Physical Education, Physical Activity & Academic Achievement: A Longitudinal Study for 1st and 8th Grade Students

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Physical Education, Physical Activity & Academic Achievement: A Longitudinal Study for 1st and 8th Grade Students

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Introduction

The prevalence of obesity in children has greatly risen across developed countries in the past two decades, including the United States. While there can be a number of factors that contribute to obesity, it is known that increasing energy intake or decreasing energy expenditure will contribute to obesity. It is suggested that a lack of physical activity along with high levels of sedentary behaviors, such as television viewing, can cause obesity in children (Ebbeling, Pawlak, & Ludwig, 2002). Sedentary behavior is a risk factor for chronic disease and obesity in childhood, which poses a health threat that tracks into adulthood (Sisson et al., 2009). A nationally representative study conducted by Ebbeling (2002) found in the United States, children spend three-fourths of the time they are awake being sedentary and only engage in vigorous physical activity for an estimated 12 minutes per day. Vigorous exercise is defined as physical activity at a high enough intensity to induce sweating, heavy breathing, and an increased heart rate, or exercising at 6 or more metabolic equivalents (McGraw-Hill Concise Dictionary of Modern Medicine, 2002). The most overweight children tended to engage in the least vigorous physical activity or the most television watching. The risk for obesity was reduced by 10% for each hour of moderate to vigorous intensity physical activity per day while it increased by 12% for each hour per day of television viewing (Ebbeling et al., 2002). The main institution responsible for engaging children in physical activity is physical education in the school systems (Sallis et al., 1997). According to the Society of Health and Physical Educators (SHAPE America), the recommendation should be 150 minutes per week of physical education in elementary school and 225 minutes per week for middle school and high school (Physical Education Guidelines, SHAPE America). The failure of schools to meet this recommended minutes results in a lack of engagement of children in moderate to vigorous intensity physical
activity in the school setting. The purpose of this study is to examine the physical education requirement, factors that affect physical activity levels for grade-school children, and how physical activity can affect academic achievement.

*Literature Review*

In the United States today, physical education requirements are laid out by the states to meet the national standards of what a physically literate individual should demonstrate. Most states have policies stating they will teach physical education; however, very few provide daily physical education (PE) classes. The recommendation should be 150 minutes of PE weekly throughout the school year in elementary school, and 225 minutes in middle school and high school, and a total of 60 minutes of physical activity each day (Physical Education Guidelines, SHAPE America). With numerous studies showing that lower amounts of physical activity are contributing to the rise in childhood obesity, physical education is as important as ever in today’s schools. The Society of Health and Physical Educators, known as SHAPE America, is the organization that publishes the national standards K-12 for physical education. SHAPE America has five standards of what a “physically literate” individual should be able to demonstrate:

- **Standard 1:** The physically literate individual demonstrates competency in a variety of motor skills and movement patterns.
- **Standard 2:** The physically literate individual applies knowledge of concepts, principles, strategies and tactics related to movement and performance.
- **Standard 3:** The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.
Standard 4: The physically literate individual exhibits responsible personal and social behavior that respects self and others.

Standard 5: The physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction.

School districts then use these national standards as a framework to develop their individual standards and curriculum for physical education (SHAPE America, 2013). The 2006 School Health Policies and Programs Study was conducted by the Centers for Disease Control and Prevention to describe the characteristics of school physical education. The study showed, 69.3% of elementary schools, 83.9% of middle schools, and 95.2% of high schools required some amount of physical education to graduate or continue into the next grade level. When defining daily physical education as 36 weeks of 150 minutes per week (elementary) and 225 minutes per week (middle school and high school) of physical education, across the United States, only 3.8% of elementary schools (excluding kindergarten), 7.9% of middle schools, and 2.1% of high schools provided daily physical education. A larger number of schools provided daily physical education, or its equivalent, for half the school year—4.7% of elementary schools (excluding kindergarten), 14.5% of middle schools, and 6.6% of high schools. (Lee, Burgeson, Fulton, & Spain, 2007). It is clear that the physical education hours are not being met across the United States meaning that children are missing out on the benefits of physical education.

In an overview of research conducted by Bailey (2006), results showed that school, through physical education and after school involvement, is the main outlet for children to be physically active. It has also been shown that school-based programs can improve physical activity in the students and these changes can be carried through later in life. The evidence shows that physical education can help improve academic success by increasing blood flow to the brain,
improving mood and self-esteem, and increasing mental alertness. The available research indicates that physical education does not result in lower achievement in other subjects despite the fact that it lowers the amount of classroom time that can be dedicated to these subjects.

