



The role of formal schooling on weight in young children



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ABSTRACT

Aim: This study examined whether children's exposure to formal schooling has an impact on their weight-related health outcomes, using data from the Early Childhood Longitudinal Study-Kindergarten Class of 1998–1999.

Methods: Considering that children, at similar ages, may have one more or less year of schooling based on their birthdates and school's cut-off dates for Kindergarten enrollment, this natural experimental study compared weight-related health outcomes of the treatment group (children whose birth dates were within three months before the cut-off) and that of the comparison group (children whose birth dates were within three months after the cut-off) using the OLS regression.

Results: Formal schooling significantly reduced the risk of being obese for initially obese children at the beginning of Kindergarten and did not bring about excessive weight gain problems for initially non-obese children. The beneficial effect of schooling, in reducing recurrent obesity/overweight, was concentrated in boys, Whites, and children who attended schools in states that adopted policies following national or state PE standards, while the adverse effect of schooling, in developing obesity/overweight, was on children who attended school with poor peers and children of the third quintile SES families.

Conclusions: School-based anti-obesity strategies should be targeted to more susceptible children and schools serving disadvantaged children.

1. Introduction

The prevalence of childhood obesity has been increasingly cited as a major health concern in the U.S. in recent decades. Recent statistics drawn from the National Health and Nutrition Examination Survey (NHANES) show that the prevalence of obesity of school-aged (6–11) children has rapidly surged from 4.0% in early 1970s up to 15.3% in late 1990s, while it has steadily increased up to 17.4% in 2014 (Ogden et al., 2016; Ogden, Flegal, Carroll, & Johnson, 2002). Despite clear evidence about the adverse consequences, the cause of the rapid rise in childhood obesity is still open to debate (Daniels, 2006; Datar, Sturm, & Magnabosco, 2004; Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008; Trasande & Chatterjee, 2009).

Considering that the majority of children aged 6–11 are enrolled in school, previous studies investigated the impact of the diverse obesogenic components inside schools on children's weight, such as a calorie-dense school nutrition program and school food policy allowing competitive foods (Li & Hooker, 2010; Millimet, Tchernis, & Husain, 2010), as well as low levels of physical activity due to insufficient Physical Education (PE) classes (Cawley, Frisvold, & Meyerhoefer, 2013; Datar & Sturm, 2004; Kim, 2012). Previous studies have also

emphasized that rigorous school schedules and the consequent behavioral changes in everyday routines, such as skipping breakfast and insufficient sleep duration have adverse impacts on children's weight (Deshmukh-Taskar et al., 2010; Mitchell, Rodriguez, Schmitz, & Audrain-McGovern, 2013; Seegers et al., 2011). Recent studies identified that school contexts, such as a school's race/ethnic makeup and the aggregated school-level socioeconomic status were important determinants for child adiposity (Lee, Harris, & Lee, 2013; Richmond, 2008).

While prior studies have made important contributions to our understanding of the diverse risk factors inside school walls, there are several issues to be addressed. First, previous studies have revealed the impact of a specific risk factor at school on children's weight in experimental settings (Carrel et al., 2005; Dziewaltowski et al., 2010; Spiegel & Foulk, 2006; Williamson et al., 2007), but there has been a lack of knowledge regarding the impact of formal schooling (i.e., education of an average 6.7 h per day for about 180 days in the regular school year which is provided by trained teachers inside the classroom) itself on developing obesity from a comprehensive viewpoint. Recently, the exemplary study done by Anderson, Butcher, Cascio, and Schanzenbach (2011) found that schooling has no deleterious effect on

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children's weight. In particular, Anderson et al. (2011) were concerned about the use of being in the 1st grade as independent variable due to the huge non-compliance rate (37.2%) and instead employed state's cutoff date (and accordingly, 'predicted' school exposure) as an instrumental variable. While their work made considerable progress in exploring the effect of the schooling, several issues still need to be addressed. First, as mentioned in their work, parental selection on when children start schooling could bring about a critical endogeneity issue. At the same time, parental choice on either public school or private school may also mask the effect of schooling. Second, though the findings from the cross-sectional analysis are reliable, it may not be enough to explain the changes in children's weight after schooling. Through the pre-post analysis, internal validity can be supplemented. Third, we completely agree with the use of each state's school entry cutoff as most valid instrument variable to address non-compliance issue (i.e. children start their schooling earlier or later than state cutoff dates). But, it is the only case when state's cutoff date regulation is strictly implemented in each school. We noticed that many schools set up their own school entry cutoff dates and that 5 states (CO, MA, NH, NJ, and PA) have a Local Education Agency set the date range. Lastly, since children spend one third of their time at home and one third of their time in school, school context (such as curriculum, teacher qualification, and school-level economic status) as well as parenting style and home environment should be considered.

