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The Relationship Between BMI and Mandated Physical Education Requirements of Elementary

Schools

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**Abstract**

The physical activity policies of elementary schools in Arkansas and correlations between physical activity requirements and body mass index have been studied. Examination of the policies at the individual school, district, or state level were noted. The statewide BMI database was consulted. Interviews with physical education teachers was conducted to assess policy implementation. Results may provide schools and policy makers with insight on future physical activity policies.

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### Review of Literature

The World Health Organization defines obesity as “an abnormal or excessive fat accumulation that may impair health” (WHO, 2017). Obesity has become a major health issue in the United States (U.S.), affecting more than one third of U.S. adults (CDC, 2016). Seventeen percent of all children and adolescents in the United States are classified as obese (Fernandes & Sturm, 2011; August et al., 2008). The percentage of children who are considered obese has tripled since the 1970s (CDC, 2017). According to *The State of Obesity: Better Policies for a Healthier America* (2016), 14.2% of children between 0-2 years of age are obese and 20.0% are obese between the ages of 10-17 years old. In Arkansas, childhood obesity rates are at 21.7%, which is three percentage points greater than the national average.

Body Mass Index (BMI) was used as a standard with the measurement of weight divided by height<sup>2</sup>; which is then graphed by age and sex, 95<sup>th</sup> percentile or above for age and sex is the accepted boundary for obesity (CDC, 2016; August et al., 2008).

Co-morbidities of obesity that can have both short term and long term implications include cardiovascular disease, hypertension, hyperlipidemia, type II diabetes, sleep apnea, & bone/joint problems (Kamik & Kanekar, 2012; CDC, 2017). These chronic illnesses, once only seen in adults are now being diagnosed in children (Davis et al., 2012). There may be adverse changes in vascular structure and function leading to increased arterial stiffness as well as endothelial dysfunction with early atherosclerosis in both the coronary arteries and aorta as early as thirteen (Kelly et. al., 2013). Nonalcoholic fatty liver disease due to visceral adiposity and insulin resistance, if severe enough predisposes to cirrhosis and the need of a liver transplant (Kelly et. al., 2013). Elizabeth Pulgarón (2013) analyzed three comorbidities of childhood obesity in depth. The first was asthma. She suggests that children who have asthma avoid physical activity to reduce the possibility of experiencing respiratory distress but less energy expenditure leads to a higher likelihood of gaining weight. She also posits a link between attention-deficit-hyperactivity disorder (ADHD) at around 6-7% with nearly half of children with ADHD being overweight or obese (Ibrahim, T. et al, 2016).

The CDC notes that children who are obese are at higher risk to be bullied and teased than their peers of normal weight and thus more likely to suffer from social isolation, depression, and lower self-esteem (CDC, 2017). It is believed that stress, anxiety and depression are factors in pediatric obesity (Pervanidou & Chrousos, 2016; Wilson & Satao, 2013). Stress creates a domino effect in patients who are already obese correlated with the release of cortisol which stimulates appetite and increases body weight (Pervanidou & Chrousos, 2016). It influences the food choices a youth makes leading them to emotionally eat as well as choose foods that are highly palatable, energy dense, and high in fat and sugar providing a relief to stress but cause weight gain (Wilson & Satao, 2013). It is unfortunate to see but these children who are obese are in a vicious cycle between distress, overeating, impaired self-image, and thus maintaining and worsening distress (Pervanidou & Chrousos, 2011). Looking at this mental/physiological aspect of stress leads us to see that there is a lot of different dimensions to battling the high prevalence of obesity in children.

Research has shown that physical activity reduces metabolic risks and is an ideal intervention for children that can easily be implemented in schools (Carlson et al., 2013; Cawley, Frisvold, & Meyerhoefer, 2013; Davis et al., 2012, & Fernandes & Sturn, 2011). Physical activity has been shown to improve bone mineral density, increases school performance, and have a positive effect on mental health (Pradinuk, Chanoine, & Goldman, 2011). Physical activity has been proven to lower emotional stress related to real-life stress (von Harren et al., 2015). Children who had high overall daytime physical activity showed no or only minimal increases in salivary cortisol levels while those with little physical activity has increased cortisol levels after stress (Martikainen et al., 2013).

Children typically spend over half of their time in school making it an appropriate setting for physical activity (Carlson et al., 2013 & Kriemler et al., 2011). Research has suggested that since schools are where children spend a large percentage of their time that the school can be a supportive environment to help students develop positive habits that are needed to live a healthy and active lifestyle (Pradinuk, Chanoine, & Goldman, 2011).

