THE IMPACT OF PHYSICAL EDUCATION ON CHILDHOOD OBESITY: A TRADEOFF BETWEEN HEALTH AND ACADEMICS?

A Thesis
submitted to the Faculty of the
Graduate School of Arts and Sciences
of Georgetown University
in partial fulfillment of the requirements for the
degree of
Master of Public Policy

By

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Washington, DC
April 16, 2007

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ABSTRACT

The purpose of this paper is to examine the relationship between physical education in schools and childhood obesity. Children spend a significant amount of their lives at school. Outside of the home, there is no other environment to which they have as much exposure. As a result, physical education in schools has the potential to have a strong impact on children's physical fitness and well-being. This paper uses nationally representative, longitudinal data to test the link between physical education and children's body mass index (BMI). As the focus of education in the United States moves in the direction of standards based reform, the importance of physically active time during the school day may be overlooked. Results from this study indicate that greater frequency of physical education classes reduces the risk of obesity in children 6 to 11 years of age.

Acknowledgements

I would like to warmly thank my thesis advisor, Donna Morrison for her all of her guidance during this process, her patience made all the difference.

I would also like to thank Kerry Pace whose efforts ensured that I came to, and remained at Georgetown to complete my education.

Finally I would like to thank my parents, for insisting that I play outside, and my brother, for coming with me.

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Chapter 1. Introduction

The purpose of this paper is to examine the relationship between physical education in schools and childhood obesity. As the focus of education in the United States moves in the direction of standards based reform, the importance of physically active time during the school day may be overlooked. With limited resources available to school districts, physical education classes, like other non-academic subjects, may among the first to go when a school experiences budget shortages. Given the problem the United States is facing with obesity, if physical education classes do have an impact on children's health, it is important that researchers, educators and policymakers understand and appreciate this impact.

Children spend a significant amount of their lives at school, outside of the home there is no other environment that they are more exposed to. As a result, physical education in schools may have the potential to have a strong impact on children's physical fitness and well-being. This paper uses nationally representative, longitudinal data from the National Center for Education Statistics to test the link between physical education and children's body mass index (BMI).

Chapter Two will provide an overview of relevant literature concerning the rise of childhood obesity in the United States, physical education activities and America's

schools, and previous research considering the link between childhood obesity and physical education in the school environment. Chapter Three explains the data and methods I will use in my analysis, discussing my data source, limitations of my analysis, and the variables used. Chapter Three also includes a conceptual model illustrating the predicted relationships between my explanatory variables and childhood obesity. Finally the chapter outlines the statistical analysis undertaken in this study and explains the theory behind my choice of models. Chapter Four explains the results of the analysis and includes tables illustrating these results. In conclusion, Chapter Five discusses the policy implications of these results.

Chapter 2. Literature Review

I. OBESITY IN CHILDREN

According to the 1999-2000 National Health and Nutrition Examination Survey (NHAHES), fifteen percent of children and youth in the United States are overweight or obese -- a figure that is three times what it was in the 1960s.[1] Hedley et al (2004) updated the United States prevalence estimates of overweight in children using the most recent national height and weight data.[2] Overweight was defined as BMI above the ninety-fifth percentile of the sex-specific body mass index by age. There were no significant changes in the prevalence of overweight between 1999-2000 and 2001-2002 (15 percent versus 16.5 percent). Among children ages six to nineteen in 1999-2002, thirty-one percent were at risk for being overweight of overweight, and sixteen percent were overweight.[3] There is every indication that childhood obesity is increasing.[4]

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[1] Allison A. Hedley, et al., "Prevalence of Overweight and Obesity Among US Children, Adolescents, and Adults, 1999-2002." *JAMA* 291 (2004): 2847-2850. This study utilized data from the National Health and Nutrition Examination Survey. More information regarding the NHAHES, including methodology, datasets and results, are available from the Center for Disease Control's website, at http://www.cdc.gov/nchs/nhanes.htm.

[2] *Id.*

[3] *Id*.

[4] *Id*. *See also* Carol Torgan, "Child Obesity on the Rise," *The NIH Word on Health* June, 2002, http://www.nih.gov/news/WordonHealth/jun2002/childhoodobesity.htm; American Obesity Association, "AOA Fact Sheets: Obesity in Youth," American Association of Obesity, http://www.obesity.org/subs/fastfacts/obesity_youth.shtml.

As noted by a 2006 policy statement issued by the Council on Sports Medicine and Fitness and the Council on School Health, the growing proportions of overweight children has severe implications.[5] Co-morbidities associated with obesity in children include but are not limited to: insulin resistance, type 2 diabetes, hypertension, obstructive sleep apnea, poor self-esteem and a lower health-related quality of life.[6] Additionally, up to eighty percent of obese children will continue to be obese into adulthood, and will therefore face higher rates of hypertension, dyslipidemia, and insulin resistance, all of which are risk factors for coronary artery disease, which is the leading cause of death in North America.[7]

In a recent study, Kimbro et al. confirmed that obesity can begin to develop at a very early age.[8] Estimating racial and ethnic differentials in children's overweight and obesity status in three year olds from low-income, urban families, Kimbro and her colleagues utilized observation and interviews. Data was collected at birth, one year and three years. They defined overweight as weighing more than eighty-five percent of those in their age group (as measured against the growth charts developed by the

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[5] Council on Sports Medicine and Fitness and Council on School Health, "Policy Statement, Active Healthy Living: Prevention of Childhood Obesity Through Increased Physical Activity**,"** *Pediatrics* 117 (May 2006): 1834-1842.

