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Evaluation of a Social Determinant of Health: Academic Achievement Through Physical Education Policy Regarding Time

Vanessa Rodriguez, EdD, PA-C[1] and Daniel Gutmore, PhD[2]

Abstract

Physical activity can meaningfully influence educational outcomes, yet, remains insufficient among youth (World Health Organization, 2018). Youth who are not physically active are more likely to encounter chronic health issues including obesity, depression, and anxiety (Bartelink et al., 2019, Bélair et al., 2018, Krebs, 2003).School-sponsored physical education (PE) is one way for students to participate in physical activity. However, state policies allotting time for PE vary nationally. Furthermore, many schools respond to pressures of increasing student standardized test scores by replacing structured time in PE with more time in tested subjects (Center on Education Policy, 2007, 2008). This study explores national associations of PE time policies and academic achievement on standardized tests through a fixed effects panel data analysis. The change in PE policies, as measured by mandated PE time, significantly predicted mean reading and math performance. Findings enhance the limited literature on PE policy associations with academic achievement.

Keywords: Physical Education, Education Policy, Physical Activity, School Health, Academic Achievement.

1. Introduction

One way to help youth do well academically is through physical activity (PA). PA improves cognitive learning in a child's formative years, in addition to improving their physical, mental, and fiscal health. Physical education (PE) structures PA for students in schools. Originally, policies were developed to guide implementation of PE availability and quality in schools. However, although numerous studies have focused on PA as a conduit to maintaining physical emotional, financial, and social health (Cawley et al., 2013; Christiansen et al., 2018; Kosteas, 2012), limited studies have been conducted to see if PE policies are working to impact academic achievement. The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) have also advocated for PA due to the positive effects of PA on an individual's whole being (WHO, 2018; CDC, 2018) the rise in incidences of obesity, and the lack of policy and oversight for K–12 PE.

[1]Seton Hall University, Department of Physician Assistant, 123 Metro Blvd., Nutley, NJ 07110, U.S.A.
Email: vanessa.rodriguez@shu.edu
[2]Seton Hall University, Department of Education Leadership Management and Polic, 400 South Orange Ave., South Orange, NJ 07079, U.S.A. Email: gutmorda@shu.edu

Given the lack of research in this area, this study examined the association between PE policies and academic achievement. The study focused on PE policies and academic achievement in mathematics and reading results of eighth graders to capture the nature of increasing behavioral and cognitive dissonance (Wills et al., 2019), and increasing body mass index (Fryar et al., 2018) in the transition from childhood to adolescence occurring during this critical grade level. Furthermore, the study aligns with U. S. Department of Health and Human Services (HHS) objectives of increasing the proportion of eighth graders with math and reading skills at or above the proficient level (HHS, 2020). This study investigated the following questions concerning PE and academic achievement:

1. Does the change in PE policies, as measured by mandated PE time, predict current mean reading performance in U.S. states?
2. Does the change in PE policies, as measured by mandated PE time, predict current mean math performance in U.S. states?

2. Literature Review

The concept of physical fitness initially came to prominence in American culture in the early 19th century (Welch, 2004). European migration from countries such as Germany and Sweden inspired the concept of health and fitness through gymnastics. Soon after, the first school in the United States merged this fitness concept with education to offer PE. Welch (2004) explained the original intention of PE was to better prepare students physically for war. Eventually, the importance of fitness and its impact on education was expanded in the 19th century by physicians in American universities with a goal to teach people how to take care of their bodies (Park, 1987). As Americans began to move into cities, the disease rate increased, and there was a decline in health and fitness (Roetert & Pate, 2019). However, interest in sport arose with the mandate for youth to receive public education, and visionaries like John Dewey promoted educating the whole child and noted that playing games aided the child in learning; these factors helped to encourage PE in American public schools (Welch, 2004).

The influence of schools on student physical activity was highlighted through Kahan and McKenzie (2017) study of the association between school and neighborhood characteristics and student achievement on fitness tests. Due to the greater correlations between school characteristics and fitness achievement scores, the study suggested the school holds the responsibility for supporting students with the opportunity to engage in activity that can promote their health and well-being. The study revealed school variables impacted children's PA more than did neighborhood variables. School variables included incidents of crime, availability of free and reduced lunch programs, and school size. Neighborhood variables included crime within neighborhoods, walkability within the town, and neighborhood demographics.

