JONES, DAVID D., Ed.D. The Relationship between Physical Fitness and Academic Achievement among 4th and 5th Grade Boys and Girls from High and Low-Poverty Schools. (2018)
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        This study examined the relationship between fitness (cardiorespiratory endurance) and academic achievement (North Carolina End-of-Grade Math and Reading Assessments) in 4th and 5th grade boys and girls from high and low-poverty schools (N=2194). The primary aim of this study was to clarify specific relationships among cardiorespiratory endurance, academic achievement, gender, and poverty in order to help guide school policy. The secondary aim was to use detailed findings from this study to make specific recommendations to stakeholders in the school district to change school programs and policies toward increasing physical activity for specific student populations. Descriptive, correlational, and regression analysis were performed to analyze the relationship among fitness, academic achievement, gender, and poverty. Results demonstrated that students from low-poverty schools generally outperformed students from high-poverty schools in all measurements of fitness and academic achievement. Main effects of gender and poverty were seen on academic achievement and cardiorespiratory endurance, though the effect of poverty was much stronger than that of gender. Positive correlations were demonstrated between fitness and academic scores among the full participant group. Fitness was a significant predictor of math and reading across both poverty levels, though generally stronger in low-poverty schools. The strongest relationship between fitness scores and academic achievement was found with math scores for girls from high-poverty schools. Findings from this

study were used to make specific recommendations to stakeholders in the school system

toward increasing student physical activity levels among high-poverty elementary

schools.

THE RELATIONSHIP BETWEEN PHYSICAL FITNESS AND ACADEMIC

ACHIEVEMENT AMONG 4TH AND 5TH GRADE BOYS AND GIRLS

FROM HIGH AND LOW-POVERTY SCHOOLS

by

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APPROVAL PAGE

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PROJECT OVERVIEW

Introduction

The positive relationship between youth fitness levels and academic achievement

(AA) has been well documented (Chomitz et al., 2009; Janak et al., 2014; Wittberg,

Northrup, & Cottrell, 2009; VanDusen et al., 2011), but a critical need exists to assess the

effect of poverty on this relationship. Data suggest that students from high-poverty (HP)

backgrounds generally perform worse in physical and academic assessments, and have

more room for growth than their socioeconomically advantaged peers. In fact, children

from HP homes typically score lower on standardized exams (Chomitz et al., 2009;

Hochschild, 2003; Tremblay, Inman, & Willms, 2000; Wittberg et al., 2009), are more

sedentary (Newacheck et al., 2003; Singh, Kogan, Siahpush, & Van Dyck, 2009; Stevens

et al., 2008; USDHHS, 2017), more obese, and less fit than those from low-poverty (LP)

homes (Jin & Jones-Smith, 2015). In this studied southeastern school district alone, over

50,000 students, more than ⅓ of the total student population, come from poverty, as

defined by students who receive free-or-reduced (F&R) lunch, based upon household

income level (WCPSS, 2016). There is a critical need to better elucidate the effect of

poverty on youth fitness and academics in order to fill an existing gap in recent research,

specifically by exploring the interaction of cardiorespiratory endurance (CE), AA, and

gender in an understudied low-income population. Replicating similar findings among

CE, AA, gender, and poverty can potentially and positively impact thousands of

elementary students in this school district. By ignoring the role poverty plays on youth

fitness and AA, many students, specifically those from HP households, may continue to

lag behind their LP counterparts in physical fitness and academic success.

This study is novel because it is the first of its kind in this school district, 15th

largest in the country with over 150,000 students, and findings will help fill a critical gap

in research by examining the role poverty plays on CE and academics. Results from this

research will inform health advocates and school administrators how to implement

program and policy changes that could improve the fitness, health, and academic success

of these students.

The primary aim of this study is to clarify specific relationships among CE, AA,

gender, and poverty by analyzing data among 4th-5th grade boys and girls from both HP

and LP schools in order to help guide school policy. The secondary aim is to use detailed

findings from this study to make specific recommendations to stakeholders in the school

district to implement programs and policies toward increasing physical activity (PA) for

specific groups of students.

Review of Literature Relevant to this Project

Considering the focus on standardized test scores in recent years, it has become

common among schools to reduce PA time, such as recess or physical education, in order

to increase instructional classroom time (CDC, 2010). Mounting research rebukes this

notion though, and suggests that increasing the PA opportunities in schools can actually

improve fitness and AA (ACSM, 2016; CDC, 2010), especially impactful for HP students who face additional obstacles toward attaining personal health and academic success. Mounting research supports the view that PA interventions, single bouts of PA, and physical fitness benefit children's cognitive functioning (ACSM, 2016).

Academic achievement, which is often measured by standardized test scores, has been positively associated with PA (CDC, 2010) and fitness levels (ACSM, 2016; CDC, 2014; Chomitz et al., 2009; Fair, Reed, Hughey, Powers, & King, 2017; Janak et al., 2014; Santana et al., 2017; VanDusen, Kelder, Kohl, Ranjit, & Perry, 2011; Wittberg, Northrup, & Cottrell, 2009) across numerous studies. As such, increasing student PA levels could potentially improve fitness and academic scores. Despite these associations and the national recommendation for youth to attain 60 minutes of daily PA, the majority of students nationally do not achieve this amount (CDC, 2015). In fact, the tendency to cut PA time in favor of instructional class time has been particularly pronounced in HP schools (London & Castrechini, 2011), dramatically affecting the specific group of students who already perform worse both physically and academically than their socioeconomically advantaged peers.

Few studies have effectively examined the association between fitness and AA while controlling for student poverty levels (Coe, Peterson, Blair, Schutten, & Peddie, 2013), and future research on specific subgroups of students, including gender and socioeconomic status, has been strongly encouraged (CDC, 2010). This limitation of failing to adequately control for confounding variables (such as poverty) may have led to imprecise and generalized results in previous research (Welk et al., 2010). Some recent

research has ignored poverty levels altogether (CDC, 2010; Sardinha, Marques, Martins, Palmeira & Minderico, 2014; Wittberg, Northrup, & Cottrell, 2012) or included very few low-income students in the sample (Coe et al., 2013). Even among researchers who have incorporated student poverty into their studies, many concluded that the moderating roles of socioeconomic status within the fitness and AA relationship warrant further exploration (Blom, Alvarez, Zhang, & Kolbo, 2011).

This study will also clarify the influence of gender on the fitness-academic relationship, and examine differences between math and reading within this relationship. Research has clearly demonstrated significant positive relationships between CE and AA across both genders and multiple academic subjects, though some subtle patterns were discovered. A stronger positive relationship between CE and academics generally exists among girls than boys (ACSM, 2016; Eveland- Sayers, Farley, Fuller, Morgan, & Caputo, 2009; Fair et al., 2017; Santiago, Roper, Disch, & Morales, 2013) and math generally tends to have a stronger positive relationship to CE than reading (ACSM, 2016; Chomitz et al., 2009; Coe et al., 2013; Eveland-Sayers et al., 2009; Hansen et al., 2014; Joshi, Howat, Bryan, & Dick, 2011; Santiago et al., 2013; Wittberg et al., 2012).

Findings from this study will directly benefit HP schools in this southeastern school district by potentially leading to new school-based PA policies. Nationally, the poverty rate among public school students is 51% (SEF, 2015). County-wide, this rate is approximately 35%, correlating to over 50,000 students from HP households in this district alone (WCPSS, 2016). Of the 400 elementary students directly instructed by this researcher, 75%, or 300 total students, come from HP households, and only about 50%,

or roughly 200 students, are academically grade-level proficient (WCPSS, 2016). Those same students have a PA schedule comparable to most elementary schools in the district, participating in 25 minutes of daily recess, one 45 minute physical education class each week, and an occasional PA break in the classroom lasting 10 minutes or less. As such, thousands of students across the school district are part of the 78.4% of children between the ages of 6 and 19 nationwide who are not attaining the recommended 60 minutes of moderate-to-vigorous PA (MVPA) at least 5 days per week (CDC, 2015). Increasing PA amounts through additional physical education, recess, classroom-based PA, or extracurricular physical activities are policies that could greatly benefit low-income students physically, and have also been shown to improve academic performance without negatively impacting it (CDC, 2010). Clarifying the role of poverty on fitness and academics will help fill a critical void, and may advance the implementation of new PA programs at HP schools where many students are already more likely to be obese, less fit, and score lower on standardized tests than students in predominantly LP schools.

For this study, CE was selected over other fitness components, such as flexibility and muscle strength/endurance, because it is a better indicator of overall health. Strong CE can reduce risk factors for cardiovascular disease and metabolic syndrome in children/adolescents (Brage et al., 2004; Ortega, Ruiz, Castillo, & Sjöström, 2008). Additionally, CE has demonstrated stronger associations with AA than other measures of fitness (Bass, Brown, Laurson, & Coleman, 2013; Castelli, Hillman, Buck, & Erwin, 2007; VanDusen et al., 2011). In the few recent studies that have controlled for poverty, it was determined that poverty level weakened the relationship between multiple fitness

components and academics (Coe et al., 2013; Janak et al., 2014; London & Castrechini, 2011), and also negatively and independently associated with student fitness (Jin & Jones-Smith, 2015) and AA (Chomitz et al., 2009).

The overarching objective of this study is to clarify the relationship among CE, AA, gender, and poverty, and use findings to guide PA programs for students in this school district. Data from the five highest-poverty elementary schools (averaging 79% F&R lunch rate) and the five lowest-poverty elementary schools (averaging 5% F&R lunch rate) in the school district will be analyzed by utilizing a sample of 2194 total 4th and 5th grade students. Results will be used to benefit specific groups of students in an under-studied county by guiding future PA policies.