[6] *Id.; See also* American Obesity Association, *supra* at note 4.

[7] *Id*.

[8] Rachel T. Kimbro, Jeanne Brooks-Gunn, and Sara McLanahan, "Racial and Ethnic Differentials in Children's Overweight and Obesity Among Three-Year-Olds," *American Journal of Public Health* 97 (2007): 298-305.

federal government), and obese as weighing more than ninety-five percent of those in their age group.[9] Using logistic regression analyses they found that thirty-five percent of the study children were overweight or obese. The researches found racial and ethnic disparities, but also found that birth weight, mother's weight status and "taking a bottle to bed" were important predictors of three year olds' overweight or obesity status.[10]

II. PHYSICAL EDUCATION AND HEALTH IN SCHOOLS

Since 1987, the National Association for Sport and Physical Education (NASPE) and the American Heart Association (AHA) have been conducting the *Shape of the Nation Report* to provide current information about the status of physical education in the United States. The 2006 reports that only 23 percent of students attended a daily physical education class in 2003, a decrease from 42 percent in 1991.[11] The report also found that despite the growing obesity problem, most states are not living up to the recommendations and calls to action from the federal government and other organizations regarding physical education. Although most states mandate physical education, most do not require a specific amount of instructional time and

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[9] *Id*. These cut-offs are consistent with other literature.

[10] *Id*. The research showed that Hispanic children were more likely than black or white children to be classified as overweight or obese.

[11] National Association for Sport and Physical Education & American Heart Association, *Shape of the Nation Report: Status of Physical Education in the USA*, (Reston,

about half allow exemptions, waivers, and substitutions.[12] Another factor affecting such mandates is local control of education. Some states establish standards or guidelines and leave specific decisions regarding time, class size, and student assessment to local districts or individual schools. As a result there are very different patterns of delivery for physical education within states. Currently only three states, Arkansas, California and Illinois require schools to measure body mass index for each student.[13]

The NASPE and AHA report also addresses parental support for increased physical education and makes two national recommendations for physical education in schools. In terms of public support, the report presents statistics showing that ninety-five percent of parents believe physical education should be part of the school curriculum at all levels, eighty-five percent of parents believe that education should take place daily (along with eighty-one percent of teachers), and three quarters of parents and teachers think physical education should be maintained in the face of standards based reform or other budgetary concerns.[14] The authors recommend that children should have sixty minutes of physical activity daily and that elementary

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Virgnia: National Association for Sport and Physical Education, 2006), http://www.aahperd.org/naspe/ShapeOfTheNation/PDF/ShapeOfTheNation.pdf.

[12] *Id.*

[13] *Id*.

[14] *Id.*

school children should be engaged in at least 150 minutes of physical education classes each week.[15]

Parsard and Lewis (2006), examined both opportunities for physical activity in schools as well as the existence of routine physical assessments of children at school.[16] Their conclusions were similar to those expressed in the NASPE & AHA report. The research utilized the Foods and Physical Activity in Public Elementary Schools Fast Response Survey System questionnaire.[17] Parsard and Lewis found that almost all public elementary schools required physical education for all elementary grades, though the percentage of schools that provided physical education daily ranged from 17 to 22 percent.[18] The average number of minutes of physical education classes ranged from 85.4 minutes for first graders to 98.0 minutes for sixth graders.[19] Twenty-nine percent of public elementary schools reported that they do not measure students' weight, and of those schools that do track weight information, 39 percent share that

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[15] *Id.* The report also recommends increasing physical education time to 225 minutes for middle and high school aged children.

[16] Basmat Parsad and Laurie Lewis, "Calories In, Calories Out: Food and Exercise in Public Elementary Schools, 2005 (NCES 2006-057)," U.S. Department of Education. (Washington, DC: National Center for Education Statistics, 2006), http://nces.ed.gov/pubs2006/2006057.pdf.

[17] For more information about the Foods and Physical Activity in Public Elementary Schools data, or to download the public use data and documentation, *see* National Center for Education Statistics, Public-Use Data Files and Documentation: Foods and Physical Activity in Public Elementary Schools, 2005, *available at* http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2006106.

[18] Parsard and Lewis, *supra* note 16 at vi.

[19] *Id*.

information with the children's parents.[20] Sixty-six percent of schools reported that they never calculate student body mass index, but of the schools that do, forty-nine percent share this information with the children's parents.[21]

III. OBESITY AND PHYSICAL EDUCATION IN SCHOOLS

Although there is extensive literature documenting the rise of obesity in the United States, little research has focused on the link between childhood obesity and physical education.

In a notable exception, Datar and Sturm (2004) examined the effect of physical education instruction time on body mass index change in elementary school. Using data from the first two years of the Early Childhood Longitudinal Study, Datar and Sturm used a difference in difference approach to examine an increase in physical education instruction time between kindergarten and first grade on the difference in body mass index change.[22] They found that for girls who were overweight or at risk of being overweight in kindergarten an additional hour of physical education reduces

[20] *Id*. at vii.

[21] *Id*.

[22] Ashlesha Datar and Roland Sturm, "Physical education in elementary school and body mass index: evidence from the Early Childhood Longitudinal Study," *American Journal of Public Health* 94 (2004): 1501-1506. Detailed information concerning the Early Childhood Longitudinal Study will be provided in Chapter Three.

body mass index.[23] Their conclusion was that expanding physical education classes could be an effective intervention for fighting obesity in early childhood.[24] Their results were limited to girls, and a comparison between kindergarten and first grade. The present analysis expands on their research by using data from the same study, but containing information from kindergarten through the fifth grade.