It is important to determine the current amount of physical activity for grade school students in the United States outside of physical education classes. Many factors go into the amount of physical activity a child will participate in during free time, including, their confidence or self-esteem about being physically active, the availability of other sedentary activities they could potentially choose instead of physical activity, and their peer or social group’s attitude towards physical activity. Children that are obese report having lower self-efficacy related to physical activity compared to non-obese children. They also exhibit lower amounts of physical activity, which could be a result of the low self-efficacy (Trost, Kerr, Ward, & Pate, 2001). Physical education is intended to have a focus on developing physical competence and confidence while performing a range of physical activities (Bailey, 2006). A higher amount of physical education can lead to higher self-efficacy and overall self-esteem. Another factor that seems to interfere with the amount of physical activity children engage in is the hours of television the child watches per day. The United States National Health and Nutrition Examination Survey, 2001-2006, found over 47% of the children and adolescents included in the sample recorded over 2 hours of screen time per day. When looking at body mass index, 45% of participants classified as normal weight, 51% of those classified as overweight, and 59% of those classified as obese engaged in two or more hours of screen time a day (Sisson et al., 2009).

Other factors that may have an impact on physical activity were identified through a systematic umbrella literature review of the studies on the socio-cultural determinants of physical
activity. The review found encouragement from others and having a partner to engage in physical activity with seemed to be associated with higher levels of physical activity among children and adolescents (Jaeschke et al., 2017). Previous research has suggested that PE may lead to children reducing their physical activity outside of school; however, it has actually been shown that PE and recess contributes to increasing the child’s overall physical activity and does not reduce after-school physical activity. Evidence has suggested PE can even lead to a more active lifestyle outside the school, when programmed correctly (Morrow, Jackson, & Payne, 1999).

The last area to look into is the relationship between health and academic achievement. Physical education and physical activity both work towards creating healthier individuals which could lead to higher achieving students. The main focus of the school system is to educate children, meaning that academics are the top priority and often the reason used to limit physical education hours. It may seem as though promoting health and physical activity in the school could interfere with learning; however, being overweight is associated with lower cognitive function and school performance. On the opposite side of this, increased physical activity is linked to better cognition, concentration and memory (Ickovics, 2014). In a study conducted in New Haven, Connecticut using twelve K—8 schools, researchers constructed a health index including 14 important indicators of healthiness. Four broad domains (physical health, health behaviors, family environment, and psychological well-being) were broken down to determine the index. The students participating were between the ages of 9 and 13 and were enrolled in 5th and 6th grade. The study measured academic achievement with standardized test scores in mathematics, reading and writing using the Connecticut Mastery Test and Connecticut Academic Performance Test. The results of the study showed the higher heath index scoring students were
more likely to meet goals on all academic performance tests. For each additional point on the health index scale, the likelihood of achieving the academic goal increased by 18%. They concluded that students with 9 or more points were 2.2 times more likely to meet their academic achievement goals than the students with 6 or fewer points, or health assets. Based on the evidence expressed in the study, a documented relationship was discovered between health and academic achievement demonstrating that more is better in terms of health indicators (Ickovics, 2014). The information gained through this study provides evidence for the argument that a higher level of health is associated with higher academic performance.

In addition to the previously stated research demonstrating the relationship between health and academics, physical activity in particular has been associated with mathematic and reading achievement in grade-school students. In a study done at Texas Tech University (2008), data from the Early Childhood Longitudinal Study was used to look at the relationship between physical activity and academic achievement (K-5th grade). Through the analysis, it was found that while prior reading achievement was the greatest predictor, physical activity did contribute to predicting reading achievement. The results for achievement in mathematics were similar, with prior achievement being the greatest predictor of math achievement. In both cases parents reported that physical activity was a factor in the prediction of their academic achievement (math and reading). In addition to these findings, it was concluded that socioeconomic status is a factor in academic achievement and children from higher socioeconomic status have an advantage when it comes to academic achievement (Stevens, Stevenson, & Lochbaum, 2008). Their research findings link physical activity to academic achievement and stated PE, with the intention of improving fitness of the students, could aid in academic achievement as well (Stevens et al., 2008).
Previous research clearly conveys the negative comorbidities of obesity, especially in children (Ebbeling et al., 2002; Sisson et al., 2009)). Increased physical activity and decreased screen time are important factors in reducing the number of children with body mass indexes that are classified as overweight and obese (Crespo et al., 2001). It is also evident that schools across the United States are lacking in their instruction of physical education. A very small percentage of schools are meeting the recommended amount of PE despite the fact that research shows it is beneficial to children’s memory and concentration in the classroom (Ickovics, 2014). Physical education promotes physical activity in grade school students which has been linked to a higher level of academic achievement.

