Maternal, Child, and Parenting Factors Associated with Obesity Among Pre-Kindergarten Children in Mississippi

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Background: Obesity among children and youth has been consistently assessed among public school students in Mississippi since 2005. Significant declines in the prevalence of obesity among elementary students over the past decade suggest that changes may be occurring prior to entry into public school. *Purpose*: The purpose was to collect anthropometric data on a weighted, representative sample of children ages 3 to 5 years in licensed childcare facilities across Mississippi, and to correlate maternal, child, and parenting characteristics to obesity. *Methods*: The Body Mass Index was calculated using measured height and weight data. *Results*: A total of 14.12% of the 1,728 children were obese. Differences were not noted by age or gender but were significant by race, with 16.73% of Black children and 9.22% of White children categorized as obese ($p < 0.0001$). Obesity was significantly correlated with breastfeeding, hours of sleep, hours of child's screen time, parent's perception of the child's weight gain, child's birth weight, mother's diabetes, and type of delivery. *Conclusion*: These findings provide a more complete picture of children's health and factors impacting children's health at an early age, and they can be of great value in future policy-making efforts to address unhealthy weights among children in Mississippi.

Keywords: obesity, child, maternal, parenting, disparities

Introduction

Between 2005 and 2015, Body Mass Index (BMI) and BMI percentiles have been calculated six times on Mississippi's public school students in grades K-12 using measured height and weight data for weighted, representative samples in the Child and Youth Prevalence of Obesity Studies (CAYPOS; Kolbo et al., 2008; Kolbo et al., 2006; Kolbo et al., 2012; Kolbo et al., 2016; Molaison, Kolbo, Speed, Dickerson, & Zhang, 2008; Molaison et al., 2010; Zhang et al., 2014). Two similar studies using identical methods have been conducted among Mississippi's Head Start preschoolers aged 3 to 5 years (Harbaugh, Bounds, Kolbo, Molaison, & Zhang, 2009; Harbaugh et al., 2011). In Mississippi's most recent CAYPOS, the prevalence of overweight, obesity, and overweight and obesity combined remained higher than national averages, yet rates neither increased nor decreased significantly since 2005 ($p = 0.6904$; Kolbo et al. 2016). The combined prevalence of overweight and obesity for all students in grades K-12 was 43.4%, compared to 43.9% in 2005. As with all previous CAYPOS, there was no difference between boys and girls ($p = 0.570$). However, the prevalence of obesity in 2015 was again significantly higher among Black students ($p < 0.001$) than among White students.

Similar to 2011 and 2013, in the 2015 CAYPOS, there was a significant difference in obesity prevalence by grade level ($p = 0.0029$), with the lowest prevalence again among the elementary students. Unlike all previous years, the highest prevalence of obesity was among high school students, and a linear increase on overweight among high school students between 2005 and 2015 was observed ($p = 0.0152$). The significant linear decrease in obesity prevalence among elementary school students observed from 2005 to 2013 continued to 2015 ($p = 0.0209$). The combined prevalence of overweight and obesity among elementary school students also showed a significant linear decline ($p = 0.0002$).

