I, Elisa Morath, hereby submit this original work as part of the requirements for the degree of Master of Science in Nutrition.

It is entitled:
The Associations among BMI and Race, Gender and Socioeconomic Status in Third Graders in Cincinnati Public Schools

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This work and its defense approved by:

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The Associations among BMI and Race, Gender and Socioeconomic Status in Third Graders in Cincinnati Public Schools

A thesis submitted to the
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ABSTRACT

Objectives. To determine whether there are associations among body mass index (BMI), gender, race and socioeconomic status in third graders from Cincinnati Public Schools (CPS).

Design. Cross-sectional study

Participants/Setting. Participants were third graders (N=1,511) from 27 elementary schools located in the Cincinnati Public School district in Hamilton County, Ohio. Schools were selected based on percent participation in the National School Lunch Program (NSLP), which was chosen as an indicator of socioeconomic status (SES).

Outcome Measures. Weight status based on BMI category as indentified by BMI percentile.

Methods. Height and weight of third graders at each school were measured using standard practices with a scale and stadiometer. Measurements were taken throughout the 2010-2011 school year. BMI and BMI percentile were calculated using standard calculations by PowerSchool, an online program used by CPS to monitor and house various student data including race, gender and age. Data was then recoded for statistical analysis.

Results. A significant association was found between BMI category and participation in the NSLP ($\chi^2 = 29.739, p<.001$). There was also a significant association between BMI category and race ($\chi^2 = 37.533, p<.001$), with students classified as “other” race having the highest percentage of both overweight and obesity, while students in the white group had the highest percentage of underweight and normal weight. No significant association between BMI category and gender was found ($\chi^2 = 3.647,$
A significant association was, however, found between BMI category and gender within the highest quartile of participation in the NSLP ($\chi^2 = 12.399, \ p= .006$). Lastly, a significant association was found between BMI category and race within the lowest quartile of participation in the NSLP ($\chi^2 = 16.686, \ p= .011$).

**Conclusion.** While no association between BMI category and gender was found, African-American students and other non-white students were more likely to be overweight and obese, regardless of participation level in the NSLP. A significant association between BMI category, level of school participation in the NSLP, and gender was found, demonstrating that third-grade girls attending a school with a high participation in the NSLP were more likely to be overweight or obese than boys attending the same schools. Also, a significant association was found between BMI category, race and participation in the NSLP, indicating that African-Americans and non-white races still have an increased prevalence of overweight and obesity even in schools with higher SES status.
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INTRODUCTION

The rise in childhood obesity is a major public health concern both in the United States and developed countries around the world. Since 1980 the prevalence of obesity, as defined as a body mass index (BMI) above the 95th percentile, has tripled among school-age children and adolescents in the United States and remains at 17%.1

Many factors are thought to be associated with the childhood obesity epidemic including race, socioeconomic status (SES) and genetics, as well as many lifestyle choices including increased fast food and sugary beverage consumption, and sedentary behaviors such as watching television or playing video games.2,3 School food environment, access to fresh foods including fruits and vegetables, and nutrition education are also thought to be associated with weight status.4,5

The rise in overweight and obesity among children in the United States has been seen across genders and ethnic groups, but several studies have demonstrated an overwhelming proportion of overweight and obesity among minorities, particularly African-Americans and Hispanics.6,7,8,9 However, no significant change in weight status has occurred from 1999-2006 for non-Hispanic white, non-Hispanic black, and Mexican-American boys and girls.1

The current study will evaluate the extent to which BMI categorization, underweight, normal weight, overweight or obese as defined by the Centers for Disease Control (CDC)10, is associated with gender, race and SES. For the purposes of this study, SES will be defined by percentage of school participation in the National
School Lunch Program (NSLP) from 27 elementary schools in the Cincinnati Public School (CPS) district in Cincinnati, Ohio.

