Obesity Among Middle School Children: More Cause for School Leaders' Concern?*

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Abstract

In this study, the authors examined the relationship of 1,128 sixth and seventh grade students' grades in four subject areas (i.e., math, reading, science, and social studies) and their scores on the Texas Assessment of Knowledge & Skills (TAKS) Reading, Math, and Writing measures for the 2006-2007 school year as a function of their weight status (i.e., Obese versus Non-Obese). Statistically significant differences were found between the percentage of boys and girls who were Obese, as well as among the ethnic categories of Hispanic, African-American, Asian-Pacific Islander, and White and among grade levels. Obese children were found to have statistically significantly lower course grades in math, reading, science, and social studies. Similar results were present for the three TAKS measures. Implications of our findings are discussed, as well as suggestions for further research.

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Obesity among 6 to 11-year-old children has increased from an estimated 4.2% in 1963-1965 to an estimated 18.8% in 2003-2004 (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). Similar percentages have been reported for adolescents ages 12 – 19, with an estimated 4.6% in 1963-1965 and an estimated 17.4% in 2003-2004 (Ogden, Flegal, Carroll, & Johnson, 2002). These percentage estimates of obesity reflect an increase of approximately 400% in the 40 year time period. Translating these percentages into numbers

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means that about nine million students in the United States who are over the age of 6 meet the Centers for Disease Control and Prevention (CDC, 2007) definition of obesity.

If the focus is placed on a specific state such as Texas, the one in which student data were gathered for this study, the prevalence of children and adolescents being overweight is greater than the national prevalence rates. According to Hoelscher et al. (2005), 42% of Texas fourth grade children, 39% of eighth grade adolescents, and 36% of eleventh grade adolescents were in the weight categories of obese and overweight in 2004-2005. When examining only the obese category, 20% of Texas eighth grade students were obese (Hoelscher et al., 2005), compared with the national average of 17.4% (Ogden et al., 2002). Readers should note that these percentages are substantially higher than the percentages of obesity and overweight at a national level.

Most persons are aware of the health-related consequences of obesity in general, although they may not be familiar with the health-related consequences of obesity in childhood. According to the CDC (2007), children and adolescents who are obese may experience not only immediate health difficulties, but also health difficulties later in adulthood. Health-related difficulties obese children and adolescents may experience include, but are not limited to, cardiovascular disease, high blood pressure, high cholesterol levels, abnormal glucose tolerance, asthma, hepatic steatosis, sleep apnea, and Type 2 diabetes (CDC, 2007, Dietz, 1998; Freedman, Dietz, Srinivasan, & Berenson, 1999; Rodriguez, Winkleby, Ahn, Sundquist, & Kraemer, 2002).

These health-related consequences of obesity have an economic effect as well. Koplan, Liverman, and Kraak (2005) reported that obesity-related hospital visits in 1997-1999 cost 127 million dollars, compared with an estimated cost of 35 million dollars in 1979-1981. In this time period of approximately 20 years, the costs had increased over 300%. With adult obesity alone costing an estimated 129 billion dollars in 2004 and with childhood and adolescent obesity increasing at a tremendous rate, the economic consequences of children and adolescents remaining obese to adulthood are severe (Koplan et al., 2005). If costs for only a single state are analyzed such as Texas, the current costs for dealing with obesity-related health consequences will increase from the current 10.5 billion dollars to an estimated 39 billion dollars by 2040 (Texas Department of State Health Services, 2004). Readers should be able to see the reasons why obesity is viewed as being such a serious national public health priority.

In this investigation, our focus is on the relationship of obesity at the middle school level with student academic performance. More specifically, what difference, if any, does obesity make on student academic performance in the classroom setting and on standardized state assessments? We believe that schools should be concerned about this potential relationship due to the mandates of the No Child Left Behind Act (2001) in which schools are held accountable for their students' academic performance. Schools are already required to analyze their students' academic performance by subgroups to ensure that all students are making adequate yearly progress. Subgroups by which test scores must be disaggregated include, but are not limited to, economically disadvantaged, ethnic membership, and students with special learning needs. To the extent that obesity influences student academic performance, then schools may need to analyze this subgroup's academic test scores.

