

Childhood obesity rates in Mississippi (Prevalence and Trends in Overweight and Obesity among Mississippi Public School Students, 2005 – 2011) *J Miss State Med Assoc.* 2012 May; 53(5):140-146. is reprinted with permission of the JOURNAL OF THE MISSISSIPPI STATE MEDICAL ASSOCIATION, P.O. Box 2548, Ridgeland, MS 39158-2548.

Prevalence and Trends in Overweight and Obesity among Mississippi Public School Students, 2005-2011

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ABSTRACT

This study estimated the prevalence of overweight and obesity in Mississippi public school students in grades K - 12 and assessed changes in the prevalence between 2005 and 2011. In 2011, Body Mass Index was calculated using measured height and weight data for a weighted representative sample of 4,235 public school students. Additional analyses compared 2011 prevalence estimates by gender, race, and grade levels and for changes between 2005 and 2011. The prevalence of overweight and obesity among public school students no longer appears to be increasing although a significant downward trend was not observed ($p = 0.0845$), and rates remain higher than national averages. In 2011, the combined prevalence of overweight and obesity for all students in grades K - 12 was 40.9% as compared to 42.4% in 2009, 42.1% in 2007 and 43.9% in 2005. Significant decreases in overweight and obesity were found among white students and elementary school student groups from 2005 to 2011. White students' combined rates fell from 40.6% in 2005 to 34.8% in 2011 ($p = 0.0006$). Similarly, combined rates in elementary school students dropped from 43.0% in 2005 to 37.3% in 2011 ($p = 0.0045$). In 2011, the prevalence of overweight and obesity was significantly low-

er among white students than black students ($p < 0.001$) and significantly lower among white female students than black female students at all three grade levels. These findings are discussed in light of recent statewide educational initiatives and health disparities. Implications for future practice, policy, and research are presented.

KEY WORDS: CHILDHOOD, OVERWEIGHT, OBESITY

INTRODUCTION

Recent data indicate that the prevalence of overweight and obesity in Mississippi children and youth has remained level since 2005.¹⁻⁶ According to the Child and Youth Prevalence of Obesity Surveys (CAYPOS),¹⁻⁴ a primary source of obesity data in Mississippi, 25.5% of Mississippi students in grades K - 12 were obese and 18.4% were overweight (43.9% combined rate) in 2005.² In 2007, 23.5% were obese and 18.6% were overweight (42.1% combined).³ In the 2009 CAYPOS, 23.9% were obese and 18.5% were overweight (42.4% combined).⁴ Analysis revealed no significant differences in the prevalence rates between the 2005, 2007 and 2009 CAYPOS.

Similar to the CAYPOS data, the Mississippi Youth Risk Behavior Survey (YRBS) revealed that self-reported prevalence of obesity in public high school students between 2007 (17.9%) and 2011 (15.8%) had plateaued. Likewise, the differences were not statistically significant.⁵⁻⁶ In addition, the national Youth Risk Behavior Survey (YRBS) reported no significant changes in the percentage of obesity among US students in grades 9-12 who attended public and private schools between 2005 and 2011.⁷⁻⁸ The most recent National Health and Nutrition Examination Survey (NHANES) also showed no significant changes in the percentage of obesity among US children aged 2 to 19 years between 2003 - 2004 and 2005 - 2006, nor between 1999 - 2010.⁹

The stabilization of obesity and overweight prevalence in Mississippi may be associated with recent statewide efforts aimed at improving student health. Between 2006 and 2008, the Mississippi Department of Education, in conjunction with the Mississippi State Department of Health, began implement-

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ing a range of state-wide educational initiatives, including mandates for establishing school wellness policies, new beverage regulations, and more stringent nutrition, physical activity, and physical education standards.^{4, 10-18}

While it is welcome news that the prevalence of overweight and obesity among children is no longer increasing, high prevalence rates remain a great concern. It is well documented that overweight and obesity in childhood are associated with a number of serious health conditions continuing into adulthood, including cardiovascular disease, diabetes, musculoskeletal disorders, psychological problems, and risky health behaviors.¹⁹⁻³¹ As such, the purpose of this study was to continue monitoring the prevalence of overweight and obesity as implementation of health and wellness programs is expanding in the state's public schools.¹⁷⁻¹⁸

