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Severe Obesity and selected risk factors in a sixth grade multi-racial cohort: the HEALTHY study

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Abstract

Purpose—To document the prevalence of severe obesity and associated risk in the HEALTHY cohort.

Methods—6,365 students were assessed at school-based screenings.

Results—6.9% of students were severely obese. Severe obesity was associated with elevated cardiometabolic risk and race/ethnicity.

Conclusions—Severe obesity is common and requires preventive intervention.

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Conflicts of Interest: None.

Keywords

obesity; hyperinsulinism; glucose intolerance; hyperlipidemia; hypertension

Introduction

Increasing rates of pediatric obesity (1) have stimulated the development of prevention programs to minimize obesity and related morbidities. HEALTHY was an NIDDK-funded, three-year intervention designed to reduce risk factors for type 2 diabetes [i.e., Body Mass Index (BMI) ≥ 85th percentile for age and sex, fasting glucose ≥ 100 mg/dL, and fasting insulin ≥ 30 μU/mL] in a diverse sample of US school children. We recently reported baseline data for the HEALTHY cohort of 6,358 6th grade students, which documented high rates of obesity and diabetes risk factors (2). In this report, we focus on baseline data relating to the sub-group of students with severe obesity [BMI ≥ 99th percentile for age and sex (3)]. The prevalence of severe obesity also has increased (4), and approximately 4% of American children have a BMI ≥ 99th percentile (3). Severe obesity is a robust predictor of medical and psychosocial morbidity, as well as persistence of obesity into adulthood (4). Thus, we examined rates of severe obesity in the HEALTHY 6th grade cohort, and the relation between severe obesity, and cardiometabolic risk factors and race/ethnicity.

Methods

Forty-two middle schools with ≥ 50% of minority children or students eligible for free/ reduced lunch were recruited at 7 US centers. Sixth grade students were invited to health screenings in fall 2006; 57.6% of students enrolled. The study was approved by the Institutional Review Boards at each site, and parent consent and child assent were obtained.

Assessment methods were reported previously (5). Height, weight, waist circumference and blood pressure were measured, and fasting blood draws were obtained to assess metabolic (glucose, insulin) and additional cardiovascular (total cholesterol, LDL, HDL, triglycerides) risk factors. BMI percentile for age and sex was calculated using the CDC program (6,7). Youth with BMI ≥ 85th but < 95th percentile were classified as overweight and those ≥ 95th but <99th percentile as obese. Students with BMI ≥ 99th percentile were classified as severely obese. Blood was analyzed by Northwest Lipid Metabolism and Diabetes Research Laboratories, University of Washington, Seattle.

Ethnicity and race were self-reported. Students checking ‘Hispanic or Latino’ ethnicity were classified as Hispanic (n=3376); non-Hispanics choosing only ‘Black or African American’ race were classified as Black (n=1254); non-Hispanics choosing only ‘White’ race were White (n=1197); all other response categories (n<140 each) were combined into ‘Other.’ A parent or guardian reported family history of diabetes.

Generalized linear mixed models (SAS Proc GLIMMIX) that included a random effect for school to adjust for clustering of children within schools were used to examine the relation between risk factors, and levels of BMI and race/ethnicity categories.

Results

Students (N=6,358) averaged 11.8 years (SD = 0.6) and 48% were male. The number and percent of students in the BMI categories are presented in Table 1. There were 441 students (6.9%) in the severely obese category (Mean BMI = 35.2 kg/m^2 ± 3.7). Rates of severe obesity differed by sex (7.5% of boys and 6.4% of girls, p = 0.007). Severe obesity also

varied by ethnic group with rates of 4.9%, 8.0%, and 7.3% for White, Black and Hispanic youth, respectively ($p<.0001$). Rates of severe obesity also differed as a function of race/ethnicity and sex ($p = 0.01$) with the highest rates observed in Black girls (8.7%) and Hispanic boys (8.2%), and lowest rates among White girls (4.1%) and boys (5.8%).

Table 2 shows the percent of students with a family history of type 2 diabetes and cardiometabolic risk factors within BMI percentile categories (all p's <0.001). In general, the prevalence of risk increased as a function of BMI percentile. Severely obese children were more likely than those with more moderate obesity (i.e., BMIs 95-< 99th percentile) to have a family history of diabetes, elevated waist circumference and insulin levels, and low HDL-cholesterol and high blood pressure. Table 2 also documents that among severely obese youth, risk varied as a function of racial/ethnic group, with Hispanic students having highest rates of elevated insulin, and White students having highest rates of elevated total cholesterol and blood pressure.