While the CAYPOS is methodologically sound in the ongoing surveillance of obesity among public school students in grades K-12, one of the limitations is the ability to determine if these significant declines noted at the elementary level in Mississippi public schools are due to something occurring at the elementary grade level or whether students are arriving in public school with BMIs that are already lower than in previous years. Numerous studies have recently called for earlier assessment and comprehensive treatment of factors associated with childhood obesity (Farley & Dowell, 2014; Graversen et al., 2014; Kumanyika, Swank, Stachecki, Whitt-Glover, & Brennan, 2014; Pan, McGuire, Blanck, May-Murriel, & Grummer-Strawn, 2015; Wang, Gortmaker, & Taveras, 2011) and racial disparities (Balistreri & Van Hook, 2011) at a time when significant declines among the pre-K population are being reported (CDC, 2013; Farley & Dowell, 2014; Lo et al., 2014; Ogden, Carrol, Kit, & Flegal, 2014; Wen, Rifas-Shiman, Kleinman, & Taveras, 2012). A number of maternal, child, and parenting factors that appear to be associated with obesity at an early age have been identified in these and other recent studies. Maternal factors include the mother's weight gain during pregnancy, tobacco use, the development of gestational diabetes, gestational age of her child at delivery, and type of delivery (Durmus et al., 2013; Linabery et al., 2013; Nehring et al., 2013; Oken, Levitan, & Gillman, 2008). Parenting factors include whether or not the child was breastfed, age of introduction to solid foods, hours of sleep, and active play versus screen time (Anderson, Economos, & Must, 2008; Feig, Lipscombe, Tomlinson, & Blumer, 2011; Flores & Lin, 2013; Seach, Dharmage, Lowe, & Dixon, 2010). Child factors include the child's birth weight and weight gain in infancy (Rooney, Mathiason, & Schauberger, 2011). The purpose of this study was to associate the prevalence of obesity with such variables among a pre-K population in order to provide additional insight into, and a more comprehensive understanding of, differences in race, gender, and grade levels being observed over the past decade in grades K-12 through the CAYPOS.

Methods

Support and approval for this study were obtained from the Mississippi Department of Health (MSDH), the MSDH Childcare Regulation and Licensure Division, the MSDH Child Care Advisory Council, and Head Start of Mississippi. The study received Institutional Review Board approval through the Human Subjects Committee at the University of Southern Mississippi and MSDH in September 2016. Data collection occurred between October 2016 and August 2017.

A total of 94,975 children were enrolled in 1,517 Mississippi childcare centers licensed by MSDH at the onset of the study. The sampling frame consisted of 46,411 children in 1,241 of these licensed centers offering childcare to children ages 3 to 5 years. Consistent with sampling methods employed in the previous CAYPOS, the sample design was a two-stage stratified probability design. In the first stage, 100 licensed childcare facilities were randomly selected. A systematic sample of centers was drawn with probability proportional to the enrollment of children ages 3 to 5 years in each center. In the second stage, where centers had fewer than 50 children ages 3 to 5 years, all were selected. In centers where there were more than 50 children ages 3 to 5 years, classrooms were randomly selected within the sampled centers using equal probability systematic sampling. The sample was designed to result in a self-weighting sample so that every eligible child had an equal chance of selection, improving the precision of the estimates.

The weighting process developed sample weights to assure the weighted sample estimates accurately represented the pre-K population in licensed childcare centers in Mississippi. Every eligible child was assigned a base weight, which was equal to the inverse of the probability of selection for the child. Adjustments were made to the initial weights to remove bias from the estimates and reduce the variability of the estimates.

Center directors were sent a letter requesting their participation in the study, with an invitation to receive training on the study that included free lunch and reimbursement for travel. Follow-up letters, e-mail, phone calls, and visits to the center informed center directors of the study. Center directors completed consent forms prior to participation in the study. Each center received $100 for participating in the study, which included assisting with the sampling of classrooms, encouraging parents to participate in the study, distributing parent consent forms and parent surveys, and coordinating a time for a trained MSDH representative to collect heights and weights of children whose parents consented to participation in the study. The MSDH representatives traveled to each of the centers to collect the data and return collected data to the project principal investigator (PI).

After parental consent was obtained, the parent survey was used to obtain information on six variables. The questions and response sets (in parentheses) in the parent survey included:

- "From birth until your child was 1 year old, how did your child's weight gain compare to other children their age?" (The child gained less weight than other children their age; The child gained the same as other children; The child gained more weight than other children their age);
- "Was your child breastfed?" (Yes; No; Don't know); "If yes, how many months old was your child when breastfeeding was stopped?" (open-ended);
- "How many months old was your child when they first had baby food or other solid foods?" (open-ended);
- "How many total hours of sleep does your child currently get each night at home?" (open-ended);
- "How many total hours does your child usually watch TV or play on a computer or a phone each day at home?" (open-ended); and
- "How many total hours of exercise or physical activity (running around, jumping, dancing, etc.) does your child usually get each day at home?" (open-ended).