Another concern noted in the 2009 CAYPOS was the increasing disparity between races. In 2005, differences in the prevalence of obesity and overweight between black and white students were not significant. However, the prevalence of obesity was significantly higher among black students than white students in 2007 (25.7% vs. 21.0%) and again in 2009 (27.4% vs. 19.5%). When examined by grade level in 2009, only at the elementary level were the differences significant between the black and white students. And, when compared by gender, the prevalence of obesity was significantly higher in 2009 among black females than among white females. As such, the current study intended to assess any differences in the prevalence by gender, race, and grade level as well as changes in the prevalence by gender, race, and grade levels between 2005 and 2011.

METHODS

Similar to the 2005, 2007, and 2009 CAYPOS, in the 2011 CAYPOS, the sampling frame consisted of 467,941 students in 892 public schools offering kindergarten or any combination of grades 1 through 12 in Mississippi. The sample design was a two-stage stratified probability design.¹⁻⁴ The first stage included the random selection of 95 schools. A systematic sample of schools was drawn with probability proportional to the enrollment in grades K - 12 of each school. In the second stage of sampling, classes were randomly selected within the sampled schools. Classes were selected using equal probability systematic sampling. All eligible students in the selected classes were asked to participate in the survey. The sample was designed to yield a self-weighting sample so that every eligible student had an equal chance of selection, thereby improving the precision of the estimates.

As in each of the previous years, the weighting process was intended to develop sample weights so that the weighted sample estimates accurately represented the entire K -12 public school students in Mississippi. Every eligible student was assigned a base weight which was equal to the inverse of the probability of selection for the student. Adjustments were made to the initial weights to remove bias from the estimates and reduce the variability of the estimates.

The most recent CAYPOS (2011) was conducted in April 2011. The study received continued institutional review board approval through the Human Subjects Committee at The University of Southern Mississippi, as the study protocol matched the four prior CAYPOS.¹⁻⁴ As with all of the previous CAYPOS, once selected schools agreed to participate and classes were chosen, measuring the equipment (i.e., digital scales and stadiometers) and passive consent forms were delivered to the schools. Each school designated a school nurse who was responsible for collecting data and had been trained on the use of equipment. Two or three days before data collection began, students in the selected classes were read a prepared paragraph containing information about the study. Each student was then given a passive parental consent form to take home to parents or guardians. If a parent did not want his or her child to participate in the study, the parent was instructed to indicate such on the form, sign it, and have the child return it to the teacher. Prior to the collection of height and weight, the nurse would check with the teacher to determine if any students returned a signed form. Students who returned a signed form did not participate in the study. There were neither consequences for nonparticipation nor rewards for participation.

As with all the previous CAYPOS, the protocol for making measurements required that the weight scale be placed on a hard, smooth surface; carpeted areas were not to be used. The scale was calibrated to zero before use and recalibrated after every 10th student. All students were weighed and measured in a location where the information gathered would be confidential. Other students were not able to read the scale or height measurement or hear a weight or height given. Nurses reported the height and weight, rounded to the nearest whole inch or pound, respectively, along with age, gender, date of birth, racial or ethnic background, and the school code number. No allowance was made for weight of clothing; however, students were asked to remove belts, heavy jewelry, jackets, and shoes. No student names were written on the data collection forms.

As in the previous CAYPOS, nurses were sent an email with a link to a secure website developed and maintained by Qualtrics, Inc.³² to record and submit their data. These data were compiled in aggregate form by the Qualtrics software and made available in excel format to the study authors for analysis.

