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Childhood Obesity at New York City Public Hospitals

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Introduction: Childhood obesity is a large and growing health problem in the US and in many other parts of the world[1,2,3,4,5,6,7]. Latest CDC estimates are of 17% prevalence of obesity among US adolescents.[8] Childhood obesity is associated with health complications for the affected child, notably diabetes. Type II ("Adult Onset", or "Insulin Dependent") diabetes was rarely observed in children until the current epidemic of childhood obesity[9,10,11]. Childhood obesity is a major risk factor of adult obesity, with its associated morbidity and mortality[12,13]. New York City and State have made efforts to combat this epidemic. Some recent efforts include requiring restaurants to post calorie counts along with prices and a proposal for a special tax on sugary drinks.

Estimates of the prevalence and cost of obesity are considerations in the New York debate. Our office was asked to estimate the prevalence of obesity among the children cared for, largely at public expense, by the public hospital system in New York City. Those hospitals are operated by a city owned corporation, the New York City Health and Hospitals Corporation (HHC). HHC does not routinely measure body fat to identify obesity; we do routinely measure height and weight in children. From this, one can calculate body mass index (BMI), an easily calculated and widely used objective measure of underweight, normal weight, overweight and obesity[14,15.] Once BMI is calculated, it can be compared to age and sex specific charts or tables to classify the patient's weight status[16]. These tables and charts define "obese" children as those with a BMI index on the 95th percentile of the reference population, based on "Z scores." BMIs are not normally distributed and the "Z score" has been modified from its standard definition of part of a normal distribution[17]. Individuals with large muscle mass will have a high BMI and may be misclassified as obese, but this misclassification is relatively rare and the index can be used for population studies such as ours.

Methods: We searched electronic medical records of patients aged 2-18 years old for measures of sex, age, BMI, height and weight. The study period covers the time from January 1, 2009 through August 31, 2010. If BMI was found, that measure was used. If BMI was not found, we attempted to calculate BMI from height and weight measures. If height and weight were not measured concurrently, we combined individual measurements if they were separated by less than 90 days in time. Body mass index is defined as weight (in Kg))/ height^2 (in meters). Patients were categorized as "obese", "overweight", "normal weight" or "underweight" by matching the BMI to age and sex specific CDC tables. When BMI was measured more than once for a given patient, we used the most recent measurement. These files were merged with data from billing computers which contain language spoken at home, race, and financial/insurance information.

Data on language spoken at home is missing in many cases. New York is cosmopolitan and some rarely spoken languages were recorded when the data were obtained. In order to keep the tables manageable and interpretable, we grouped over 160 recorded languages into English, Spanish, other Indo-European languages (including French, Hungarian, Farsi, Hindi, Urdu…), East Asian Languages (including Cantonese, Mandarin, Burmese, Vietnamese, Tagalog…), Semitic (including Hebrew, Arabic, Maltese…), and other languages (including Creole, Swahili, Bambara, Basque…).

In the future, HHC will change to the CDC/Census bureau methods for dividing the population by race and ethnicity. This retrospective look is based on the older methodology, where “Hispanic” is considered a separate “Race”, as opposed to being an ethnicity. Hispanic patients are broken down into Black Hispanic, White Hispanic, and Undifferentiated Hispanic. As can be inferred from the language data, HHC sees a large immigrant community; in this population “Black” is not synonymous with “African American” and many of the White patients are also foreign born. “Native”, by our definition, includes people who self identify themselves at descendents of indigenous North, Central or South Americans; not of primarily European, African or Asian ancestry.

Statistics: Calculations were made using SAS 9.2®. Summary statistics (e.g. mean, quartiles) were calculated with Proc Univariate. Tables, counts and chi square statistics were made with Proc Freq.