Organizations such as the National Association for Sport and Physical Education (NASPE) recommend 150 minutes of physical activity per week, broken down into Physical Education class for at least 30 minutes each day (Carlson et al., 2013, Davis et al., 2012). Cawley et al. (2013) noted schools who increased their P.E. time to follow the national recommendations of 150 minutes/week saw a decrease in BMI scores. Fernandes & Stern (2011) further suggest physical activity to include at least 20 minutes a day of unstructured activity that occurs during recess. Recess is seen as just as important for the well-being of an elementary student. It gives the child unstructured activity time as well as the opportunity to be active in a mode of their choosing. They have the ability and free time to practice movement and motor skills (American Academy of Pediatrics, 2013). Structured and unstructured activity found in P.E. and recess are both important interventions associated with a healthy body weight.

Unfortunately, the NASPE recommendation of 150 minutes per week of physical activity is not consistently being implemented. Schools either do not implement the recommended amount of time or completely dismiss physical education (PE) all together (Carlson et al., 2013 & Cawley, Frisvold, & Meyerhoefer, 2013 & Slater et al., 2012). While sixteen states have policies regarding physical activity requirements, only three states have policies mandating the recommended requirement of 150 minutes of physical activity (Carlson et al., 2013). Policies may be developed at the local, district, or state level and mandate not only the amount of PE, but may also mandate specific requirements for time children spend being physically active. Vague or “weak” wording in the actual policy may lead to less accountability by the schools and therefore create an environment with no urgency for change (Carlson et al., 2013).

Accountability of the individual schools may be increased when policies are developed at the local level (Kim, 2012). Slater et al (2012) found that schools have increased accountability when the policy is created at the state or district level. Arkansas is one of the few states that do have policies in place for physical activity. The previous requirement of 60 minutes of physical education a week is significantly less than the recommendations of 150 minutes (Carlson et al., 2013). Recently the amount of time in P.E. each week has decreased to a recommendation of 40 minutes a week with a total of 90 minutes of physical activity each calendar week (Arkansas Department of Education, 2016). It is also

interesting to note when looking further at the Arkansas Department of Education webpage that this physical activity does not necessarily have to be implemented in P.E. but may be incorporated into other subject areas (Arkansas Department of Education, 2014). Ultimately based on the Arkansas department of Education rules that govern nutrition and physical activity that were implemented in May 2016, it is the school district's decision as to whether there is a need for an excess amount of physical education in their district (Arkansas Department of Education, 2016).

Research has shown thus far, that obesity is a prevalent problem in the United States, and the school setting is the ideal place to implement interventions. With Arkansas having an obesity prevalence higher than the national average and a state policy that does not meet national standards, there is a need for physical activity interventions to be assessed. In the literature, interviewing of teachers was completed asking about the frequency and length of physical activity (Fernandes & Sturn, 2011). Specifically, P.E. teachers are the most reliable source to assess if physical activity requirements are being met. If physical activity is occurring in the P.E. class, then that is where researchers need to focus time discovering the relationship of the children's BMI to physical education. There is a need to discover if the schools are monitoring the physical education requirements and upholding them. Fortunately, Arkansas screens all children in the public-school system in Kindergarten, second grade, fourth grade, sixth grade, eighth grade, and tenth grade for BMI which is also posted for public viewing on the Internet. Using both of these resources there is a potential to dig into the vastness of obesity and the impact of physical education.

### **Aims**

The first aim of this study is to explore physical activity policies of 210 elementary schools in the state of Arkansas. The second aim of this study is to explore the correlation between the amount of physical activity received in structured and unstructured activities and the BMI of students.

*Research Question 1: Do most schools in Arkansas follow the state policy mandating physical activity of a minimum of 60 minutes/week or do they follow policies mandating over 60 minutes established at the district or individual school?*



*Research Question 2: Is there a correlation between the amount of physical activity children receive in the school setting to BMI scores?*

### **Methodology**

Approval from the University of Arkansas Institutional Review Board was obtained. Policy requirements for physical education at the state and district level were sought out. Data was found for 210 schools in the state of Arkansas with random selection for phone interviews, with 40 phone responses and 4 in person responses. Each school's physical education teacher was interviewed to obtain the amount of time students spend in PE as well as at recess. Demographics of each elementary school were obtained by the yearly report sent into the state. BMI averages for each school were obtained from the yearly BMI report card. Correlation analysis was done for second and fourth grade boys and girls between the amount of physical activity completed and the BMI averages. A Spearman rank correlation test was performed to determine characteristics of PE and recess and the BMIs of the schools.