Cawley et al. (2005) looked at state physical education requirements as quasi-natural experiments to estimate the causal effect of physical education on weight in children.[25] The research merged nationwide data from the Youth Risk Behavior Surveillance System for 1999, 2001, and 2003 with data on state minimum physical education requirements from the 1994 and 2000.[26] The findings demonstrated that while raising physical education requirements may make students more active, this increase in physically active time has no statistically significant impact on the probability that a child is overweight.[27]

Levin et al. (1999) investigated associations of overweight and underweight with physical activity among high school student and found associations to exist for

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[23] *Id*.
[24] *Id*.
[25] John Cawley, Chad D. Meyerhoefer, and David Newhouse, "The Impact of State Physical Education Requirements on Youth Physical Activity and Overweight," *NBER Working Paper* No. W11411 (June 2005).
[26] *Id*.
[27] *Id*.

both genders.[28] Using a nationally representative sample of 13,295 students from the 1999 Youth Risk Behavior Survey, Levin and her colleagues looked at five measure of physical activity: vigorous-intensity activity, moderate intensity activity, strength training, enrollment in physical education, and sports participation.[29] Logistic regression showed that boys who were overweight were less likely to be active than boys of normal weight, and girls who were overweight were less likely to be involved in sports than girls of normal weight.[30] The study concluded that interventions to increase physical activity should target all both sexes, and that the most effective policies might be requiring physical education or sports. [31]

Story (1999) reviewed research concerning school-based interventions designed to prevent and treat obesity. He identified eleven controlled experimental studies conducted between 1965 and 1999.[32] Overall, the results showed modest but positive short term results. From these experiments, Story developed a comprehensive model for school-based obesity prevention consisting of eight components: health instruction, health services, school environment, food service, school-site health promotion for

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[28] Sarah Levin, Richard Lowry, David R. Brown, William H. Dietz, "Physical Activity and Body Mass Index Among US Adolescents, Youth Risk Behavior Survey, 1999," *Archives of Pediatric & Adolescent Medicine* 157 (2003): 816-820.

[29] *Id*.

[30] *Id*.

[31] *Id*.

[32] M. Story, "School-based Approaches for Preventing and Treating Obesity," International Journal of Obesity, 23, Supplement 2 (1999): s43-s51.

faculty and staff, social support services, physical education classes, and integrated and linked family and community health promotion efforts.[33] Story concluded that although a multi-pronged approach is needed to combat obesity, schools are in a "unique position to play a pivotal role in promoting healthy lifestyles and helping to prevent obesity" in children.[34] This is the fundamental premise of the present study.

IV. CONCEPTUAL MODEL

The conceptual model guiding this study is presented in Figure 1. BMI is chosen as the measure of outcome, obesity, because it is a reliable and inexpensive alternative to a direct measure of body fat. [35] As shown. The prevalence of obesity at the school level is assumed to be a function of a number of distinct and inter-related factors. At the most fundamental level, the risk of obesity for any child is a function of their health status and genetic disposition. Thus, the first set of controls that must be taken into account are child-level characteristics. The characteristics in this model include gender and race, as well as a control of the child's BMI in kindergarten. Children's kindergarten BMI is especially useful as a control because it captures

[33] *Id*.

[34] *Id*. at s50; *see also* Council on Sports Medicine and Fitness and Council on School Health, *supra* note 5, stressing the criticalness of physical activity in the school setting.

[35] Division of Nutrition and Physical Activity, National Center for Chronic Disease

genetic factors and provides a baseline of the child's physical development before schools have had a change to have an impact on children's nutrition and physical activity levels. Additionally it is predicted that a child's health and insurance status will have an impact. Next, we need to account for parent-level factors, both in terms of genetic predisposition for weight-related problems as well as the dietary and nutritional practices and level of activity that parents encourage within their homes. Evidence shows that each of these is highly correlated with traditional measures of socioeconomic status, so the model includes controls for socioeconomic status, parental health and family composition. Other relevant family controls are whether the family receives food stamps and whether the family engages in physical activity together. These controls account for nutritional and lifestyle factors that have a direct impact on the risk of obesity. Because these variables attempt to capture genetic and family level factors, they are measured at the kindergarten level, when the school setting has not yet had a significant impact on the children.

It is also predicted that neighborhood and school characteristics will have an impact. Whether the child resides in an urban or rural area might impact how much physical activity the child is exposed to because of availability of outdoor play space or

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Prevention and Health Promotion, *Body Mass Index: BMI for Children and Teens*, Department of Health and Human Services, http://www.cdc.gov/ nccdphp/dnpa/bmi/childrens_ BMI/about_childrens_BMI.htm, (accessed April 10, 2007).

