



Ottawa County Health Department

Survey of Body Mass Index among Ottawa County Third Graders 2010-2011

INTRODUCTION

Obese children are at risk for serious health problems during their childhood and are significantly more likely to become obese as adults. Documented childhood and adult health risks linked to obesity include cardiovascular disease, type 2 diabetes, asthma, gall bladder disease, sleep apnea, osteoarthritis, some types of cancer, and social discrimination. The prevalence of obesity nationally among 6-11 year olds has increased in the last 30 years from 6.5% (1976-1980) to 19.6% (2007-2008).¹ Numerous factors have been associated with this increase including higher caloric intake, increased sedentary behavior, and socioeconomic stress.

To assess the prevalence of childhood obesity locally, the Ottawa County Health Department (OCHD) initiated a survey of body mass index (BMI) among local youth. During the 2004-2005 school year, the OCHD measured the BMI of a random sample of pre-kindergarten, third grade and sixth grade students in Ottawa County. Following data collection and analysis of those first year results, the OCHD narrowed the population for assessment to local third graders only for the 2007-2008 school year. In addition, the Department compared the results among the students attending private schools, higher income public schools, and lower income public schools. In 2010-2011, the survey was completed again sampling third graders by school type. The complete reports from the previous BMI surveys, as well as BMI data on other age groups in Ottawa County, can be viewed at www.miottawa.org/health.

RESULTS

Overall, 653 Ottawa County third graders from 18 different schools were assessed for BMI (Table I and Table II). Of those sampled, 9.3% of students were classified as obese (Figure 1). The type of school attended was a significant risk factor for obesity. Specifically, 17.6% of students in lower income public schools were classified as obese compared to 9.7% of students in higher income public schools and 4.1% of students in private schools (Figure 1). After adjusting for gender, students in lower income public schools were 5.0 times (95% CI=1.4-18.3) more likely to be obese than students in private schools. Students in lower income public schools were 2.04 times (95% CI=1.3-3.1) more likely to be obese compared to students in higher income public schools. Students attending higher income public schools were not more likely to be obese than private school students (the 95% CI for odds ratio contained 1). Finally, gender was not significantly associated with any of the BMI categories (Figure 2).

Since three cycles of collected BMI data were available for Ottawa County third graders, an analysis was done to assess whether or not there has been any statistically significant change in BMI or weight category from the 2004-2005 school year to the 2010-2011 school year. There was no evidence of a significant difference in either the mean BMI or the percent distribution of third graders by weight category across the three survey periods (see Table IV and Figure 3).

DISCUSSION

Findings

Among Ottawa County third graders, 9.3% of students were classified as obese and an additional 15.4% were classified as overweight. Although the prevalence of obesity in Ottawa County is lower than the national average for 6-11 year olds (19.6% in 2007-2008¹), there were significant differences among students attending the three school types included in the survey. Students in lower income public schools had the highest prevalence of obesity (17.6%) followed by students in higher income public schools (9.7%) and private school students (4.1%). These school categories are assumed to be a rough indicator of individual socioeconomic position which has been inversely associated with childhood obesity.² In other words, as overall household income decreases there is an association with an overall increase in the proportion of children who are obese. To our knowledge however, this is the first study to demonstrate this association among students at the local level.

In the United States, the National Center for Health Statistics (NCHS), a division of the Centers for Disease Control and Prevention, has been monitoring child and adolescent BMI since the early 1960's.¹ The NCHS separates youth into three age groups: 2-5 years old, 6-11 years old and 12-19 years old. The 6-11 year old age group may be a useful comparison to Ottawa County's survey of local third graders, though it is a broader age range. In the first NCHS survey period (1963-1965) the overall national prevalence of obesity in youth aged 6-11 was 4.2%. Between this period and 2007-2008, obesity increased to 19.6%, an increase of nearly 500%. While Ottawa County third graders overall have a much lower prevalence of obesity, the prevalence of obesity in lower income public schools is nearly the same as the U.S. prevalence in 2007-2008. At this time, there is no evidence that third grade BMI and obesity has changed in Ottawa County over the past 6 years. It remains to be seen if the distribution of weight categories among local third graders will show future increases comparable to those observed nationally.

Intervention Implications

Interventions aimed at promoting healthy lifestyles among Ottawa County elementary school students should be targeted toward lower income public schools.