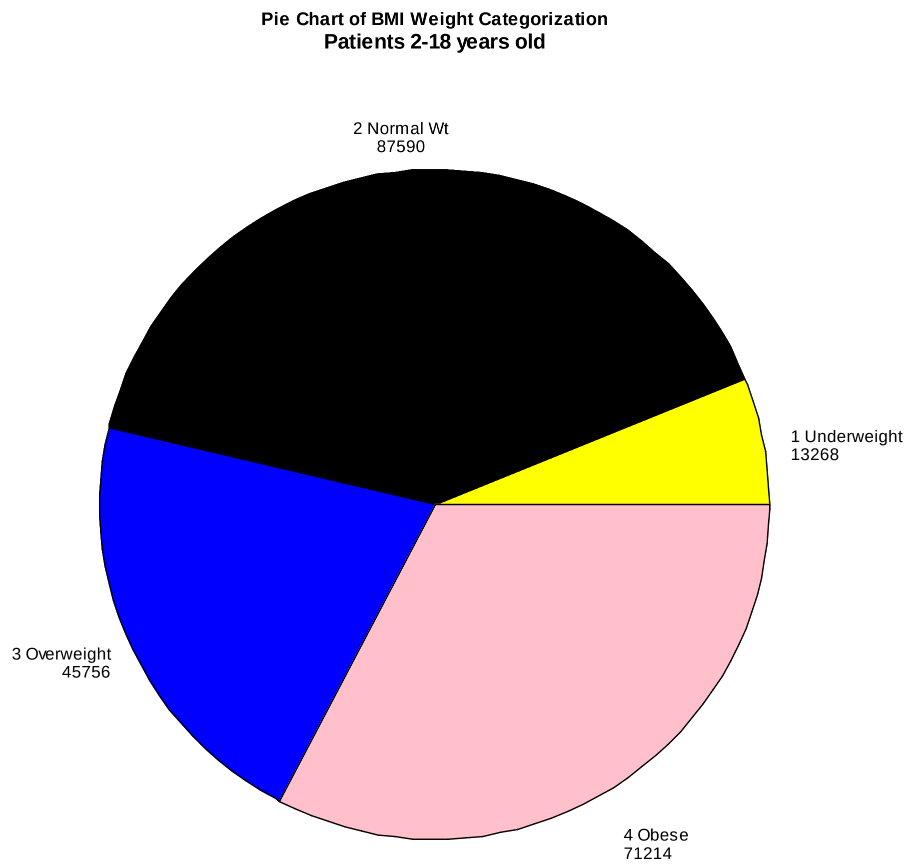
Results: We had BMI data for 217,828 patients; these data were missing for 8,189 (3.6%) of children; 53.7% of the children were obese or overweight (table 1 and figure 1).

Table 1: Table showing the breakdown of HHC children by BMI category

BMI Category	N	Percent
1 Underweight	13268	6%
2 Normal Wt	87590	40%
3 Overweight	45756	21%
4 Obese	71214	33%

Frequency Missing = 8189

Figure 1: Pie Chart Dividing the HHC Children by BMI Category



When broken down by sex, we find that obesity was slightly more common in boys, but overweight was more common in girls (table 2).

Table 2: Body Mass Index category by sex			
BMI Category	sex		
Frequency Column Percent	Female	Male	Total
1 Underweight	6516 6%	6752 6%	13268
2 Normal Wt	45120 42%	42470 39%	87590
3 Overweight	24033 22%	21723 20%	45756
4 Obese	33046 30%	38168 35%	71214
Total	108715	109113	217828
Frequency Missing = 8189			

Table 3 shows the BMI categories of children divided into pre-pubescent (<12 years old) and adolescent (12-18 years old) groups.

Table 3: BMI Category by age group			
BMI Category	Age group		
Frequency Column Percent	Adolescent	Pre-Pubescent	Total
1 Underweight	4936 7.26	8332 6%	13268
2 Normal Wt	28340 42%	59250 39%	87590
3 Overweight	15752 23%	30004 20%	45756
4 Obese	18986 28%	52228 35%	71214
Total	68014	149814	217828
Frequency Missing = 8189			

Table 4: BMI category by race								
BMI Category	race							
Frequency Column Percent	Native	Asian	Black	Hispanic	Hispanic Black	Hispanic Other	Hispanic White	Hawaiian /Pacific
1 Underweight	137 7%	488 6%	6731 9%	3945 4%	62 5%	32 2%	14 5%	0 0%
2 Normal Wt	919 49%	3892 46%	29073 39%	41505 40%	542 42%	565 43%	88 31%	9 36%
3 Overweight	349 19%	1568 19%	13472 18%	24589 23%	261 20%	321 24%	73 26%	7 28%
4 Obese	473 25%	2431 29%	25140 34%	34322 33%	421 33%	401 31%	110 38%	9 36%
Total	1878	8379	74416	104361	1286	1319	285	25
Frequency Missing = 9123 (Missing either BMI or Race)								