DATA ANALYSIS

Body Mass Index (BMI) was computed for each responding student based on height (in meters) and weight (in kilograms). The height in feet and inches was first converted to meters. The weight in pounds was then converted to kilograms. BMI was calculated using the SAS program, gc-calculate-BIV.sas as follows: $BMI = \text{Weight (in kg)} / [\text{Height (in m)}]^2$. BMI values were checked to ensure that the results were biologically plausible, using the limits developed by the Centers for Disease Control and Prevention (CDC). BMI percentiles were computed using the SAS program, gc-calculate-BIV.sas. Children and adolescents were classified into four categories: (1)

underweight (BMI is less than the 5th percentile); (2) normal weight (BMI is equal to or greater than the 5th but less than the 85th percentile); (3) overweight (BMI is greater than the 85th but less than the 95th percentile); and (4) obese (BMI is greater than or equal to the 95th percentile).³³

SUDAAN 10.0³⁴ was used to calculate weighted estimates and standard errors. Proc Crosstab procedure was used to compare prevalence of child overweight and obesity among different subgroups, such as gender, race, and grade level. The differences were assessed separately for each survey year and considered statistically significant if the p-values from the Chi-square tests were less than 0.05. For comparisons of subgroups with more than two levels (e.g., obesity by gender by race by grade, etc.), no statistical tests were conducted due to substantially decreased sample sizes and possibly unreliable estimations. The comparison of their 95% confidence intervals (CIs) was simply used for these situations - differences between estimates were considered statistically significant if their associated 95% CIs did not overlap. In addition, SUDAAN logistic regression procedure was used to investigate linearity of the longitudinal trends in overweight and obesity. Since elapsed time was the same between successive CAYPOS surveys, the logistic regression used orthogonal variables to model longitudinal trends while controlling for students' gender, race, and grade level. The linear coefficient (-3, -1, 1, 3) and quadratic coefficients (4, -4, -4, 4) were assigned over the years 2005, 2007, 2009, and 2011, respectively.

RESULTS

Characteristics of Participants from the 2011 CAYPOS

Eighty-four of the 95 schools sampled participated in the study (88.4%). The student response rate was 88.1% (4,235 usable records/4,804 eligible sampled students). Thus, the overall response rate was 77.9% (product of school response rate and student response rate), which was above the threshold of 60% required to obtain weighted estimates. The final sample consisted of 4,235 students in grades K - 12, including 2,179 males (51.6%), 2,049 females (48.4%), 2,087 white students (48.5%), 1,958 black students (47.2%), and 186 students from other racial/ethnic backgrounds (4.3%) (Table 1). The number of students in other race categories was too small for separate analysis and, therefore, was not included in the comparison analyses.

Results of 2011 CAYPOS Based on Subgroups of Participants

As a group, 23.7% of the children and youth in grades K - 12 were classified as obese and another 17.2% of the children were classified as overweight giving a combined total of 40.9% of the children and youth at or above the 85th percentile for BMI for age and gender (Table 2).

Gender

In 2011, 23.0% of females were classified as obese, with another 17.4% as overweight (40.4% combined). As for males,

Table 1: Characteristics of 2011 CAYPOS Participants, Grades K-12

Characteristic	Unweighted count	Weighted percent
Gender ^a		
Male	2,179	51.6
Female	2,049	48.4
Race ^b		
White	2,087	48.5
Black	1,958	47.2
Other	186	4.3
Grade		
Elementary		
K	392	8.9
1st	336	7.5
2nd	329	7.9
3rd	406	9.5
4th	422	9.6
5th	352	7.9
Middle school		
6th	329	7.9
7th	352	8.4
8th	225	5.4
High school		
9th	395	10.1
10th	345	8.8
11th	201	4.8
12th	151	3.3
Total	4,235	100

^a Seven students were missing on gender.

^b Four were missing on race.