Discussion

Data from the HEALTHY study document that 6.9% of a diverse sample of US sixth graders were severely obese, a rate notably higher than the 4% reported among 5-17 year old Black and White children participating in the Bogalusa Heart Study (3). As shown in previous studies (4), the prevalence of severe obesity varies markedly by race/ethnicity group. In the current study, we observed rates of 4.9%, 8.0%, and 7.3% for White, Black and Hispanic youth, respectively, which are higher across all racial/ethnic groups than those derived from the 1999-2002 NHANES data (4). Although differences in sampling may explain differences in prevalence across studies, the current findings provide compelling evidence of high rates of severe obesity in American middle school children. Indeed, the average BMI of the severely obese children in the HEALTHY cohort was 35.2 kg/m^2, a level consistent with adult Class 2 obesity (8).

Among severely obese children, patterns of risk varied by race/ethnicity, which replicates findings of previous investigations (9). Specifically, Hispanic students had highest rates of risk for type 2 diabetes, White youth had a differentially high risk for elevated total cholesterol and high blood pressure, while Black youth were less likely to have low HDL or elevated triglycerides. These data provide additional documentation of variations in risk across racial/ethnic groups and demonstrate that even among severely obese youth, there are different patterns of risk in children of different racial/ethnic backgrounds.

Rates of severe obesity have increased more rapidly than those of moderate obesity in adults (10), and the current investigation suggests that there may be a similar pattern among US public school students. Severe pediatric obesity is thought to require aggressive intervention, which raises the question of whether school-based prevention programs such as HEALTHY will benefit this sub-group of children. Thus, it will be important to evaluate whether public health efforts that target multiple environmental and behavioral factors to decrease pediatric overweight, in general, also will reduce increases in severe obesity.

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Table 1

Number and percent of students in BMI Percentile categories by sex and race/ethnicity

	Boys					Girls				
BMI Percentile	**Hispanic N %**	**Black N %**	**White N %**	**Other N %**	**Total N %**	**Hispanic N %**	**Black N %**	**White N %**	**Other N %**	**Total (N)**
<85 [Normal Weight]	685 43.05	319 55	325 52.59	120 50.63	1449	921 51.54	336 49.78	351 60.31	166 56.27	1774
≥85-<95 [Overweight]	307 19.3	100 17.24	120 19.42	49 20.68	576	373 20.87	131 19.41	120 20.62	56 18.98	680
≥95-<99 [Obese]	468 29.42	120 20.69	137 22.17	49 20.68	774	379 21.21	149 22.07	87 14.95	56 18.98	671
≥99 [Severely Obese]	131 8.23	41 7.07	36 5.83	19 8.02	227	114 6.38	59 8.74	24 4.12	17 5.76	214
Total	1591	580	618	237	3026	1787	675	582	295	3339

Table 2

Percent of students with risk factors for diabetes and CVD by BMI percentile and risk factors among severely obese students by race/ethnicity

	Family History Type 2 Diabetes	Waist ≥ 90 percentile	Glucose > 100 mg/dl	Insulin ≥ 30 μU/mL	Total Chol ≥ 170 mg/dl	LDL > 110 mg/dl	HDL < 35 mg/dl	Trig > 110 mg/dl	High Blood Pressure
BMI Percentile		%	%	%	%	%	%	%	
<85	12.4	0.24	13.5	0.8	26	10.9	1.1	11.5	8.9
≥85–<95	16.5	18.7	15.5	3	31.4	18.2	4.3	25.4	9.8
≥95–<99	21.3	84.5	20.2	13.4	35.5	21.7	8.8	40.7	20.3
≥99	28.5	99.5	22.5	40	34.1	20.1	16.4	44.3	31.6
p value	< 0.001	< 0.001	0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
p value [≥95-<99 vs. ≥99*]	0.006	< 0.001	0.268	< 0.001	0.641	0.556	< 0.001	0.172	< 0.001
BMI ≥99 [Severely Obese]	**Family History Type 2 Diabetes**	**Waist ≥ 90 percentile**	**Glucose > 100 mg/dl**	**Insulin ≥ 30 μU/mL**	**Total Chol ≥ 170 mg/dl**	**LDL > 110 mg/dl**	**HDL < 35 mg/dl**	**Trig > 110 mg/dl**	**High Blood Pressure**
Race/Ethnicity		%	%	%	%	%	%	%	%
Hispanic	32.3	99.6	22.8	45.7	28.8	13.3	19.7	54.1	28.6
Black	23.8	100	22.6	30.4	35.5	29.03	7.5	18.3	28.9
White	20.9	98.3	23.3	30	50	33.9	20	53.3	48.3
p value	0.18	0.98	0.99	0.012	0.007	0.0001	0.023	<0.001	0.0105