Study Purpose and Hypothesis

The purpose of the present investigation is to demonstrate a relationship between physical education, physical activity, and academic achievement in K-8th graders. In the United States, the emphasis is shifting away from physical education to make time for more academic courses; however, this can cause detrimental effects on children’s overall health and can lead to academic decline. By finding the relationship between these variables, the importance of physical education in schools can be crystalized and promote schools to meet the nationally recommended minutes of physical education. Based on previous findings, the hypothesis of the present study is that increased physical education in grade-school will be associated with higher academic achievement. In addition, the present study hypothesizes higher levels of physical education will be associated with greater amounts of physical activity outside of the classroom. The present study will also provide information that could indicate whether physical education has a greater
influence on academic achievement in elementary school (first grade) or middle school (eighth grade).

**Methodology**

Participants were children selected from secondary, publically available, de-identified data from the nationwide Early Childhood Longitudinal Study, Kindergarten 2011 (ECLS-K: 2011). The ECLS-K is a project involving the U.S. Departments of Agriculture, Health and Human Services, and Education. Participation in the ECLS-K: 2011 study was voluntary and no one was required to complete the questionnaires or participate in the assessments. The purpose of this data collection is to gather information on children’s school experiences from kindergarten through eighth grade, including input from parents, teachers, students and the schools. Data collections began in kindergarten from a nationally representative cohort of 16,464 children in the fall and spring of the 2010-2011 school year. Waves of data were then collected in the fall and spring of their first-grade, spring of third-grade, spring of fifth-grade and spring of eighth-grade years. This longitudinal data will allow for the tracking of students’ academic success over the years as well as other factors that may have an impact.

The present study will look at the relationship between physical education and academic achievement (as indicated by mathematics and reading and science scores on direct cognitive assessments) for first and eighth grade as well as the relationship between physical education and physical activity outside of school (as reported by students and parents). The relationship between body mass index and academic achievement will also be analyzed over these grades, as well as poverty level and sex. For the purpose of this study, poverty was assessed as Federal Poverty Level standards adjusted for household size with:
PRIVATE SCHOOL DATA WAS EXCLUDED IN ORDER TO REDUCE THE IMPACT OF DIFFERENCES BETWEEN PUBLIC AND PRIVATE SCHOOLS. PRIVATE SCHOOL ENROLLMENT TYPICALLY IS LESS DIVERSE THAN THAT OF PUBLIC SCHOOLS, STUDENTS ATTENDING PRIVATE SCHOOLS TYPICALLY COME FROM HIGHER SOCIOECONOMIC STATUS, AND THE CLASS SIZE AT A PUBLIC SCHOOL IS TYPICALLY LARGER THAN THAT OF A PRIVATE SCHOOL (CHOY & MPR ASSOCIATES, 1997). DUE TO THE EXCLUSION OF PRIVATE SCHOOL DATA, THE SAMPLE SIZE (N) OF THE PRESENT STUDY IS 14,328 STUDENTS. IN THE PRESENT STUDY, 51.3% AND 48.3% OF THE SAMPLE WERE MALE AND FEMALE, RESPECTIVELY. IN ADDITION, 30.6% OF THE SAMPLE SELF-REPORTED AS A MINORITY RACE WITH 24.6% IDENTIFYING WITH LATIN/HISPANIC DESCENT.

**Data Analysis**

Multiple linear regression (MLR) using ordinary least square (OLS) was employed to investigate the impact of PE, physical activity (PA), and student characteristics on student IRT scores (reading, math, and science) for 1st grade and 8th grade students using ECLS data. Item response theory, IRT scores, is a model used to accurately score and develop various abilities, traits or behavioral characteristics (An & Yung, 2014). Main effects included PE, PA, Poverty Level, Sex, and BMI. Note that PA was only available for the 1st grade iteration. The regression model was the forward step methodology with elimination of the predictor if the contribution to the model was not reached (p ≤ 0.10). Overall model significance was reported using the global F-test with significance set at α ≤ 0.05. Overall variance explained was assessed by regression model coefficient of determination (R², Sum of Squares Regression/Sum of Squares Total).
Significance of each predictor included in the model was described using the $t$-statistic with inclusion of predictors with $p \leq 0.15$. Additionally, Kruskal-Wallis tests were performed to study the difference of BMI across the three poverty level at both grade levels. A comparison of BMI between grades was not made to account for the differing standards by age. Statistical analysis was performed using SPSS version 22.