Table 2: Prevalence of Overweight and Obesity by Grade Level and Race, 2011

	All (K-12) (%, 95% CI) ^a	Elementary (K-5) (%, 95% CI)	Middle School (6-8) (%, 95% CI)	High School (9-12) (%, 95% CI)
All				
Overweight ^a	17.2 (16.0-18.4)	15.4 (13.9-17.0)	19.3 (16.9-22.0)	18.9 (16.5-21.4)
Obesity ^b	23.7 (22.0-25.4)	21.9 (19.7-24.3)	28.6 (24.6-33.0)	23.1 (20.8-25.6)
White				
Overweight	15.3 (13.6-17.1)	13.2 (11.1-15.6)	17.3 (13.8-21.6)	18.5 (14.9-22.7)
Obesity	19.5 (17.6-21.5)	17.8 (15.0-20.9)	23.0 (17.6-29.4)	21.0 (18.1-24.2)
Black				
Overweight	19.3 (17.7-21.0)	18.4 (16.0-21.0)	20.0 (16.8-23.5)	20.1 (17.3-23.1)
Obesity	27.8 (25.1-30.6)	26.8 (22.9-31.2)	32.4 (28.0-37.1)	25.0 (22.3-27.9)
Male				
Overweight	17.0 (15.6-18.6)	15.9 (13.7-18.4)	18.2 (14.5-22.5)	18.3 (16.0-20.9)
Obesity	24.4 (21.8-27.1)	21.4 (18.8-24.3)	32.0 (26.9-37.7)	24.2 (19.6-29.4)
Female				
Overweight	17.4 (15.5-19.4)	14.9 (12.6-17.5)	20.5 (17.5-23.8)	19.5 (15.7-23.9)
Obesity	23.0 (20.8-25.4)	22.5 (19.7-25.6)	25.3 (20.5-30.8)	21.9 (18.1-26.3)
White male				
Overweight	15.3 (13.1-17.8)	15.0 (12.4-17.9)	14.2 (11.2-17.8)*	16.7 (12.6-21.8)*
Obesity	21.6 (18.7-24.9)	18.5 (15.8-21.5)	29.5 (21.1-39.7)*	23.9 (17.6-31.6)
Black male				
Overweight	18.8 (16.8-20.9)	16.9 (14.7-19.3)	19.9 (17.3-22.8)	20.7 (18.1-23.5)
Obesity	26.2 (22.9-29.8)	24.1 (22.0-26.4)	32.8 (27.6-38.5)	23.8 (20.4-27.4)
White female				
Overweight	15.2 (12.9-17.9)	11.2 (9.2-13.6)	20.5 (18.7-22.4)*	20.4 (16.0-25.7)
Obesity	17.1 (14.8-19.8)	17.0 (13.8-20.9)	16.5 (9.8-26.4)*	17.8 (14.6-21.5)*
Black female				
Overweight	19.8 (17.3-22.6)	19.9 (17.9-22.2)	20.0 (18.9-21.2)	19.3 (15.1-24.4)*
Obesity	29.4 (25.6-33.5)	29.7 (26.5-33.1)	32.0 (26.4-38.2)	26.4 (22.4-30.8)

^a Body Mass Index (BMI) \geq 85th percentile and $<$ 95th percentile for age and gender.

^b Body mass index (BMI) \geq 95th percentile for age and gender.

* 95% confidence interval.

Sample size is less than 50. The estimates may not be reliable.

Figure 1. Obesity Prevalence by Race among Mississippi Elementary School Students

