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Short communication

Prevalence and subgroup comparisons of obesity and severe obesity among Mississippi public school students

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ABSTRACT

This study examined the prevalence of obesity and severe obesity among Mississippi K-12 public school students and the obesity rate differences within subgroups categorized by sex, race, and grade level. Anthropometric data from a weighted, representative sample of Mississippi public school students were collected through the biennial Child and Youth Prevalence of Obesity Survey (CAYPOS). Overall prevalence rates and those of the subgroups were calculated and compared. The 2017 data indicated that overall 23.7% of Mississippi public schools students met the criterion of class I obesity, 9.1% met the criterion of class II obesity, and 3.2% met the criterion of class III obesity. Among those with severe obesity, the prevalence was significantly higher among black students (10.9%) when compared to their white counterparts (7.3%) ($p < 0.001$), and among high school students (12.0%) when compared to elementary (6.5%) and middle school students (9.6%) ($p < 0.001$). As to racial differences by sex, black females had the highest severe obesity rates (11.9%), followed by black males (9.9%). White females had the lowest severe obesity rate (5.8%). At lower grade levels, black students had higher prevalence rates than whites but at 12th grade level the gap between the two races are almost closed. These findings were compared to other current studies in order to better evaluate the current health profiles of Mississippi public school students.

1. Introduction

It is well-known that adult obesity rates in the state of Mississippi has been among the highest in the nation and significantly above the national average (America's Health Rankings. Annual Report - Obesity in Mississippi. [cited, 2020). However, the state does not have a designated statewide data monitoring system to track childhood obesity prevalence and trends (Mississippi State Department of Health, 2018). In an effort to bridge the gap, the Child and Youth Prevalence of Obesity Survey (CAYPOS) has been collecting anthropometric height and weight data of school-aged children since 2003 (Kolbo et al., 2006, 2019; Molaison et al., 2020). The data collected over the last decade revealed a trend of the combined rates of overweight and obesity of Mississippi public school K-12 students dropping significantly since 2005 (Molaison et al., 2020; Zhang et al., 2015). The purpose of this study was to examine the obesity and severe obesity rates in Mississippi using the 2017 CAYPOS data.

2. Methods

As in all CAYPOS, approval was obtained through the Institutional Review Board at The University of Southern Mississippi. The sampling and weighting processes in 2017 were similar to those used in all prior CAYPOS (Kolbo et al., 2006, 2019; Molaison et al., 2020; Zhang et al., 2015). The sampling frame for this study consisted of 478,056 students in 892 Mississippi public schools (K-12). A two-stage stratified probability design involved first selecting approximately 10% of all schools with probability proportional to school enrollment size and then randomly selecting a number of classrooms within the sampled schools.

The sampling method 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. In addition, the weighting process was also designed to collect weighted sample estimates that accurately represented the entire K-12 public school students in Mississippi. Anthropometric data (actual heights and weights) were collected directly by school nurses.

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As in each CAYPOS, Body Mass Index (BMI) was computed for each student based on height (in meters) and weight (in kilograms). BMI was calculated using BMI = Weight (in kg)/[Height (in m)^2] (Pan et al., 2016). BMI percentiles were computed using the SAS program, gc-calculate-BIV.sas created by CDC. Class I obese was defined as a student's BMI greater than or equal to the 95th percentile for age and sex, class II obesity as a BMI at or greater than 120% of the 95th percentile for age and sex, and class III obesity as a BMI at or greater than 140% of the 95th percentile for age and sex (Centers for Disease Control and Prevention. A SAS program for the, 2000). Classes I, II, and III obesity are not mutually exclusive. Obesity in this study refers to class I obesity and severe obesity refers to class II obesity which also includes class III obesity. SUDAAN 12.01 was used to calculate weighted estimates and standard errors (RTI International, 2012). The prevalence of severe obesity and differences among subgroups, such as sex, race, and grade level, and were considered statistically significant if the *p*-values from the Chi-square tests were<0.05.

3. Results

Seventy-eight of the 95 sampled schools participated (86.3%). Student response rate was 84.0% (4,348 participating/5,198 eligible). The overall response rate was 68.9% (product of school response rate and student response rate), which was above the threshold of 60.0% required to obtain weighted estimates. When categorized by sex, the sample consisted of 2,271 (52.2%) males and 2,077 (47.8%) females. When categorized by race, there were 2,250 (51.4%) black students, 1,810 white students (42.0%), and 288 (6.6%) students from other ethnic/racial backgrounds.