We believe that the issue of obesity is quite relevant for educational administrators. School leaders have seen a reduction, and in some cases, the elimination of physical education at their schools (Trost, 2007). A t the same time, educational administrators have seen an increase in the percentage of their students who are obese. This reduction and elimination, in some cases, of physical education classes has coincided with an increased emphasis on improving students' test scores in response to the accountability focus of the No Child Left Behind Act (2001). It would be ironic if, in this effort to enhance student achievement by providing more class time, that student obesity would increase, particularly if student obesity influences student academic performance. Educational administrators would be well-advised to examine their physical education programs at their schools, particularly if these programs have been reduced or eliminated at their schools.

Previous researchers have established a relationship between student obesity and academic performance. In a recent study, Crosnoe and Muller (2004) utilized a national database, the National Longitudinal Study of Adolescent Health, to address this issue for adolescents. In an analysis of data from 11,658 students enrolled in 126 schools across the U.S., Crosnoe and Muller (2004) found that adolescents who were at risk of being

obese had lower academic test scores than did adolescents who were not at risk of being obese. Though their study was of much younger children from the Early Childhood Longitudinal Study database, Datar, Sturm, and Magnabosco (2004) reported that the math and reading scores of children who were overweight were significantly lower than the math and reading scores of children who were of normal weight.

In another investigation conducted on overweight school children in grades 7 through 9 in Thailand, Mo-Suwan, Lebel, Puetpaiboon, Junjana (1999) reported that students' grade point averages were statistically related with their weight category. That is, lower grade point averages were present for overweight 7th through 9th grade students in their study than for students in the normal weight category. Also reported by Mo-Suwan et al. was that grade point averages tended to decrease as adolescent weight increased.

In a second international investigation of 10,000 Finnish individuals, Laitinen, Power, Ek, Sovio, and Jarvelin (2002) found that obese individuals at 14 years of age were more likely to have poorer academic performance at 16 years of age than were non-obese individuals. This relationship between weight classification and academic performance was present throughout the age ranges in their study. Findings from this study were supported by Mikkila, Lahti-Koski, Pietinen, Virtanen, and Rimpela (2003) who reported a statistically significant association between obesity and poor academic performance at school. In their study of over 60,000 Finnish adolescents, obese teenagers had lower school performance than did adolescents who were of normal weight. In the most recent research study found in which student weight and academic performance was analyzed, Bagully (2006) utilized the National Longitudinal Survey Year 97 database. In his analysis of the BMI scores of 1,626 teenagers and their test performance in math, he discovered that math test scores were significantly lower for obese students than for students who were not obese.

Until recently, persons who were at or above the 95th percentile on their BMI score were labeled overweight. However, on January 27, 2007, the Expert Committee of the American Medical Association (2007) began using the term obese to describe that same group. This change reflects a major change in terminology from the previous term, overweight. The weight classification for persons whose BMI scores were at or greater than the 85th percentile but lower than the 95th percentile was also changed, from at risk of overweight to overweight. These authors believe that these terminology changes reflect the increased emphasis placed on weight issues in today's times.

1 Purpose of Study

The purpose of this study is to determine the relationship between middle school children's weight and their academic performance, both at the classroom level and at the state level. That is, an examination of sixth and of seventh grade students' weight to their teacher-assigned grades was conducted as was an examination of their weight to their state-mandated assessments. Interest in this study was to obtain further information regarding the relationship of obesity to student performance.

2 Research Questions

The following research questions were addressed in this study:

1. What is the percentage of obesity among sixth and seventh students?
2. What is the difference between Obese and Non-Obese middle school children percentages as a function of student gender, ethnicity, and grade level?
3. What is the difference in student grades in math, reading, science, social studies, and conduct as a function of weight groupings?
4. What is the difference in student scores on the TAKS Reading, Math, and Writing tests as a function of weight groupings?

