



Healthcare Utilization by Obese and Overweight Children

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Objective To examine the relationship between childhood obesity and health care use in a large, nationally representative group of children with measured anthropometrics.

Study design Analysis of 5 combined National Health and Nutrition Survey datasets from 2001 to 2010. Unadjusted and adjusted logistic regression models assessed the relationship between health care use variables and weight status (overweight: body mass index 85th to <95th percentile for age and sex; obese: body mass index \geq 95th percentile for age and sex) for children 2-18 years of age.

Results Overweight and obese children are more likely to receive their routine medical care in an emergency department than a primary care setting (overweight OR 1.95; 95% CI 1.22-3.14 and obese OR 1.88; 95% CI 1.24-2.86) than their normal-weight peers. After we adjusted for relevant covariates, this finding persisted among overweight, but not obese, children. Other health care use variables were not significantly associated with weight status.

Conclusion Overweight children may be more likely to use the emergency department than primary care settings for routine medical care. Interventions to establish primary care medical homes for overweight children merit consideration. (*J Pediatr* 2015;166:626-31).

Childhood obesity is a national health care epidemic¹ with multiple associated comorbidities. Along with the surge in common childhood comorbidities, such as asthma,² there is an increased prevalence of diseases once thought to be limited to adults. These include nonalcoholic fatty liver disease,³ obstructive sleep apnea,⁴ hypertension,⁵ and type 2 diabetes.⁶

Obesity in adults is a well-known contributor to increased health care expenses.^{7,8} Recently, several studies have suggested childhood obesity also contributes to increased health care expenditures.⁹⁻¹⁴ Many of these previous studies, however have been limited by small and relatively homogeneous study populations.¹⁰⁻¹² Those that have more nationally representative sample populations have their own limitations.¹⁵ Two nationally representative studies in which the authors used Medical Expenditure Panel Survey data demonstrated increased health care use and cost in overweight children.^{9,14} One major limitation of these studies, however, is the reliance on parental report of weight rather than measured anthropometric data.¹⁶

The purpose of our study is to determine the influence of childhood weight status across a range of health care use measures through analysis of a nationally representative dataset with measured anthropometrics.

Methods

The National Health and Nutrition Examination Survey (NHANES) assesses the health and nutritional status of adults and children in the US through a combination of structured questionnaires, physical examination, and laboratory data.¹⁷ Five 2-year datasets from 2001 to 2010 (2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010) were pooled together to create a 10-year analytic file for the study.

Our population of interest included all nonpregnant children ages 2-18 years enrolled in the NHANES dataset from 2001 to 2010 with a calculated body mass index (BMI). In the 2001-2010 NHANES pooled dataset, 52 139 subjects had a calculated BMI; of these, 17 500 were between 2 and 18 years of age. Pregnant females were excluded from 2001-2008 because weight gain is expected in pregnancy and, thus, may not be a reliable indicator of a participant's true weight status. Pregnancy status, however, was not made publicly available for sampled female subjects in the 2009-2010 dataset so all females from this 2009-2010 dataset with a calculated BMI were included in subsequent analyses. This approach is not expected to significantly alter our study results because only 56 pregnant women (0.32% of the total unweighted sample population) were excluded from the 2001-2008 datasets. The final number of subjects from the pooled 2001-2010 dataset was 17 444, representing 65.4 million children ages 2-18 years.

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BMI Body mass index
NHANES National Health and Nutrition Examination Survey

The independent variable in the analysis was BMI percentile categorized as normal weight (less than the 85th percentile for age and sex), overweight (between the 85th and less than the 95th percentile for age and sex), and obese (greater than or equal to the 95th percentile for age and sex).¹⁸ Anthropometrics for NHANES subjects were collected in Mobile Examination Centers by trained health technicians with regularly calibrated equipment in accordance with the NHANES Anthropometry Procedures Manual.¹⁹ Because the NHANES does not provide BMI percentile information, a publicly available SAS program for Centers for Disease Control and Prevention growth charts (SAS Institute, Cary, North Carolina) was used to assign each child a BMI percentile using the variables of age in months, sex, height or recumbent length, and weight.²⁰

The primary outcomes of interest were a range of health care use measures focused on accessing routine primary care, hospitalizations, and mental health (**Table I**; available at www.jpeds.com). These measures were constructed using responses to the Hospital Utilization and Access to Care section of the NHANES survey. They included: whether the individual had a routine health care location (yes or no), the site for the routine health care (emergency department, primary care setting [included doctor office/health maintenance organization, health center or clinic, and hospital outpatient department], no routine location, and other site), the presence of an overnight hospitalization in the previous year, the total number of hospitalizations in the previous year, the presence of a mental health visit in the previous year, and the total number of health care visits in the previous year.

