Health Care Utilization by Body Mass Index in a Pediatric Population

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ABSTRACT

OBJECTIVE: We tested the hypothesis that the frequency of emergency department (ED) visits, outpatient clinic visits, and hospitalizations were higher among children with higher body mass index (BMI) categories, even after controlling for demographics, socioeconomic status, and presence of other chronic medical conditions.

METHODS: We obtained electronic height, weight, and utilization data for all residents of Olmsted County, Minnesota, aged 2 to 18 years on January 1, 2005 (n = 34,335), and calculated baseline BMI (kg/m^2). At least 1 BMI measurement and permission to use medical record information was available for 19,771 children (58%); 19,528 with follow-up comprised the final cohort. BMIs were categorized into underweight/healthy weight (<85th percentile), overweight (85th to <95th percentile), and obese (≥95th percentile). Negative binomial models were used to compare the rate of utilization across BMI categories. Multivariable models were used to adjust for the effects of age, race, sex, socioeconomic status, and chronic medical conditions.

RESULTS: Compared to children with BMI <85th percentile, overweight and obese status were associated with increased ED visits (adjusted incident rate ratio [IRR] 1.16, 95% confidence interval [CI] 1.10, 1.23; and IRR 1.27, 95% CI 1.19, 1.35, respectively; *P* for trend <.0001), and outpatient clinic visits (IRR 1.05, 95% CI 1.02, 1.08; and IRR 1.07, 95% CI 1.04, 1.11, respectively; *P* for trend <.0001). No associations were observed between baseline BMI category and hospitalizations in the adjusted analyses.

CONCLUSIONS: Children who are overweight or obese utilize the ED and outpatient clinics more frequently than those who are underweight/healthy weight, but are not hospitalized more frequently.

KEYWORDS: adolescent; child; emergency service; health services utilization; hospital utilization; obesity; pediatric obesity; preschool

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WHAT'S NEW

Adjusting for demographics, socioeconomic status, and chronic medical conditions, children who are overweight or obese make more frequent emergency department and outpatient clinic visits than underweight or healthy-weight children.

PEDIATRIC OBESITY IS a pressing population health problem. Data from the 2011–2012 National Health and Nutrition Examination Survey (NHANES) demonstrated that 16.9% of youth ages 2 to 19 years were obese, defined by body mass index (BMI) at the 95th percentile or higher.[1] It is estimated that 50% of children and 70% of teenagers with obesity will remain obese as adults.[2] In adulthood, obesity is associated with the development of several chronic diseases, including diabetes, hypertension, heart disease, hyperlipidemia, asthma, and sleep disorders.[3]

The increased health care costs of pediatric obesity are well described.[4–10] However, few studies have evaluated the effect of pediatric obesity on health care utilization. In some studies, children with obesity have been shown to have greater frequency of emergency department (ED) visits,[9,11–13] acute-care visits,[14,15] and hospitalizations.[15,16] In contrast, other studies have found no difference in outpatient visits,[4,11] ED visits,[4,11] or hospitalizations[14] in children with obesity. However, the specific visit types leading to increased utilization have not been well delineated while concurrently controlling for demographic factors, socioeconomic status (SES), and chronic medical conditions. In addition, most studies of health care utilization in children with obesity have utilized parental reports of weight and height rather than measured anthropometric data. Parental reports of height and weight can underestimate BMI and the prevalence of obesity in children.[17,18]

To address these limitations, we conducted a study to identify the frequency of health care utilization by BMI

category in a defined population using the Rochester Epidemiology Project (REP) data linkage system. We hypothesized that increased health care utilization in the outpatient, ED, and inpatient settings would occur among children categorized in higher BMI categories, independent of their chronic medical conditions, SES, and demographics.