3 Method

Participants

Participants in this study were 1,166 middle school students (286 sixth grade students and 880 seventh grade students) enrolled in a middle school in an urban city school district located in the Southwest in the 2006-2007 school year. Over half, 50.3% (n = 586), were boys and 49.7% (n = 580) were girls. Regarding ethnicity, the majority of students were White (n = 632, 54.2%), followed by Hispanic (n = 252, 21.6%), Black (n = 185, 15.9%), and Asian-Pacific Islander (n = 92, 7.9%). Concerning students' weights, 4.3% (n = 50) were labeled as being Underweight, 58.1% (n = 677) as being at a Healthy Weight, 17.2% as being Overweight (n = 201), and 20.4% (n = 238) as being Obese. The percentages of students in these four weight categories were separated by grade level (Table 1) and by gender and ethnicity (Table 2).

Table 1

Descriptive Statistics for Weight Categories by Percentage of Students at Each Grade Level

	Obese	Overweight	Healthy	Underweight
Grade Level	%age	%age	%age	%age
Sixth	30.4	17.5	48.3	3.8
Seventh	17.2	17.2	61.3	4.4

Table 1

Table 2

Descriptive Statistics for Weight Categories in Percentages of Students by Gender and Ethnicity

	Obese	Overweight	Healthy	Underweight
Boys	%age	%age	%age	%age
Hispanic	32.3	19.7	45.7	2.4
African-American	22.4	18.8	54.1	4.7
Asian-Pacific Islander	31.3	22.9	35.4	10.4
White	15.4	17.0	63.6	4.0
Girls				
Hispanic	25.6	18.4	52.0	4.0
African-American	22.0	19.0	58.0	1.0
Asian-Pacific Islander	13.6	18.2	56.8	11.4
White	16.9	14.0	64.6	4.5

Table 2

Then, these four weight categories were aggregated into an Obese category and into a Non-Obese category (i.e., Overweight, Healthy Weight, and Underweight category). These aggregated groups resulted in 238 students (20.4%) being labeled as Obese and 928 students (79.6%) as being Non-Obese. Tables 3 and 4 show the numbers and percentages of students labeled as being Obese or Non-Obese separated by gender, ethnic membership, and grade level. Statistical analyses were conducted for the two weight categories of Obese and Non-Obese.

Table 3

Descriptive Statistics for Boys' and Girls' Weight by Ethnic Membership

	Obese		Non-Obese	
Ethnic Membership	N	%	n	%
Boys				
Hispanic	41	32.3	86	67.7
African-American	19	22.4	66	77.6
Asian-Pacific Islander	15	31.3	33	68.8
White	50	15.4	274	84.6
Girls				
Hispanic	32	25.6	93	74.4
African-American	22	22.0	78	78.0
Asian-Pacific Islander	6	13.6	38	86.4
White	52	16.9	256	83.1

Table 3

Table 4
Descriptive Statistics for Boys' and Girls' Weight by Grade Level

	Obese		Non-Obese	
Grade Level	N	%	n	%
Boys				
Sixth	43	27.9	111	72.1
Seventh	83	19.2	349	80.8
Girls				
Sixth	44	33.3	88	66.7
Seventh	68	15.2	380	84.8

Table 4

Instrumentation

The Body Mass Index (BMI), used to determine body fatness in each of the participants, is the ratio of a person's weight to their height squared (Himes, & Dietz, 1994). Though BMI does not directly calculate body fat, it was selected as the principal method for classification because researchers have demonstrated that, for most children and teens, it strongly correlates to measures which do directly calculate body fat (Mei, Grummer-Strawn, Pietrobelli, Goulding, & Dietz, 2002). Due to the age of the participants, BMI-for-age growth charts were utilized to obtain a BMI percentile ranking for each participant. Those percentile rankings were then used to classify each student into one of four weight categories, as defined by the Centers for Disease Control and Prevention (CDC) (2007), in the following manner: Underweight (i.e., Less than the 5th percentile), Healthy Weight (i.e., the 5th to the 84th percentile), Overweight (i.e., the 85th to the 94th percentile), and Obese (i.e., Equal to or greater than the 95th percentile).

Though the term obesity is generally not used to describe children, in recent years both the American Academy of Pediatrics (2003) and the Institute of Medicine of the National Academies (2005) have adopted

the CDC definition of overweight children (equal to or greater than the 95th percentile in BMI) to define obesity. That same standard was applied to the participants of this study for determining obese status.