Purpose and Research Questions

Purpose

The purpose of this study is to determine the relationship between cardiorespiratory endurance (CE) levels and academic achievement (AA) scores (math and reading) among 4th-5th grade boys and girls from high-poverty (HP) and low-poverty (LP) schools.

Research Questions

What is the relationship between:

1. CE levels and math achievement among 4th-5th grade boys from HP schools?
2. CE levels and math achievement among 4th-5th grade girls from HP schools?
3. CE levels and reading achievement among 4th-5th grade boys from HP schools?
4. CE levels and reading achievement among 4th-5th grade girls from HP schools?

5. CE levels and math achievement among 4th-5th grade boys from LP schools?

6. CE levels and math achievement among 4th-5th grade girls from LP schools?

7. CE levels and reading achievement among 4th-5th grade boys from LP schools?

8. CE levels and reading achievement among 4th-5th grade girls from LP schools?

Methods

Fitnessgram, a reliable and valid method for assessing youth fitness (Morrow, James, Martin, & Jackson, 2010; Plowman and Meredith, 2013) is the recommended testing program in this county and was used to assess CE. Cardiorespiratory endurance assessments, including the mile run and PACER (Progressive Aerobic Cardiovascular Endurance Run) test, represent student fitness level, and were the only two methods available in the county for assessing student CE. All physical educators were provided with detailed instructions for proper and consistent fitness testing across the county, and had the choice of which of the two tests to administer, usually dependent upon their physical resources. The PACER test is a 20 meter progressive shuttle run administered with an audio cadence and commonly performed in a gymnasium, and the mile run is preferably performed on an outdoor track. Standardized end-of-grade state exams in math and reading, also deemed highly reliable (NCDPI, 2016), were used to assess AA. Fitness and academic data from 2194 elementary students were used for this study. Fitness and academic assessments were administered near the end of the 2016-2017 school year. Additional assessment details are provided APPENDIX A (Table 1: Fitness and Academic Assessment Details).

Fourth and fifth grade student data were collected from 10 elementary schools total; five with the highest average poverty rates and five with lowest average poverty rates, as identified by free-and-reduced (F&R) lunch rates. If students were assessed in both the mile run and the PACER test, PACER scores were used because of higher reliability and better conformity across tests (Plowman & Meredith, 2013). If students were not assessed in the mile run or PACER test, then data from that student were excluded. The five HP schools averaged 79% F&R rate, while the five LP schools averaged 5% F&R rate, as of the 2016-2017 school year. Math and reading end-of-grade exam scores were collected from the same students. Any students missing both math and reading exam scores were excluded. Both fitness and academic test scores were automatically collected and stored, and accessed upon request from the healthful living department and the research, data and accountability office, respectively. All collected data had personally identifying information removed to protect student confidentiality.

All test scores were entered into statistical software (SPSS). Reading, mile run and PACER scores were converted to z-scores so that all raw data can be standardized and compared to the sample mean (it was not necessary to convert math scores). Reading scores required conversion to z-scores because of inconsistent score ranges between 4th and 5th grade. When combining and converting PACER z-scores and mile z-scores into CE z-scores, the sign of every mile z-score value was reversed to align with PACER z-scores. Descriptive, correlational, and regression analyses were completed to address the primary aim, and determine the relationship among CE, AA, gender, and poverty level for each participant group. All results were then synthesized and analyzed to address

primary aim two: recommend specific PA-based policies for stakeholders in the school district.

Results

Findings demonstrated that students from LP schools outperformed students in HP schools in average (mean) mile times, PACER laps, math scores, and reading scores, supporting previous findings that students in HP schools fall behind their LP counterparts both physically and academically. A main effect of poverty, listed in order of decreasing strength, was statistically demonstrated on reading, math, and CE scores across the participant set, further emphasizing disparities between students from HP and LP schools. Main effects of gender were demonstrated on reading and CE scores, though this effect was minimal. The main effects of poverty on AA were much stronger than that of gender. The correlation between CE and AA was statistically significant and positive across the entire combined data set, among six of the 8 student participant subgroups, and relationships were generally stronger among LP schools than HP schools. In HP schools, CE was a statistically significant predictor of females' math and reading scores, but not that of males'. In LP schools, CE was a statistically significant predictor of math and reading scores for both males and females. Among all eight participant subgroups, CE predicted the largest AA increase among females' math scores in HP schools, meaning a female's average math score is estimated to increase 2.614 points for each standard deviation increase in CE z-score (15 laps in PACER or 139 second decrease in mile run). In further analysis of gender differences, males outperformed females in average math

and CE scores across each student subgroup, and females outperformed males in average reading scores.

Discussion and Future Implications

The results from this study directly guide specific recommendations to schools in this southeastern school district. Schools with the highest F&R rates are the priority for obvious reasons, but recommendations are given to any schools with poverty rates of 40% or higher. Findings from students in this district show that CE and AA are positively linked, students from LP schools outperform students from HP schools in average CE and AA measures, and males score significantly higher in CE than females. Interestingly though, CE is a significant predictor of females' math scores from HP schools (recall that females from HP schools averaged the lowest scores in math and CE compared to all other student subgroups). As a result, recommendations are primarily aimed at increasing the PA, physical fitness levels, and AA in HP schools, with particular attention also directed at the female students. In order to help close this gap between students in HP and LP schools, recommendations are divided into three distinct categories: increase the amount of student PA time at school, improve the quality of this PA time, and provide additional resources to schools with high student poverty rates.

Increase the Amount of Student PA Time at School

Previous research has consistently demonstrated that increasing PA time through additional PE, recess, PA-based classroom activities, and extra-curricular activities do not negatively affect academic performance, and may even improve it (CDC, 2010). All schools, but those specifically with high F&R lunch rates, are strongly encouraged to

increase total student PA time through these same programs, aiming for the

recommended 60 total minutes of daily physical activity. While most elementary

students in the county attend PE for 45 weekly minutes and recess for 25-30 daily

minutes, time increases could result in physical and academic improvements. Research

has even suggested that time spent in recess positively associates with cognitive skills,

attitudes, and academic behavior (CDC, 2010). Increasing the total duration of daily PA

breaks in the classroom would help reach the 60 minute recommendation, and can also be

combined with academic content in the classroom. Classroom-based PA breaks lasting a

minimum of 15 or more total minutes should be mandated daily in schools, with even

more time devoted to PA on non-PE days. Additionally, schools should aim toward

providing PA options for students outside of regular school hours, such as before/after-

school programs and/or athletics to all students. The implementation of female-specific

programs are also recommended to HP school, since findings suggests these females have

the lowest CE, comparatively. Girls on the Run, for example, is an effective after-school

program that significantly increases weekly PA levels for elementary aged-girls (Girls on

the Run, 2015), and is already in place at a small percentage of elementary schools in the

county.

Improve the Quality of PA Time at School

The PA opportunities provided to students, including PE, recess, classroom

breaks, and extra-curricular activities, should be valuable and productive to all students

both physically and academically. The state mandated PE curriculum, aligning with

national PE standards, should be delivered by certified, well-trained specialists who

emphasize instructional strategies that provide students substantial MVPA (USDHHS, 2012), and all PE teachers should be trained on effective and appropriate fitness testing practices (SHAPE, 2017b). When implementing recess programs, national recess guidance recommendations should be consulted and followed so that all students may enjoy highly active, safe, and enjoyable PA during those times. When implementing classroom-based PA breaks, countless free resources exist (Active Academics, Instant Recess, GoNoodle), many of which combine physical activities with standard-based academic lessons in the form of easily accessible videos, handouts, or lesson plans (SHAPE, 2017a). Integrating daily classroom PA interventions with academic concepts has been shown to increase overall PA amounts while improving academic performance (CDC, 2010), on-task behavior, and even overall student health (Whitt-Glover, Porte, Active Living Research, & Robert Wood Johnson Foundation, 2013). When implementing extra-curricular activities such as before/afterschool, staff should be trained in the recommended standards for after-school physical activity (Move More After-School Collaborative, 2009) so that students are participating in a safe, active, and challenging environment.

Provide Additional Resources to Schools with High Student Poverty Rates

Physical resources and developmentally appropriate equipment are needed to create productive and physically active environments for students. Many organizations serve this need specifically for high-poverty populations. Level the Playing Field, a non-profit organization based in Washington D.C and new to the city, identifies HP schools in need of sports equipment, and provides that equipment completely free of charge (LPF,

2017). Playworks, a daily recess and after-school program aimed primarily at HP

schools, has dramatically increased PA levels during recess times in comparison to

control schools, and is a recommended PA-based program for low-income and high

minority schools (Barros, Silver, & Stein, 2009). They also create and coach all-female

sports teams, a program that could directly benefit those female students in high-poverty

schools who exhibit the lowest average CE scores. First-Tee, a character-based golf

program that currently operates specifically at a dozen HP elementary schools in the

county, gives students an opportunity to be physically active after school, provides golf

equipment to schools, and has shown to improve student confidence in academic ability

(The First Tee Triangle, 2018). Improving physical resources outside the school may

benefit students as well. When gathering data for this research study, it became evident

that most LP schools are able to assess their students with the mile run on an outdoor

running track, while most of the HP schools lack an outdoor track and primarily use the

indoor gym for PACER assessments. Creating equal access to outdoor facilities, such as

safe playgrounds, playing fields, and running tracks for students of all economic

backgrounds may help close the physical and academic gap that currently exists between

them. Providing additional play equipment and technological resources to all classroom

teachers, such as ipads, ipods, smart TV's, and SmartBoards, can allow students to more

easily interact with PA-based resources in the classroom and provide teachers a more

accessible means to implement PA breaks in the classroom.