**REVIEW OF LITERATURE**

**Childhood Obesity**

Overweight and/or obese children have higher rates of increased blood pressure, poor blood lipid levels, and type 2 diabetes.\(^1\) Childhood obesity also increases the risk for obesity in adulthood, putting those adults at an increased risk for cardiovascular disease, diabetes and certain cancers.\(^1\) Overweight and/or obese children have also been found to have increased absences from school, need for disciplinary action, depression, anxiety, withdrawal, and low self-esteem.\(^{11,12}\) Concern and anxiety over poor body image has also been seen by children in as young as the third-grade. Poor self-image issues are associated with early dieting and restraint, leading to disordered eating behaviors into adolescence and adulthood and an increased risk of obesity.\(^{11}\)

**BMI and Socioeconomic Status**

Socioeconomic status (SES) has also been found to be a key indicator of weight status. For years, children in higher SES groups were perceived to be of more normal weight, while children in lower SES groups were perceived to be overweight or obese.\(^6\) However, this is not the case among all races, and economic disparities appear to be shrinking in recent years. Based on NHANES data from 1999-2002, a reverse association between SES and weight status only existed in white girls, not boys. In African-American children and adolescents, a positive association existed in girls, and African-American adolescent girls with a high SES were actually more
likely to be overweight than those in a medium SES. In Mexican-American children, however, no associations between SES and overweight were found.\textsuperscript{6,13}

Another SES factor, health insurance status, might also be contributing to the high obesity rates, as children and adolescents without health insurance are associated with overweight status.\textsuperscript{9} Children in single-parent households, households with parents with fewer years of education, and children of immigrant parents are also more likely to be of overweight status.\textsuperscript{9,14}

**National School Lunch Program**

The National School Lunch Program (NSLP) is a federally assisted meal program that provides free and reduced lunches in public and non-profit private schools and childcare institutions across the United States. In 2009, the program provided lunches to over 31 million school children each day.\textsuperscript{18}

Schools that participate in the NSLP are provided reimbursement and donated commodity foods from the United States Department of Agriculture (USDA.) Participating schools must provide lunches that meet the following federal Dietary Guidelines for Americans: no more than 30% of calories come from fat; less than 10% from saturated fat; and one-third of the Recommended Dietary Allowances of protein, Vitamin A, Vitamin C, iron, calcium, and calories must be met.\textsuperscript{18} Student eligibility for free lunch is based on family income at or below 130% of the poverty level. Students from families with incomes between 130 and 185% of the poverty level are eligible for reduced-price lunch, which students can be charged no more than 40 cents per meal.\textsuperscript{18}
It is the position of the American Dietetic Association that the NSLP plays a crucial role in providing necessary nutrients for low income families, including fresh fruits and vegetables to children who may otherwise not receive them at home.\textsuperscript{5} In a recent study conducted by the Food and Nutrition Service of the United States Department of Agriculture, students participating in the NSLP were found to consume more fruit juice for breakfast and one more vegetable per lunch than their non-participating student counterparts.\textsuperscript{5}

While the NSLP aims to provide nutritionally balanced meals and prevent under-nutrition, it may not adequately address the concern for over-nutrition.\textsuperscript{13} The program has undergone recent criticisms for contributing increases in dietary fat and calories to children participating in the program.\textsuperscript{14} However, whether or not participation in the NSLP is a contributing factor to the obesity epidemic is not yet clear. Previous studies have exhibited mixed findings; however multiple studies have shown that an increase in the weight-status of low-income girls is associated with participation in the NSLP, and is more so affected than boys participating in the program. Girls participating in the program also have a higher weight status than other low income girls not participating in the program.\textsuperscript{14}

In a study by Hernandez et al., the BMIs of kindergarten through fifth grade students participating in the NSLP were evaluated to determine a relationship between NSLP and weight status. Additional factors were also considered, such as physical activity level, television viewing, and maternal characteristics.\textsuperscript{14} The results indicated that low-income girls who participate in the NSLP have a faster rate of weight change than low-income girls who do not participate in the program.
Additionally, low-income boys participating in the program did not show a significant difference over low-income boys who did not participate. This finding demonstrates an association between NSLP participation and weight status on low-income girls versus boys.\textsuperscript{14}

In earlier studies by Millimet et al and Schanzenbach, an association between NSLP participation and obesity was found in first and third-graders when examining longitudinal data from the Early Childhood Longitudinal Study-Kindergarten (ECLS-K.) Significant increases in weight were found in both first and third-graders who participate in the NSLP. However, no significant differences were found between genders in either study.\textsuperscript{14}