Procedures

Height and weight measurements used for determining BMI and BMI percentile rankings were obtained at routine health screenings across this urban school district in all middle schools, which typically occurred during the first three months of school. Those measurements were then entered into the district's Health Master software by health professionals. Once entered, the software calculated BMI percentile rankings using BMI-for-age growth charts. The senior researcher then coded each student using CDC (2007) weight classifications, and the standard for determining obesity.

Student indicators and performance data were then added to the health statistics to determine the effects of obesity on student performance. End-of year class grade averages were obtained for Mathematics, Reading, Science, and Social Studies from the district's main database, as were student results on the Texas Assessment of Knowledge and Skills (TAKS) test. The TAKS is the state-required assessment measure and is administered annually to students. Of interest in this study were students' scaled scores on the TAKS Reading, Math, and Writing scores. Readers are referred to the Texas Education Agency website for detailed information about the TAKS, including reliability and validity information (http://www.tea.state.tx.us/student.assessment/[1]). Extensive documentation exists for the reliabilities of TAKS Reading, Math, and Writing scores as well as for the content validity of each of these measures.

4 Results

To determine the extent to which a relationship might be present between student gender and student weight, a Pearson chi-square was conducted. Pearson chi-square procedures are the appropriate statistical procedure when both the independent and dependent variables are categorical or grouping variables. This analysis failed to result in a statistically significant finding, $X2(1, N = 1{,}166) = 0.86$, $p = .353$, Cramer's $V = .02$. In this study, boys (21.5%) and girls (19.3%) had similar percentages of obesity.

To ascertain the extent to which a relationship might be present between student ethnicity and student weight, a Pearson chi-square was conducted. This analysis yielded a statistically significant finding, $X2(3, N = 1{,}161) = 19.14$, $p < .001$, Cramer's $V = .13$. Of the middle school students whose weights and grades were analyzed in this study, 29.0% of Hispanic students were obese, compared with 22.2% of African-American students, 22.8% of Asian-Pacific Islander students, and 16.1% of White students. The effect size for this difference was small (Cohen, 1988).

Because of the statistically significant differences found in the presence of obesity by ethnic membership, two additional Pearson Chi-squares were conducted to determine the extent to which boys and girls differed in obesity among the ethnic categories. A statistically significant finding was present for boys, $X2(3, N = 584) = 18.62$, $p < .001$, Cramer's $V = .18$, but not for girls, $X2(3, N = 577) = 5.68$, $p = .128$, Cramer's $V = .09$. As depicted in Table 3, Hispanic boys (32.3%), Asian-Pacific Islander boys (31.3%), and Hispanic girls (25.6%) had the highest percentage of obesity, with Asian-Pacific Islander girls (13.6%) and White boys (15.4%) having the lowest percentage of obesity. The effect size for the male gender difference was small (Cohen, 1988).

Next, another chi-square, conducted to determine whether a relationship was present between grade level and student weight, resulted in a statistically significant finding, $X2(1, N = 1{,}166) = 23.36$, $p < .001$, Cramer's $V = .14$. The percentage of children labeled as being obese was 30.4% in the sixth grade, compared with a percentage of 17.2% of students in the seventh grade who were obese (See Table 1). The effect size for this difference was small (Cohen, 1988).

Prior to conducting statistical analyses to ascertain whether differences were present in students' course grades and TAKS scores, checks of skewness and of kurtosis were conducted. Of the 14 standardized skewness and kurtosis values (i.e., 4 course grades and 3 TAKS measures), 8 values were outside of the limits of normality. Given the robustness of parametric procedures, however, a decision was made to use a parametric procedure instead of a non-parametric one. In this case, a Multivariate Analysis of Variance (MANOVA)

[1] http://www.tea.state.tx.us/student.assessment/

procedure was used. The MANOVA for the teacher-assigned course grades was statistically significant, Roy's Largest Root, F (4, 1123) = 5.84, p < .001, with a small overall effect size ($\eta 2$ = .20). Follow-up univariate tests revealed a statistically significant difference in Reading grades, F(1, 1126) = 13.16, p < .001, with a small effect size ($\eta 2$ = .12); in Math grades, F(1, 1126) = 18.49, p < .001, with a small effect size ($\eta 2$ = .16); in Science grades, F(1, 1126) = 13.32, p < .001, with a small effect size ($\eta 2$ = .12); and in Social Studies grades, F(1, 1126) = 17.85, p < .001, with a small effect size ($\eta 2$ = .16). In every teacher-assigned grade, obese students had lower grade averages than did the non-obese students. Using Cohen's (1988) criteria, these findings represent small effect sizes. Readers are referred to Table 5 for the descriptive statistics for students' class grades by weight status.