In summary, evidence is mounting that physical activity, physical fitness, and

academic achievement are all positively related. Results from this research study support

this notion, and also draws attention to physical and academic disparities between students from high and low-poverty schools. Research strongly suggests that when students increase physical activity and/or physical fitness, academic achievement improves. If total PA time in HP schools is increased, the quality of this PA time is improved, and additional resources are given to those students in HP schools who need it the most, then thousands of students can potentially improve their overall health, physical fitness, and academic success.

CHAPTER II

DISSEMINATION

Chapter 2 serves as a comprehensive report to be given to stakeholders in this studied southeastern school district, such as superintendents, principals, and the school board. It presents the overview and findings from this research, as well as detailed recommendations based upon those results so that stakeholders may modify physical activity-based programs in the county for specific schools and student populations.

Introduction

The primary aim of this study is to clarify specific relationships among cardiorespiratory endurance (CE), academic achievement (AA), gender, and poverty by analyzing data among 4th-5th grade boys and girls from both high-poverty (HP) and low-poverty (LP) schools in order to help guide school policy. The secondary aim is to use detailed findings from this study to make specific recommendations to stakeholders in the school district to implement programs and policies toward increasing physical activity (PA) for specific student populations. Stakeholders in this southeastern school district include the school board, area superintendents, and principals, all of whom have decision-making authority over school policy. The long-term goal is to implement new PA-based policies in HP schools that can potentially improve overall student health, physical fitness measures, and academic achievement scores among these specific students who need it the most.

Background Information

The positive relationship between youth fitness levels and AA has been well documented (Chomitz et al., 2009; Janak et al., 2014, Wittberg, Northrup, & Cottrell, 2009; VanDusen et al., 2011), but a critical need exists to assess the effect of poverty on this relationship. Data suggest that students from HP backgrounds generally perform worse in physical and academic assessments, and have more room for growth than their socioeconomically advantaged peers. In fact, children from HP homes typically score lower on standardized exams (Chomitz et al., 2009; Hochschild, 2003; Tremblay, Inman, & Willms, 2000; Wittberg et al., 2009), are more sedentary (Newacheck, et al., 2003, Singh, Kogan, Siahpush, & Van Dyck, 2009; Stevens et al., 2008; USDHHS, 2017), more obese, and less fit than those from LP homes (Jin & Jones-Smith, 2015). In this southeastern school district alone, over 50,000 students, more than ⅓ of the total student population, come from poverty, as defined by students who receive free-or-reduced (F&R) lunch, based upon household income level (WCPSS, 2016). Replicating similar findings among CE, AA, gender, and poverty can directly impact thousands of elementary students in this school district. By ignoring the role poverty plays on youth fitness and AA, many students, specifically those from HP households, may continue to lag behind their LP counterparts in physical fitness and academic success.

Methods

Assessment Measures

Fitnessgram is the recommended testing program in this county and was used to assess CE. Cardiorespiratory endurance assessments were administered with either the

mile run or PACER (Progressive Aerobic Cardiovascular Endurance Run) test, and were the only two methods available in the county for assessing student CE. All physical educators were provided with detailed instructions for proper and consistent fitness testing across the county, and had the choice of which of the two tests to administer. Standardized end-of-grade state exams in math and reading were used to assess AA. Fitness and academic assessments were administered near the end of the 2016-2017 school year, and data from 2194 elementary students were gathered. Additional assessment details are provided in Appendix A (Table 1: Fitness and Academic Assessment Details).

Participant Information

Fourth and fifth grade student data were collected from 10 elementary schools total; five with the highest average poverty rates (averaging 79%) and five with lowest average poverty rates (averaging 5%), as identified by F&R lunch rates. If students were assessed in both the mile run and the PACER test, PACER scores were used because of higher reliability and better conformity across tests (Plowman & Meredith, 2013). If students were not assessed in the mile run or PACER test, then data from that student were excluded. Math and reading end-of-grade exam scores were collected from the same students. Any students missing both academic scores were excluded. All merged data had personally identifying information removed to protect student confidentiality.

Data Analysis

All test scores were entered into statistical software (SPSS). Reading, mile run and PACER scores were converted to z-scores so that all raw data can be standardized

and compared to the sample mean (it was not necessary to convert math scores). Reading

scores required conversion to z-scores because of inconsistent score ranges between 4th

and 5th grade. Descriptive, correlational, and regression analyses were completed to

address the primary aim, and determine the relationship among gender, CE, AA, and

poverty level for each participant group. All results were then analyzed to address

primary aim two, and make specific PA based recommendations to stakeholders in the

school district.

Results

All tables and figures are located in Appendix A: Results. Table 2 provides

descriptive participant data. A total of 2194 4th and 5th grade participants were included

in this study. Males outnumbered females (1137 to 1057) and students from LP schools

outnumbered students from HP schools (1354 to 840). Table 3 provides mean

comparisons between HP and LP schools. Students from LP schools outperformed

students from HP schools in every measurement of fitness and academics. Males

averaged higher math and CE scores than females at both poverty levels, and females

averaged higher reading scores than males at both poverty levels. Table 4 provides

correlation scores for the entire combined participant set. Correlations between CE and

both AA measurements were statistically significant and positive (CE*math, r = .238;

CE*math, r = .147). Table 5 provides correlation scores for HP schools. Math

significantly and positively correlated to all measures of CE (math*PACER, r = .134;

math*mile, r = -.196; math*CE z-score, r = .130). Table 6 provides correlation scores for

LP schools. Math and reading were both significantly and positively correlated to CE

(math*CE, r = .228; reading*CE, r = .097). Correlations between CE and math were

much stronger than correlations between CE and reading across both poverty levels.

Table 7 provides correlation scores from each participant subgroup. Six of the eight total

participant subgroups demonstrate a statistically significant correlation between CE and

math/reading both. Males from HP schools were the only participant group who did not

demonstrate statistically significant positive correlations between CE and academic

scores. Table 8 provides results from multiple regression analysis for HP Schools. A

regression model was fit with math score as the dependent variable and CE z-score,

gender, and the interaction between CE z-score and gender as predictors. The model

explained 2.2% of the variance in math score ($R^2 = .022$, $F (3,836) = 7.371$, $p < .001$).

Females' average math score is estimated to increase an average of 2.614 points ($p <$

.001) for each standard deviation increase in CE z-score (equal to 15 PACER laps or 139

seconds in mile run). The difference between male and female math slopes is statistically

significant ($p < .01$), meaning average math scores increase more for females than males

relative to the same increase in CE z-score. A regression model was also fit with reading

z-score as the dependent variable and CE z-score, gender, and the interaction between CE

z-score and gender as predictors. The model explained 0.9% of the variance in reading z-

score ($R^2 = .009$, $F (3,836) = 3.501$, $p < .05$). Females' average reading z-score is

estimated to increase .144 points (equal to .132 raw reading points) for each standard

deviation increase of CE z-score. Table 9 provides results from multiple regression

analysis for LP schools. A regression model was fit with math score as the dependent

variable and CE z-score, gender, and the interaction between CE z-score and gender as

predictors. The model explained 5.0% of the variance in math score (R^2 = .050, F (3, 1350) = 24.685, p < .001). For every standard deviation increase of CE z-score (equal to 15.8 PACER laps or 159 seconds in mile run), males' and females' average math scores are estimated to increase 1.933 (p < .001) and 1.860 (p < .001) points, respectively. A regression model was also fit with reading z-score as the dependent variable and CE z-score, gender, and the interaction between CE z-score and gender as predictors. The model explained 1.2% of the variance in reading z-score (R^2 = .012, F (3, 1349) = 6.537, p < .001). For every standard deviation increase of CE z-score, males and females reading z-scores are estimated to increase .061 (.046 raw points, p < .05) and .108 (.081 raw, p < .001) points, respectively. Table 10 presents the main effects and interaction between gender and poverty on reading z-scores by way of a two-way ANOVA. A main effect of gender (F (1, 2189) = 7.030, p < .05) and poverty (F (1, 2189) = 1076.449, p < .001) on reading z-scores was demonstrated. The impact of poverty on reading z-score is much higher than that of gender, as demonstrated by a much higher partial eta squared. Table 11 presents the main effects and interaction between gender and poverty on math scores by way of two-way ANOVA. A main effect of poverty on math scores was demonstrated (F (1, 2190) = 1012.198, p < .001). The impact of poverty on math score is much higher than that of gender (partial eta squared is much higher). Table 12 presents the main effects and interaction between gender and poverty on CE scores by way of two-way ANOVA. A main effect of gender (F (1, 2190) = 109.760, p < .001) and poverty (F (1, 2190) = 52.839, p < .001) were both demonstrated on CE z-score, though both impacts were negligible (low partial eta squared values).

Figures 1-4 (in Appendix A) provide a scatter plot and best fit line with CE on the x-axis, and math or reading along the y-axis for HP and LP schools, and demonstrate positive relationships between CE and math/reading for both HP and LP schools. Figure 1 shows that in HP schools, 1.7 % of the variation in CE scores is due to the variation in math scores (R2 linear = .017). Figure 2 shows that in HP schools, .2 % of the variation in CE scores is due to the variation in reading scores (R2 linear = .002). Figure 3 shows that in LP schools, 5.2 % of the variation in CE scores is due to the variation in math scores (R2 linear = .052). Figure 4 shows that in LP schools, .9 % of the variation in CE scores is due to the variation in reading scores (R2 linear = .009). Relationships between CE and math were stronger than that of CE and reading in both poverty levels, while both relationships in LP schools were stronger than those in HP schools.

Discussion

Results from this study, performed on a large southeastern school district and using nearly 2200 4th and 5th grade students from both HP and LP schools, support previous findings on the relationship among fitness, AA, gender, and poverty. These research findings provide evidence that CE and AA are positively linked, though generally weaker among high-poverty schools. In fact, CE is a significant predictor of AA across the majority of student subgroups. Students from LP schools outperform students from HP schools in average CE and AA measures, and males outperform females in average CE scores in both poverty categories. Interestingly, among all eight student subgroups, CE predicts the largest increases among females' math scores from

HP schools, despite females from HP schools averaging both the lowest math and CE scores among all student subgroups.