**BMI as a Determinant of Weight Status**

Weight status can be determined and defined by BMI, a measurement screening tool for weight status widely accepted for use among children due to its ease of collection and correlation to percent body fat.\textsuperscript{15,16} Using BMI to assess fatness in children assumes that BMI should represent adiposity independent of age, race and sex.\textsuperscript{16} However, studies have shown that sexual maturation, not age, may be the best indicator of BMI status, as girls with a higher stage of sexual maturation but the same BMI as boys will have higher body fat.\textsuperscript{16} Despite its limitations, BMI measurement in children does have a high sensitivity in indicating excess adiposity in overweight and obese children.\textsuperscript{17}

**Healthy Choices for Healthy Children Act**

Ohio Senate Bill 210, also known as the Healthy Choices for Healthy Children Act, was signed into law on June 18, 2010. This act enforces several measures to
combat childhood obesity in Ohio’s public schools, including limiting the availability of sugary beverages, increasing physical activity, and ensuring access to healthy meals and beverages.\textsuperscript{19} In relation to this study, this act requires all Ohio public schools to annually conduct BMI screenings for all kindergarten, third-grade, fifth-grade and ninth-grade students. This data must then be reported to the Ohio Department of Health each year. This new act required schools to complete these assessments starting in the 2010-2011 school year.\textsuperscript{19} Thus, Cincinnati Public Schools (CPS) and the Cincinnati Health Department utilized the help of volunteers from the University of Cincinnati to accomplish completing the data collection for this new state mandate. Part of the data collected is presented here.

\textbf{Purpose and Hypothesis}

The purpose of this study was to determine the extent to which BMI is associated with gender, race, and SES (as defined by school participation in the NSLP) among third-graders in CPS. Based on previous findings\textsuperscript{1,6,7,8,9,14}, the hypotheses are as follows: there will be no significant association between BMI category and gender; there will be a significant association between BMI category and race; there will be a significant association between BMI category and SES; and there will be a significant association between BMI category and gender or race, within the highest quartile of participation in the NSLP.
METHODS

Sample

Data from 1,598 third-grade students from 27 Cincinnati Public Schools located in Hamilton County, Ohio were chosen for analysis in this study. Inclusion criteria included attending the third grade and being between eight and 12 years of age. Subjects were excluded if they were less than eight years of age, older than 12 years of age, refused BMI measurement, or were missing demographic data such as race and gender. The final sample size used for analysis was 1,511 students.

Data Collection Method

Height and weight for each third-grade student were assessed by the school nurse, Cincinnati Health Department nurse, or student volunteers from the University of Cincinnati’s Nursing College and/or Department of Nutritional Sciences. Height was measured using a wall or portable stadiometer while student shoes were removed. Weight was measured using existing school scales or a portable scale provided by the University of Cincinnati. Weight was measured with student shoes and any heavy outerwear removed, such as sweatshirts or jackets. Height and weight at each school were measured in the school nurse’s office or in a large room, such as the school gymnasium or all-purpose room.

Height and weight data were then entered into PowerSchool, an online program used by CPS to store and compute various student data. PowerSchool then computed BMI and BMI percentile and categorized each student as underweight, normal weight, overweight, or obese. BMI was calculated by dividing weight in kilograms by height in meters squared. BMI categories based on percentile were
determined to be the following: less than 5\textsuperscript{th} percentile=underweight, 5\textsuperscript{th} to 84.99\textsuperscript{th} percentile=normal weight, 85\textsuperscript{th} to 94.99\textsuperscript{th} percentile=overweight, and greater than or equal to 95\textsuperscript{th} percentile=obese. Race, gender and age information were already stored in PowerSchool for each student. Each of the 27 school's participation percentage in the NSLP was provided by the Cincinnati Health Department. Data including BMI, BMI category, race, gender, age, and participation in the NSLP were then analyzed.

**Coding the Data**

To interpret the demographic and BMI data collected for each student and each school, the results were recoded for statistical analysis. BMI category, race and gender were each assigned a numerical value. BMI category was separated into four categories: underweight, normal weight, overweight and obese. Race was divided into three categories: African-American, white, and other. Other included multi-racial, Hispanic, Asian, American Indian/Alaskan, Pacific Islander/Hawaiian, or unidentified. School participation percentage in the NSLP was divided into quartiles: $\leq 43.5\%$, 43.6\% - 78.95\%, 78.96\% - 92.56\%, and 92.57\% - 100\%.