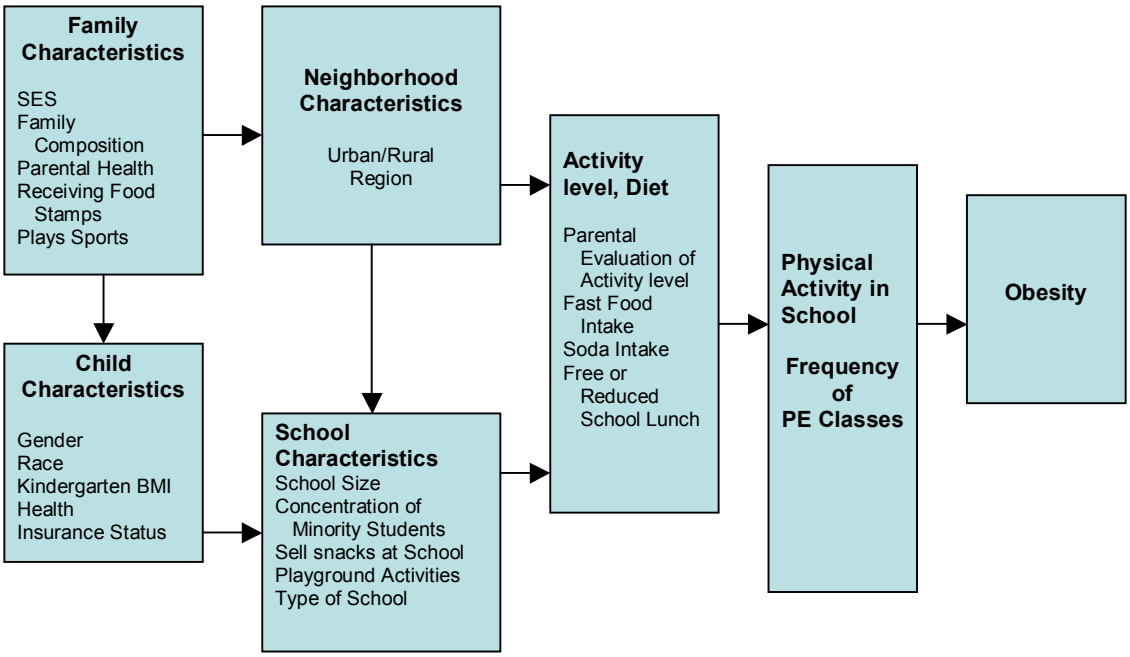
how often the child walks versus rides in a car as a method of transportation. School characteristics like whether the school is public or private, school size, and the concentration of minority students are thought to have an effect on the school environment, where the children spend a significant amount of time. These controls are measured in the base year, kindergarten, but it is assumed that they remain the same over time. Playground activities and whether the school sells snacks are measured in the fifth grade, because they are meant to capture the school environments impact of physical activity and nutrition outside of physical education classes, and to capture differences in the types and intensity of activities that children do in PE across different types of schools.

Activity level and diet variables attempt to control for diet and exercise as well, and are measured at the fifth grade level. These variables include a measure of parental evaluation of activity level in order to capture the child's activity outside of the schools, and whether the child receives a free or reduced price lunch at school, which serves as a proxy for the types of food the child's family can afford. This variable captures the effect of the federal policy of free or reduced price lunches, as they are generally not very nutritious. Fast food and soda intake are key nutritional

values, as high fast food and soda consumption are not considered nutritious and should have a high correlation with obesity because of their high caloric content.

Finally the frequency of physical education classes is also measured in the fifth grade. This variable captures the element of scheduled physically active time that the children are exposed to in school, and is the key explanatory variable in this study. It is posited that physical education is the key avenue for schools to impact a child's risk for obesity as it requires physical activity. Policymakers cannot use the school environment to control genetics or diet, but it can use the school curriculum to mandate physical activity in physical education classes.

Figure 1: Conceptual Model



Chapter 3. Data and Methods

I. DATA

To determine whether school based physical education classes have an effect on childhood obesity, I will utilize data from the Early Childhood Longitudinal Study (ECLS), which is conducted by the National Center for Education Statistics (NCES).[36] The ECLS is a nationally representative sample of approximately 22,000 children enrolled in about 1,000 kindergarten programs during the 1998-1999 school year (ECLS).[37] Children were selected from public and private schools and from different racial, ethic and socioeconomic backgrounds. The ECLS sample design is a dual-frame, multistage sample, first counties were selected, then schools within the counties and then kindergarteners from within the sampled schools.[38] This cohort was followed until grade eight, with surveys of the full sample in the fall and spring of kindergarten and first grade and in the spring of the third, and fifth and eight grades.[39]

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[36] A detailed description of the Early Childhood Longitudinal Study is available on the NCES website, at http://nces.ed.gov/ecls/. It is also possible to order the ECLS-K Longitudinal Kindergarten-Fifth Grade Public-Use Data File and Electronic Codebook from the website, at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2006035.

[37] Karen Tourangeau, Christine Nord, Thanh Lê, Judith M. Pollack, and Sally Atkins-Burnett, "Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User's Manual for the ECLS-K Fifth-Grade Data Files and Electronic Codebooks (NCES 2006–032)," U.S. Department of Education (Washington, DC: National Center for Education Statistics, 2006), http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2006032.

[38] *Id.*

[39] *Id*.

As of winter 2007, data on the full sample of children from the first six waves, through the spring of the fifth grade, had been made available for public use, and I use data from these waves in my analysis. A key component of the ECLS is that it was designed to assess children along a number of dimensions, including their physical, social, emotional and cognitive development.[40] This design was chosen to serve the ECLS purpose of describing and analyzing children's success in school, but the richness of the data also invites a wide range of research.[41]

II. ANALYSIS SAMPLE

To be eligible for analysis, each child in the study had to have non-missing information on the number of physical education classes attended in a week. The resulting sample includes 11,560 observations.

III. LIMITATIONS

Despite the aforementioned richness, the ECLS has some limitations for the purposes of my study. Primarily, because of the strong genetic component of obesity, the lack of a variable for parent's BMI is a substantial limitation. Because I do not have a parental BMI variable or a satisfactory proxy available in the ECLS data, I am

[40] *Id*.
[41] *Id*.

unable to control for any genetic predisposition. I compensated for this by including other family level variables, including a self-rating of parental health and whether the family plays sports as a unit, all of which are correlated with weight. I was also able to limit the effect of omitting a parental BMI measure by including a baseline measure of the children's BMI, measured when they were in kindergarten. Additionally, I do not have detailed information about the physical education classes, such as types and intensity levels of activities.