Consent was required for the trained MSDH representative to then collect the child's height and weight, and for the MSDH Office of Vital Records to merge the child's BMI data with official birth record data (mother's weight gain, gestational diabetes, smoking, gestational age of child at delivery, type of delivery, and child's birth weight).

Measurements were performed by placing the weight scale on a hard, smooth surface. Children's weight was measured using an MS7301 Automatic Step-On Digital Scale. The scale was calibrated to zero before use and recalibrated after every 10th child. Children's height was measured using an HM200P PortStad Portable Stadiometer. Children were weighed and measured in a location where the information gathered would be confidential, and a center representative remained present, affording a measure of safety with two adults present. The MSDH representative recorded height and weight, rounded to the nearest whole inch or quarter pound. Heights and weights were added only to the survey form that had been initially completed by the parent.

After heights and weights were collected at each center, parents who consented received a $20 gift card. If heights and weights were collected on all eligible children sampled for participation in the center, the center received a $20 gift card. Consent forms, surveys, and recorded heights and weights for each center were placed in a sealed envelope at the center and then hand-delivered by the MSDH representative to the principal investigator for data entry. After data entry, the electronic file was sent to Westat Research Corporation for weighting and determination of BMI. Once Westat returned the file, the new data file with the BMI data was then submitted to the Office of Vital Records for matching with official birth record data. The matched file was returned to the PI for analysis.

Data Analysis

BMI was computed by Westat for each child 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 Statistical Analysis System 9.3® (SAS) program (gc-calculate-BIV.sas) as follows: BMI = Weight (in kg) / [Height (in m)]. BMI values were checked to ensure the results were biologically plausible, using the limits developed by the Centers for Disease Control and Prevention (CDC, 2015). BMI classifications are age- and gender-specific as specified by the CDC. Children were classified as:

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

SAS was used to calculate weighted estimates and standard errors. PROC FREQ procedure was used to compare prevalence of child obesity among different subgroups: gender (male and female); race (Caucasian, African-American, Other); and age (3, 4, and 5 years). Chi-square tests for categorical variables and *t*-tests and ANOVA for continuous variables were performed to test differences among obesity groups using the significance level 0.05. The Satterthwaite *t*-test was used if the equal variance assumption was violated as indicated by Levene's test at $\alpha = .05$.

Results

Characteristics of Pre-K Obesity Study Participants

A total of 1,728 surveys with height and weight information were received from 69 (75%) of the 92 eligible centers. The response rate of the children was 90% (1,728 participating divided by 1,911 total sampled children). Thus, the overall response rate was 68%, above the threshold of 60% required to obtain weighted estimates.

After calculation of the BMI, the data were submitted to the Office of Vital Records at MSDH for matching with official birth record data. Of the 1,728 BMI data records, 1,588 records (92%) were able to be matched with official birth record data, which provided information on six of the twelve variables. Of those, 35 children were either 2 or 6 years at the time of the study so were excluded from analyses. A total of 1,553 birth records (1,588 - 35 = 1,553) were available for analysis. Consequently, BMI data were correlated with the six parent survey variables on the original sample of 1,728 children. The 175 records that could not be matched (1,728 - 1,553 = 175) with the official birth records were treated as missing in correlations between BMI and the six birth record variables.

The sample of 1,728 children consisted of 873 males (50.52%) and 855 females (49.48%). A total of 567 (33.49%) were age 3, 778 (45.95%) were age 4, and 348 (20.56%) were age 5. There were 586 White students (33.91%), 998 Black students (57.75%), and 144 students from other racial/ethnic backgrounds (8.33%). The number of students in other race categories (e.g., Asian, Latino, Other) was too small for separate analysis and was not included in the comparison analyses.

