Pediatric Idiopathic Intracranial Hypertension and Extreme Childhood Obesity

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Objective To estimate the magnitude of the association between overweight, moderate, and extreme childhood obesity and the risk of idiopathic intracranial hypertension (IIH).

Study design Risk estimates were obtained from the Kaiser Permanente Southern California Children's Health Study (n = 913 178). Weight classes were assigned by body mass index specific for age and sex. A combination of electronic database searches followed by complete medical records review was used to identify all children diagnosed with IIH between 2006 and 2009.

Results We identified 78 children with IIH, the majority of whom were girls (n = 66, 84.5%), age 11-19 (n = 66, 84.5%), non-Hispanic Whites (n = 37, 47.4%), and overweight or obese (n = 57, 73.1%). The adjusted ORs and 95% CIs of IIH with increasing weight class were 1.00, 3.56 (1.72-7.39), 6.45 (3.10-13.44), and 16.14 (8.18-31.85) for underweight/normal weight (reference category), overweight, moderately obese and extremely obese 11-19 year olds, respectively (*P* for trend < .001). Other independent IIH risk factors included White non-Hispanic race/ethnicity for all age groups and female sex, but only in older children. Overweight/obese children also had more IIH symptoms at onset than normal weight children.

Conclusions We found that childhood obesity is strongly associated with an increased risk of pediatric IIH in adolescents. Our findings suggest that the childhood obesity epidemic is likely to lead to increased morbidity from IIH particularly among extremely obese, White non-Hispanic teenage girls. Our findings also suggest careful screening of these at risk individuals may lead to earlier detection and opportunity for treatment of IIH. *(J Pediatr 2012;161:602-7)*.

Idiopathic intracranial hypertension (IIH) is a disorder that typically presents with headache and blurred vision and is diagnosed by the presence of papilledema and elevated intracranial pressure in the absence of infectious, vascular, or structural causes. It most often affects obese or overweight adult females and can lead to blindness in up to 10% of patients, particularly if it is not recognized or treated promptly.[1]

Once thought to be rare, IIH is becoming more common with an estimated incidence of 15-19 cases per 100 000 among overweight or obese women ages 20-44.[2] This increasing incidence has been attributed to the growing obesity epidemic among adults.[1]

Over the last 30 years the prevalence of pediatric obesity has tripled. Yet, whether obesity or other putative IIH risk factors like the use of tetracyclines or retinoids for acne are more important in pediatric IIH is unclear. The few studies that have examined the relationship between pediatric IIH and obesity[3-8] have yielded conflicting results. Some studies suggested that obesity is only a risk factor for IIH in postpubertal age children.[3] All had significant methodological limitations including descriptive case series design with obesity information on cases only, small sample sizes (15-50), and referral center bias.[3-8] None of these studies reported risk estimates, which are necessary when counseling obese patients to prevent IIH. The purpose of this study was to identify risk factors for pediatric IIH and estimate the magnitude of the association between overweight, moderate, and extreme childhood obesity and the risk of pediatric IIH in a population-based, multiethnic cohort of children.

Methods

The institutional review board at Kaiser Permanente Southern California (KPSC) approved this study. Informed consent was waived as this was a database and chart review study only without direct patient contact.

For this cross-sectional study, we used data on children enrolled in the KPSC Children's Health Study, which is described in detail elsewhere.[9] KPSC is a large prepaid health maintenance organization with over 3.2 million members including over 900 000 members 18 years and younger. It provides comprehensive

BMI	Body mass index
IIH	Idiopathic intracranial hypertension
KPSC	Kaiser Permanente Southern California
PPV	Positive predictive value

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health care coverage to ~20% of the population in the geographic area it serves. The cost of specialist consultations, hospitalizations, magnetic resonance imaging scans, other diagnostic tests, and medications are fully covered. The KPSC pediatric membership is representative of the general pediatric population in Southern California with respect to ethnicity, age, sex, and socioeconomic status with the exception of an under-representation of the lowest and highest ends of the socioeconomic spectrum.[9] After exclusion of 265 241 members who did not have any medical encounters in 2007-2009, 1 030 730 patients were eligible for participation in the cohort study. Out of these patients, 920 034 patients (89.2% of eligible patients) had at least 1 valid weight and height in the 3-year study period. After exclusion of pregnant patients (n = 6856), 913 178 patients were included in the final analytical cohort. This cohort is described in detail elsewhere.[10]