Furthermore, schools are in a unique position to promote recommendations from governmental organizations (Kahan and McKenzie, 2017). In 2015, the U.S. Congress passed the Every Student Succeeds Act (ESSA), which identified PE as a critical component of a well-rounded education, thus allowing schools to allocate federal funds to PE. In 2017, schools began to receive federal funding for PE under the ESSA. Policy analysts referred to lack of federal oversight embedded in the policy (Adler-Greene, 2019). The ESSA leaves the development and enforcement of educational legislation to the states, and in the process, removes much of the state accountability from the federal government.

As schools are identified by the federal government as an agent to promote PA through physical education, PA can also positively impact personal finances, including as much as a 10% higher salary (Kosteas, 2012). Kosteas also found a relationship between PA and lower debt. Kosteas used a fixed effects model to control for variability such as the amount of vigorous exercise undertaken by a participant. Biddle and Asare (2011) studied mental health in correlation with PA, and the lack thereof, within a child and adolescent population. Although they found inconsistent or small positive correlations between mental health and PA, the consistent correlations between sedentary lifestyle and its negative effect on cognition demonstrated positive impact of PA. The study concluded an association between PA and improvement in psychosocial outcomes among children and adolescents.

Several studies have analyzed the association between PE in schools and academic achievement. Carlson et al. (2008) explained that PE is linked with academic benefit, and the increased time in PE does not impact the academic performance of elementary students in a negative way. Dexter (1999) concluded that academic ability is maximized when students are involved in sports during PE. Ericsson (2008) studied 251 elementary students over a three-year period to analyze effects of lengthening physical education on motor skills, attention, and cognition. His findings indicated that students who have more days per week in physical education score higher in math, reading, and writing.

Comparatively, Tremarche et al. (2007) found that students that spent more time in PE achieved higher scores on standardized tests, while Sallis et al. (1999) found within a 2-year study that doubling PE time raised reading scores. Some studies developed experimental designs to explore the association between PE and academic performance. Budde et al. (2008) conducted an experimental study including 115 teenagers between 13 and 16 years old at a high-performing school to look at the association between coordinated exercise and academic performance. He found that coordinated exercise improved academic scores. This supports the benefit PE has for students.

3. Design/Method

The research design selected for this study is non-experimental and correlational. Preexisting data from the National Assessment of Educational Progress (NAEP) and Society of Health and Physical Educators (SHAPE America) *Shape of the Nation* report were analyzed using fixed effects panel regressions (NAEP, 1998, 2002, 2007, 2011, 2013, 2017; SHAPE America, 1997, 2001, 2006, 2010, 2012, 2016). The dependent (outcome) variables were the NAEP reading and math scores, due to the study alignment with HHS objectives of increasing the proportion of eighth graders with math and reading skills at or above the proficient level (HHS, 2020). The predictor variables was mandated PE time. Calendar year was included as a control variable in this study to account for natural changes in reading and math scores from year to year that may otherwise be confounded with changes in PE policies related to time. Two data sources were analyzed to answer the research questions. The first data source was the NAEP mathematics and reading assessments. The assessments measured students' mathematics and reading knowledge and was distributed to students across the nation. The data from the following years were reviewed: 1998, 2002, 2007, 2011, 2013, and 2017. The data are publicly available through the National Center for Education Statistics. The second data source used was the *Shape of the Nation* report. This is a national study and measured school policies specific to health. The study was conducted in 1997, 2001, 2006, 2010, 2012, and 2016. The data are publicly available through the SHAPE America website.

The NAEP and *Shape of the Nation* data were compiled into an electronic spreadsheet and imported into SPSS for statistical analysis. To conduct the fixed effects panel regressions, the data were entered in long format, meaning that each case represented data from one state for one year. To account for the fact that the NAEP and *Shape of the Nation* data were not collected in the same calendar years and the fact that newly mandated PE policies need time to take effect, corresponding NAEP and *Shape of the Nation* data were offset by one year (e.g., *Shape of the Nation* data from 2016 was matched with NAEP data from 2017). Means and standard deviations were reported for continuous variables, and frequencies and percentages were reported for categorical variables.