**Results**

In the present study, 51.3% and 48.3% of the sample were male and female, respectively. In addition, 30.6% of the sample self-reported as a minority race with 24.6% identifying with Latin/Hispanic descent. For poverty, 25.4% of the sample classified as $<$100% income threshold, 22.1% as 100-200% income threshold, 51.9% as $>$ 200% income threshold, and 0.6% was not ascertained. The student characteristics are shown in Table 1. The mean, standard deviation and sample size are provided for each variable. Differences between the average IRT scores in each subject, BMI, and frequency of physical education per week between first and eighth grade. Table 1 also shows that the sample size of students decreased between first and eighth grade. There was a statistically significant decrease in the average number of days students receive PE from 4.17 days in first grade to 3.88 days in 8th grade, $d = 0.291$, $t(11,964) = 10.94$, $p<0.001$.

Table 2 illustrates the regression results with IRT scores as the response variables. Analyses for both 1st and 8th grade reached statistical significance ($p<0.001$) across IRT subject (reading, math, and science). Sex had significance on IRT scores (Male=1, Female=2). On average, females students had higher 1st grade reading IRT scores [$\beta=2.22$, $p<0.001$] and 8th grade math IRT scores [$\beta=1.99$, $p<0.001$]. Students’ BMI was significant to their IRT scores across grades and subjects with a lower BMI associated higher average IRT scores. In 1st grade,
across all subjects, poverty had a significant impact on students’ IRT scores, however in 8th grade the relationship was not significant. The Kruskal-Wallis test indicated that there was a significant inverse relationship between poverty levels and student BMI for 1st and 8th grade, \( \chi^2(2) = 191.30, p < 0.001 \) and \( \chi^2(2) = 155.89, p < 0.001 \), respectively. Physical education was only found to have a significant relationship with academic achievement in first grade in the subject of mathematics [\( \beta=0.14, \ p=0.013 \)]. Regarding PA, data was only available for 1st grade. In the 1st grade, physical activity was significant for mathematics and science IRT scores [\( \beta=0.09, \ p=0.007 \) and \( \beta=0.18, \ p<0.001 \) respectively]. However, PA did not reach significance for reading IRT.

Table 1. Student Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading IRT 1st Grade</td>
<td>60.58</td>
<td>13.69</td>
<td>13554</td>
</tr>
<tr>
<td>Reading IRT 8th Grade</td>
<td>95.51</td>
<td>12.88</td>
<td>11075</td>
</tr>
<tr>
<td>Math IRT 1st Grade</td>
<td>44.29</td>
<td>12.71</td>
<td>13554</td>
</tr>
<tr>
<td>Math IRT 8th Grade</td>
<td>80.35</td>
<td>14.53</td>
<td>11075</td>
</tr>
<tr>
<td>Science IRT 1st Grade</td>
<td>26.98</td>
<td>8.85</td>
<td>13554</td>
</tr>
<tr>
<td>Science IRT 8th Grade</td>
<td>42.68</td>
<td>9.09</td>
<td>11075</td>
</tr>
<tr>
<td>1st Grade BMI</td>
<td>16.57</td>
<td>2.92</td>
<td>13554</td>
</tr>
<tr>
<td>8th Grade BMI</td>
<td>17.58</td>
<td>4.43</td>
<td>11075</td>
</tr>
<tr>
<td>Frequency of PE/week 1st Grade</td>
<td>4.17</td>
<td>2.16</td>
<td>12861</td>
</tr>
<tr>
<td>Frequency of PE/week 8th Grade</td>
<td>3.88</td>
<td>2.48</td>
<td>10144</td>
</tr>
</tbody>
</table>
### Table 2. Regression Statistics for IRT by Sex, BMI, Poverty, Physical Education and Physical Activity