Results Based on Subgroups of Participants

As a group, 14.12% of the children were classified as obese (Table 1). The prevalence of obesity did not differ by gender or age. A total of 15.01% of males were classified as obese. Of the females, 13.22% were obese. Differences in obesity prevalence by gender were not statistically significant ($p = 0.601$). In children age 3 years, 11.99% were classified as obese. Among children age 4 years, 14.40% were obese, and among 5-year-olds, 16.95% were obese. Differences in the prevalence of obesity by age were not statistically significant ($p = 0.376$). In terms of race, 9.22% of White children were classified as obese. Among Black children, 16.33% were obese. Obesity prevalence among Black children was significantly higher than among White children ($p < 0.001$).

Table 1
Percent Obese by Subgroup of Participants

Subgroups	Obese n (%)	Overweight n (%)	Normal n (%)	Underweight n (%)
All	244 (14.12%)	287 (16.61%)	1139 (65.91%)	58 (3.36%)
Black	167 (16.73%)	157 (15.73%)	629 (63.03%)	45 (4.51%)
White	54 (9.22%)	104 (17.75%)	421 (71.84%)	7 (1.19%)
Male	131 (15.01%)	142 (16.27%)	574 (65.75%)	26 (2.98%)
Female	113 (13.22%)	145 (16.96%)	565 (66.08%)	32 (3.74%)
Age 3	68 (11.99%)	92 (16.23%)	391 (68.96%)	16 (2.82%)
Age 4	112 (14.40%)	134 (17.22%)	508 (65.30%)	24 (3.08%)
Age 5	59 (16.95%)	55 (15.80%)	220 (63.22%)	14 (4.02%)

Maternal, Child, and Parenting Variables Correlated with Obesity

Breastfeeding. A total of 712 (41.86%) mothers reported that they did breastfeed, while 989 (58.14%) reported that they did not. Differences by child's age and gender were not significant. However, differences in breastfeeding were significant by race ($p < 0.001$). A total of 49.3% of White mothers reported breastfeeding, compared to 39.8% of Black mothers (refer to Table 2). Obesity was negatively correlated to breastfeeding ($p = 0.0046$) (refer to Table 3). Among obese children, 33.47% were breastfed, while 66.53% were not breastfed.

Table 2
Bivariate Analyses Including Age, Gender, and Race

Variable 1		Variable 2			Test Statistic	*p*
Race		Breastfed	Non-breastfed			
	White	351 (49.3%)	227 (22.9%)		χ^2 = 164.583	< .0001
	Black	283 (39.8%)	700 (70.8%)			
	Other	78 (10.9%)	62 (6.3%)			
Race		Sleep Hours (*M, SD*)				
	White	9.341 (1.28)			*F* = 106.49	< .0001
	Black	8.041 (1.23)				
	Other	8.95 (1.18)				
Race		Screen Hours (*M, SD*)				
	White	1.87 (1.07)			*F* = 125.07	< .0001
	Black	3.15 (1.86)				
	Other	2.26 (1.35)				
Age		Screen Hours (*M, SD*)				
	3	2.50 (1.67)			*F* = 3.155	0.043
	4	2.73 (1.73)				
	5	2.71 (1.72)				
Perceived Weight Gain		Male	Female			
	Less	129 (15.0%)	151 (17.8%)		χ^2 = 6.468	0.039
	Same	599 (69.8%)	600 (70.8%)			
	More	130 (15.2%)	97 (11.4%)			
Perceived Weight Gain		White	Black	Other		
	Less	114 (19.7%)	139 (14.1%)	27 (19.4%)	χ^2 = 18.601	< .001
	Same	410 (70.8%)	694 (70.2%)	95 (68.4%)		
	More	55 (9.5%)	155 (15.7%)	17 (12.2%)		
Gender		Birth Weight in Grams (*M, SD*)				
	Male	3,170.2 (563.1)			*t =5.64*	< .0001
	Female	3,011.0 (550.7)				
Race		Birth Weight in Grams (*M, SD*)				
	White	3,242.5 (539.4)			*F* = 29.095	< .0001
	Black	3,011.3 (556.3)				
	Other	3,066.9 (581.3)				
Gender		Physical Activity Hours (*M, SD*)				
	Male	3.58 (1.69)			*t =2.56*	0.0107
	Female	3.37 (1.71)				