To identify potentially incident cases, we searched electronic databases for any mention of *International Classification of Diseases, 9th Edition* diagnostic code for IIH (348.2) between January 1, 2006-December 31, 2009 including all inpatient and outpatient encounters since enrollment into the health plan (n = 167). Diagnoses were confirmed and additional clinical details were extracted through full medical records abstraction including all inpatient and outpatient records, computed tomography and magnetic resonance imaging scans, and diagnostic test results by two neurologists (A.G. and S.B.) according to criteria for pediatric IIH proposed by Rangwala and Lui.[11] Briefly, IIH was defined as presence of papilledema and elevated opening cerebrospinal fluid pressure (>180 mm H_20 if less than age 8 and >250 mm H_20 if age 8 or older); normal cerebrospinal fluid composition, no evidence of hydrocephalus, vascular or structural central nervous system lesions; and normal mental status.[11] Because Tanner stage information on our background population was not complete, age <11 years was used as a surrogate for prepuberty.

Charts of cases were also abstracted for any mention of other potential risk factors for IIH including oral contraceptive use, thyroid replacement, other hormone use, high-dose over the counter vitamins, otitis, sinusitis, polycystic ovary syndrome, and metabolic syndrome.

We confirmed the diagnosis of IIH in 78 children. The diagnosis of IIH was suspected but not confirmed in another 33 children because of insufficient documentation (eg, opening pressure noted as "high" but not recorded or no documentation of fundoscopic exam), lumbar puncture was not done (eg, obese child with bilateral papilledema and new onset headache with unsuccessful lumbar puncture attempts), or because papilledema was absent (n = 5). Another 56 children had diagnostic codes for IIH entered in error (rule out diagnosis, later diagnosed with migraine, infection, or structural lesion), resulting in a positive predictive value (PPV) of 66.1% for confirmed and suspected cases, and a PPV of 46.4% for confirmed cases only.

Body weight and height were extracted from electronic health records when available from the same day. Body mass index (BMI) was calculated as weight (kilograms) divided by the square of the height (meters). For patients enrolled into the study in years 2007, 2008, and 2009, the median BMI-for-age of all encounters in the year of study enrollment for a patient was used for analysis. Based on a validation study including 15 000 patients with 45 980 medical encounters, the estimated error rate in body weight and height data was <0.4%.[12]

Definitions for overweight and obesity in children and adolescents are based on the sex-specific BMI-for-age growth charts developed by the Centers for Disease Control and Prevention and World Health Organization definitions for overweight and obesity in adults.[13-15] Children were categorized as underweight (BMI-for-age <5th percentile), normal weight (BMI-for-age ≥5th and <85th percentile), overweight (BMI-for-age ≥85th percentile or a BMI ≥25 kg/m^2), moderately obese (BMI-for-age ≥95th percentile or a BMI ≥30 kg/m^2), and extremely obese (BMI-for-age ≥1.2 × 95th percentile or a BMI ≥35 kg/m^2).[13]

Race and ethnicity information were obtained from health plan administrative records and birth certificates. We categorized race/ethnicity as non-Hispanic White, Hispanic White, Black (regardless of ethnicity), Asian or Pacific Islander, other, or multiple race/ethnicity, and unknown due to missing information (52.5%). A validation study compared health plan administrative records and birth certificate records of 325 810 children.[16] The PPV for Hispanic ethnicity was 95.6%. PPV for White, Black, Asian/Pacific Islander, American Indian/Alaskan Native, multiple, and other was 89.3%, 86.6%, 73.8%, 18.2%, 51.8% and 1.2%, respectively.

For unknown race and ethnicity information, administrative records were supplemented by an imputation algorithm based on surname lists and address information derived from the US Census Bureau.[17-19] Hispanic ethnicity and Asian race were assigned based on surnames. For Blacks and Non-Hispanic Whites, the child's home address was used to link racial/ethnic information from the US Census Bureau. Race/ethnicity was hierarchically assigned using probability cutoffs of >50% for Asian surname, >50% for Hispanic surname, >75% for Black race from geocoding if probability for Asian surname was <50% (Hispanic Blacks are assigned to Black race for this study), and White race >45% from geocoding if no other assignment could be made before. The specificity and PPVs were >98% for all major racial/ethnic groups.[9]

We used Medi-Cal status as an indicator for low socioeconomic status. Medi-Cal is the California state-subsidized program providing health care coverage for more than 6 million low-income children and families as well as elderly, blind, or disabled individuals.

Statistical Analyses

Differences in the distribution of basic demographics across groups defined by weight class were assessed with the χ^2 test. T test was used to compare normally distributed variables across groups. For IIH cases, age was assigned as age at first mention of IIH diagnosis. For non-IIH cases, age was assigned based on the age on July 1 of the year of study enrollment.