**Statistical Analysis**

Data was entered into Statistical Package for the Social Sciences (version 18.0, 2010, SPSS, Inc., Chicago, IL). Chi-square tests were used to determine the associations between BMI category and gender, BMI category and race, and BMI category and participation in the NSLP. Chi-square tests were also used to determine the association between BMI category and gender or race, within each quartile of participation in the NSLP.
RESULTS

Demographics

Among the 1,511 third-grade students in the study, boys comprised 50.3% of the sample and had a mean BMI of 18.4, while girls made up 49.7% of the sample and had a mean BMI of 18.7. There were no significant differences between genders as shown in Table 1. Of the total 1,511 students, 992 (65.7%) were African-American, 406 (26.9%) were white, and 113 (7.5%) were of other race. The mean age of all students was 9.1 years, with the lowest age equaling 8.0 years and the maximum age equaling 11.6 years.

Of the total sample size, 52 (3.4%) students were categorized as underweight, 953 (63.1%) as normal weight, 229 (15.2%) as overweight, and 277 (18.3%) as obese. The total combined overweight and obese students equaled 33.5%, or more than one-third of the sample. Regarding participation in the NSLP, the smallest portion of the sample represented the lowest quartile of participation, with only 21.2% of the sample representing less than 43.5% of school participation in the program. The largest portion of the sample represented the largest quartile of participation, with 30.6% of the sample representing the top seven percent of participation in the NSLP as shown in Table 1.
Table 1. Mean Values (SD) and Number (n, %) of Demographic Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total (n=1,511)</th>
<th>Boys (n=761)</th>
<th>Girls (n=751)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>9.1 (.49)</td>
<td>9.1 (.52)</td>
<td>9.0 (.46)</td>
</tr>
<tr>
<td>BMI</td>
<td>18.6 (4.0)</td>
<td>18.4 (3.9)</td>
<td>18.7 (4.1)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>65.7%</td>
<td>65.4%</td>
<td>65.9%</td>
</tr>
<tr>
<td>White</td>
<td>26.9%</td>
<td>26.8%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Other</td>
<td>7.5%</td>
<td>7.8%</td>
<td>7.2%</td>
</tr>
<tr>
<td>BMI Category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>3.4%</td>
<td>1.5%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>63.1%</td>
<td>32.8%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Overweight</td>
<td>15.2%</td>
<td>7.4%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Obese</td>
<td>18.3%</td>
<td>8.5%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Participation in Free/Reduced Lunch Program</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤43.5%</td>
<td>21.2%</td>
<td>10.8%</td>
<td>10.4%</td>
</tr>
<tr>
<td>≥43.6% - ≤78.95%</td>
<td>28.4%</td>
<td>13.2%</td>
<td>15.2%</td>
</tr>
<tr>
<td>≥78.96% - ≤92.56%</td>
<td>19.9%</td>
<td>10.3%</td>
<td>9.5%</td>
</tr>
<tr>
<td>≥92.57% - ≤100%</td>
<td>30.6%</td>
<td>15.9%</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

BMI Category Outcomes

There was a significant association between BMI category and participation in the NSLP (χ² = 29.739, p<.001). The lowest quartile of participation in the NSLP also had the highest percent of normal weight (71.9%). The highest quartile of participation, however, also had the highest within quartile percentage of obesity (21.9%). It is also worth noting that obesity in the highest quartile of NSLP participation (21.9%) was nearly double that of obesity in the lowest quartile of NSLP participation (11.3%). Also, percent of overweight and obesity increased as participation in the NSLP increased, while percent of normal weight decreased as
participation increased. Therefore, it can be concluded that there is an increase in overweight and obesity among the highest quartiles of participation in the NSLP, as shown in Table 2.

Table 2. Weight status and the Participation of National School Lunch Program (NSLP) (N=1511)

<table>
<thead>
<tr>
<th>Participation in Free/Reduced Lunch Program</th>
<th>≤43.5%</th>
<th>≥43.6% - ≤78.95%</th>
<th>≥78.96% - ≤92.56%</th>
<th>≥92.57% - ≤100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>4.1%</td>
<td>5.4%</td>
<td>2.0%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>71.9%</td>
<td>61.8%</td>
<td>59.3%</td>
<td>60.6%</td>
</tr>
<tr>
<td>Overweight</td>
<td>12.8%</td>
<td>14.7%</td>
<td>18.0%</td>
<td>15.4%</td>
</tr>
<tr>
<td>Obese</td>
<td>11.3%</td>
<td>18.3%</td>
<td>20.7%</td>
<td>21.9%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pearson Chi Square test, $\chi^2 = 29.739$, df=9, p<.001