The 2017 data indicated that overall 23.7% of Mississippi public schools students (K-12) met the criterion of class I obesity, 9.1% met the criterion of class II obesity, and 3.2% met the criterion of class III obesity (Table 1). Within the subgroups examined, the criterion of class I obesity was met by 22.8% males and 24.7% females, 21.7% white students and 25.4% black students, 21.0% of elementary school students, 26.1% middle school students and 25.2% high school students. The criterion of class II obesity was met by 9.2% of males and 9.0% of females, 7.3% of white students and 10.9% of black students, 6.5% of elementary school students, 9.6% of middle school students, and 12.0% high school students. And the criterion of class III obesity was met by3.4% of males and 3.0% females, 1.8% of white students and 4.3% of black students, 1.7% of elementary school students, 3.8% of middle school students, and 4.5% of high school students.

When examining racial differences by sex (Table 1), 8.6% white males, 5.8% white females, 9.9% black males, and 11.9% black females were considered class II obese; 2.0% white males, 1.5% white females, 4.2% black males and 4.4% black females were class III obese. This revealed that among the white students the males had higher obesity rates, whereas among the black students the females had higher obesity rates than their counterparts. Among the four racial and sex subgroups, black females appeared to have the highest obesity rates in all classifications, followed by black males indicating that obesity was more prevalent among black students than white counterparts.

For severe obesity (class II and III), the prevalence differed by race ($p < 0.001$) and grade level ($p < 0.001$) (Table 2). However, significant differences were not observed between males and females.

Racial differences of obesity prevalence by grade were further examined. Fig. 1 indicates that at lower grade levels (K-3), black students had higher prevalence rates than their white counterparts. From grades 4 to 11, the pattern fluctuates with blacks having higher rates in 5th, 6th, 8th, 10th and 11th grades and whites having higher rates in 4th, 7th, 9th and 12th grades. Interestingly, at 12th grade level, the gap between the two races are almost closed.

Table 1
Prevalence of Obesity among Mississippi Public School Students, CAYPOS, 2017

		Class I Obesity[a]	Class II Obesity[c]	Class III Obesity[d]
		%, 95% CI[b]	%, 95% CI	%, 95% CI
Total		23.7 (22.0–25.5)	9.1 (7.9–10.4)	3.2 (2.5–3.9)
Sex				
	Male	22.8 (20.4–25.5)	9.2 (7.7–10.8)	3.4 (2.5–4.5)
	Female	24.7 (22.8–26.8)	9.0 (7.6–10.8)	3.0 (2.2–4.0)
Race				
	White/Non-Hispanic	21.7 (19.6–24.0)	7.3 (6.1–8.6)	1.8 (1.1–2.8)
	Black/Non-Hispanic	25.4 (23.0–28.0)	10.9 (9.3–12.7)	4.3 (3.3–5.6)
Race by sex				
	White male	22.3 (18.9–26.1)	8.6 (6.7–11.0)	2.0 (1.1–3.8) *
	White female	20.9 (17.9–24.3)	5.8 (4.4–7.5)	1.5 (0.8–2.9) *
	Black male	22.6 (19.3–26.3)	9.9 (8.0–12.1)	4.2 (3.0–5.8) *
	Black female	28.0 (25.4–30.7)	11.9 (9.8–14.4)	4.4 (3.0–6.2)
Grade Level				
	Elementary school	21.0 (18.6–23.7)	6.5 (5.2–8.1)	1.7 (1.2–2.3)
	Middle school	26.1 (23.9–28.6)	9.6 (7.8-11.9)	3.8 (2.7–5.4)
	High school	25.2 (22.4–28.2)	12.0 (9.7–14.8)	4.5 (3.1–6.4)

[a] Students whose BMI-for-age and sex were at 95th percentile or greater.
[b] Confidence Interval.
[c] Students whose BMI-for-age and sex were at or more than 120% of the 95th percentile.
[d] Students whose BMI-for-age and sex were at or greater than 140% of the 95th percentile.
* Cell size is less than 50. The estimate may not be reliable.

Table 2
Prevalence of severe obesity among Mississippi public school students

CAYPOS, 2017		Severe Obesity[a]	P-value
		%, 95% CI[b]	
Total		9.1 (7.9–10.4)	
Sex			0.900
	Male	9.2 (7.7–10.8)	
	Female	9.0 (7.6–10.8)	
Race			<0.001
	White/Non-Hispanic	7.3 (6.1–8.6)	
	Black/Non-Hispanic	10.9 (9.3–12.7)	
Grade Level			<0.001
	Elementary school	6.5 (5.2–8.1)	
	Middle school	9.6 (7.8-11.9)	
	High school	12.0 (9.7–14.8)	

[a] Students whose BMI-for-age and sex were at or greater than 120% of the 95th percentile
[b] Confidence Interval

4. Discussion

Recent research findings regarding the prevalence of obesity are mixed, with some indicating increases (Pan et al., 2016; Robbins et al. Aug, 2015; Day et al., 2014), and others describing significant decreases