<table>
<thead>
<tr>
<th>Grade</th>
<th>IRT</th>
<th>Sex (p-value)</th>
<th>BMI (p-value)</th>
<th>Poverty (p-value)</th>
<th>PE</th>
<th>PA (p-value)</th>
<th>F</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reading</td>
<td>2.22 (&lt;0.001)</td>
<td>-0.16 (&lt;0.001)</td>
<td>2.53 (&lt;0.001)</td>
<td>x</td>
<td>x</td>
<td>$F(3,10611)=216.13$</td>
<td>0.058</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>x</td>
<td>-0.13 (0.003)</td>
<td>2.36 (&lt;0.001)</td>
<td>0.14 (0.013)</td>
<td>0.09 (0.007)</td>
<td>$F(4,10610)=157.73$</td>
<td>0.056</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>x</td>
<td>x</td>
<td>1.93 (&lt;0.001)</td>
<td>x</td>
<td>0.18 (&lt;0.001)</td>
<td>$F(2,10612)=476.40$</td>
<td>0.082</td>
</tr>
<tr>
<td>8</td>
<td>Reading</td>
<td>1.99 (&lt;0.001)</td>
<td>-0.20 (&lt;0.001)</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>$F(2,12554)=84.18$</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>1.99 (&lt;0.001)</td>
<td>-0.16 (&lt;0.001)</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>$F(1,12555)=44.80$</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>x</td>
<td>-0.004 (&lt;0.001)</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>$F(1,12555)=13.39$</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Value expressed as β(p-value), x denotes lack of significance for inclusion in model, - denotes that data was not available for predictor. All Models were significant to the $p< 0.001$ level.
Discussion

The purpose of the present investigation was to assess the contribution of physical activity and physical education to IRT scores in the areas of reading, mathematics, and science. ECLS K data was used to measure all variables for students in first grade and eighth grade. Physical activity was assessed using parental reports and physical education was reported by school administrators. The effect of poverty level, BMI and sex were also calculated for the variables of academic achievement. Using longitudinal data allowed the impact of these factors over time to be tracked as the students advanced through grade school. Physical activity was only recorded at the first grade level unfortunately; the relationship between physical activity and IRT scores is unavailable in eighth grade. The results of this study indicate the relationship between the amount of physical education and the students’ IRT scores is only present in the first grade on the mathematics section. The results of the other analyses did not find a significant relationship between academic achievement and physical education. This finding brings to question the reasoning for the increase in recommended minutes, from 150 minutes to 225 minutes per week, as students’ transition from elementary school to middle school (Physical Education Guidelines, SHAPE America). The impact of physical education may be stronger at a younger age and could provide more benefits to academic achievement if physical education minutes were increased in elementary school rather than middle school. Engagement in physical activity (at least 20 minutes as reported by parents) had a significant positive influence on IRT scores in mathematics and science, however the reading IRT scores were not significantly related to physical activity. Due to the lack of data on physical activity, the importance of physical activity over time could not be analyzed in this study.

Despite the fact that the current study did not find a significant impact of physical education on IRT scores, other than mathematics in the first grade, multiple factors could play a role in this
PHYSICAL EDUCATION, PHYSICAL ACTIVITY & ACADEMIC ACHIEVEMENT: A LONGITUDINAL STUDY FOR 1st and 8TH GRADE STUDENTS

(Bailey, 2006; Morrow, Jackson, & Payne, 1999). Other research has shown that the methodology for physical education instruction may be a critical factor in the effectiveness (Sallis et al., 1997; Weaver et al., 2017). Many intervention programs that aim to specifically increase the intensity of physical education to moderate or vigorous have shown promising results. One intervention, called Partnerships for Active Children in Elementary Schools (PACES) was analyzed by researchers at The University of South Carolina (2017) to determine its effectiveness of increasing moderate-vigorous physical activity in the school setting. This study used accelerometers to measure the amount of moderate to vigorous physical activity (MVPA) during physical education classes at baseline and then compared these measurements to the intervention. The results of the study showed an increase in the amount of MVPA time of 5.8% for boys and 3.9% for girls analyzing 41 physical education classes at baseline and post intervention (Weaver et al., 2017). Another intervention designed with similar goals is known as SPARK (Sports, Play and Active Recreation for Kids). The study used elementary schools in San Diego to compare three different groups to assess the effectiveness of the intervention. There was a condition with a specialist leading the intervention, a teacher led intervention in which the classroom teachers were trained and then implemented the SPARK program, and a control condition, in which physical education was taught by untrained classroom teachers and the SPARK program was not used. The finding of this study showed an increase in physical activity in school but no significant out-of-school changes. The researchers estimate the students in the specialist-lead condition engaged in approximately 13 more hours than the students of the control group over the span of 36-week school year (Sallis et al., 1997). The results of these studies bring to question whether physical education should be quantified by minutes or if the main focus should be on the intensity of the
physical activity during the class. Future research should be conducted to understand the importance of moderate to vigorous activity and its impact on academic achievement.