Future Implications and Recommendations

There exists obvious gaps between students from HP and LP schools, both physically and academically. Additionally, results from this research demonstrate a positive relationship between CE and AA, and indicate that CE is a significant predictor of math and reading scores among most students in this study. As a result of these findings and supporting evidence from previous research, it is recommended that HP schools implement policy change aimed at increasing PA levels among their students, with particular attention also devoted to female students.

Physical Activity-based recommendations, listed below, were created specifically for elementary schools where the student poverty rate is 40% or higher (qualifying as Title I schools). The long term goal of these recommendations is to close the aforementioned gaps among students from HP and LP schools by improving PA levels, physical fitness, and AA among those students who need it the most. Recommendations are part of a Comprehensive School Physical Activity Program (CSPAP), and detail a multi-component approach where schools utilize staff, community engagement, and a variety of PA opportunities to increase PA levels for students (CDC, 2013).

Increase the Amount of Student PA Time at School

Schools should consider increasing the amount of time students are physically active at school each day, aiming for the recommended 60 daily minutes. Total PA levels can dramatically increase through the implementation of additional high-quality PE

classes, classroom-based PA breaks, extra-curricular activities (USDHHS, 2012), and recess (CDC and SHAPE, 2017). Increasing the total amount of PA time through these strategies has not been shown to negatively impact academic performance, and may even be improve it (CDC, 2010; ACSM, 2016).

Improve the Quality of PA Time at School

Schools should ensure that the PA programs provided to students, including PE, recess, classroom breaks, and extra-curricular activities, are valuable and productive to all students both physically and academically. This can be accomplished by providing professional development to all staff that oversee these programs. National standards, recommendations, lessons, and additional resources for these programs, designed to increase moderate-to-vigorous PA (MVPA) among students in a safe and challenging environment, should be provided to staff in an effort to improve the overall quality of student PA.

Provide Additional Resources to Schools with High Student Poverty Rates

Stakeholders in the school system should make an effort to provide the necessary funding, professional development, and physical resources to schools with high student poverty rates. Physical resources and developmentally appropriate equipment are needed to create productive and physically active environments for students in physical education, recess, the classroom, and for extra-curricular programs. Many free and/or non-profit organizations serve this need for high-poverty schools through free equipment, structured recess programs, after-school programs, athletic teams, and digital resources to use in the classroom. Additionally, outdoor play areas such as playgrounds, fields, and

running tracks should be equally accessible to students across the county, despite differences in F&R rates.

If HP schools can implement policies that increase the overall amount of PA time, improve the quality of that PA time, and provide additional resources for the students who need it the most, then schools may be able to close the physical and academic gap that exists between them and LP schools. Specific recommendations and resources are located in Table 13 (Appendix A) and presentation slides used for dissemination in the school district are provided in Figure 6 (Appendix B).

CHAPTER III

ACTION PLAN

Introduction

Results from this study, performed on a large southeastern school district and using nearly 2200 4th and 5th grade students from both high poverty (HP) and low-poverty (LP) schools, support previous findings on the relationship among fitness, academic achievement (AA), gender, and poverty. These research findings suggest that cardiorespiratory endurance (CE) and AA are significantly and positively linked across the majority of student subgroups (male/female, HP/LP, math/reading). Relationships between CE and AA were generally stronger in the LP schools than HP schools, and CE was determined to be a statistically significant predictor of AA across a majority of student subgroups. Students from LP schools generally outperform students from HP schools in average CE and AA measures, and males outperform females in average CE scores across both poverty levels. Interestingly, among all eight combinations of student subgroups, CE was the strongest predictor of math scores among females from HP schools, despite females from HP schools averaging the lowest math and CE scores among all student groups.

Target Audience

Findings from this study will be disseminated to the professional field in general, and also to stakeholders in this studied southeastern school district. Presentation slides are located in Appendix B: Figure 6. Results have already been presented at the 2018 National SHAPE America Convention (Appendix B: Figure 5), to the healthful living director of the county, and to over 25 elementary physical educators. Findings will also be presented to the school board, area superintendents, and principals within the school district, all of whom have the authority to implement new physical activity (PA) programs in schools. More specifically, principals in HP schools may be able to create new PA-based policies that will improve student health, physical fitness, and academic success for those students who are lagging behind their counterparts in the LP schools.

Short-Term Action Plan

Within six months, significant findings and future recommendations will be presented to stakeholders in this southeastern school district. Physical activity-based recommendation, directly guided by results acquired from 4th and 5th grade students in this county, are primarily aimed at increasing the PA levels of students in HP schools with particular attention also devoted to female students. Research findings show that students in HP schools have more room for growth than those in LP schools, performing worse in average CE, math, and reading measures. Similarly, females in HP scores scored the lowest (comparatively) in CE and math, yet this specific group also demonstrated the strongest positive relationship between CE and math. Evidence suggests that females' average math score is estimated to increase an average of 2.6

points for every 15 lap improvement in the PACER (or 139 second improvement in the mile run). Although findings and recommendations are primarily directed to HP schools, research suggests that all schools could benefit by increasing student PA levels.

Long-Term Action Plan

During the 2018-2019 school year, policy change within the school district will ideally be implemented across multiple HP elementary schools. Recommendations are divided into three separate categories, with hopes that multiple schools will implement at least one recommendation in the coming year, with more policies being implemented in future years. Under the assumption that schools do initiate new PA policy, there is potential to perform a future study, where fitness and academic scores in schools with new PA programs would be compared to those without new programs. Findings and recommendations will also be presented to physical educators across the county, so that they may use that data to better impact their own students. The long term goal of these recommendations is to create policy change in numerous HP schools that will improve PA levels, physical fitness, and AA among those students who need it the most.

Recommendations

Total PA levels among students at school can be dramatically increased through the implementation of effective physical education (PE) classes, classroom-based PA breaks, extra-curricular activities (USDHHS, 2012), and recess (CDC and SHAPE, 2017). Additionally, mounting research supports the view that PA interventions, single bouts of PA, and physical fitness benefit children's cognitive functioning (ACSM, 2016). Increasing the total amount of time dedicated to PE, recess, classroom physical activities,

and extra-curricular activities has not been shown to negatively impact academic performance, and may even be improve it (CDC, 2010). More specifically, intervention-based PA studies found significant increases in math scores when increasing PA from two to five days a week (Ericsson, 2008), and significant increases in language arts schools when PE was increased from 28 to 56 hours of PE per year (Tremarche, Robinson, & Graham, 2007).

In order to help close the aforementioned physical and academic gap between students in HP and LP schools, schools should move toward implementing a series of recommended policy changes. Physical activity-based recommendations are divided into three distinct categories: increase the amount of student PA time at school, improve the quality of this PA time, and provide additional resources specifically to schools with high student poverty rates. As part of a Comprehensive School Physical Activity Program (CSPAP), a goal of these PA-based recommendations is to help enable all students to participate in 60 daily minutes of moderate-to-vigorous PA (MVPA) (CDC, 2013). Table 13 (Appendix A) gives a detailed summary of these recommendations from each category.

Increase the Amount of Student PA Time at School

All schools, but those specifically with high F&R lunch rates, are strongly encouraged to increase total student PA time, with the ultimate goal of every student accumulating the recommended 60 daily minutes of PA in order to improve fitness and potentially AA. In fact, Gallahue and Donnelly (2003) found that in order for elementary aged children to enhance physical fitness levels, roughly 200 weekly minutes or more

need to be allocated to these types of activities. The Physical Activity Guidelines Advisory Committee (2008) conducted an extensive review of evidence and concluded that "PA is positively related to cardio-respiratory fitness in children and youth, and both preadolescents and adolescents can achieve improvements in cardio-respiratory fitness with exercise training" (p. 501). This statement is supported by research by Resaland, Andersen, Mamen, and Anderssen (2001), who performed a 2-year intervention study with PA and found that students who participated in 60 minutes of daily MVPA had significantly higher VO2 max levels than students in a control group who participated in 45 minute bouts of PA just twice a week.

While most elementary students in the county attend PE for 45 weekly minutes and recess for 25-30 daily minutes, aiming for a minimum of 60 and 30 minutes, respectively, could result in physical and academic improvements. Similarly, increasing the total duration of daily PA breaks in the classroom would add to this amount, especially important for non-PE days. Physical activity breaks in the classroom can also be easily combined with academic content during teacher instruction. Short PA breaks during the school day not only increase PA levels, they also improve student behavior and even some measures of student health (Whitt-Glover, Porte, Active Living Research, & Robert Wood Johnson Foundation, 2013). Additionally, schools should aim toward offering two or more separate extra-curricular opportunities, such before/after-school programs and/or athletic clubs to all students. The implementation of extra-curricular activities (including programs both inside and outside of school) can provide additional PA time for students outside of regular school hours, improve math and reading scores, decrease risky health behaviors, and contribute to healthy lifestyles (Little, Wimer, &

Weiss, 2008). A gender specific athletic club, such as Girls on the Run, is an effective after-school program that significantly increases weekly PA levels for elementary aged-girls (Girls on the Run, 2015), and is already in place at a small percentage of elementary schools in the county. At least one female specific program is recommended to increase interest, participation, and PA levels among female students in HP schools. Schools are encouraged to incorporate PA increases across each of these areas as part of a comprehensive PA-based policy change.