IV. VARIABLES

The dependent variable, body mass index (BMI) in the fifth grade is the composite measure crated by NCES. It was calculated by multiplying the composite weight measure, weight in pounds by 703.0697261393 and dividing by the square of the child's composite height in inches. This is consistent with standard body mass index calculation.[42] The obese cut-off was calculated using Center for Disease Control growth charts, at age ten, the median age of children in the fifth grade.[43]

[42] Division of Nutrition and Physical Activity, National Center for Chronic Disease Prevention and Health Promotion, *Body Mass Index: BMI for Children and Teens*, Department of Health and Human Services, http://www.cdc.gov/ nccdphp/dnpa/bmi/childrens_ BMI/about_childrens_BMI.htm, (accessed April 10, 2007).

[43] *Id*.

The key explanatory variable, physical education, is measured as the number of times per week that children were exposed to physical education classes in the fifth grade.

Other explanatory variables are drawn from four different categories, individual characteristics, family characteristics, neighborhood characteristics and school characteristics. Individual characteristics include: gender, body mass index in kindergarten, activity level as indicated by parents, food consumption, and sports participation. Family characteristics include a composite socioeconomic status variable, parental self-rating of health status and number of siblings in the family. Neighborhood characteristics include region and the degree of urbanization. School characteristics include school type and size, as well as whether snacks are made available for student purchase. A complete table of the explanatory variables, as well as a description of their coding is provided in Table 1.

V. METHODS

I begin with a univariate analysis of the dependent and explanatory variables. I then conduct a bivariate analysis focusing on the relationships between obesity, physical education attendance, and my controls for individual, family, neighborhood and school characteristics.

Finally, given that my dependent variable is binary (1 = obese, 0 = not obese) I estimate probit models to examine the inter-relationships among these variables in a multivariate context. I examine the results for a series of four incremental models. The first model measures only the effect of physical education. The second model adds school characteristics, including playground activities, type of school, school enrollment, concentration of minority enrollment, and whether snacks are available for student purchase at school. The third model builds on the second by adding in the individual lifestyle characteristics of the students, including nutrition and activity variables, and student health as rated by a parent. The fourth and final model adds regional and demographic measures, including gender, race, location, socioeconomic status, insurance status, the number of siblings in the family, self-rated parent health, whether the family has depended on food stamps in the past twelve months and the child's kindergarten BMI measure. This group of models will allow me to illustrate the correlation between obesity and physical education, and then add in other factors that I predict will have an impact on childhood obesity.

Chapter 4. Results

Table 2 presents the means of the dependent and explanatory variables. As shown, 23 percent of the sample is classified as obese (with a BMI greater than or equal to the ninety-fifth percentile). According to the American Obesity Association, 15.3 percent of children between the ages of 6-11 are obese in the United States.[44] The percentage found in the study could be higher because it is calculated only a fifth grade. The average number of physical educations classes attended by students each week is 2.3. Ninety-two percent of the sample is covered by some sort of health insurance, which is not surprising considering the prevalence of public programs designed to cover children when their parents lack an employer-based or private plan (e.g., SCHIP) . There are four variables in the analysis that depend on parental ratings: measures of student health, parent health, and of student activity levels. Perhaps not surprisingly, the results show that parents give high ratings to both themselves and their children in these measures. For example, according to the parent survey, 42 percent of the children are reportedly more active than other children, while only 3 percent of the children are rated as less active than other children. The average child

[44] American Obesity Association, "AOA Fact Sheets: Obesity in Youth," American Association of Obesity, http://www.obesity.org/subs/fastfacts/obesity_ youth.shtml (accessed December 28, 2006).

health rating is 4.6, and the average parent health rating is 3.9, both on five point scales. This suggests that these variables may have less explanatory power than they would if the measures were objectively rated.

Table 3 provides levels of obesity by physical education, individual, family, regional and school characteristics. Here we see evidence of relationships between obesity and the other variables. To begin, as the frequency of physical education increases the prevalence of obesity among the children trends downward (28.3 percent of children who have no physical education classes are obese, while 22.8 percent of children who have classes five times a week are obese). SES also exhibits an inverse relationship with being obese. Hispanic and Black children are more likely to be obese than White or Asian children. Other factors associated with higher proportions of obesity include being less active than other children, not having health insurance, receiving a free or reduced-price school lunch, having a high fast food or soda intake, having a family that did not play sports together, and having a family that had received food stamps in the past year.

Thus far, I have documented a statistically significant negative association between the frequency of physical education and the risk of obesity. Given that many additional factors are correlated with both the opportunities that are provided across different schools as well as the characteristics of the students who attend, it is

important to examine whether this bivariate relationship remains when these additional variables are controlled. Table 4 provides the results from estimating a series of 4 probit models. Model 1 is the most basic model, allowing us to see the total effect of physical education on the risk of obesity among middle-school-aged children. As anticipated from the results of the bivariate analysis, physical education has a statistically significant negative effect on the likelihood of childhood obesity ($p \leq .05$). Because the type and intensity of activities comprising the physical education curriculum can vary considerably across schools and I am unable to control for this directly, the next model adds controls for other school characteristics. The risk of obesity is smaller for children who attend private school and for those whose schools offer playground activities ($p < .001$). This is likely to be because private schools have more students with a higher socioeconomic status or more involved parents, and more organized activities increases children's activity level. A higher concentration of minority students in a school is increases the likelihood of obesity ($p < .001$). Surprisingly, the ability to purchase snacks at school is associated with a *lower* risk of childhood obesity ($p < .001$) level. The effect of school enrollment is not statistically significant. It is important to note that the estimated coefficient for physical education remains statistically significant even with the inclusion of these controls. This gives us

greater confidence that the frequency of physical education measure is not simply acting as a proxy for the socioeconomic characteristics of the child's school.