There was also a significant association between BMI category and race ($\chi^2 = 37.533$, p<.001). White students had the highest percent of normal weight (70.4%) within their race, and interestingly also had the highest percent of underweight (5.9%). African-American students, however, had the second highest percentage of overweight and obesity within their race, 15.9% and 20.4% respectively, while the other races had the highest percents of overweight and obesity within their races, 16.8% and 27.4% respectively. Obesity within African-American students was nearly twice that of white, and obesity within other races was over 2.5 times that of white students, as shown in Table 3.
Table 3. BMI Category and Race (% Within Race) (N=1511)

<table>
<thead>
<tr>
<th>BMI Category</th>
<th>African-American</th>
<th>White</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>2.5%</td>
<td>5.9%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>61.2%</td>
<td>70.4%</td>
<td>53.1%</td>
</tr>
<tr>
<td>Overweight</td>
<td>15.9%</td>
<td>12.8%</td>
<td>16.8%</td>
</tr>
<tr>
<td>Obese</td>
<td>20.4%</td>
<td>10.8%</td>
<td>27.4%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pearson Chi Square test, $\chi^2 = 37.533$, df=6, p<.001

Regarding BMI category and gender, there was no significant association found ($\chi^2 = 3.647$, p=.302). However, girls had a slightly higher percentage in obesity, while boys had a non-significant increase in normal weight, as shown in Table 4.

Table 4. Percentage of BMI Category by Gender (N=1511)

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>3.0%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>65.3%</td>
<td>60.9%</td>
</tr>
<tr>
<td>Overweight</td>
<td>14.7%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Obese</td>
<td>17.0%</td>
<td>19.7%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pearson Chi Square test, $\chi^2 = 3.647$, df=3, p=.302

A significant association was also found between BMI category and gender within the highest quartile of participation in the NSLP ($\chi^2 = 12.399$, p=.006). In the highest quartile of participation, defined as a school’s participation ≥92.57% - ≤100%, girls had over 2.6 times the percent of underweight and 1.73 times the amount of obese weight status than boys. Therefore, it can be concluded that third-grade girls attending a school with the highest percent participation in the NSLP had much higher rates of obesity and underweight than boys, as shown in Table 5.
Table 5. BMI Category and Gender Within the Highest Quartile of Participation in Free/Reduced Lunch Program (N=462)

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>1.2%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>66.4%</td>
<td>54.3%</td>
</tr>
<tr>
<td>Overweight</td>
<td>16.2%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Obese</td>
<td>16.2%</td>
<td>28.1%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pearson Chi Square test, $\chi^2 = 12.399$, df=3, $p=.006$

Lastly, a significant association was found between BMI category and race within the lowest quartile of participation in the NSLP ($\chi^2 = 16.686$, $p=.011$). Other races had the highest percent of within race overweight and obesity, 23.7% and 18.4% respectively. This is equivalent to 2.75 times the percent of overweight whites and 1.4 times the percent of overweight African-Americans. Whites had overall higher percents of normal weight status, and the lowest percents of overweight and obese status. This data indicates a significant association of increased overweight and obesity in both other races and African-Americans, even in schools with the highest SES, as shown in Table 6.

Table 6. BMI Category and Race within the Lowest Quartile of Participation in Free/Reduced Lunch Program (N=320)

<table>
<thead>
<tr>
<th></th>
<th>African-American</th>
<th>White</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>2.1%</td>
<td>4.8%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>66.3%</td>
<td>78.6%</td>
<td>52.6%</td>
</tr>
<tr>
<td>Overweight</td>
<td>16.8%</td>
<td>8.6%</td>
<td>23.7%</td>
</tr>
<tr>
<td>Obese</td>
<td>14.7%</td>
<td>8.0%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pearson Chi Square test, $\chi^2 = 16.686$, df=6, $p=.011$
DISCUSSION

As predicted based on previous literature, BMI category and gender in this study did not show any significant association. However, when BMI category and gender were further examined within the quartiles of participation in the NSLP, a significant association was shown related to increased percentages in both obesity and underweight among third-grade girls attending schools with the highest participation in the program. This high participation is an indicator of school population with lower SES, thus suggesting that third-grade girls attending lower SES schools are more likely to be either obese or underweight than boys attending schools of lower SES.