Table 4: BMI category by race (continued)							
BMI Category	race						
Frequency Column Percent	No Description	Other	Other Race	South Asian/Middle East	Unknown	White	Total
1 Underweight	14 3%	729 7%	4 11%	630 8%	110 10%	275 6%	13171
2 Normal Wt	148 37%	4076 41%	10 29%	4293 51%	435 38%	1752 35%	87307
3 Overweight	86 22%	1957 19%	7 20%	1844 22%	245 21%	808 16%	45587
4 Obese	151 38%	3269 33%	14 40%	1609 19%	359 31%	2120 43%	70829
Total	399	10031	35	8376	1149	4955	216894
Frequency Missing = 9123 (Missing either BMI or Race)							

"Language spoken at home" is missing for most (94%) children. Our studies of various adult populations show these data to be absent 30-50% of the time. For instances where the information was recorded for the children, table 5 shows the breakdown of BMI status by primary language at home. Languages other than English or Spanish are grouped as described in the methods section.

Table of Body Mass Index by language group								
BMI Category	langroup							
Frequency Column Percent	E Asian	English	Other Indo-European	Other	S Asian	Semitic	Spanish	Total
1 Underweight	4 4%	837 9%	8 6%	25 9%	5 5%	2 3%	136 3%	1017
2 Normal Wt	65 63%	3544 38%	62 45%	136 51%	63 58%	24 41%	1727 41%	5621
3 Overweight	12 12%	1933 21%	41 30%	50 19%	19 17%	19 33%	1275 31%	3349
4 Obese	22 21%	2956 32%	26 19%	55 21%	22 20%	13 23%	1039 25%	4133
Total	103	9270	137	266	109	58	4177	14120
Frequency Missing = 211897 (Missing BMI or Language)								

Discussion: Several recent studies of several different populations have shown high and increasing levels of childhood obesity. The levels we report are among the highest reported for a large population base.

The rates of obesity among Asians, and people speaking Asian languages is higher than some others report, but relatively low compared to other HHC children. The rates of obesity we observe among Blacks and Latinos are high, consistent with many other reports[18]. Our white pediatric population represents less than 3% of the total; excluding the "white Hispanic" population, the 43% obesity rate is the highest race specific rate. As noted above, "white" and "black" HHC patients differ from "typical American" white and black patients in many ways, including proportions of immigrants and relatively low SES. This may partially explain the high rate of obesity we observe in the white population. Future research may allow us to model markers of poverty or SES in our modeling and better explain some of our findings.

Recent research has linked childhood obesity to increased morbidity and increased mortality, when the patients are children[19,20], and when obese children become adults[13,21]. This increase disease burden is associated with significantly increased medical cost[22,23]. Most proposals to reduce childhood obesity and its consequences involve subsidy or other support by government or insurers[24]. The proposal to increase the tax on sugary drinks has the potential to decrease obesity by discouraging unhealthy behavior, while possibly increasing funds available to treat the consequences of obesity, and recouping the public costs of induced obesity.

Limitations: We do not model dietary or several social variables which might help explain our high rates of obesity. BMI is a frequently used measure of obesity, but it is not as precise as anthropomorphic measures, nor does it account for different types of obesity and their effect on morbidity[25].

Future research including socio-economic and insurance variables may shed additional light as to why these rates are so high. We may also be able to include some insurance and cost information to more precisely measure the economic consequences of obesity. Future research may also be able to more directly model the connection between sugar consumption, obesity, morbidity, mortality, and direct and indirect costs.

Conclusion: Childhood obesity rates among children treated at New York City public hospitals are among the highest reported in large population studies; the majority of children are overweight or obese. The racial breakdown shows expected relatively high rates among Blacks and Hispanics; the high rate of white children is not expected based on most existing literature. These high rates of overweight and obesity are expected to lead to future health and economic costs.

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