Future Research

To better understand the demonstrated association between lower income and obesity in children, future research may want to consider incorporating a variable for each student observation that indicates whether the individual is eligible for the free and reduced lunch program since household income is a qualifying factor for eligibility.

METHODS

Sampling

Stratified cluster sampling was used to randomly select elementary schools for participation in the Ottawa County BMI survey. Ottawa County elementary schools with third graders (n=66) were stratified into three categories: 1) Private schools (n=20) 2) Higher income public schools (n=34) and 3) Lower income public schools (n=12). The income classification of public schools was determined on the basis of free and reduced lunch (FRL) enrollment during the 2008-2009 academic school year.³ Schools with less than 40% of their students enrolled in the FRL program were classified as higher income public schools, and schools with 40% or more of their students enrolled were classified as lower income public schools (see Table I). FRL program information is not available for private schools. Schools in each category were then randomized,⁴ and invited to participate in the survey. If a school declined to participate, the next school in the randomly generated list was contacted until a sufficient number of third graders were achieved for the sample in that stratum. Lower income public schools were

oversampled to ensure an accurate assessment of this at-risk population and to match the sampling methodology of the previous 2007-2008 survey. Overall, the minimum number of students necessary to obtain an estimate of the obese or overweight population of third graders in Ottawa County was 700 (twice the sample size for a true random sampling strategy).⁵ The number of third graders in the final sample, which included oversampling of schools in the lower income public school stratum, was 1005. After duplicate analysis of the 2010-2011 data with and without oversampling of the third grade student population in lower income public schools, there is no evidence that oversampling has an effect on the statistical conclusions of the study. Therefore, this report contains the analysis of the smaller sample of third graders with oversampling removed (n=653). To reduce both time and staff resources, future surveys may want to consider a smaller sample size (750 to 800) that is proportional to the distribution of third graders in the three assessed school types within the county (See Tables V & VI) .

Measurement

Consent for student participation was passively obtained from parents. All consenting third graders in attendance on the day of a screening were measured for height and weight in a private, participant blinded setting without footwear or large, bulky outer layers. Height and weight measures were obtained in duplicate using a digital scale and a tape measure attached to a flat vertical surface. After the initial weight measure, students were told to step off the scale while the scale was recalibrated. If the second weight measurement differed by more than 0.25 pounds from the initial reading, a third measurement was taken. Similarly, if the second height measurement was more than 0.25 inches different from the first height, a third measurement was taken. Height measurements were recorded by hand to the nearest quarter of an inch using a hand-held right angle while weight measurements were recorded to the nearest tenth of a pound. Additional information recorded included the student's date of birth, the student's gender, and date of measurement. All recorded information was then entered into a Microsoft Excel database.

Analysis

Average height and weight were calculated using the two closest measurements. If three measurements were equally spaced, the two lower measurements were used in order to prevent an overestimation of body mass index. Body mass index was calculated using the formula $BMI = (\text{Weight in kilograms})/(\text{Height in meters})^2$. Age and gender specific BMI percentiles were calculated using a custom developed Excel formula modified from available youth BMI percentile programs from the Centers for Disease Control.⁶ BMI-for-age was classified using the scale in Table III.

SAS version 9.2 was used to analyze the data. All county-wide estimates were weighted based on the probability of selecting schools in the different strata to adjust for the stratified cluster sampling design. Logistic regression that accounted for the sampling design (Proc Surveylogistic) was used to assess which variables might be associated with obesity and to estimate the odds of being obese by school type after adjusting for gender.

Limitations

Student-level socioeconomic information was not obtained so a direct association between BMI and socioeconomic position could not be assessed. Further, the classification of higher and lower income schools was based on FRL enrollment for the 2008-2009 academic year, which may not accurately reflect the income of the families of students attending the school during the 2010-2011 academic year. Finally, family socioeconomic position is influenced by a complex group of variables including race, ethnicity, neighborhood, parental education, and family makeup. None of these factors were measured in this study thereby preventing an in-depth analysis of their association with childhood obesity.

Two limitations were encountered when analyzing the longitudinal (year to year) results. First, the raw data set for the 2004-2005 academic year survey did not indicate grade level. Instead of grade, age in months was recorded for each student. The three age groups surveyed were reported as pre-kindergarten, third grade and sixth grade, so some judgment was used in selecting the observations in that data set that represented third grade students. Second, the 2004-2005 academic year data did not utilize a sample design based on school type (higher income, lower income and private); the sample consisted of schools randomly sampled from all Ottawa County schools.