Improve the Quality of PA Time at School

The PA opportunities provided to students, including PE, recess, classroom breaks, and extra-curricular activities, should be valuable and productive to all students both physically and academically. Schools should ensure all PE programs align with national PE standards, are delivered by certified specialists who emphasize moderate-to-vigorous PA in their instruction (USDHHS, 2012) and are trained in appropriate fitness testing practices (SHAPE, 2017b), demonstrate the four components of a quality PE program (CDC, 2013), and are evaluated as part of the Comprehensive School Physical Activity Program (CSPAP) (SHAPE, 2015). When implementing recess programs, national recess guidance recommendations should be consulted and followed so that all students may enjoy highly active, safe, and enjoyable PA during those times. Guidelines include, among other recommendations, prohibiting the use of PA or student exclusion as a form of punishment, prohibiting recess as a PE substitution, and providing staff members who supervise recess with ongoing professional development (CDC and SHAPE, 2017). Additionally, CDC and SHAPE (2017) have created 19 specific

strategies developed to improve the overall quality of recess, which should be shared with staff. When implementing classroom-based PA breaks, effective and free resources (such as Active Academics, Instant Recess, and GoNoodle) are easily accessible and already integrated into academic lessons where students learn instructional content through PA (SHAPE, 2017a). Research suggests that integrating daily classroom PA interventions into the school day can increase total PA levels, academic performance (CDC, 2010), and on-task behavior (Whitt-Glover et al., 2013). When implementing extra-curricular opportunities for students, such as before/afterschool or athletic programs, three factors have been identified as critical to achieving positive youth outcomes: access to and sustained participation, quality programming and staffing, and strong partnerships among the program and other learning areas (Little, Wimer, & Weiss, 2008). All staff should be aware of and trained in the recommended standards for after-school physical activity (Move More After-School Collaborative, 2009). Research has shown that while many after-school programs do dramatically increase PA levels for students, active times can vary greatly from child to child and program to program, impacting their overall effectiveness in terms of student PA (Beets, 2012). Creating low-cost after-school programs is also essential, since students from high-poverty households are less likely to attend after-school programs and do so less frequently than those from lower-poverty households (Little, Wimer, & Weiss, 2008).

Provide Additional Resources to Schools with High Student Poverty Rates

Improving the overall quality of PA programs, as mentioned above, often-times demands a well-trained staff. If funding is not available to train recess, classroom, or

after-school staff, the PE teacher should provide the necessary resources to them, at a minimum. Providing the necessary funding and professional development to PE teachers, classroom teachers, recess supervisors, and before/after-school staff will ensure that all staff are updated on best practices so that high-quality programs can be delivered. Even with proper training, physical resources and developmentally appropriate equipment are required to create productive and physically active environments for students. Level the Playing Field, a non-profit organization based in Washington D.C and now expanding to other cities, identifies HP schools in need of sports equipment and provides that equipment completely free of charge (LPF, 2017). Playworks, an in-school and fully staffed recess program serving HP schools, has dramatically increased PA levels during recess times compared to non-Playworks schools, and is a recommended PA-based program for low-income and high minority schools (Barros, Silver, & Stein, 2009). Trained Playworks staff also create and coach all-girl sports teams, a program that could directly benefit those female students in high-poverty schools who exhibit the lowest average CE scores. First-Tee, a character-based golf program that currently operates specifically at a dozen HP elementary schools in the county, gives students an opportunity to be physically active after school, offers scholarships to low-income families, provides equipment to the schools, and has shown to improve student confidence in academic ability through integrated character education (The First Tee Triangle, 2018). The funding organization, 21st Century Community Learning Centers, is another possible option that provides resources to low-income schools in an effort to improve academic components by providing before and after-school programs, weekend,

and summer enrichment programs in high-poverty schools (NCDPI, 2018). Improving

physical resources outside the school may benefit students as well by providing more safe

and enjoyable opportunities to be active. When gathering data for this research, it

became evident that most LP schools are able to assess their students with the mile run on

an outdoor running track, while most of the HP schools lack an outdoor track and

primarily use the indoor gym for PACER assessments. Creating equal access to outdoor

facilities, such as playgrounds, playing fields, and running tracks for students of all

economic backgrounds may also help close the physical and academic gap that currently

exists between schools. Providing additional play equipment and technological resources

to all classroom teachers, such as ipads, ipods, smart TV's, and SmartBoards, can ease

the manner in which classroom breaks are delivered to students. Finally, extra-curricular

programs on school grounds require the same developmentally appropriate equipment

that help make PE programs and recess safe and more physically active for students.

Schools should evaluate these programs, ensure they are equipped with the proper

training, resources, and equipment, and continue to promote increases in PA. A summary

of all recommendations are included in table 13 (Appendix A).

Increasing PA time, improving the quality of this PA time, and providing

additional resources are all recommendations aimed improving the overall fitness and

academic performance of students in HP schools. Improving the overall effectiveness of

PE, recess, PA-based classroom breaks, and extra-curricular activities may dramatically

help close the gaps seen between students from different poverty levels, specifically by

improving the physical fitness and academic success of students in HP schools.

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APPENDIX A

RESULTS

Table 1. Fitness and Academic Assessment Details

Assessment	Administered By	Calculated Reliability	Assessment of:	Unit of Measurement	Date of Assessment
Fitnessgram PACER test	Physical educators	.64-.90	Cardiorespiratory Endurance	Laps	April - June 2017
Fitnessgram Mile Run	Physical Educators	.64 and up	Cardiorespiratory Endurance	Minutes: Seconds	April - June 2017
End-of-Grade Math	Classroom Teachers	.92	Math Comprehension	Raw Score (400-500)	May - June 2017
End-of-Grade Reading	Classroom Teachers	.89	Reading Comprehension	Raw Score (400-500)	May - June 2017

(All Fitnessgram information is referenced from Plowman & Meredith, 2013.
All math and reading information is referenced from NCDPI, 2016.)

Table 2. Descriptive Participant Data

	Students from High-Poverty Schools	Students from Low-Poverty Schools	Total Students
Males	439	698	1137
Females	401	656	1057
Total Students	840	1354	2194

Table 3. Mean Comparisons between High and Low-Poverty Schools

	High-Poverty	Low-Poverty
PACER (laps)	26.83	35.8
PACER (z-score)	-.1069	.4713
Mile (sec)	732.12	648.76
Mile (z-score)	.4506	-.0739
CE (z-score)	-.1879	.1168
Math (raw score)	447.26	459.48
Reading (z-score)	-.7287	.4525
Reading (4th raw score)	441.2	453.7
Reading (5th raw score)	446.6	458.3
Male Reading (z-score)	-.7903	.4227
Female Reading (z-score)	-.6613	.4843
Male Math (raw score)	447.58	459.88
Female Math (raw score)	446.91	459.06
Male CE (z-score)	.0268	.3292
Female CE (z-score)	-.4230	-.1092

Table 4. Pearson Correlation for Full Participant Set

		PACER (laps)	Mile (sec)	CE (z-score)	Math	Reading (z-score)
PACER (laps)	Pearson Correlation	1	b	1.000**	.216**	.146**
	n	788	0	788	788	788
Mile (sec)	Pearson Correlation	b	1	-1.000**	-.289**	-.172**
	n	0	1406	1406	1406	1405
CE (z-score)	Pearson Correlation	1.000**	-1.000**	1	.238**	.147**
	n	788	1406	2194	2194	2193
Math	Pearson Correlation	.216**	-.289**	.238**	1	.782**
	n	788	1406	2194	2194	2193
Reading (z-score)	Pearson Correlation	.146**	-.172	.147**	.782**	1
	n	788	1405	2193	2193	2193

**. Correlation is significant (p < .01 level for 2-tailed test)
b. Cannot be computed because at least one of the variables is a constant

Table 5. Pearson Correlation for High-Poverty Schools

		PACER (laps)	Mile (sec)	CE (z-score)	Math	Reading (z-score)
PACER (laps)	Pearson Correlation	1	b	1.000**	.134**	.060
	N	642	0	642	642	642
Mile (sec)	Pearson Correlation	b	1	-1.000**	-.196**	-.074
	N	0	198	198	198	198
CE (z-score)	Pearson Correlation	1.000**	-1.000**	1	.130**	.048
	N	642	198	840	840	840
Math	Pearson Correlation	.134**	-.196**	.130**	1	.690**
	N	642	198	840	840	840
Reading (z-score)	Pearson Correlation	.060	-.074	.048	.690**	1
	N	642	198	840	840	840

**. Correlation is significant ($p < .01$ level for 2-tailed test)
b. Cannot be computed because at least one of the variables is a constant

Table 6. Pearson Correlation for Low-Poverty Schools

		PACER (laps)	Mile (sec)	CE (z-score)	Math	Reading (z-score)
PACER (laps)	Pearson Correlation	1	b	1.000**	.111	-.029
	N	146	0	146	146	146
Mile (sec)	Pearson Correlation	b	1	-1.000**	-.249**	-.114**
	N	0	1208	1208	1208	1207
CE (z-score)	Pearson Correlation	1.000**	-1.000**	1	.228**	.097**
	N	146	1208	1354	1354	1353
Math	Pearson Correlation	.111	-.249**	.228**	1	.669*
	N	146	1208	1354	1354	1353
Reading (z-score)	Pearson Correlation	-.029	-.114**	.097**	.669**	1
	N	146	1207	1353	1353	1353

**. Correlation is significant ($p < .01$ level for 2-tailed test)
b. Cannot be computed because at least one of the variables is a constant

Table 7. Pearson Correlation with CE (z-score)

		Math	Reading (z-score)
HP Males	Pearson Correlation	.066	.033
	N	439	439
HP Females	Pearson Correlation	.222**	.122*
	N	401	401
LP Males	Pearson Correlation	.234**	.081*
	N	698	698
LP Females	Pearson Correlation	.212**	.139**
	N	656	655

**. Correlation is significant (p < .01 level for 2-tailed test)
*. Correlation is significant (p < .05 level for 2-tailed test)