### **Implications**

This research is significant not only to the field of nursing, but as well to the field of elementary education. As the obesity levels in elementary aged children continue to be on the rise, the potential for more problems in health is bound to occur. More questions arose from this study that would require further research to be done to thoroughly grasp other components that may affect childhood obesity. This research clearly shows both the education and healthcare field have a need for interventions with increased amount of physical activity in the physical education classes each week.

### **Statistical Analysis**

Four Spearman-Rank correlations were run, one for each grade level, gender combination. This includes 2<sup>nd</sup> grade male/female and 4<sup>th</sup> grade male/female. The alpha level used for each test was based on

the selection of an overall alpha level of 0.05, divided by the number of tests conducted in order to give an accurate Type-1 error rate against which to determine statistical significance. Thus, each correlation was tested using an alpha of 0.0125. A Spearman-Rank correlation was used instead of a Pearson correlation to avoid overestimating or even underestimating the strength of each association.

## **Results**

A total of 41 physical education teachers responded to phone calls and 4 physical education teachers responded to in person interviews. Of the 41 phone interviews, only 29 had the appropriate BMI information accessible and thus could be a part of the research. The hours of physical activity were obtained through the phone interview with the P.E. teacher at each individual school. The P.E. teacher was asked how many minutes total the student comes to P.E. each week and out of that time how many minutes are they physically active. An additional question was how many minutes a day do the students go to recess. To condense the data for statistical analysis the minutes of being physically active in P.E. each week plus the minutes of recess each week were combined

### **Second Grade**

Two Spearman-Rank correlations were run for second graders, one for each gender. The results are provided in Table 1 below, including confidence intervals for each correlation. A similar percent of males and females have BMI scores placing them in the overweight/obese category at 33.1% females & 34.5% for males. On average, approximately one-third of male and female second graders are overweight/obese. The average number of minutes of overall weekly exercise in hours is the same for all students, as it is the mean across all schools represented in the study. Thus, on average students exercise approximately 3 hours per week.

For both male and female second graders, there is a moderate negative correlation between the amount of exercise and the percent of students who are overweight/obese, but neither are statistically significant.

### **Fourth Grade**

Two Spearman-Rank correlations were run for fourth graders, one for each gender. The results are provided in Table 1 below, including the confidence intervals for each correlation. A similar percent of males and females have BMI scores placing them in the overweight/obese category at 41.9% for females and 38.1% for males. The average number of minutes of overall weekly exercise is the same for all students, as it is the mean across all schools represented in this study. Thus, on average the students exercise approximately 3 hours/week.

For both male and female fourth graders, there is a near zero correlation between amount of exercise and the percent of students who are overweight/obese led to neither relationship being statistically significant. Our p value is almost 1 which indicates weak evidence against the null hypothesis. However, from second grade to fourth grade the mean percent of students who are obese/overweight has increased 8.8% in females & 3.6% in males.

### **Discussion**

There was a total of 29 schools involved in the final statistical analysis of this research. Based on the results of this research there is no sound way to support or disprove the correlation between physical education and the BMI of students. The 95% confidence interval used led to each correlation including 0 which means that there can no full confidence that the information is statistically meaningful. There are a few components to look at when explaining the results of the research.

### **Hours of Physical Activity**

Each school had around the same amount of time in physical education and recess each week. This is an unexpected result as it was expected for there to be variation depending on where people lived in the state of Arkansas. However, this shows that there is consistency between districts and schools throughout the state on what their requirements are for amount of time in physical activity. Like mentioned in the aims

the required time by the state of Arkansas is 60 minutes of P.E. each week. When we look at the values of how many minutes' children are in P.E. the mean is 50 minutes which is below the required time states by the state of Arkansas. We then have to put into play that the majority of students are not physically active for the whole duration of class so the amount drops below this mean of 50 minutes. The average minutes of recess each week is 144 minutes which does increase the hours of physical activity each week. Subjective information found while conducting phone interviews was that the majority of the P.E. teachers didn't know if their students time in P.E. was a school, district, or state requirement and they didn't know how many minutes were recommended by the state for students to be in P.E. class.