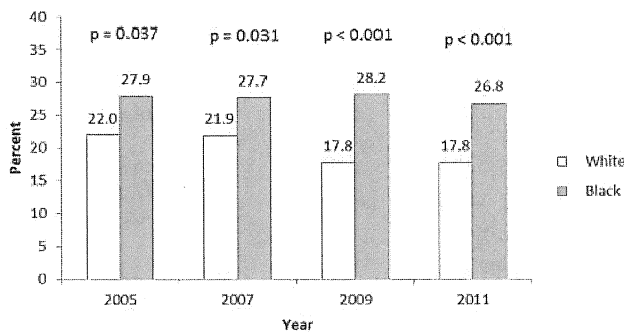


Figure 2. Obesity Prevalence by Race among Mississippi Middle School Students

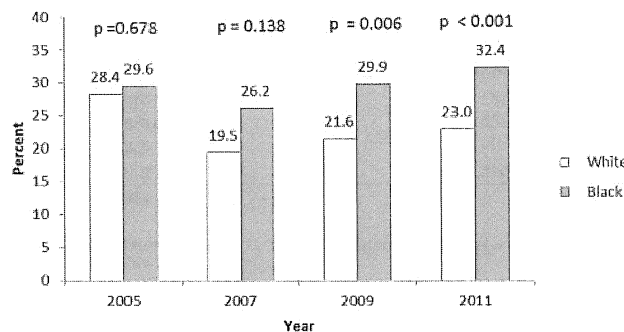
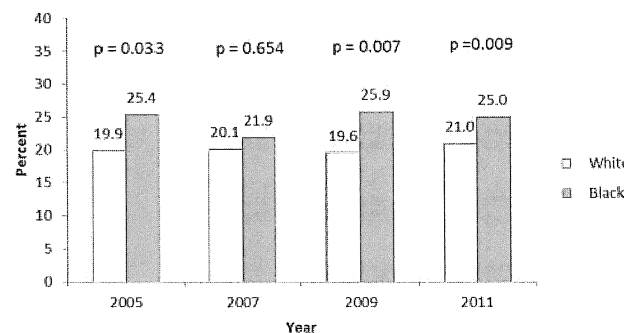


Figure 3. Obesity Prevalence by Race among Mississippi High School Students



24.4% were obese and another 17.0% were overweight (41.4% combined).

Race

In terms of race, 19.5% of the white students were classified as obese, with another 15.3% as overweight (34.8% combined). Among the black students, 27.8% were obese and 19.3% were overweight (47.1% combined). The prevalence of obesity for black students was significantly higher than white students ($p < 0.001$).

Grade Level

Among elementary level students (grades K - 5), 21.9% were classified as obese, with 15.4% classified as overweight (37.3% combined). Among the middle school students (grades 6 - 8), 28.6% were obese and 19.3% were overweight (47.9% combined). Among the high school students (grades 9 - 12), 23.1% were obese and 18.9% were overweight (42.0% combined). Differences in the prevalence of obesity by grade level were statistically significant ($p = 0.008$).

Gender and Race

As for gender and race, among black females, 29.4% were obese and 19.8% were overweight (49.2% combined). Among white females, 17.1% were obese and 15.2% were overweight (32.3% combined). The prevalence of obesity for black females was significantly higher than white females.

Among black males, 26.2% were obese and 18.8% were overweight (45.0% combined). Among white males, 21.6% were obese and 15.3% were overweight (36.9% combined). The prevalence of obesity for black males was significantly higher than white males.

Race and Grade Level

Among both white and black students, the highest rates were at the middle school level. Among black students, 32.4% were obese and 20.0% were overweight (52.4% combined) at the middle school level, 26.8% were obese and 18.4% were overweight (45.2% combined) at the elementary level, and 25.0% were obese and 20.1% were overweight (45.1% combined) at the high school level (Figures 1-3).

Among white students, 23.0% were obese and 17.3% were overweight (40.3% combined) at the middle school level, 21.0% were obese and 18.5% were overweight (39.5% combined) at the high school level, and 17.8% were obese and 13.2% were overweight (31.0% combined) at the elementary school level. At all three grade levels, the difference in the prevalence of obesity between white and black students was statistically significant.

Gender, Race, and Grade Level

When race and gender were combined at the elementary level, 17.0% of white females were obese and 11.2% were overweight (28.2% combined). Among black females, 29.7% were obese and 19.9% were overweight (49.6% combined). At the middle school level, 16.5% of white females were obese and 20.5% were overweight (37.0% combined). Among black females, 32.0% were obese and 20.0% were overweight (52.0% combined). At the high school level, 17.8% of white females were obese and 20.4% were overweight (38.2% combined). Among black females, 26.4% were obese and 19.3% were overweight (45.7% combined). At all three school levels, the differences in rates of obesity between white and black females were statistically significant. At all three school levels, the dif-

ferences between black males and white males were not significant.