Table 8. Multiple Regression Data for High-Poverty Schools

	B	**Std. Error**	**Sig.**	**Lower Bound (95% CI)**	**Upper Bound (95% CI)**	**Interaction Sig.**
Male*CEz for Math	.591	.414	.154	-.222	1.404	.006**
Female*CEz for Math	2.614	.601	.000***	1.435	3.793	.006**
Male*CEz for Readingz	.029	.041	.484	-.052	.110	.113
Female*CEz for Readingz	.144	.060	.016*	.027	.261	.113

(Math Adjusted R Squared = .022, Reading Adjusted R Squared = .009)
* Significant (p < .05); ** Significant (p < .01); *** Significant (p < .001)

Table 9. Multiple Regression Data for Low-Poverty Schools

	B	**Std. Error**	**Sig.**	**Lower Bound (95% CI)**	**Upper Bound (95% CI)**	**Interaction Sig.**
Male*CEz for Math	1.933	.308	.000***	1.329	2.537	.872
Female*CEz for Math	1.860	.333	.000***	1.207	2.513	.872
Male*CEz for Readingz	.061	.028	.030*	.006	.116	.258
Female*CEz for Readingz	.108	.030	.000***	.048	.167	.258

(Math Adjusted R Squared = .050, Reading Adjusted R Squared = .012)
* Significant (p < .05); ** Significant (p < .01); *** Significant (p < .001)

Table 10. ANOVA Tests of Between-Subjects Effects:
Gender and Poverty on Reading

Dependent Variable: Reading

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	727.858[a]	3	242.619	362.971	.000	.332
Intercept	38.346	1	38.346	57.367	.000	.026
Gender_coded	4.699	1	4.699	7.030	.008*	.003
Poverty	719.527	1	719.527	1076.449	.000**	.330
Gender_coded * Poverty	.588	1	.588	.879	.349	.000
Error	1463.186	2189	.668			
Total	2191.044	2193				
Corrected Total	2191.044	2192				

a. R Squared = .332 (Adjusted R Squared = .331)
* Significant (p < .01); ** Significant (p < .001)

Table 11. ANOVA Tests of Between-Subjects Effects:
Gender and Poverty on Math

Dependent Variable: Math

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	77754.065[a]	3	25918.022	339.219	.000	.317
Intercept	425494287.149	1	425494287.149	5568935.029	.000	1.000
Gender_coded	289.423	1	289.423	3.788	.052	.002
Poverty	77336.962	1	77336.962	1012.198	.000**	.316
Gender_coded * Poverty	2.713	1	2.713	.036	.851	.000
Error	167326.874	2190	76.405			
Total	454064896.000	2194				
Corrected Total	245080.939	2193				

a. R Squared = .317 (Adjusted R Squared = .316)
* Significant (p < .01); ** Significant (p < .001)

Table 12. ANOVA Tests of Between-Subjects Effects:
Gender and Poverty on CE

Dependent Variable: Cardiorespiratory Endurance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	155.536[a]	3	51.845	55.752	.000	.071
Intercept	4.019	1	4.019	4.321	.038	.002
Gender_coded	102.068	1	102.068	109.760	.000**	.048
Poverty	49.136	1	49.136	52.839	.000**	.024
Gender_coded * Poverty	.017	1	.017	.018	.893	.000
Error	2036.520	2190	.930			
Total	2192.056	2194				
Corrected Total	2192.056	2193				

a. R Squared = .071 (Adjusted R Squared = .070)

* Significant (p < .01); ** Significant (p < .001)

Figure 1. Scatterplot and Best Fit Line of CE and Math Scores in HP Schools
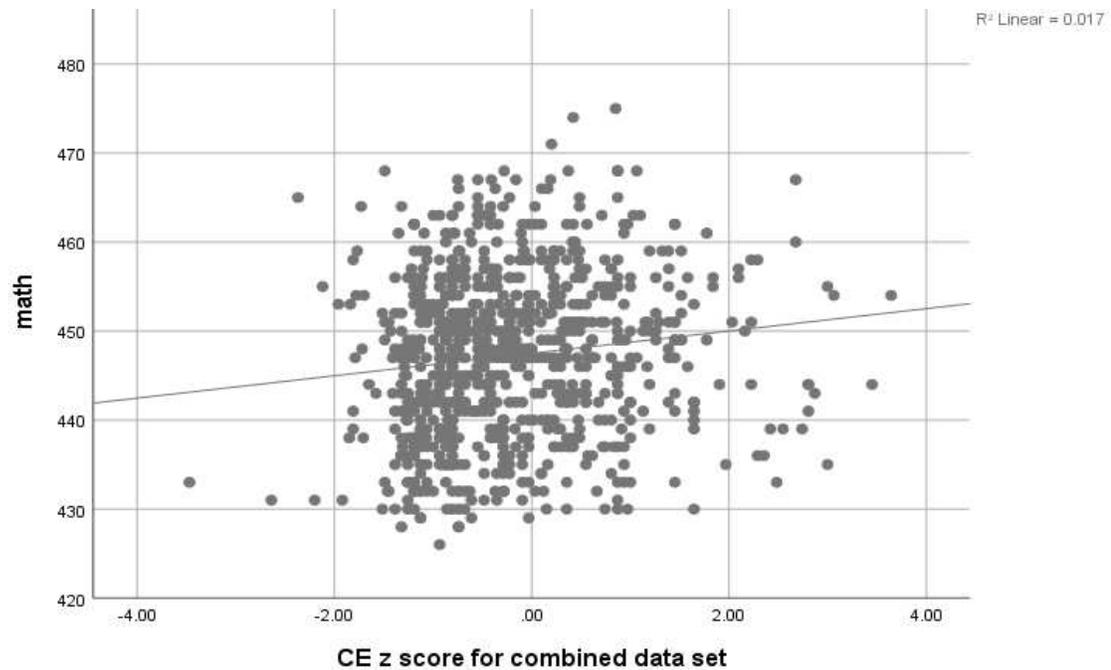
Figure 2. Scatterplot and Best Fit Line of CE and Reading Scores in HP Schools
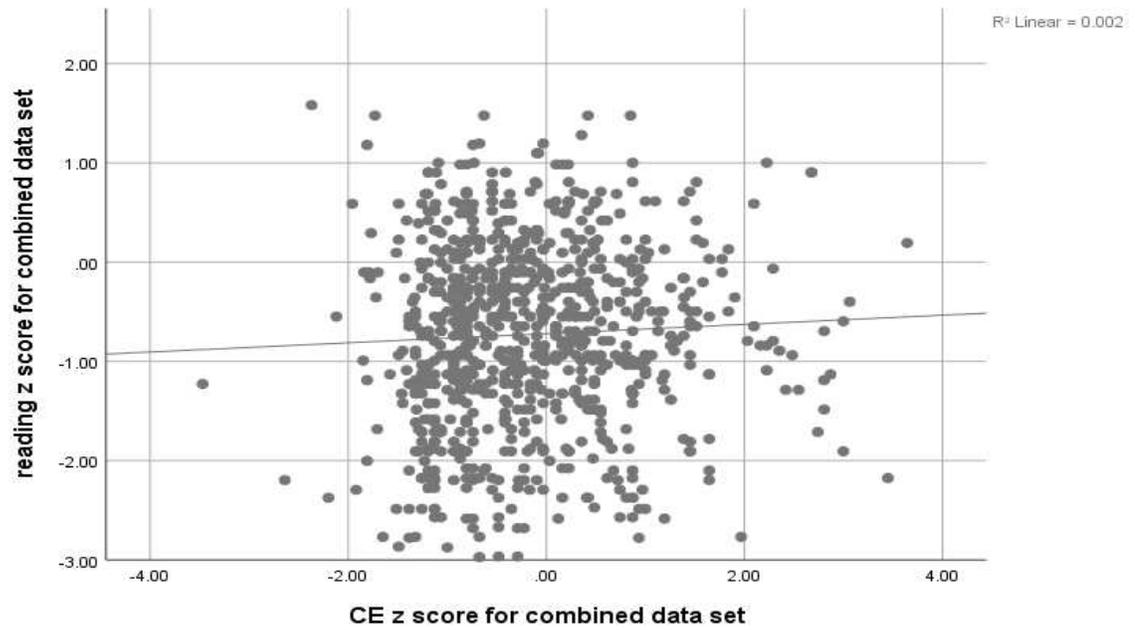
Figure 3. Scatterplot and Best Fit Line of CE and Math Scores in LP Schools
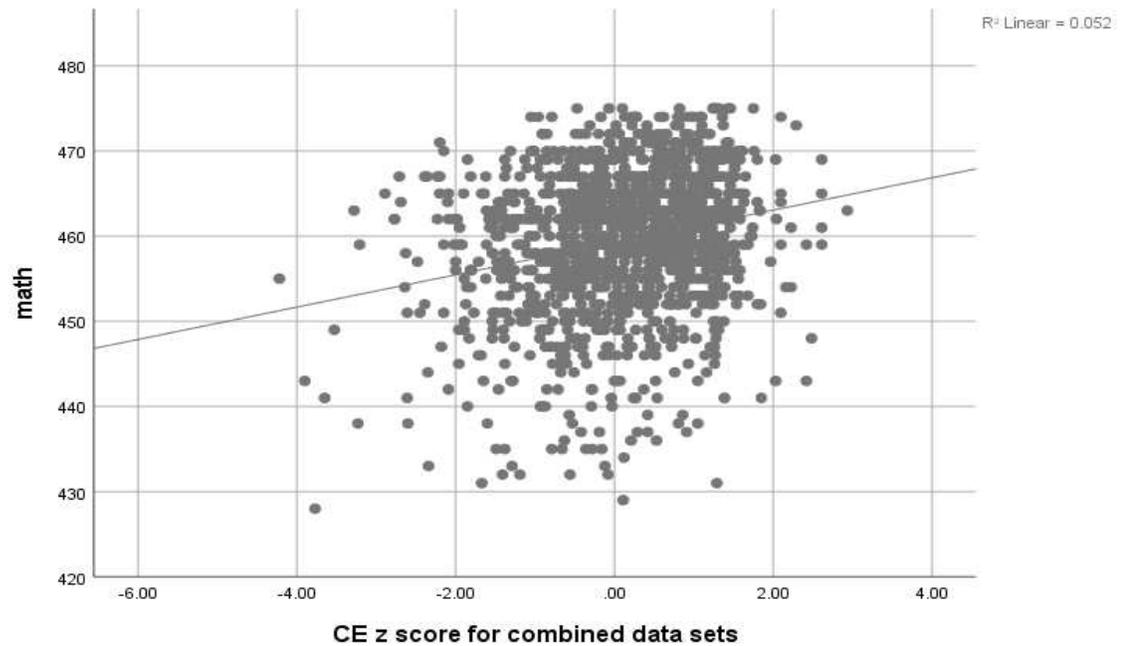
Figure 4. Scatterplot and Best Fit Line of CE and Reading in LP Schools
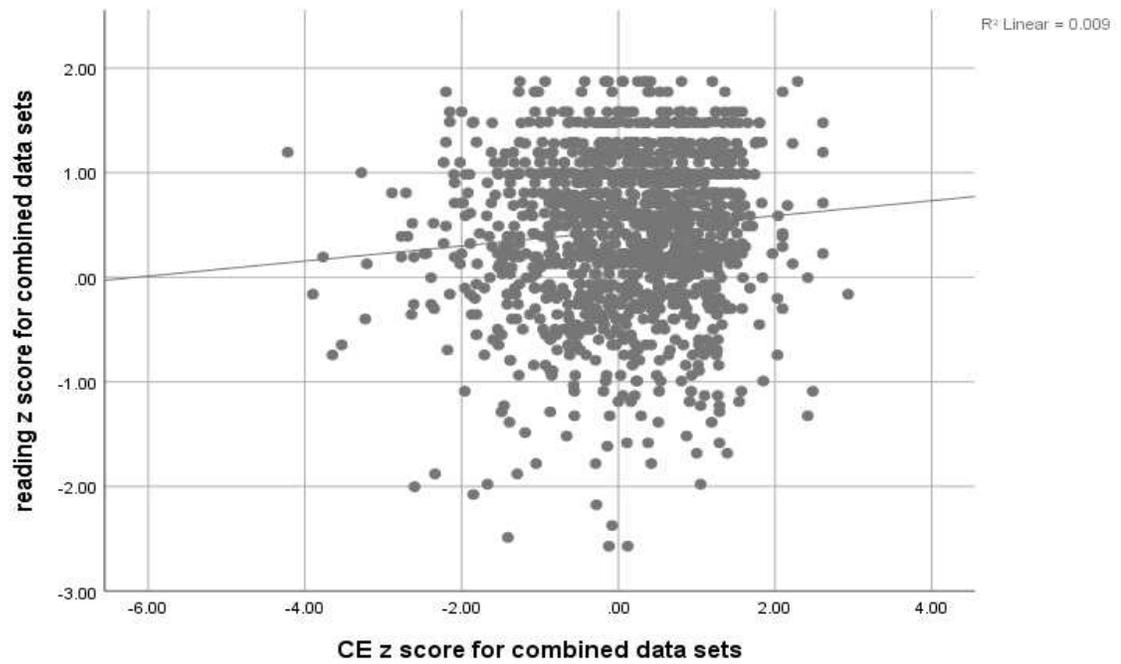
Table 13. Summary of Specific PA Recommendations