## **BMI**

The percent of students who are overweight/obese is lower than expected. However, there is something interesting to note when looking just at the difference in means between the two age groups. Like mentioned in the results sections above there is an 8.8% increase in female BMI scores between second and fourth grade. There was also a 3.6% increase in males between the two grade levels. This is a significant BMI increase considering there is no change in the hours of physical activity between the two. This would require some additional research as to see what other factors are being put into play to cause such a distinct increase in BMI percentages. Some thoughts that would need further investigation would include that in fourth grade males and females begin to start puberty which leads to changes in hormones and body structure. Another thought is that as a student gets older they spend less time playing and more time simply socializing and using technological devices. This could be seen in the school setting but also more so during the student's time at home after school. Overall this would be something that would want to be looked further into.

### **Limitations**

There were quite a few limitations that occurred during the process of obtaining the research for this particular project. The original goal was to contact 210 P.E. teachers throughout the state of Arkansas giving us a variability in sizes of schools. Upon beginning the research, it was soon discovered that getting ahold of physical education teachers is difficult due to a short time frame each day that they are available to reach the phone. Voicemails often had to be left for teachers and calls were not returned. Due to the confined time frame of my research and the difficulty of receiving information from P.E. teachers I was only able to have phone interviews with 41 P.E. teachers. Going on to looking at the publicly available BMI data only 30 out of the 41 schools had data available for both genders and both 2<sup>nd</sup> grade and 4<sup>th</sup> grade.

The data for physical activity obtained through interviews were only available at the school/grade level, which allowed for only one measurement of physical activity for all children from grades K-4, no matter the student's gender or age. On top of that the BMI percentages are mean averages for the whole grade/gender and thus we don't have individual BMI scores for each student. In turn, the statistical tests conducted are based upon an approximation for male and female students in grades 2 and 4 and an average of their overall weekly physical activity. It is safe to say that if we had the data readily available for each individual student BMI and minutes of physical activity it would have allowed us to have more robust statistical tests, the assumption of normality to be met for both variables of interest, and potentially the ability to generalize the results beyond the sample collected.

Additionally, there are many factors not accounted for in this study. First, BMI values for second and fourth graders at each school are not known necessarily at the beginning of the school year. Thus, we cannot safely conclude that exercise requirements enforced by the school alone do or do not have an impact on student's BMI scores. There may be external factors that play a part in this measurement. Second, additional physical activity such as sports & playing at home is not quantified and thus is not

accounted for in this study. The amount, type, and frequency of physical activity that takes place outside of the school setting most likely has a bit of impact on the child's BMI. Estimating physical activity habits of the individual students at each school would provide additional information for future research, allowing for a broader definition of being "active" and potentially providing insight into where the bulk of physical activity is taking place whether it is at school, or somewhere outside of the gym and playground.

### **Conclusion**

Pediatric obesity is a very prevalent occurrence in America today that is leading to co-morbidities that have not been seen in children till the past few decades. There is a desperate need for there to be a greater understanding of what components of American society causes obesity. With children being in school for the majority of their time during the school week, it is where intervention and management of children's weight should and most accessibly can occur. Throughout this research the aim was to see whether schools in Arkansas followed the recommended time by the state or if they did less or more than the recommendation. On top of that we wanted to see if there is a relationship between the amount of physical activity during school and a student's BMI. Based on the results it seems that with the first aim we saw that a lot of schools didn't meet the recommended time for physical education, but they did have a large amount of time blocked off for recess. Looking at the second aim we cannot confidently say whether there is a correlation or not between the two factors. Though there weren't significant findings during this research, this research is leading us one step closer to uncovering more about pediatric obesity. There is hope that this research can lead to change in the school physical education school system as well as for the school system to use this research to see the necessity to implement into the student's habits that they take with them into their homes.

Table 1 Descriptive statistics and correlations of average BMI with average hours of physical activity for second graders and fourth graders by gender.

	Number of Schools	Percent of Students Overweight/Obese		Hours of Physical Act.		Spearman Corr.	95% CI	p-value
		Mean	Std. Dev.	Mean	Std.Dev.			
Grade 2								
Female	29	33.1	8.2	3.1	0.96	-0.24	-0.56 - 0.14	0.21
Male	29	34.5	8.5	3.1	0.96	-0.22	-0.54 - 0.16	0.26
Grade 4								
Female	28	41.9	9.0	3.1	0.96	0.06	-0.32 - 0.42	0.77
Male	29	38.1	8.8	3.1	0.96	-0.07	-0.42 - 0.31	0.74

Table 2 Mean values for total physical education time and total time in recess each week.

Mean Total Physical Education/ Week	Mean Total Amount of Recess/Week
50 minutes	144 minutes

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