METHODS

STUDY DESIGN AND SETTING

We conducted a retrospective cohort study using data from children residing in Olmsted County, Minnesota, on January 1, 2005. Study participants' medical records were followed longitudinally from their first BMI measurement after January 1, 2005, through last follow-up or December 31, 2013 (whichever came first), for documentation of hospitalizations, ED visits, and clinic visits. The study protocol was approved by the institutional review boards at both Mayo Clinic and Olmsted Medical Center. Most medical care in Olmsted County is provided by Mayo Clinic and its affiliated hospitals, Olmsted Medical Center and its affiliated hospital, and the Rochester Family Medicine Clinic. The health care records from these institutions have been linked and indexed since 1966 through the REP research infrastructure.[19,20]

STUDY POPULATION

We used the REP to identify all children aged 2 to 18 years who resided in Olmsted County on January 1, 2005. Children whose parents had provided research authorization to review their child's medical records for general research studies were included in this study, in accordance with Minnesota Statute 144.335.[21,22] Individuals who had not given permission to at least 1 health care institution in Olmsted County to use their medical records for research were excluded. Children who had at least 1 BMI measurement recorded in the electronic medical record between January 1, 2005, and December 31, 2013, were included, and their BMI category (based on age and sex) was based on their first measurement during this time period. Out of 34,335 potential participants, at least 1 BMI measurement was recorded in 19,863 children (58%). Research authorization was available for 19,771 (99.5%) of 19,863 of these children. There was no follow-up for 243 children (1.2%) after their initial BMI measurement, leaving 19,528 children for this analysis. The characteristics of those with at least 1 BMI measurement were similar to those of the 2005 Olmsted County population (sample population median age 9.8, 50.2% male; total population median age 10.0, 51.1% male).[23]

MEASURES OF BMI (EXPOSURE VARIABLES)

Height, weight, calculated baseline BMI (kg/m^2), and heath care utilization data for all study participants were obtained from the electronic medical record. BMI data under the first percentile and above the 99th percentile were considered potentially erroneous outliers and were manually reviewed using medical records to ensure accuracy. BMI measurements made in the last 6 months of pregnancy and first 3 months postpartum were excluded. Baseline BMI measurements (first BMI measurement after January 1, 2005) were categorized into underweight/healthy weight (<85th percentile), overweight (85th to <95th percentile), and obese (≥95th percentile) by US Centers for Disease Control and Prevention standards using the patient's age and sex.[24] In addition, age, sex, race, chronic medical conditions, and SES were included as potential confounding variables. The diagnostic indices of the REP were searched electronically to extract all International Classification of Diseases, Ninth Revision (ICD-9), codes in the medical records of all children ages 2 to 18 years assigned to any health care institution in Olmsted County in the 5 years before January 1, 2005. These ICD-9 codes were grouped into the clinical classification code categories proposed by the Agency for Healthcare Cost and Utilization Project.[25,26] Ten chronic conditions (other upper respiratory, skin disorders, osteoarthritis and joint, anxiety/depression/bipolar, attention-deficit disorder/behavior, asthma, chronic neurologic, developmental, headaches/migraines, and back problems) with a prevalence of >5% of children in Olmsted County were assessed.[27] Two additional conditions, diabetes and dyslipidemia, which have been associated with elevated BMI, were also included. The number of comorbidities was classified as 0, 1, 2, or 3 or more.

MEASURES OF HEALTH CARE UTILIZATION

Using the REP research infrastructure, outpatient clinic visits, ED visits, and hospitalizations from the first BMI measurement after January 1, 2005, through last follow-up or December 31, 2013 (whichever came first), in Olmsted, County were identified for each child. After assessing the distribution, outpatient clinic visits were classified into quartiles, hospitalizations were categorized into 0 or 1 or more, and ED visits were categorized as 0, 1 to 2, or 3 or more.

MEASURE OF SES

SES was measured by an individual housing-based index (HOUSES Index), which has previously been shown to be associated with health outcomes in both children and adults.[28–31] Briefly, geocoded address information was used to match study subject address to geographic reference data and real property data from the assessor's office of the county government. A standardized HOUSES Index score was formulated by summing z scores for 4 real property features (value, square footage, number of bedrooms, and number of bathrooms), with a higher HOUSES Index score indicating a higher SES.

STATISTICAL ANALYSIS

Demographic characteristics and utilization measures were compared across BMI categories by chi-square tests. The utilization rates (count per person-year) of ED visits, outpatient clinic visits, and hospitalizations during