Covariates for the analysis included child age, sex, race/ethnicity (non-Hispanic white, African-American, Hispanic, and other), health insurance status (private, public, or no insurance), household income, the presence of asthma or diabetes, and the educational attainment of the head of household (less than 9th grade, 9th-11th grade, high school or General Educational Development, some college, or college graduate and greater). This information was obtained from the Demographic, Medical Conditions, and Health Insurance Surveys sections of the NHANES survey.

Recoding of variables was performed to address skip patterns, categorize answer choices in a meaningful way (**Table I**), and address differences in survey order from year to year.

Frequency data were analyzed in SAS and no more than 10% of values for each variable analyzed (independent, dependent, or covariate) was missing. Per NHANES technical guidance, Rao-Scott F-adjusted χ^2 statistics were performed to determine associations between weight status and health care use variables in SAS.²¹ Unadjusted and adjusted logistic regression models were run using SUDAAN 11.0 (RTI International, Research Triangle Park, North Carolina) to assess the association between health use outcome variables and BMI percentile categories and account for the complex survey design of the NHANES.²² We analyzed additional models with each of the related covari-

ates removed and found no significant difference from the results presented. We performed an estimation of correlation matrix among covariates and did not show any ill-conditioned problems with multicollinearity.

We also used appropriate sample weighting to account for the complex survey design of the NHANES. NHANES sample weights are representative of the US Civilian Noninstitutionalized Census population. NHANES technical reports recommend using the sample weights for the smallest analytic subpopulation sample to obtain the most conservative estimates.²³ Therefore, we used the physical examination sample weights and multiplied by 0.2 because we combined five 2-year survey cycles. Those persons outside of this age range (younger than 2 years and greater than 18 years) in the datasets were still included in the analysis but were weighted to $1 \times 10^{e-6}$ per the NHANES technical guidance. For ages 0-2 years, we used weight for recumbent length measurements to classify children as normal, overweight, and obese. For ages older than 18 years, we used adult Centers for Disease Control and Prevention weight classification measures: BMI <25 is normal weight, BMI 25-29 is overweight, and BMI ≥ 29 is obese. Again, these individuals were then weighted to 1×10^{e6} . The study was reviewed and was determined to be exempted from review by the Stony Brook University Institutional Review Board.

Results

The characteristics of the sample population are outlined in (**Table II**). The 17 444 sampled children represent 65.4 million children living in the US between 2001 and 2010. Of these, 69.4% were in the normal weight category, 14.7% were in the overweight category, and 15.9% were in the obese category. Hispanic children were more likely to be obese than other racial/ethnic groups, comprising 25.3% of all obese children. School age children and adolescents were more likely to be obese than preschool children, 40.7% and 43.1% vs 16.2% of the obese group, respectively. The distribution of males and females was fairly equivalent in the overweight (49.8% vs 50.3%) and the normal-weight groups (50.2% vs 49.8%). The obese group, however, had a greater percentage of males (54.7%) than females (45.3%).

Association of weight status and health care use is outlined in **Tables III-V**. Normal-weight children were more likely to use a primary care setting (93.7%) than both overweight (92.0%) and obese children (91.9%) for their care (**Table III**). In addition, overweight and obese children were both more likely to use the emergency department for their routine location of care. In an unadjusted logistic regression analysis, compared with normal-weight children, overweight (OR 1.95, 95% CI 1.22-3.14), and obese children (OR 1.88, 95% CI 1.24-2.86) were more likely to receive routine medical care in an emergency department setting than a primary care setting. Weight status was not significantly associated with any other health care use measure (**Tables IV and VI** [**Table VI**; available at www.jpeds.com]).

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