Taking such gaps into consideration, this study reexamined whether children's exposure to formal schooling has an impact on their weight-related health outcomes, using a natural experimental design on the basis of school-setup school entry cutoff date. In particular, considering children's demographic characteristics, their initial weight when they entered school, family SES and home environments, and school contexts, such as whether children enroll in schools adopting national or state PE standards or schools with poor peers, this study explored the heterogeneous effect, if any, of formal schooling on children's weight. Given the significant public health implications of the childhood obesity problem, identifying the impact of schooling on children's weight could help to develop and evaluate school-based anti-obesity intervention strategies.

2. Methods

2.1. Participants

Data for this study was gathered from the Early Childhood Longitudinal Study-Kindergarten Class of 1998–1999 (ECLS-K), which selected 21,260 nationally representative Kindergarteners in the fall of 1998 and followed them through the eighth grade (total eight waves). Additional information regarding PE policy was acquired from School Health Policies of Program Study (SHPPS) of 2000 by the Centers for Disease Control and Prevention (CDC), which was designed to assess school health programs from a survey of 51 state-level personnel.

For our natural experiment design, we paid attention to three waves, i.e., near the beginning of Kindergarten (fall of 1998; wave 1), near the end of Kindergarten (spring of 1999; wave 2), and near the end of the 1st grade (spring of 2000; wave 4). We carefully selected 2000 children (from 122 schools in 34 states) from wave 1 who met our criteria: (1) they were enrolled in public Kindergarten for the first time; (2) their information regarding demographics, family characteristics, home environments, and school contexts in each wave were available; (3) each school's cut-off date, for children's Kindergarten enrollment (i.e. a turn-five cut-off date based on the child's birthdate), was between July 30, 1998 and October 16, 1998; (4) the children's birthdate was within three months before/after the cut-off date. Note that we deliberately chose this cutoff date ranges since a majority of states (34 states) adopted the cutoff date between July 30, 1998 and Oct 16, 1998 in school year of 1998–1999 and limiting to these dates could mitigate a systematic sampling error (i.e., in some states kindergarteners are

systematically younger than those in other states due to cutoff date). Readers also should be cautioned that the samples included in our study were less likely to be Hispanic and earned less income at the baseline than the original sample in the ECLS-K, meaning that our sample was not completely randomly selected.

2.2. Instrumentation

Direct child assessments, as well as in-depth interviews with parents in the ECLS-K, provide rich information suitable for our study. First, the ECLS-K objectively measured and recorded children's height and weight with standardized protocols and calibrated equipment. We transformed the children's height and weight into BMI percentile and BMI z-score, on the basis of the CDC's gender- and age-specific growth chart. We also recoded BMI percentile into a dichotomous obesity indicator (1 = BMI above or at 95th percentile; 0 = otherwise) and dichotomous overweight indicator (1 = BMI above or at 85th percentile; 0 = otherwise), following CDC guideline (for more details, refer to <http://www.cdc.gov/obesity/childhood/basics.html>). We confirmed that the prevalence of obesity and overweight obtained from the ECLS-K was compatible with those obtained from the NHANES mentioned above. Second, information on children's demographic and family characteristics was obtained from the computer-assisted parental interview in the ECLS-K. Children's demographic variables included age, gender, race/ethnicity, participation in pre-Kindergarten, and birth weight. Their family characteristics included household income, parents' marital status, mother's educational achievement and working hours, whether living with older adults (age ≥ 65), and number of siblings. For our subgroup analysis, we utilized a family SES scale (in quintiles) which was computed on the basis of household income and parent/guardian's education and occupation in the ECLS-K (for more details, refer to Section 7.4.2 in <http://nces.ed.gov/pubs2001/2001029rev.pdf>). In order to control for quality of home environments, we utilized the questions: "how often do parents/family members read books, tell stories, sing songs, help to do arts, involve in household chores, play games, talk about science projects, play with construction toys, and play a sport or exercise?" We recoded non-dichotomous responses into 0 (\leq twice per week) and 1 (\geq three times per week) by each activity and incorporated them into our model. We also included binary variables indicating each state in which the children resided and school characteristics such as location (urban/suburb/rural), total enrollment, and teacher/students ratio.

Additional information regarding school contexts were acquired from the survey of state-level personnel in SHPPS 2000 and from school administrators' questionnaire in the ECLS-K. First, to examine whether the schooling impact is moderated by quality PE offered by schools, we utilized the question of "Has your state adopted a policy stating that schools will follow any national or state PE standards or guidelines (e.g., the National Association of Sports and Physical Education (NASPE) guideline)?" in SHPPS 2000 and merged it into our ECLS-K data. Second, to examine whether the schooling impact is moderated by school-level economic status, we calculated the percentage of children who were eligible for the free/reduced-price school lunch program in each school and used it as a proxy indicator of school-level economic status. The total enrollment and the number of children who were eligible for the free/reduced-price school lunch program were obtained from the ECLS-K. Then, we created binary indicators of whether schools had affluent students (percentage of free/reduced-price school meal eligibility (FR) $\leq 5\%$), whether schools had less affluent students ($5\% < \text{FR} \leq 50\%$), and whether schools had impoverished students ($\text{FR} > 50\%$).

2.3. Procedure: natural experiment design & pre-post comparison

To explore the causal inference of children's formal schooling on their weights, random assignment experimental design would be the

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