Social Determinants of Overweight and Obesity Rates by Elementary School in a Predominantly Hispanic School District

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ABSTRACT

Objective: This study analyzes the social determinants associated with the overweight or obesity prevalence of 85 elementary schools during the 2010–11 academic year in a predominantly Hispanic school district.
Methods: A binomial logistic regression is used to analyze the aggregate overweight or obesity rate of a school by the percent of Hispanic students in each school, selected school and neighborhood characteristics, and its geographical location.
Results: The proportion of Hispanic enrollment more readily explains a school's aggregate overweight or obesity rate than other social determinants or spatial location. Number of fast food places and the academic ranking of a school appear to slightly impact the aggregate prevalence rate. Spatial location of school is not a significant factor, controlling for other determinants.
Conclusions: An elementary school's overall overweight or obesity rate provides a valuable health indicator to study the social determinants of obesity among Hispanics and other students within a local neighborhood.

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Obesity is a major health problem among our nation's school children. In the U.S., it is estimated that 1 in every 3 children aged 6–11 was overweight or obese in 2011–2012 (Ogden, Carroll, Kit, & Flegal, 2014). Our nation's obesity problem is especially acute for elementary school age Hispanic children; nearly half (46%) are overweight or obese (Ogden et al., 2014). Over 12 million Hispanic students in the U.S. attend public elementary and secondary schools, and nationally account for 1 in 4 elementary public school students (Fry & Lopez, 2012; National Center for Education Statistics, 2015). Many school districts are addressing the obesity problem by measuring student height and weight in order to screen for obesity, as well to estimate and monitor the school prevalence of healthy weight, underweight, overweight, or obese (Nihiser et al., 2007). Collection of Body Mass Index (BMI) data are now required for schools in about half of the states in the nation (Ruggieri & Bass, 2015). Studies have used BMI surveillance data collected by schools districts to estimate the prevalence of overweight and obese students and to show the association between the rate of obesity and social determinants such as race, ethnicity, and socioeconomic status, (Moreno, Johnson-Shelton, & Boles, 2013; Robbins, Mallya, Polansky, & Schwarz, 2012) . Most of these studies have used the BMI of individual students in a school district as the dependent variable. Fewer studies have analyzed the aggregate obesity prevalence by individual schools in a school district as the unit of analysis or dependent variable (Alviola, Nayga, & Thomsen, 2013; Alviola, Nayga, Thomsen, Danforth, & Smartt, 2014; Elder et al., 2010). To our knowledge, few studies have investigated the social determinants associated with obesity by elementary school in a predominantly Hispanic school district (Elder et al., 2010; Holub et al., 2014). Using the aggregate overweight and obesity prevalence rate of an elementary school provides an excellent opportunity for a community to evaluate the social determinants contributing to obesity within a local neighborhood.

This study presents the prevalence of overweight or obesity by elementary school, among students enrolled in kindergarten through 5th grade, for one of the 50 largest public school districts in the nation. The school district is located in the Southwestern United States and the district has an enrollment of nearly 90,000 students with 65% of its students classified as Hispanic. The study uses the overall overweight or obesity rate of an elementary school as the unit of analysis or the dependent variable in its analysis. Neighborhood and socioeconomics characteristics associated with an elementary school are used in this study to explain a school's aggregate overall overweight or obesity rate. Prior studies (Bryant, Hess, & Bowen, 2015; (Huang, Cheng, & Theise, 2013; Kimbro & Denney, 2013; Singh, Kogan, Van Dyck, & Siahpush, 2008) have shown that social determinants such as the neighborhood characteristics where children live, play, and attend school are important contributors to understanding the prevalence of childhood obesity. The study assesses the impact of the proportion of Hispanic

students, school and other neighborhood attributes, and geographic location of the school on the overall overweight or obesity rate of an elementary school. By using the aggregate overweight or obesity rate associated with an elementary school as a dependent variable, local school districts can better assess the complex link between the social determinants and obesity in their communities. Furthermore, the merits of studying the overall overweight or obesity rates at the aggregate school level can be demonstrated as a policy research recommendation for local school districts collecting BMI data.

Methods

Body Mass Index (BMI) Data

This study uses secondary, de-identified anthropometric data collected in the 2010–11 school year (SY) from a large, urban school district in the Southwest with an enrollment of over 90,000 students. A district-wide obesity surveillance project has been underway since SY 2007–2008, during which public school nurses have been collecting the heights and weights of all kindergarten, third, and fifth grade students, annually. The school district's obesity surveillance project is conducted in collaboration with the local health department. The 2010–11 school year was selected for analysis because the BMI data and the school and neighborhood characteristics were more readily available for that school year to the researchers. School nurses recorded height, weight, sex, date of birth, and grade for each student in the selected grades. Nurses used wall mounted stadiometers to measure height and calibrated beam balance scales to measure weight. Each of the school nurses in the district received training on measuring height and weight using these instruments. A school district nurse coordinated the training and was responsible for quality assurance. Details on the methods used by school nurses to measure height and weight in this school district are described in Cantarero, Myers, Scharmen, Kinyua, and Jimenez (2016).