The third model includes all the variables in the second, but adds measures related to the children themselves including their activity level, nutrition quality and health status. As shown, nutrition (having a high soda intake, receiving a free or reduced price school lunch), and being less active than other children are each associated with a higher probability of being obese ($p < .001$). Children who have a high intake of fast food are also at greater risk of a serious weight problem ($p < .01$). Contrary to expectations, health as rated by parent, the family not playing sports together, and being more active than other children were not statistically significantly related to the likelihood of being obese. As in Model 2, the coefficient for physical education remained statistically significant at the .05 level even with these child- and family-level controls.

Model 4 adds demographic characteristics of the child, socioeconomic status and kindergarten BMI. Under this model, the coefficient for physical education remains negative, but is actually more statistically significant than in the previous three models ($p < .01$). As this model controls for socioeconomic status and kindergarten BMI, this result is especially striking, because of the strong correlation between obesity and low socioeconomic status, and it suggests that physical education can have

an impact on the risk for obesity even amongst this segment of the population that is most at risk.

The fourth model indicates that increased socioeconomic status and a central city location are negatively associated with childhood obesity ($p < .001$). The central city result is surprising, because it was predicted that living in a city would have a positive impact on obesity because of reduced play space. However, this result can be accounted for once we recognize that children in central cities may walk more than others and thus engage in higher levels of physical activity than their counterparts outside of the central cities. Kindergarten BMI ($p < .001$) is positively associated with obesity, because it is natural that children who are overweight or obese in kindergarten who have not made significant lifestyle changes would be more likely to be obese in fifth grade than children who were not overweight in kindergarten. Being from the Midwest and the West of the country as compared to the South are shown to have a negative effect on childhood obesity ($p < .01$). Being insured also has a negative effect, at the .05 level, presumable insured children are more likely to visit doctors and see out medical advice. Finally being male is predicted to have a small, marginally significant, negative effect ($p < .10$), which is explained by natural differences in the prevalence of body fat across genders.

None of the other variables added into Model 4 are statistically significant, including race. It is worth noting that the concentration of minority students in a school loses its predictive powers in Model 4, suggesting that once you control for socioeconomic status of the child's family, race does not have a statistically significant effect on the risk of childhood obesity. Receiving a free or reduced price lunch, attending a private school and being less active than other children, also are no longer statistically significant in Model 4. The only other change is that high fast food intake gains in predictive power, becoming statistically significant at the .001 level.

Chapter 5. Conclusion and Policy Implications

My results revealed that increased levels of physical education instruction are associated with lower levels of childhood obesity among children ages 6 to 11 years old. This result is intuitive because children spend significant portions of their lives in school, particularly during daylight hours. Physical activity and diet are the two key components that govern individual's weight. It is important to bear in mind that I was not able to control for parental weight when assessing children's risk of obesity, which means that my results may over-estimate the effects of some of my other explanatory variables. This potential problem is mitigated somewhat by the fact that I was able to control for the SES, race, health status, kindergarten BMI and nutrition quality of the child, all of which are expected to be correlated with parental weight and thus likely to capture some of the influence of hereditary factors on children's weight .

This study expands on work done by Datar and Sturm, who also worked with data from the NCES, but examined the importance of both physical education and recess and focused only on children in kindergarten and first grade.[45] My study, in contrast, looks only at physical education, but covers the period from kindergarten to fifth grade.

[45] The dataset used in my study, including data up to grade five, was not available when the Datar and Sturm paper was published.

The finding that physical education is significantly associated with childhood obesity-- even net of controls for socioeconomic status, kindergarten BMI, race and nutrition level measures-- has promising implications. Unlike genetic background and parental life-style factors such as nutritional habits and levels of physical activity, the frequency of physical education classes provided at schools are much more amenable to policy intervention. As the United States continues to engage in education reforms to ensure that children are learning academic skills in the classroom, it is important that policymakers, educators and researchers are also aware of the effects the school environment can have on children's health.

In 2001, the Surgeon General released "The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity," stating that "Overweight and obesity may soon cause as much preventable disease and death as cigarette smoking. People tend to think of overweight and obesity as strictly a personal matter, but there is much that communities can and should do to address these problems."[46] Children's main exposure to their communities is through their time in school. Therefore schools have a responsibility to attempt a positive impact on the health of children. As overweight children are more likely to grow into overweight adults, policymakers have

[46] Office of the Surgeon General, Department of Health and Human Services, *Overweight and Obesity Threaten U.S. Health Gains,* Department of Health and Human Services, http://www.surgeon general.gov/news/pressreleases/pr_obesity.htm (accessed April 10, 2007).

a unique opportunity when they decide to focus on children. Early intervention and instruction in health behaviors, such as engaging in physical activity and eating nutritious meals has the potential to effect children for the rest of their lives.

There are currently programs designed to increase physical activity in American's youth. The President's Challenge, an awards program designed to motivate all Americans, including youths, to begin and maintain a regular physical activity program challenges youths to engage in fives days a week of physical activity for six concurrent weeks.[47] This initiative does work with state departments of education, but it is completely voluntary. To really effect change in the way that schools handle physical education, there will need to be room in their curriculum, and financing for facilities and instructors.