	Increase the Amount of Student PA Time at School	Improve the Quality of PA Time at School	Provide Additional Resources to Schools with High Student Poverty Rates
Physical Education	• Provide a minimum of 45 minutes of weekly PE, but aim for 60 • 200– 300 weekly minutes of MVPA can significantly improve fitness (Gallahue & Donnelly, 2003; Resaland, Andersen, Mamen, & Anderssen, 2011).	• Ensure Programs adhere to CSPAP: 4 Components of Effective PE Program (Policy, Content, (Instruction, Assessment) • Train Teachers the SHAPE Fitness Practices	• Ensure PE programs are equipped with an adequate amount of developmentally appropriate equipment to meet curricular needs • Use grant writing, funding drives, or non-profit organizations to offset costs
Recess	• Provide a minimum of 30 or more minutes of daily recess time • Aim for more recess on non-PE days	• Provide recess staff with National Guidance Recommendations • Train staff in 5 Broad (19 specific) recess strategies (CDC and SHAPE) • Ensure trained staff supervise recess and implement recommended practices	• Provide adequate amount of developmentally appropriate recess equipment to all students • Utilize resources and staff from non-profit organizations • Ensure equal outdoor play areas to all schools (safe playground areas, fields for play, running tracks, etc…)
Classroom Breaks	• Provide a minimum of 15 or more minutes of daily classroom PA breaks • Aim for more on non-PE days • Breaks should integrate PA with academic concepts	• Train classroom teachers in classroom break resources • Provide a list of resources to classroom teachers	• Provide all classroom teachers with a list of classroom break resources • Provide safe equipment to use inside classroom settings • Provide and use technology to better deliver classroom PA programs to students (ipads, ipods, SMART TVs, SmartBoards, etc..)
Extra-curricular Activities	• Provide a minimum of 1 extra-curricular PA opportunity (before/after school, athletic club) • Aim for 2 or more extra-curricular activity opportunities for students • Aim for a female only extra-curricular activity opportunity and encourage high female participation	• Provide opportunities to participate to all students • Train all staff in the before/after school recommended standards • Create and provide partnerships with community organizations (Boys and Girls Club, YMCA, etc…)	• Ensure all extra-curricular programs are equipped with adequate amount of developmentally appropriate equipment • Provide transportation to organizations off school grounds • Request funding for resources (21st Century Community Learning Centers, [NCDPI, 2018])

APPENDIX B

DISSEMINATION OF FINDINGS

Figure 5. SHAPE America Research Poster

Figure 6. Research Dissemination Presentation
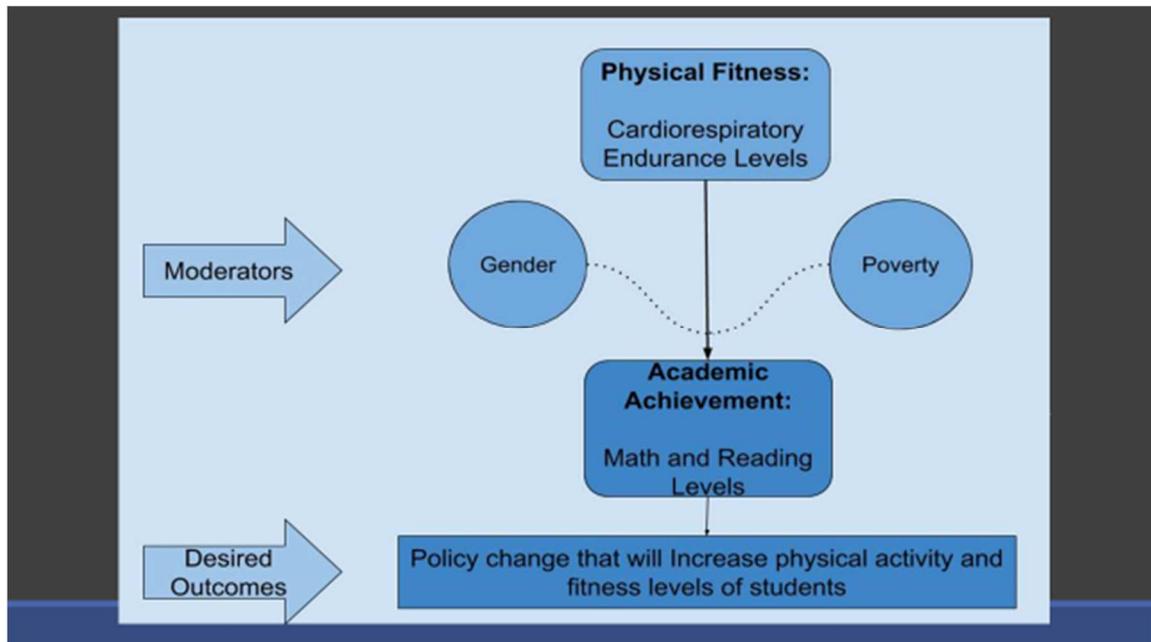
Research Aims

Primary Aim

- Clarify specific relationships among cardiorespiratory endurance (CE), academic achievement (AA), gender, and poverty

Secondary Aim

- Make specific recommendations to stakeholders in the school district to change school programs and policies toward increasing physical activity (PA) for specific groups of students.

Importance and Rationale

- Large data set from understudied population (N=2194)

- Research on impact of poverty is scarce; some knowns exist

- Findings can potentially impact thousands of students

Background

- Physical fitness, PA, and AA are all positively associated.

- The relationship between fitness and academic performance is driven by CE, and most likely a result of PA participation.

- PE, recess, PA-based classroom breaks, and extra-curricular physical activities have all been positively associated with cognitive function and/or AA.

- Students from high-poverty (HP) homes generally score lower on standardized exams and are less fit than those from low-poverty (LP) homes.

References: (ACSM, 2016; Institute of Medicine, 2013; CDC, 2014, Chomitz, et al. 2009; Jin & Jones-Smith, 2015).