Student identification numbers were used by district to link student anthropometrics to other important demographics including: ethnicity (parent-reported), school of enrollment, free or reduced price lunch (FRPL) status and number of unexcused absences. School-level estimates were calculated, and all student-level information was removed, prior to data-sharing with researchers. The primary outcome of interest was the proportion of overweight or obese students for each elementary school in the district. Height and weight measures were used to calculate sex- and age-specific BMI percentiles based on the 2000 Centers for Disease Control and Prevention (CDC) Growth Charts, using Epi Info version 7 (Barlow, 2007). An overweight or obese student was defined as having a BMI percentile greater than or equal to 85 (Barlow, 2007).

Students with invalid heights and/or weights were excluded from the dataset prior to sharing with researchers. Valid measurements were defined by the local department of health as meeting all of the following criteria: height between 36 and 84 in, weight between 25 and 350 lb, height-for-age and weight-for-age z-scores less than or equal to five based on the CDC Growth Charts (Barlow, 2007). For students enrolled in multiple schools in a single year, a single school enrollment was assigned based on the school with the greatest proportion of attendance. Hispanic ethnicity includes students of any race. Gender, ethnicity and FRPL status were assigned based on finalized and corrected student records provided by the school district during the summer of 2013.

The analytic dataset include all valid measurements taken in SY 2010–2011 consisting of 20,188 students in K, 3rd, and 5th grade. Students who were measured during the school year represented about 87% of all students (23,232 students) enrolled in K, 3rd, and 5th grade. We did not have information on the reason (e.g., student was absent, student transferred to school after the surveillance) to account for the small proportion of students who were not measured in the

surveillance. Both the school district and University of New Mexico institutional review boards reviewed and approved all study procedures prior to sharing of the aggregated dataset. The local department of health aggregated the individual student measures to calculate the following estimates for each elementary school in the district in 2010–2011: proportion overweight or obese (BMI percentile 85), proportion Hispanic, proportion receiving FRPL, and mean number of unexcused absences. Every elementary school nurse is given annual overweight and obesity rates for their schools.

For the 2010–11 school year, the study relied on available BMI data from 85 of the 89 elementary schools in the school district; 4 elementary schools in the school district had missing values for some independent variables required for our statistical analysis. Additional school or neighborhood data for this study were collected from city or state government websites as well as the school district website to determine number of parks and number of fast-food stores in each school boundary. Rank school grade (a measure of a school's academic performance) of each school was obtained from the state department of education website. This study illustrates the value of reporting and using an individual school's aggregate level of overweight or obesity rate within a school boundary area or small geographical area. Using the obesity rate of an elementary school as an aggregate benchmark can provide additional small area health information at the local level as when geographical zip codes are used to measure local disparities in health obesity rates (Drewnowski, Rehm, & Solet, 2007). The use of an aggregate level of a school's overweight or obesity rate in comparison to using individual BMI of students can also ameliorate the confidentiality concerns of a school district when individual data are considered for a study of this type.

Characteristics of Elementary Schools

The school district under study is one of the top 50 largest school districts in the nation and geographically comprises over 1000 mi^2. Table 1 provides selected characteristics for the 85 public elementary schools under study in the 2010–11 school year. Overall the average enrollment of students (kindergarten, 3rd grade, and 5th grade) in an elementary school was about 250 students, with nearly 65% of the enrollment accounted by Hispanic students. White Non-Hispanics and other Non-Hispanic races comprised, on average, about 24% and 10%, respectively, of an elementary school's enrollment. Among the elementary schools, the overall overweight or obesity rate averaged nearly 30% in the school district. Neither the proportion of Hispanic students nor the proportion of overweight and obese students in the school district is uniform by elementary school. Hispanic student enrollment ranged from 20% to nearly 100% by elementary school and the overweight or obese proportion ranged from 15% to 46%. As one would expect given the high national obesity rates of Hispanic children, the correlation for elementary school between the proportion of Hispanic students and overweight or obesity proportion is strong and positive (0.52) as shown in the Appendix to Table 1.

Table 1 also presents other school characteristics or variables (academic performance of a school, number of unexcused absences, number of public parks, and fast food places) that are hypothesized in addition to the school enrollment proportion of Hispanics to influence the overweight or obese rate of an elementary school. An elementary school's rank performance grade as reported by the state education department relies on standardized math and reading tests to derive a letter grade (A, B, C, D, or F). School letter grades are based on the State Department of Education Standard Based Assessment tests given in selected grades to assess reading and math proficiencies. An elementary school's grade is calculated by weighing a school's current standing, growth and environment to learn. Important factors that determine school's grade are: how students performed in the most recent school year, school's grade level performance in past three years, how well the school helped the top 75% of individual students improve, growth of lowest performing students