It is beyond the scope of this paper to recommend an ideal balance the education system should strike between academic instruction and promoting child health. However, it would be imprudent to improve education at the expense of health without making an informed decision, using full information and with an awareness of alternatives. Therefore it is important for further research to explore the relationship between child health and physical education in schools, in order to determine which types of programs are most effective at controlling and reducing childhood obesity.

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[47] The President's Council on Fitness and Sports, Department of Health and Human Services, http://www.fitness.gov/about_overview.htm (accessed April 10, 2007).

References

American Obesity Association. "AOA Fact Sheets: Obesity in Youth." American Association of Obesity. http://www.obesity.org/subs/fastfacts/obesity_ youth.shtml. (accessed December 28, 2006).

Cawley, John, Chad D. Meyerhoefer, and David Newhouse. "The Impact of State Physical Education Requirements on Youth Physical Activity and Overweight." *NBER Working Paper* No. W11411 (June 2005) (abstract *available at* Social Science Research Network: http://ssrn.com/abstract=741559).

Council on Sports Medicine and Fitness and Council on School Health. "Policy Statement, Active Healthy Living: Prevention of Childhood Obesity Through Increased Physical Activity**."** *Pediatrics* 117 (May 2006): 1834-1842.

Datar, Ashlesha, and Roland Sturm. "Physical education in elementary school and body mass index: evidence from the Early Childhood Longitudinal Study." *American Journal of Public Health* 94 (2004): 1501-1506.

Division of Nutrition and Physical Activity, National Center for Chronic Disease Prevention and Health Promotion. *Body Mass Index: BMI for Children and Teens*. Department of Health and Human Services. http://www.cdc.gov/ nccdphp/dnpa/bmi/childrens_ BMI/about_childrens_BMI.htm. (accessed April 10, 2007).

Hedley, Allison A., Cynthia L. Ogden, Clifford L. Johnson, Margaret D. Carroll, Lester R. Curtin, and Katherine M. Flegal. "Prevalence of Overweight and Obesity Among US Children, Adolescents, and Adults, 1999-2002." *JAMA* 291 (2004): 2847-2850.

Kimbro, Rachel T., Jeanne Brooks-Gunn, and Sara McLanahan. "Racial and Ethnic Differentials in Children's Overweight and Obesity Among Three-Year-Olds." *American Journal of Public Health* 97 (2007): 298-305.

National Association for Sport and Physical Education & American Heart Association. *Shape of the Nation Report: Status of Physical Education in the USA*. Reston, Virgnia: National Association for Sport and Physical Education, 2006. http://www.aahperd.org/naspe/ShapeOfTheNation/PDF/ShapeOfTheNation.pdf. Also available in print form.

Office of the Surgeon General, Department of Health and Human Services. *Overweight and Obesity Threaten U.S. Health Gains*. Department of Health and Human Services. http://www.surgeongeneral.gov/news/pressreleases/ pr_obesity.htm (accessed April 10, 2007).

Parsad, Basmat and Laurie Lewis. *Calories In, Calories Out: Food and Exercise in Public Elementary Schools, 2005 (NCES 2006-057)*. U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2006. http://nces.ed.gov/pubs2006/2006057.pdf. Also available in print form.

The President's Council on Fitness and Sports. Department of Health and Human Services. http://www.fitness.gov/about_overview.htm (accessed April 10, 2007).

Torgan, Carol. "Child Obesity on the Rise." *The NIH Word on Health* June, 2002, http://www.nih.gov/news/WordonHealth/jun2002/childhoodobesity.htm.

Tourangeau, Karen, Christine Nord, Thanh Lê, Judith M. Pollack, and Sally Atkins-Burnett. Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User's Manual for the ECLS-K Fifth-Grade Data Files and Electronic Codebooks (NCES 2006–032). U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2006. http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2006032. Also available in print form.

Table 1: Variables and Coding

Category	Variable	Measurement
Dependent Variable	Obese	BMI at or above the 95% percentile, calculated by student's age, height and weight
Independent Variable	Physical Education	Times per week student attended physical education classes
Gender	Male	1 if male, 0 otherwise
Race	Nonwhite	1 if nonwhite, 0 otherwise
	Hispanic	1 if Hispanic, 0 otherwise
Base BMI Measure	Kindergarten BMI	Calculated by student's age height and weight at kindergarten
Parental Report of Student Activity and Health Levels	Less Active than Others	1 if less active, 0 otherwise
	More Active than Others	1 if less active, 0 otherwise
	Student Health	1-5 Scale, lowest to highest
Student Insurance Status	Insured	1 if insured, 0 otherwise
Student Nutrition	Received a Free or Reduced Price Lunch	1 if received. 0 otherwise
	High Fast Food Intake	1 if consume more than 4 times a day, 0 otherwise
	High Soda Intake	1 if consume more than 2 times a day, 0 otherwise
Family Characteristics	Socioeconomic Status	1-5 Scale, lowest to highest
	Number of Siblings	Number of Siblings
	Does Not Play Sports Together	1 if does not, 0 otherwise
	Parent Self-rated Health	1-5 Scale, lowest to highest
	Food Stamps in Last 12 Months	1 if received, 0 otherwise

Table 1: Variables and Coding (continued)