To make comparisons among all three academic years, the two later years' samples had to be adjusted to remove oversampling in the low income school category (stratum). The samples were adjusted to reflect the true proportional distribution of third graders in the county by school type during each of the academic years. For example, the 2010-2011 sample consisted of approximately 42.5% of randomly sampled higher and lower income public schools and 15% of randomly sampled private schools. The true proportion of school types was 65% higher income public, 20% lower income public and 15% private school. Following randomized removal of the oversampled lower income school students for the 2007-2008 and 2010-2011 data sets, a simple random sample of 500 third graders was drawn from each of the three survey periods and combined into a single longitudinal data set containing an additional variable for academic year. As a result, the 2004-2005 and 2007-2008 results in this report may not match those published in the reports issued for those survey years. In addition, the percentages reported for 2010-2011 on Figure 3 may vary slightly from the others presented throughout the report.

TABLES AND FIGURES

Table I: Description of Elementary School Buildings Included in the Assessment

School Type	Buildings Sampled	FRL Range*	FRL Average*
Private	4 of 20	N/A	N/A
Public-Higher Income	6 of 34	14.3%-22.8%	22.5%
Public-Lower Income	8 of 12	40.0%-77.0%	67.2%

* % of students enrolled in the Free and Reduced Lunch program (2009-2010)

Table II: Characteristics of Students Included in the Assessment

	N	%
Total Students	653	
Gender		
Male	321	50.8%
Female	332	49.2%
School Type		
Private	98	15.0%
Public-Higher Income	424	64.9%
Public-Lower Income	131	20.1%

Table III: Child & Adolescent Weight Categories

Weight Category	BMI Percentile Range
Underweight	< 5 th percentile
Healthy Weight	5 th - < 85 th percentile
Overweight	85 th - < 95 th percentile
Obese	≥ 95 th percentile

Table IV: Comparison of Percent Distribution of Weight Category by Survey Year

Year	Obese	Overweight	Healthy Weight	Underweight
2004-2005	9.4%	14.4%	73.0%	3.2%
2007-2008	10.6%	14.8%	72.2%	2.4%
2010-2011	10.4%	15.0%	70.4%	4.2%

*Based on a re-sampled data set with a simple random sample of 500 for 2004, 2007, 2010 and removal of school type oversampling for 2007 & 2010

**Chi Square tests for Equal Proportions are not significant

Table V: Distribution by School Type after Removal of Oversampling

School Type	Count	Percent
Private Schools	98	15.00%
Public, High Income	424	64.93%
Public, Low Income	131	20.06%
TOTAL	653	

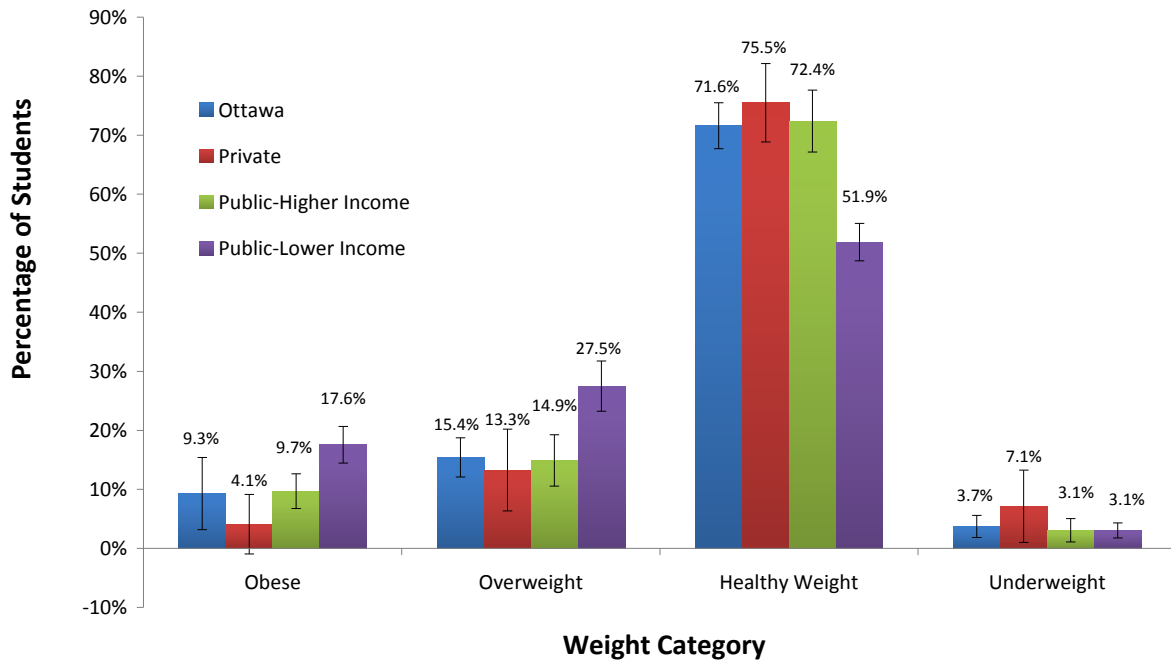
*Income based on % of students eligible for Free/Reduced Price Lunch