Overweight and Obesity Linear Trend

While the prevalence of overweight and obesity among students in grades K - 12 has dropped from 43.9% in 2005 to 40.9% in 2011, the linear trend was not statistically significant ($p = 0.0845$) (Figure 4). However, the combined prevalence of overweight and obesity for white students (40.6% in 2005 and 34.8% in 2011) has shown a significant linear decrease ($p = 0.0006$) (Figure 5). In addition, a significant linear drop was observed in the prevalence of overweight and obesity among the elementary grade level students between 2005 (43.0%) and 2011 (37.3%) ($p = 0.0045$) (Figure 6).

DISCUSSION

While Mississippi still has very high rates, the prevalence of overweight and obesity among public school students no longer appears to be increasing. This is encouraging news for the state, particularly in light of state-wide legislated school changes, publicized calls for healthy changes by influential Mississippians, grass root citizen efforts, and organizational directives aimed at child obesity reduction and prevention.³⁵⁻³⁶ In 2011, the combined prevalence of overweight and obesity for all students in grades K - 12 was at the lowest CAYPOS rate since 2005, and significant declines were found among white students and elementary school students. Since 2005, the combined prevalence of overweight and obesity has dropped significantly for white students from 40.6% to 34.8%, and has dropped significantly from 43.0% to 37.3% among elementary school students.

In Mississippi, many health and wellness policy efforts have been directed towards all students at all grade levels in the public school setting.¹⁰⁻¹⁶ The finding that the prevalence of overweight and obesity were significantly lower at the elementary grade level is very promising and may suggest that recent state-wide educational efforts implemented in the elementary schools are making progress.

However, it is important to ask whether fewer overweight or obese children are entering the public school system or whether the declines in overweight and obesity are occurring during the elementary school years. The current CAYPOS is limited to grades K- 12 and therefore cannot necessarily provide the answers to whether students are more or less obese during the preschool years. Unfortunately, there is not sufficient data related to non-low income and white preschoolers in Mississippi to answer this question adequately. However, for low-income and African-American students, the latter explanation seems plausible, since comparable CAYPOS (2005 and 2010) studies of low-income African American Head Start preschoolers in Mississippi during this period indicate that combined rates between 2005 (38.5%) and 2010 (37.8%) have not changed significantly.³⁷

Figure 4. Prevalence of Overweight, Obesity, and Combined, Mississippi, K-12, 2005-2011

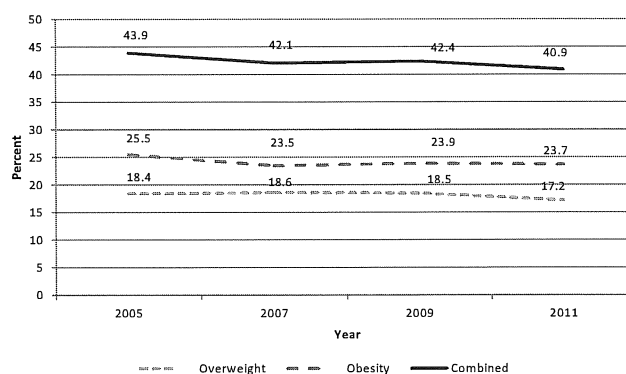


Figure 5. Prevalence of Overweight and Obesity Combined by Race, K-12, Mississippi, 2005-2011