Table 5

Descriptive Statistics for Students' Grades by Weight Status

	Obese		Non-Obese	
Grades	M	SD	M	SD
Math	81.38	8.26	83.79	7.38
Reading	82.32	7.93	84.28	7.13
Science	78.83	12.06	81.60	9.74
Social Studies	80.27	12.51	83.59	10.08

Table 5

Note. The grades of the Obese students were based on a sample size of 229 students and the grades of the Non-Obese children were based on a sample size of 899 students.

A second MANOVA, conducted to ascertain the extent to which TAKS test scores were related with student weight, was also statistically significant, Roy's Largest Root, F (3, 774) = 4.70, p < .003, with a small overall effect size ($\eta 2$ = .18). Follow-up univariate tests revealed a statistically significant difference in TAKS Reading scores, F(1, 776) = 6.70, p < .01, with a small effect size ($\eta 2$ = .09); in TAKS Math scores, F(1, 776) = 12.52, p < .001, with a small effect size ($\eta 2$ = .16); and in TAKS Writing scores, F(1, 776) = 10.07, p < .002, with a small effect size ($\eta 2$ = .13). In each of the three TAKS measures, obese students had lower TAKS score averages than did the non-obese students. Using Cohen's (1988) criteria, these findings represent small effect sizes. Readers are referred to Table 6 for the descriptive statistics for students' class grades by weight status.

Table 6

Descriptive Statistics for Students' TAKS Measures Scaled Scores by Weight Status

	Obese		Non-Obese	
TAKS Measure	M	SD	M	SD
Reading Scores	2300.20	157.76	2335.81	163.17
Math Scores	2231.90	189.21	2294.50	182.99
Writing Scores	2385.62	217.36	2451.14	222.00

Table 6

Note. The sample size for the TAKS Reading measure was 806 students (n of Obese children = 134; n of non-Obese children = 672); for the TAKS Math measure was 806 students (n of Obese children = 135; n of non-Obese children = 671); and for the TAKS Writing measure was 786 students (n of Obese children = 130; n of non-Obese children = 656).

5 Discussion

In this study, our purpose was to investigate the relationship of student weight with academic performance in the middle school setting. Student scores on both unstandardized measures (i.e., teachers' grades) and standardized measures (i.e., TAKS scores) were found to be significantly lower between Obese students and Non-Obese students. For each course grade (i.e., Math, Reading, Science, and Social Studies) and for every TAKS measure (i.e., Reading, Math, and Writing), academic performance was lower as student weight status increased. Our findings are congruent with the findings of Datar et al. (2004) regarding lower math and reading scores of overweight children when compared to the math and reading scores of normal weight children. Our findings are also commensurate with Li (1995) who reported lower course grades in 6 of 8 areas for his sample of elementary school children.

Of particular interest to readers should be the high percentage of students in the sixth grade who were obese, 30.4%. This percentage is substantially higher than the national average for middle grade students of 17.4% (Ogden et al., 2002) and substantially higher than Hoelscher et al.'s (2005) report of 20% of Texas eighth grade students being in the obese category. Our percentage of seventh grade students who were obese, 17.2%, however, is commensurate with both of these studies (Hoelscher et al., 2005; Ogden et al., 2002). Reasons for the disparity in the percentage of students with obesity between the sixth and the seventh grade are not known.