Table VI: Distribution by School Type with Oversampling

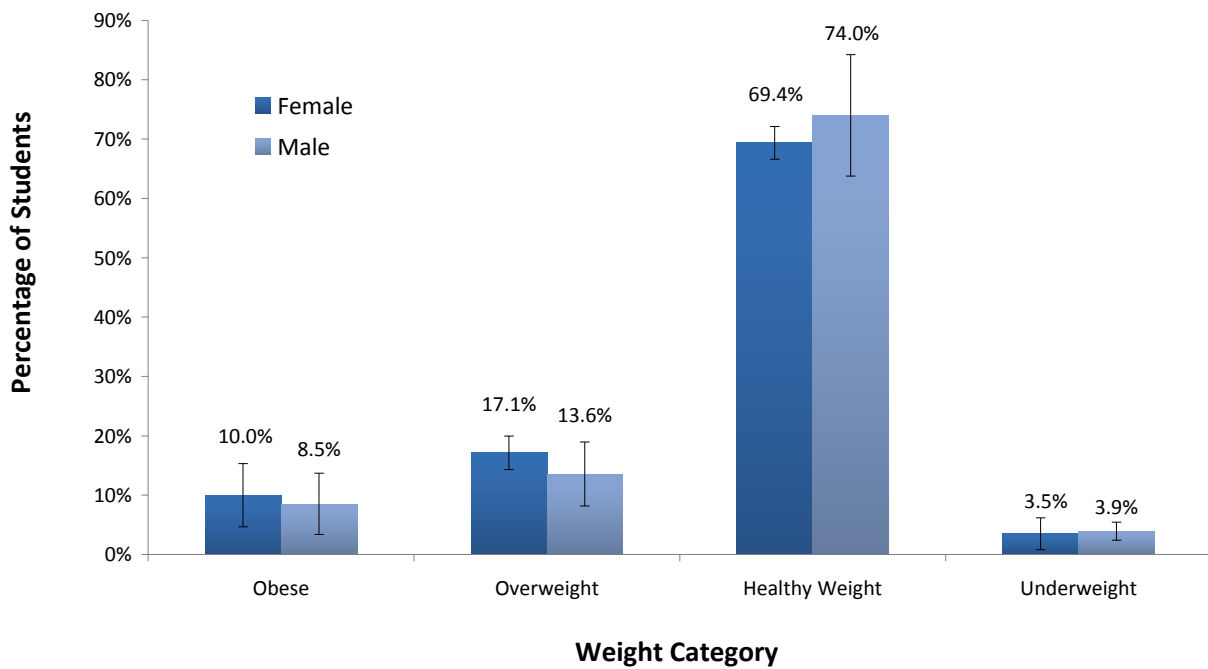
School Type	Count	Percent
Private Schools	136	13.53%
Public, High Income	424	42.19%
Public, Low Income	445	44.28%
TOTAL	1005	