Methods

- Collect CE and AA scores from 4th and 5th graders (N=2194)
  - 1137 Males, 1057 Females
  - 840 HP, 1354 LP

- Data taken from 5 high-poverty and 5 low-poverty schools
  - HP: 79% average F&R Rate
  - LP: 5% average F&R Rate

- Statistical Analyses: Descriptive, ANOVA, Correlation, Multiple Regression

Participant Information

	Students from HP Schools	Students from LP Schools	Total Students
Males	439	698	1137
Females	401	656	1057
Total Students	840	1354	2194

Results

Mean Comparisons between HP and LP Schools

	HP	LP
PACER (laps)	26.83	35.8
Mile (sec)	732.12	648.76
CE (z)	-.1879	.1168
Math	447.26	459.48
Reading	441.2	453.7
Male Math	447.58	459.88
Female Math	446.91	459.06
Male CE (z)	.0268	.3292
Female CE (z)	-.4230	-.1092
Male Reading (z)	-.7903	.4227
Female Reading (z)	-.6613	.4843

- Students from LP schools outperformed students from HP in all average measures

- Males outperformed females in average math and CE

- Females outperformed males in average reading

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Results

Mean Comparisons between HP and LP Schools

	HP	LP
PACER (laps)	26.83	35.8
Mile (sec)	732.12	648.76
CE (z)	-.1879	.1168
Math	447.26	459.48
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Male Math	447.58	459.88
Female Math	446.91	459.06
Male CE (z)	.0268	.3292
Female CE (z)	-.4230	-.1092
Male Reading (z)	-.7903	.4227
Female Reading (z)	-.6613	.4843

ANOVA Results

- Main effect of **POVERTY** demonstrated on
  - **MATH** (.316 partial eta squared)
  - **READING** (.330 partial eta squared)
  - **CE** (.024 partial eta squared)

- Main effects of **GENDER** demonstrated on:
  - **READING** (.003 partial eta squared)
 - **CE** (.048 partial eta squared)

Results

Pearson Correlation for Full Participant Set

		CE (z-score)
Math	Pearson Correlation	.238**
	n	2194
Reading (z-score)	Pearson Correlation	.147**
	n	2193

**. Correlation is significant (p < .01 level for 2-tailed test)

- Significant correlations between CE and AA (math and reading)
- Correlation with math is stronger than that of reading

Results — HP Scatterplot / LP Scatterplot
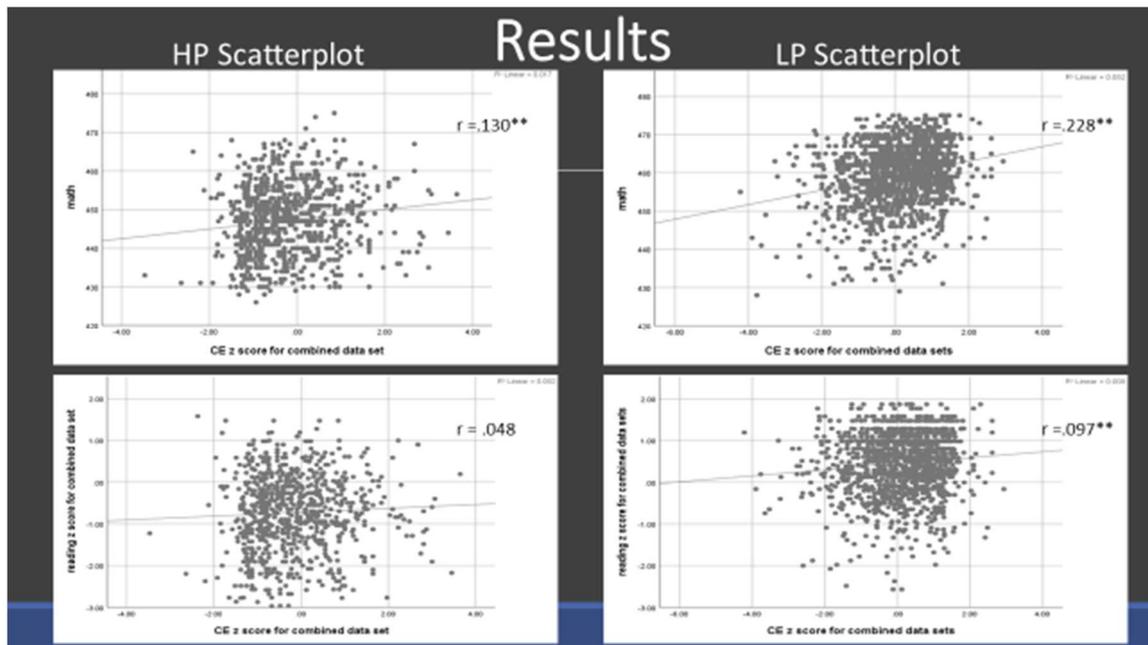
Results

Multiple Regression for HP Schools

	B	Std. Error	Sig.
Male*CEz for Math	.591	.414	.154
Female*CEz for Math	2.614	.601	.000***
Male*CEz for Readingz	.029	.041	.484
Female*CEz for Readingz	.144	.060	.016*

(Math Adjusted R Squared = .022, Reading Adjusted R Squared = .009)
* Significant (p < .05); ** Significant (p < .01); *** Significant (p < .001)

- CE is a significant predictor of female's math and reading scores
- For every SD increase in CE, females' math scores increase an average of 2.6 math points, and .144 reading z points

Results

Multiple Regression for LP Schools

	B	Std. Error	Sig.
Male*CEz for Math	1.933	.308	.000***
Female*CEz for Math	1.860	.333	.000***
Male*CEz for Readingz	.061	.028	.030*
Female*CEz for Readingz	.108	.030	.000***

(Math Adjusted R Squared = .050, Reading Adjusted R Squared = .012)
* Significant (p < .05); ** Significant (p < .01); *** Significant (p < .001)

- CE is a significant predictor of males' and females math and reading scores
- For every SD increase in CE, males' and females AA scores increase

Summary of Results

Data from this study strongly suggest that:

- A gap exists between students from HP and LP schools in average CE and AA

- CE and AA are positively associated among the full participant group

- CE is a significant predictor of math and reading scores among most student groups (stronger with math)

- Poverty demonstrates main effects on math, reading, and CE

- Gender demonstrates main effects on reading and CE (though weak)

Secondary Aim:
Create PA-Based Recommendations

Audience

- Stakeholders in the school system with policy making authority

Purpose

- Implement PA-based programs and policies specifically in HP schools, with special attention also devoted to females

Rationale

- Students in HP schools have more room for growth in CE and AA
- CE, PA and AA are all positively associated
- Females in HP schools show great potential for increased math scores with improved fitness

Recommendations to Stakeholders
in the School District

1. Increase the amount of student PA time at school
2. Improve the quality of this PA time
3. Provide additional resources specifically to schools with high poverty rates

   - Physical Education Classes
   - Recess
   - PA-Based Classroom Breaks
   - Extra-curricular Programs

Increase the Amount of Student PA Time at School

- <u>Physical Education Classes</u>
  - Mandate 45-minute classes; aim for 60 minutes a week or more
- <u>Recess</u>
  - Aim for 30 or more daily minutes
- <u>PA-Based Classroom Breaks</u>
  - Mandate daily PA breaks in classroom
- <u>Extra-curricular Programs</u>
  - Provide before/afterschool programs or athletic clubs

Increase the Amount of Student PA Time at School (cont.)

- <u>How Much Physical Activity is needed?</u>
  - National Recommendation is 60 minutes of MVPA per day

- <u>Intervention Studies</u>
  - 200-300 minutes of weekly MVPA can increase CE levels
  - Increasing PA from 2 to 5 days a week significantly increased math scores
  - Increasing PE from 28-56 hours per year significantly increased reading scores

References: (Gallahue & Donnelly, 2003; Resaland, Andersen, Mamen, & Anderssen, 2001; Ericsson, 2008; Tremarche, Robinson, & Graham, 2007)

Improve the Quality of this PA time

- Physical Education Classes
  - Program adheres to SHAPE's 4 Essential Components (Policy, Curriculum, Instruction, Assessment) and Fitness Testing Recommendations

- Recess
  - Provide staff with National Guidance Recommendations and evidence based recess strategies; Train recess staff; Ensure recommendations are in place

- PA-Based Classroom Breaks
  - Provide resources to classroom teachers; Combine with academic content

- Extra-curricular Programs
  - Provide opportunities for all students; Train staff in state standards for before/afterschool physical activity; Create partnerships within the community

Provide Additional Resources to Schools with High Poverty Rates

- Ensure adequate equipment is provided for all programs
  - Obtained through grant writing, school funds, non-profit organizations, etc.
  - 21st Century Learning Grant, Level the Playing Field

- Provide equitable access to safe play areas
  - Playgrounds, tracks, fields

- Provide easily accessible resources to classroom teachers
  - Technology (ipads, smartboards, TVs), GoNoodle, Active Academics

- Provide extra-curricular programs
  - Girls on the Run, Playworks, Before/After-School, YMCA, Boys and Girls Club

Significance of Recommendations

- **PA and Higher Fitness Levels**: linked to physical changes in the brain

- **Increased PE time**: associated with better grades, and does NOT negatively affect AA

- **Recess, Classroom Breaks and Extra-Curricular Physical Activities**: positively linked to cognitive performance and/or AA

References: (ACSM, 2016; Hillman, Erickson, & Kramer, 2008; CDC, 2014)

Conclusion

- Findings appear to support existing research on relationship between physical fitness, AA, gender, and poverty

- Increasing PA levels, specifically in HP schools, can improve overall health and potentially help close the physical and academic gap that exists between poverty levels

- Future Research Considerations: Intervention Study

The Relationship between Physical Fitness and Academic Achievement among 4th and 5th Grade Boys and Girls from High and Low-Poverty Schools

Thank you

Questions?