4. Findings

Table 1 displays descriptive statistics for the study variables by year. The percentage of states with mandated PE time was highest in 2016 (n = 15, 29.4%), and the percentage of states with mandated teacher certification in PE was highest in 2010 (n = 47, 92.2%). The average reading (M = 266.30, SD = 6.00) and math (M = 283.91, SD = 7.23) performance were both highest in 2013.

A fixed effects panel regression was conducted to address the question of whether the change in PE policies, as measured by mandated PE time, predicts current mean reading performance in U.S. states. In this analysis, the dependent variable was NAEP reading score. The predictor variable was mandated PE

time; this was a binary variable coded as 0 = no and 1 = yes. The model included dummy variables for state and an interval-level variable for year. All predictors were treated as fixed effects and entered in one step. The regression model was significant, $F(52, 229) = 37.49$, $p < .001$, $R2 = .90$, Adjusted $R2 = .87$, where R2 is the effect size or percent of the dependent variable variation that could be predicted by the independent variable, indicating that the predictors collectively explained a significant proportion of variance in reading scores. Table 2 displays the results for the regression coefficients. Mandated PE time was a significant positive predictor of reading scores ($B = 1.13$, $p = .047$), indicating that states with mandated PE time tended to have higher reading scores in the following year.

A fixed effects panel regression was conducted to address the question of whether the change in PE policies, as measured by mandated PE time, predicts current mean math performance in U.S. states. In this analysis, the dependent variable was NAEP math score. The predictor variable was mandated PE time; this was a binary variable coded as 0 = no and 1 = yes. The model included dummy variables for state and an interval-level variable for year. All predictors were treated as fixed effects and entered in one step. The regression model was significant, $F(52, 150) = 33.56$, $p < .001$, $R2 = .92$, Adjusted $R2 = .89$, where R2 is the effect size or percent of the dependent variable variation that could be predicted by the independent variable, indicating that the predictors collectively explained a significant proportion of variance in math scores. Table 3 displays the results for the regression coefficients. Mandated PE time was a significant positive predictor of math scores ($B = 1.81$, $p = .017$), indicating that states with mandated PE time tended to have higher math scores in the following year.

5. Discussion

The change in PE policies, as measured by mandated PE time, significantly predicted mean reading performance. Having mandated PE time predicted an average increase in reading scores of 1.13 points. The change in PE policies, as measured by mandated PE time, significantly predicted mean math performance. Having mandated PE time predicted an average increase in math scores of 1.81 points. The regression models were also significant, where R2 is the effect size or percent of the dependent variable variation that could be predicted by the independent variable, indicating that the predictors collectively explained a significant proportion of variance in math and reading scores.

Research has suggested that policy enforcement leads to adherence to policies, as seen in the case of PE policy (Kahan & McKenzie, 2017). This study does not generally conclude that PE policies implicate increased academic scores. However, Carlson et al. (2008) and Tremarche et al. (2007) explained that more time in PE leads to higher academic achievement, which is reinforced in this study. While looking at PE policies, only one policy is statistically significant: mandated PE time in minutes per week. This result implies that PE policy leads to increased academic scores—specifically, the PE policy that is shown to correlate with increased academic scores is PE time in minutes.

Like previous studies, this study has shown that mandating PE time suggests higher reading scores (Ericsson, 2008; Sallis et al. 1999). Ericsson's 2008 findings indicated that students who have more days per week in PE score higher in reading, in addition to math. Similarly, Sallis et al. (1999) found within a 2-year study that doubling PE time raised reading scores. These findings parallel the outcome of this study, where results suggest that states with mandated PE time in minutes per week tend to have higher reading scores in the following year ($B = 1.13$, $p = .047$).

Previous research also has supported a link between PE time and higher math scores (Ericsson, 2008). Findings from Ericsson (2008) indicated that students who have more days per week in PE score higher in math. This finding parallels the outcome of this study, where results suggest that states with mandated PE time in minutes per week tend to have higher math scores in the following year ($B = 1.81$, $p = .017$); this study's results reveal that math scores the year following implementation of mandated PE time in minutes per week show a stronger positive effect than do reading scores. As scores are assessed over several years, these parallels show that scores in both math and reading increase from one year to the next, and these increases are attributed to PE policy, specifically in minutes per week.

