U.S. Department of Education, 2000). Research that compared low-SES schools with higher-SES schools found several important differences in terms of instructional arrangements, materials, teacher experience, and teacher-student ratio exist (Sirin, 2005; Wenglinsky, 1998). Coe et al. 2006, also found increases in performance of core academic classes for children who reported vigorous PA outside of school compared to those that reported no PA outside of school. These kinds opportunities for physical and cognitive enrichment may be more accessible to students of higher SES.

On the other hand, students from lower SES are found to suffer more family problems, live in more chaotic households, have fewer social networks for support, have less opportunity for cognitive enrichment, and live in more polluted, unhealthy environments than students from higher SES households (Grissom 2005). It easy to conclude that SES impacts the health of a student, the quality of living environment, and opportunities for enrichment, that could all potentially effect fitness levels and academic achievement.

Data from subject school, reveals that 34% of students qualify for free and reduced lunch. 2011-12 data from State of California shows that 57.2% of students qualify for free and reduced lunch. From this data, one could recognize that there are

significant differences in SES of students from the subject school and students statewide. Although conclusions cannot be inferred this information that student SES differences had a direct effect on results in the current study, there is a possibility that SES may have influenced results.

Research on PF and academic achievement has shown that certain aspects of PF influence academic achievement more than other aspects of PF (Castelli et. al). Castelli et al., specifically found that aerobic fitness has been shown to have significant positive effects on Mathematics and Reading achievement. Other research has confirmed this, demonstrating that cardiovascular fitness has been shown to have the strongest association with academic achievement (Van Dusen, Kelder, Kohl, Ranjit & Perry 2011). Aerobic fitness has also been associated with positive changes in neurocognitive function (Hillman et al. 2005). In the current study, aerobic fitness represented one of six components of PF data collected, as the study was aimed at examining the relationship between overall PF and academic achievement.

FITNESSGRAM PFT standards are established so that students who met 6 of 6 of healthy fitness zone performance standards are only considered to be minimally fit or to have met a level of fitness that offers some protection in the prevention of diseases associated with physical inactivity (cde.ca.gov). Presently California's *FITNESSGRAM* performance standards are limited to three categories: (1) Needs Improvement (NI) (2) Needs Improvement-Health Risk (NI-HR) (3) Healthy Fitness Zone (HFZ). Students who achieve significantly higher levels of fitness as compared to minimal levels of fitness (6 of 6 HFZ standards), are not recognized as Proficient or Advanced similar to

those established for academic performance standards, thus potentially grouping minimally fit students with moderately or highly fit students. Potential explanation might be that *FITNESSGRAM* PFT standards are not established at high enough levels to show significant differences in academic achievement and PF in the current study.

There is evidence showing significant positive relationships between academic achievement and PF, and between academic achievement and PA in both cross-sectional studies as well as in longitudinal studies. Cross-sectional studies on the relationship between academic achievement and PF have shown that there are significant positive associations (Chomitz et al., 2009); however, it is noted that correlation does not mean that an increase in one variable is the cause for an increase in the other variable and vice-versa (Grissom, 2005). Most longitudinal studies on the subject are specific to the relationship between academic achievement and PA, and have shown significant positive correlations (Carlson, Fulton, Lee, Maynard, Brown, Kohl, & Dietz, 2008). One advantage to a longitudinal study is to establish baseline scores and observe changes as they occur over time in response to a variable (e.g. increase in PA or PF) (Carlson et al. 2008). In the present study, a longitudinal platform for research would have allowed for baseline scores to be collected and then for changes in academic achievement and PF data to be observed over time. As with cross-sectional studies, any differences in academic achievement and PF that are observed cannot solely be attributed to one variable causing another to improve or vice-versa.

SUMMARY

In conclusion, there is abundance of research that has shown significant positive effects of PF on academic achievement, and PA and academic achievement. Research shows that there is a significant positive relationship between academic achievement and overall physical fitness, but the strongest associations have been with aerobic fitness and academic achievement, of which represented one of six areas of PF assessment in the current study. Research into the effects of PA and academic achievement demonstrates that increases in vigorous PA have shown significant positive results; whereas, there have not been significant positive results from students who performed moderate or no PA. It has also been suggested that there may exist a threshold of PA (intensity and amount) needed to bring about desirable results.

The present study did not show significant differences in academic achievement and PF in 7th grade students. Participants from the current study, show student academic achievement and student physical fitness achievement scores are higher than average in the state of California. Data from the subject school, also reveals that student SES is higher than the average SES of schools in the state. Physical fitness testing performance standards are established with the goal in mind for students to achieve minimal levels of physical fitness and to offer some protection against diseases associated with physical inactivity. Students are classified in a binary system, which does not truly differentiate levels of fitness achievement. These variables may have influenced the results of this study.

Cross-sectional studies and longitudinal studies have shown significant positive relationships between academic achievement and PF, and between academic achievement and PA. Longitudinal studies have an advantage over cross-sectional studies, in that baseline assessments can be tracked over time to observe changes as variables affect them. Results of cross-sectional or longitudinal research cannot be attributed for causing academic achievement to increase due to the increases in physical fitness or vice-versa.

Research has shown the many positive effects of PA on health, cognitive function, and psychological well-being. Further research is needed to examine how variables influence student achievement and the exact amounts vigorous PA and levels of PF needed to produce desirable results. School policy makers and school administration should consider the significant positive effects of PA and PF on student's academic achievement as well as the overall health and well-being of students when making key decisions.

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