Category	Variable	Measurement
Regional Characteristics	South	1 if reside in south, 0 otherwise
	West	1 if reside in west, 0 otherwise
	Midwest	1 if reside in midwest, 0 otherwise
	Northeast	1 if reside in northeast, 0 otherwise
	Central City	1 if reside in central city, 0 otherwise
School Characteristics	Private School	1 if student attends a private school, 0 otherwise
	School Enrollment	1-5 Scale, lowest to highest
	Playground Activities	1 if school has playground activities, 0 otherwise
	Concentration of Minority Students	1-5 Scale, lowest to highest
	Salty or Sweet Snacks Sold at School	1 if sold, 0 otherwise

Table 2: Means for Key Variables

	N	Mean
Obese (BMI > 95th percentile)	11560	0.23
		(0.42)
Physical Education		
Times per week	11560	2.29
Individual Characteristics		
Kindergarten BMI	10373	16.27
Male	11560	0.50
Nonwhite	11548	0.39
Hispanic	11548	0.16
Less Active than Other Children	9956	0.03
More Active than Other Children	9956	0.47
Insured	10777	0.92
Health as Rated by Parent (1-5 Scale)	9985	4.35
Received a Free or Reduced Price Lunch	5763	0.49
High Fast Food Intake	9213	0.10
High Soda Intake	9213	0.30
Family Characteristics		
Socioeconomic Status (1-5 Scale)	11113	3.19
Number of Siblings	10000	1.46
Does Not Play Sports Together	9983	0.09
Parent Self-rated Health (1-5 Scale)	10653	3.87
Food Stamps in Last 12 Months	8486	0.12
Regional Characteristics		
South	11481	0.33
West	11481	0.21
Midwest	11481	0.28
Northeast	11481	0.19
Central City	11481	0.36
School Characteristics		
Private School	11481	0.23
School Enrollment (1-5 Scale)	11237	3.32
Playground Activities	7276	0.80
Concentration of Minority Students (1-5 Scale)	9258	2.63
Salty or Sweet Snacks Sold at School	9212	0.63

Standard deviation in parentheses.
Data from the Early Childhood Longitudinal Study, Kindergarten-Fifth Grade Public-Use Data File, U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2006.

Table 3: Relationship Between Obesity and Select Explanatory Variables

Explanatory Variables	Percent Obese (BMI≥95th percentile)
Physical Education	
None	28.25
Less than Once a Week	24.02
Once or Twice a Week	23.48
Three of Four Times a Week	21.04
Five Times a Week	22.80
Male	23.11
Female	23.26
White	21.16
Black	25.64
Hispanic	29.55
Asian	20.29
Other Race	25.89
Less Active than Other Children	32.25
More Active than Other Children	22.70
Insured	22.60
Not Insured	30.02
Did not Receive a Free or Reduced Price Lunch	21.75
Received a Free or Reduced Price Lunch	27.40
High Fast Food Intake	28.71
High Soda Intake	31.83
Socioeconomic Status	
First quintile (lowest)	28.60
Second Quintile	28.31
Third Quintile	24.43
Fourth Quintile	21.25
Fifth Quintile (highest)	16.41

Table 3: Relationship Between Obesity and Select Explanatory Variables (continued)

Explanatory Variables	Percent Obese (BMI≥95th percentile)
Family Does Not Play Sports Together	26.37
Family Does Play Sports Together	22.70
No Food Stamps in Last 12 Months	21.75
Food Stamps in Last 12 Months	26.81
Regional Characteristics	
Northeast	24.73
South	24.35
West	21.72
Midwest	21.65
Central City	21.74
Non-Central City	23.91
Public School	24.11
Private School	19.80
School Enrollment	
0-149	18.10
150-299	23.07
300-499	23.60
500-749	22.58
750+	23.60
Playground Activities	27.06
No Playground Activities	28.94
Salty or Sweet Snacks Sold at School	29.86
No Salty or Sweet Snacks Sold at School	27.64

Data from the Early Childhood Longitudinal Study, Kindergarten-Fifth Grade Public-Use Data File, U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2006.

Table Four: Probit Coefficients for Models Predicting Childhood Obesity

	Model 1	Model 2	Model 3	Model 4
Constant	-0.66***	-0.40***	-0.41***	-5.34***
Physical Education Classes/ Week	-0.03*	-0.04*	-0.04*	-0.06**
Playground Activities		-0.21***	-0.21***	-0.23***
Private School		-0.14***	-0.11***	-0.06
School Enrollment		-0.01	-0.01	0.00
Concentration of Minority Students		0.05***	0.03**	0.02
Snacks Sold at School		-0.20***	-0.18***	-0.25***
Less Active Than Other Children			0.28***	0.04
More Active Than Other Children			-0.02	-0.04
High Fast Food Intake			0.12**	0.17***
High Soda Intake			0.23***	0.27***
Received Free or Reduced Price Lunch			0.11***	-0.04
Health as Rated by Parent			-0.01	0.01
Family Does Not Play Sports Together			0.06	0.04
Male				-0.05$^{\Psi}$
Nonwhite				0.03
Hispanic				0.04
Northeast				-0.07
West				-0.13**
Midwest				-0.13**
Central City				-0.11***
Socioeconomic Status				-0.06***
Insured				-0.11*
Number of Siblings				-0.00
Parent Self-rated Health				-0.03
Food Stamps in Last 12 Months				-0.06
Kindergarten BMI				0.33***

*** significant at the .001 level
** significant at the .01 level
* significant at the .05 level
$^{\Psi}$ significant at the .1 level

Data from the Early Childhood Longitudinal Study, Kindergarten-Fifth Grade Public-Use Data File, U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2006. Limited to observations with data for the physical education classes variable.