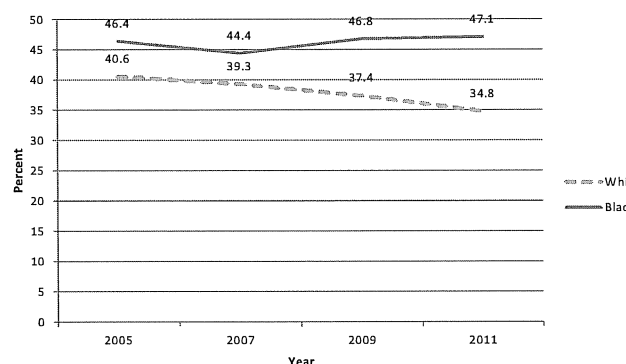
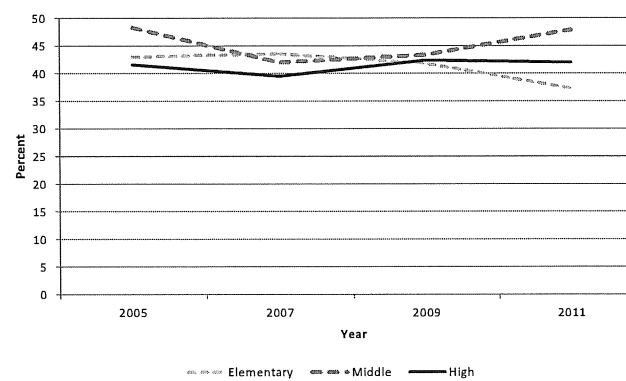


Figure 6. Prevalence of Overweight and Obesity Combined by Grade Level, Mississippi, 2005-2011



Another important question is why the prevalence dropped significantly for white students of all educational levels (40.6% to 34.8%), and in particular for white elementary students (39.9% to 31.0%) over the past six years. This contrasts with the prevalence of overweight and obesity for all levels of black students, which remained relatively stable (46.4% to 47.1%), including black elementary students (46.3% to 45.2%),

over the same time period. Of related concern is the finding that in 2011 the prevalence of obesity was again (as in 2009) significantly lower among white students than the black students at all grade levels while back in 2005 and 2007, the difference by race was only significant at the elementary grade level. This finding may suggest a growing racial health disparity over time. Further, when assessing both gender and race in 2011, the prevalence of obesity was significantly lower among white females than black females at all three grade levels. Previously (2009), significant differences were found between white and black female students only at the elementary grade level. This finding suggests that the increasing disparity over time by race may be tied to gender as well.

Racial differences in the prevalence of overweight and obesity, particularly the disproportionately higher rates among black, Hispanic and Native American children, are well documented.^{9, 22-23} However, given the lack of studies finding declines in obesity rates to date, research is lacking to fully explain the apparent declines among white but not black students. One possible explanation for the racial disparities in these findings may come through a line of recent research on racial/ethnic differences and early life risk factors.³⁸ Unlike their white counterparts, black and Hispanic preschool-aged children have been found to exhibit a higher number and range of risk factors associated with obesity (i.e., higher rates of maternal depression, more rapid weight gain in infancy, introduced to solid foods earlier, higher rates of restrictive feeding practices, more likely to have a television in their bedrooms, higher intake of fast foods, lower rates of exclusive breastfeeding, and less likely to sleep at least 12 hours/day in infancy). As such, racial/ethnic health disparities may have their origins in the earliest stages of life, long before entering the public school system. Others suggest that children with a number of these risk factors are not only more likely to develop weight problems, but a number of other adverse health conditions.³⁹ Consequently, these complications are likely to then adversely affect the child's adherence or motivation to adopt healthier behaviors. As such, those experiencing more risks may not be able to fully participate and/or benefit from the policies, programs and activities being implemented in the public school system.

This epidemiological study of the prevalence and trends of childhood obesity in Mississippi provides essential data for informing the public as well as planning and adjusting efforts to reduce this important health risk. While overall statistics indicate that obesity and overweight rates in Mississippi school children are high, they do not appear to be worsening. The growing disparities by race, gender and educational levels do warrant further investigation. On the one hand, significant declines among elementary grade level students and among white students indicate a need to explore the factors most directly associated with the positive changes. On the other hand, further study is also needed on factors associated with the lack of change among higher grade levels and black students. For

example, are the programs currently being implemented in schools being presented to or received differently by different racial groups or grade levels? Also, are there factors outside of the school setting, both during the pre-school and school-age years, that impact the effect of the programs designed to address overweight and obesity? Given that the prevalence of overweight and obesity remains high among public school students in Mississippi (seemingly unchanged among some) and the implementation of existing educational initiatives continues to expand across the state, investigation and monitoring of the prevalence needs to continue.

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