There were some limitations to this research, including the inability to determine causation and the use of standardized tests as a measurement. The outcomes in this study cannot conclude an association between PE teacher certification and academic scores, and there may be reasons for this. Although not validated in this study, it is possible PE teachers have varied years of experience, and those with more years provide better quality of PE, which may improve academic scores. Also possible is that teachers may have differing levels of degrees, bachelor's or master's degrees, and that may influence academic scores.

Further investigation into this topic is warranted given the limitations and results of this study. This study suggests that PE policy, specifically mandated time in minutes, is associated with academic achievement. Federal guidelines continue to urge increasing time for PE due to health benefit impacts for students. Further research may consider investigating why states choose not to mandate PE. Results could offer insight into barriers states face in mandating time for PE and may introduce opportunities to resolve them. To further understand how student involvement in physical education implicates academic achievement, school and district administrators should investigate underlying characteristics of PE classes: determining the exact length of classes, the types of activity students are engaged in during PE, and the intensity of physical activity students participate in. At the policy level, Kearns (2022) suggests a review and adjustment of the language to include minutes for all physical activity in addition to minutes for physical education. Specifically, further research may be helpful in identifying how schools determine the integration of physical activity during physical education, unstructured during other times in the day (i.e. free play), and how it is scheduled as traditional class periods or block schedules. These factors can be comparatively evaluated alongside student achievement and offer more support for causation between the variables. This may guide school leaders to determine how much time in physical education they should allocate for students.

Furthermore, this study included national longitudinal data starting in 1997 and ending in 2017, prior to the COVID-19 pandemic. Due to government restrictions imposed on schools to ensure health and safety during the pandemic, schools cut down or eliminated in-person instruction time in PE, among other courses. Future studies may evaluate implementation of PE policies at the school level since the start of the pandemic and associations with student academic achievement.

6. Conclusion

Overall, findings in this study are not conclusive, although results offer insight into PE policies across states over several years. Findings enhance the limited literature on PE time mandates and their association with academic achievement, and this study suggests that mandating PE time in minutes per week is associated with increased reading and math scores.

Tables

Table 1

Descriptive Statistics for Study Variables by Year

	Mandated Time		Mandated Teacher Certification		Reading Score	Math Score
Year	Yes %	No %	Yes %	No %	*M* (*SD*)	*M* (*SD*)
1997-1998	17.6	82.4	56.9	43.1	260.44 (7.14)	*
2001-2002	13.7	86.3	68.6	31.4	262.55 (6.87)	*
2006-2007	0.0	100.0	84.3	15.7	262.08 (6.89)	280.62 (8.71)
2010-2011	23.5	76.5	92.2	7.8	264.67 (6.48)	283.49 (7.60)

2012-2013	25.5	74.5	82.4	17.6	266.30 (6.00)	283.91 (7.23)
2016-2017	29.4	70.6	84.3	15.7	265.41 (5.77)	281.88 (7.11)

Note. *Math scores were not available for these years.

Table 2

Coefficients for Regression Predicting Reading Score (Research Question 1)

						95% CI	
Variable	*B*	Std. Error	Beta	*t*	Sig.	Lower	Upper
(Constant)	-140.86	49.34		-2.86	.005	-238.08	-43.64
Mandated Time	1.13	0.56	0.07	1.99	.047	0.01	2.24
Year	0.20	0.03	0.18	8.12	<.001	0.15	0.25

Note. Coefficients for state dummy-coded variables are not displayed for concision.

Table 3

Coefficients for Regression Predicting Math Score (Research Question 2)

						95% CI	
Variable	*B*	Std. Error	Beta	*T*	Sig.	Lower	Upper
(Constant)	181.02	103.92		1.74	.084	-24.31	386.35
Mandated Time	1.81	0.75	0.10	2.42	.017	0.33	3.30
Year	0.05	0.05	0.02	0.96	.337	-0.05	0.15

Note. Coefficients for state dummy-coded variables are not displayed for concision.

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