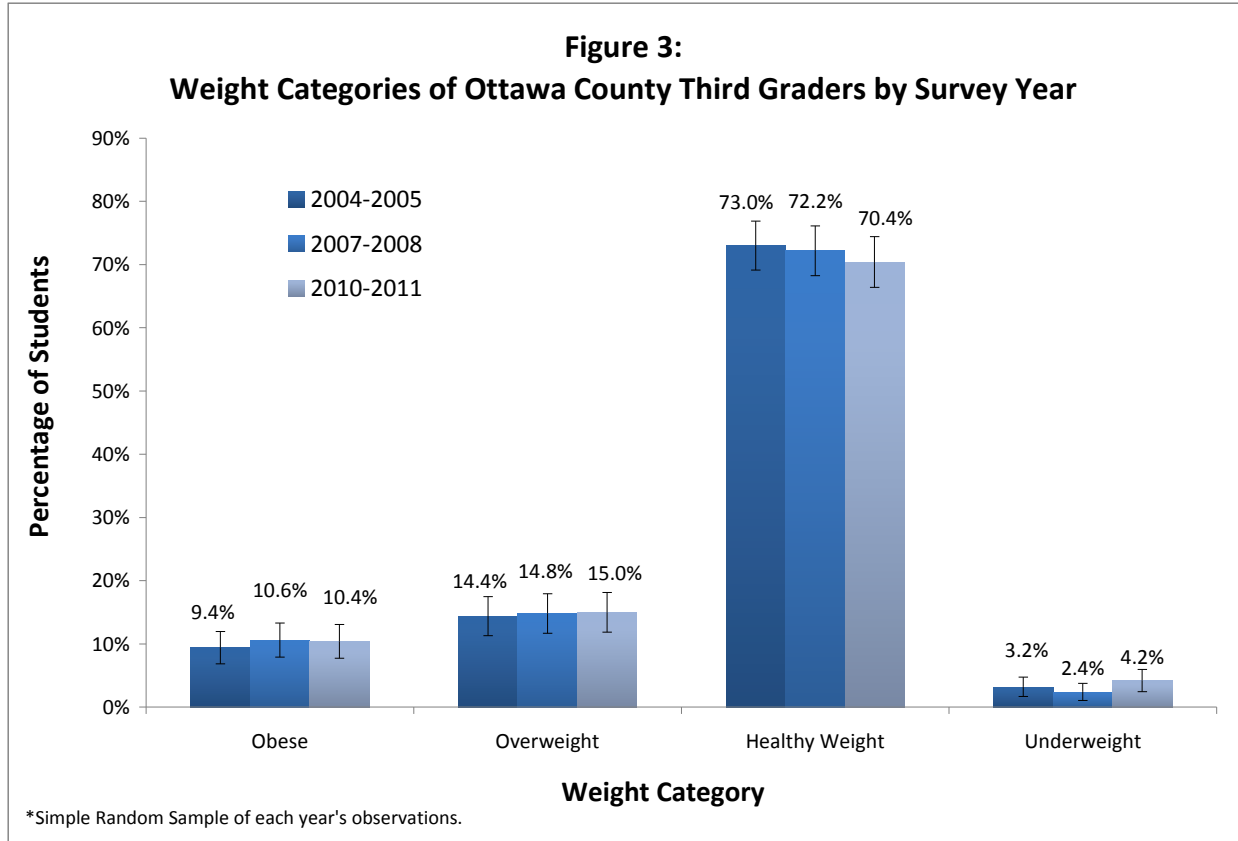
*Income based on % of students eligible for Free/Reduced Price Lunch

**Figure 1:
Weight Categories of Ottawa County Third Graders by School Type, 2010-2011**



**Figure 2:
Weight Categories of Ottawa County Third Graders by Gender, 2010-2011**





REFERENCES

¹ NHANES data on the Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963–1965 Through 2007–2008. CDC National Center for Health Statistics, Health E-Stat.

http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm

² Shrewsbury V and Wardle J. 2008. Obesity (Silver Spring). Socioeconomic status and adiposity in childhood: a systematic review of cross sectional studies 1990-2005. 16(2): 275-284.

³ Michigan Center for Education Performance & Information. http://www.michigan.gov/cepi/0,1607,7-113-21423_30451_36965---,00.html Accessed May 25th, 2010.

⁴ Stattek.com. <http://stattrek.com/Tables/Random.aspx>. Accessed March 4th, 2010

$$^5 n = x \cdot \left(\frac{z^*}{m} \right)^2 \cdot p(1-p) \text{ ----- } z^* = 1.96; m = 0.05; p = 35\% = \text{proportion at risk}; x = 2 = \text{cluster sample factor}$$

⁶ A SAS Program for the CDC Growth Charts. <http://www.cdc.gov/nccdphp/dnpa/growthcharts/resources/sas.htm> Downloaded and saved as an Excel spreadsheet with macros.