For the first grade, academic achievement was linked to poverty level, a lower poverty level contributing to higher IRT scores across all subjects (reading, mathematics and science), however for the eighth grade there was no significant relationship. This finding fits into the previous research conducted and helps corroborate the fact that poverty is a chronic stressor has impacts most areas of the individual’s life. Being raised in a low-income family puts the child at risk for lower academic and social problems and lower overall health and well-being all of which can contribute to poor performance in school (Engle & Black, 2008). Prior research has suggested the effects of poverty can begin at an extremely young age, as children born into lower SES families will be exposed to far fewer words and differences in vocabulary are apparent by 18 months (VanTassel-Baska, Stambaugh, Olszewski-Kubilius, & Corwith, 2018). The present study eliminated data from all private schools, however future research should be conducted to analyze the disparities between public and private schools academic achievement and the differences in socioeconomic status of their students’ families.

The current study also shows that a lower body mass index can result in higher IRT scores for reading and mathematics in the first grade and across all three subjects in the eighth grade. Body mass index is defined as the ratio of height and weight that is used to measure an individual’s body fat (National Heart, Lung, and Blood Institute [NIH], 2009). Sedentary behavior has been linked to a higher BMI and greater risk for obesity amongst children (Sisson et al., 2009). Physical education classes that instruct children on the importance of physical activity could play a role in lowering childhood obesity and increasing physical activity. The CDC links obesity (higher than healthy body mass indexes) to consuming unhealthy, non-nutritious food as well as lack of
physical activity (CDC, 2017). Despite the fact that our study lacked physical activity data for eighth grade, the link between lower BMI and higher IRT scores likely indicates that physical activity is associated as a factor lowering BMI. Children engaging in higher quantities of moderate to vigorous physical activity are less likely to become obese which, according to the results of the present study, will result in higher academic achievement throughout the span of grade school.

Limitations

Though the present study provides information that can be added to the collection of research on physical activity, physical education, and academic achievement, there are many limitations to the study that should be considered. The ECLS--K data was not collected for the purpose of analyzing the relationship of the current investigation. Due to the observational nature of this inquiry, the methods of measuring and reporting physical activity were not ideal for this study. The data used to describe physical activity was reported by parents, was only available for the first grade wave of data and does not provide enough information on the type, amount, or intensity of the physical activity. The amount of physical education was quantified by minutes, however, the intensity of the physical activity performed during those classes is unavailable. Additionally, the amount of time devotes to PE does not indicate the quality and structure of PE received. One observational study of third grade students participating in physical education class reported on average, the students logged about 5 minutes of vigorous physical activity and 12 minutes of moderate to vigorous physical activity a class, falling short of the recommended minutes of MVPA (Friedman et al., 2003). Other studies show that physical education classes can often lack moderate to vigorous physical activity and this could result in the lack of a significant
relationship between physical education and IRT scores. Given these limitations, the results of the present study should be generalized with caution.

Future Research Implications

The findings from the current study call for future research to be conducted. The relationship between physical education and IRT scores (mathematics) in first grade that does not remain significant into the eighth grade brings to question when physical education class is most crucial for students. Future research should be conducted to investigate if more minutes of physical education are necessary in elementary school and if the increased number of minutes recommended as students’ transition into middle school and high school is actually beneficial. There is also a need for more research on how higher intensity activity during physical education can impact academic achievement and overall physical activity in grade school. The findings of the present study indicate a relationship between BMI and IRT scores is prevalent across school year and subject. This finding prompts the future studies of factors affecting BMI in grade school students and how those factors may play a role in this relationship, specifically how increased physical activity can lower BMI, thereby increasing IRT scores. The results of the current study showed that poverty level and BMI were both influencers on academic achievement at certain points throughout grade school. According to Centers for Disease Control and Prevention (2017), the prevalence of obesity disproportionally affects children of low-income households. There appears to be a link between poverty and higher body mass indexes, as indicated by the Kruskal-Wallis test (refer to results), however, more research is needed to understand this relationship.
References


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