When examining the percentages of student obesity by ethnic membership, about a third, 32.3%, of our Hispanic boys were obese and a fourth, 25.6%, of our Hispanic girls were obese. These percentages correspond very closely to Hoelscher et al.'s (2004) study of Texas school children in which they reported that 31.1% of Hispanic boys were obese and 26.4% of Hispanic girls were obese. Given the fact that Hispanics comprise over a third, 35.7%, of the Texas population (U.S. Census Bureau, 2008), these percentages indicate a large number of obese children in Texas schools. Regarding our African-American population, 22.4% of African-American boys and 22.0% of African-American girls in our sample were obese. These numbers are very congruent with Hoelscher et al.'s (2004) report of 21.6% of African-American boys and 30.8% of African-American girls being obese in the State of Texas. Though the African-American population in Texas is substantially lower than the Hispanic population (U.S. Census Bureau, 2008), 11.9% versus 35.7%, a sizable number of African-American children are obese.

Schools are now accountable for the academic performance of every student, individually and by subgroup designation under the mandates of the No Child Left Behind Act (2001). Specifically delineated in this act are subgroups of economically disadvantaged students, at-risk students, and ethnic categories of students because numerous researchers have documented the presence of achievement gaps between the performance of students in these groups and the performance of mainstream students. Though not specified in the No Child Left Behind (2001), based upon the results of this study, schools, specifically middle schools, may need to view the academic test scores of their obese students. To the extent that the findings of this study are generalizable, then clearly obese students represent a subgroup inasmuch as an achievement gap exists between their test scores and the test scores of mainstream students. We believe that, because these findings are commensurate with the findings of other studies, middle schools should be deeply concerned about the issue of obesity among their students. Though the health-related consequences of obesity were not addressed in this study, the academic consequences were. In every academic area assessed herein, both at the school campus level and at the state level, obese adolescents demonstrated poorer academic performance than did non-obese adolescents. Moreover, as schools are accountable for student academic performance, they need to develop programs in which student weight and health are improved.

Although we found a relationship between student obesity and student academic performance, the causal linkages were not analyzed in this study. In what ways is obesity linked with student achievement? It is possible, given Schwimmer, Burwinkle, and Varni's (2003) findings, that obese children miss more days of schools than non-obese children (4.2 days compared to 0.7 days monthly). In a recent investigation, Bagully (2006) found a relationship between students' scores in math with the number of days they missed school. Attendance at school has long been documented by numerous researchers to be linked with student achievement (e.g., Lamdin, 1996). The extent to which obese children miss school significantly more often

than other children is not known. Future researchers need to analyze this issue.

Implications of our findings are present for educational administrators. Given that our study is congruent with the existing literature, that obesity is related with poorer student performance, school leaders need to be cognizant of the extent to which their student body is obese. It is possible that the higher the percentage of their students who are obese, the greater the likelihood that student academic performance may be negatively influenced. With many states providing accountability ratings for their school (e.g., Exemplary to Unacceptable), the poorer academic performance obese students may be contributing to a lowered accountability rating. In line with Trost's (2007) review of the literature, educational administrators need to reexamine their physical education programs. To the extent that physical education programs have been removed from their campuses, school leaders might wish to reconsider this program elimination. To the extent that physical education programs have been reduced, considerations should occur regarding an increase in the amount of required physical education. We do not believe that educational administrators can ignore the problems of obesity, particularly if obesity influences student achievement, an area which educational administrators are clearly held accountable for under the No Child Left Behind Act (2001).

Several cautions need to be made lest readers of this study make overgeneralizations from these findings. First, only a single urban school district's data were analyzed in this study. The extent to which middle school children in this school district are similar to middle school students in other school districts in the State of Texas, much less the rest of the country, is not known. Second, we analyzed only one year of data. The longitudinal relationship of student weight with student grades was not assessed in this study. Third, data were analyzed across only two grade levels of middle school students. Fourth, readers are urged to be cautious in their reliance on BMI results for adolescents because of growth spurts that occur (Troiano & Flegal, 1998). Accordingly, we urge readers to be cautious in the extent to which they generalize our findings. With these caveats in mind, readers should note that the results of this study were commensurate with previous studies. A relationship clearly exists between student obesity and student academic performance. As such, we contend that obesity is a relevant issue that schools are obligated to address. For schools utilizing BMI measurements, they are encouraged to examine Nihiser et al. (2007) for ways in which to maximize the effectiveness of such programs. Finally, the percentages of obese students reported in this study are substantially higher than the goal set forth in 2001, for only 5% of persons being obese (Healthy People 2010, 2001). We clearly have a long, long way to go to meet this ambitious target.

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