While this study also demonstrated, similar to previous studies, that BMI category and race were associated, this study shows a greater association between overweight and obesity among other races than African-Americans. For the purposes of this study, multi-racial and Hispanic children were combined with other races such as Asian, American Indian/Alaskan, Pacific Islander/Hawaiian, and unidentified. However, due to the limited sample of multi-racial and Hispanic students, these races could not be analyzed individually and therefore it is unclear which race most contributed to this vast increase. Based on the literature, however, one can conclude that multi-racial and Hispanic third-graders likely contributed significantly to these results.

Regarding BMI category and SES, the results of the current study are again in line with previously conducted research. SES does seem to be an indicator of BMI category, with the lowest percent participation in the NSLP being associated with
higher frequency of normal weight, and the highest percent participation being associated with higher percentages of obesity. The implications of these findings may suggest a possible link between overweight and obesity and one’s participation in the NSLP.

While the current study does have several strengths including its large sample size, validated data collection method, and relevance to today’s current obesity crisis among children, this study does have several limitations. The current study only looks at the relationship between one SES factor and BMI category, failing to examine the relationship between each specific child’s SES status and his or her associated BMI category. Instead, the current study was limited to using percent participation in the NSLP as the only socioeconomic factor. An individual or school’s eligibility in the program, instead of percent participation, may have been a more accurate determination of SES. This study also does not include data from other potential influential factors on weight status such as dietary intake patterns, school food environment, food accessibility and availability, and food preferences. It also does not examine the relationship between physical activity and weight status, which has been proven to be a highly influential factor for various ethnic groups and genders in previous studies.8

Also, while BMI assessment has been validated as an acceptable measure of determining weight status among large sample sizes, particularly in children, it does not address other important health indicators such as fat mass, fat distribution, waist circumference, waist-to-height ratio, or biochemical markers such as blood lipid levels.15 Using BMI in children to predict weight can also have limitations
because of its association with maturation.\textsuperscript{15} It also cannot distinguish between body fat, muscle mass, skeletal mass, and can often result in errors particularly during growth spurts in children.\textsuperscript{17} Additional equipment used to measure fat mass, such as dual-energy radiograph absorptiometry (DEXA), would have provided additional information and more accurate determinations of body fatness, however financial limitations due to the scope of this study prevented such measures.\textsuperscript{17}

Lastly, the same height and weight measuring equipment was not used in all schools, leading to possible inconsistencies among results and limiting the accuracy of the equipment. Also, varying staff and volunteers assessed the height and weight of the students, thus again providing possible inconsistencies and limiting the data’s validity.

\textbf{CONCLUSION}

This study evaluated the associations between BMI category (underweight, normal weight, overweight, and obese) and gender, race and socioeconomic status as determined by school participation in the NSLP. While no association between BMI category and gender was found, significant associations between BMI category and race were found to be consistent among previously published data. As predicted, African-American students and other non-white students were more likely to be overweight and obese, regardless of participation level in the NSLP. This may indicate that race, rather than socioeconomic status, is a stronger predictor of weight status. Interestingly, this study also demonstrated a significant association between BMI category and gender, and level of school participation in the NSLP.
Third-grade girls attending a school with a high percentage of participation in the NSLP were more likely to be overweight or obese than boys attending the same schools. Significant findings were also made regarding BMI category, race, and SES, as significant associations were shown in overweight and obese weight statuses in students in the lowest participation in the NSLP.

The findings of this study serve as a starting point for examining additional mediating factors of BMI category, such as individual SES, school food offerings, activity level, nutrition education, parental weight status, etc. This data may also be useful in developing future intervention programs targeting race, gender and/or low SES status in the third-grade population in Cincinnati’s public schools. The NSLP is a much needed resource for lower socioeconomic status students; therefore local Cincinnati officials should consider intervention methods to address overweight and obesity in this population that would aim to increase healthy food choices at both school and home, increase physical activity, and improve other identified influences on children's weight status. Additionally, intervention programs developed specifically for the lowest income schools would likely be the most beneficial for third-graders from CPS.
REFERENCES


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