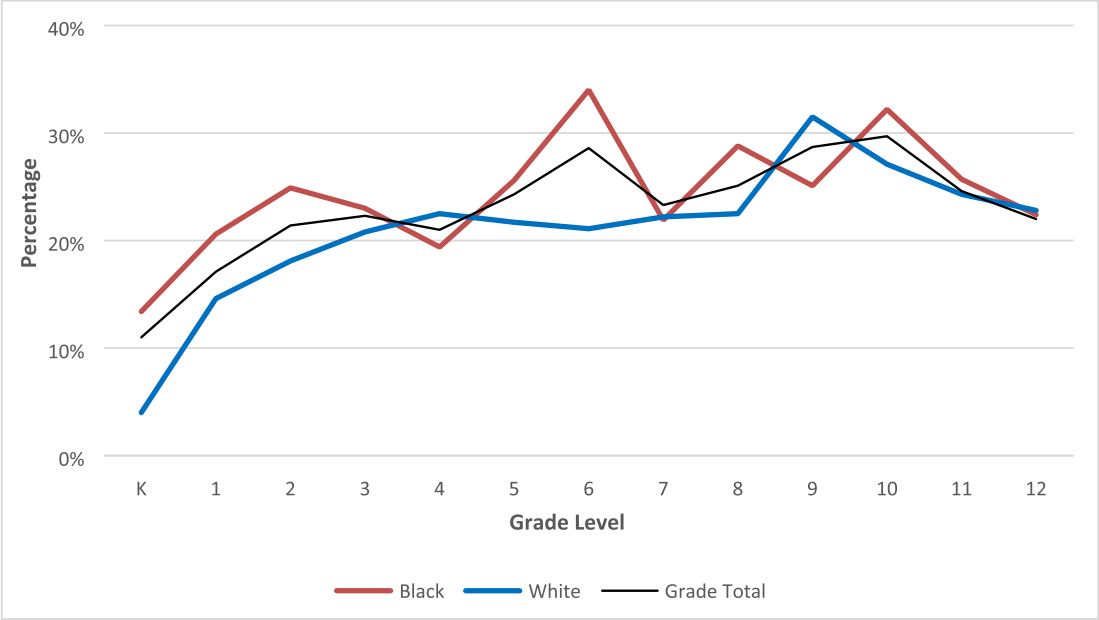

Fig. 1. Obesity Prevalence by Race and Grade among Mississippi Public School Students, CAYPOS, 2017.

(Skinner et al., 2016, 2018). The results in Mississippi appear to be comparable to recent findings in Philadelphia and New York (Robbins et al., 2015; Day et al., 2014). In the most recent study in Philadelphia (limited to grades K-8), 5.7% were severely obese (Robbins et al., 2015), and in New York the rate of severe obesity was 7.3% (Day et al., 2014). When comparing with Mississippi, in both New York and Mississippi severe obesity rates increased with age and were significantly higher among students in higher grades; and high severe obesity rates among black students were observed in all three locations.

In Mississippi, a mix of local, state, and national initiatives have been implemented through the years, likely impacting the findings being reported. For example, a number of legislative attempts to intervene in Mississippi have been public school initiatives addressing factors impacting younger students. Beginning in 2006, the Mississippi Healthy Student Act required the creation of local school wellness policies; updated and improved nutritional standards, vending, and beverage policies; implementation of required health education and physical education (Legislature, 2007). These initiatives, primarily focused on students in grades K-8, are in line with the growing number of studies calling for earlier assessment and comprehensive treatment approaches of factors clearly associated with obesity.

Racial disparities remain one of the most consistent findings in all weight categories over time. However, some recent findings suggest notable declines in the disparities, particularly in the lower grade levels (Molaison et al., 2020). Further, the findings here indicated that 10.9% of black students were severely obese in 2017. This slight decline from the previous CAYPOS (Zhang et al., 2015) may be reflecting recent efforts to address factors, such as breastfeeding, sleep, and screen time, that significantly associated with Pre-K obesity among black children in Mississippi (Kolbo et al., 2019). Continued monitoring and examination are needed to keep track of Mississippi school children's obesity trends in order to better inform obesity related public health decision making.

5. Conclusion

This study examined obesity and severe obesity prevalence rates among K-12 public school students in Mississippi. Obesity rate differences were compared by sex, race, and grade level. Our 2017 data revealed that obesity rates were higher among black students, especially black females, and students in higher grades in Mississippi K-12 public schools. Further monitoring is needed to track trends of obesity prevalence of Mississippi school children and better determine child health needs.

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CRediT authorship contribution statement

Lei Zhang: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing - review & editing. **Xiaoshan Z. Gordy:** Validation, Visualization, Writing - review & editing. **Jerome Kolbo:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing - original draft, Writing - review & editing, Funding acquisition, Project administration, Supervision. **Jacquelynn Johnson:** Validation, Visualization, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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