Race		Physical Activity Hours (*M, SD*)		
	White	3.28 (1.58)	*F* = 10.686	< .0001
	Black	3.64 (1.75)		
	Other	3.18 (1.73)		
Race		Mother's Weight Gain (*M, SD*)		
	White	40.96 (96.76)	*F* = 7.966	< .0001
	Black	28.28 (35.72)		
	Other	49.55 (136.04)		
Age		Mother's Weight Gain (*M, SD*)		
	3	43.12 (121.95)	*F* = 6.544	< .0001
	4	29.37 (17.03)		
	5	28.42 (15.03)		
Age		Mother's Tobacco Use		
	3	456 (71.25%)	χ^2 = 667.09	< .0001
	4	149 (23.28%)		
	5	35 (5.47%)		
Gender		Mother's Tobacco Use		
	Male	317 (47.46%)	χ^2 = 4.091	0.043
	Female	351 (52.54%)		

Table 3
Bivariate Analyses with Obese Group (BMI percentiles ≥ 95 %)

Variable	Test	Test Statistic	p-value
Breastfeeding	χ2	8.0331	0.0046 *
Hours of Sleep	t-test	4.25	< .0001 *
Hours of Screen Time	t-test	2.59	0.0096 *
Hours of Physical Activity	t-test	-0.15	0.8791
Introduction of Solid Foods	t-test	0.45	0.6538
Perceived Weight Gain	Satterthwaite t-test	8.30	< .0001 *
Mother's Tobacco Use	χ2	1.0795	0.2988
Mother's Weight Gain	Satterthwaite t-test	0.43	0.6687
Mother's Diabetes	χ2	9.4403	0.0021 **
Child's Birth Weight	t-test	3.32	0.0009 *
Gestation Age of Child	t-test	0.10	0.9213
Method of Delivery	χ2	12.3782	0.0004 *

* Statistically significant
** Statistically significant, yet n = less than 50

Hours of sleep. The average number of hours reported by mothers was 8.77 hours, with a standard deviation of 1.31 hours. The number of hours did not differ significantly by child's age or gender. However, there was a significant difference by race ($p < 0.001$). The mean number of hours among White children was 9.34, compared to 8.04 among Black children. The number of hours of sleep was negatively correlated to obesity ($p < 0.001$). Among obese children, the average number of sleep hours at home was 8.44 (*SD* = 1.31), while the average number of hours of sleep at home for non-obese children was 8.82 (*SD* = 1.31).

Screen time. The average number of hours mothers reported as their child's screen time was 2.64 hours, with a standard deviation of 1.70 hours. The number of hours did not differ significantly by gender, but there was a significant difference by child's age ($p = 0.043$) and race ($p < 0.001$). Children aged 3 watched 2.50 hours (*SD* = 1.67), children aged 4 watched 2.73 hours (*SD* = 1.73), and children aged 5 watched 2.71 hours (*SD* = 1.72). White children watched an average of 1.87 hours (*SD* = 1.07), and Black children watched an average of 3.15 hours (*SD*

= 1.86). Obesity was positively correlated with screen time ($p < 0.001$). Obese children watched an average of 2.95 hours ($SD = 1.76$), and children who were not obese watched an average of 2.59 hours ($SD = 1.68$).

Perceived weight gain. Perceived weight gain did not differ by child's age but differed by gender ($p = 0.014$) and race ($p < 0.001$). A higher percentage of females were viewed as gaining less weight that males (17.8% versus 15.0%), and a higher percentage of males were viewed as gaining more weight than females (15.2% versus 11.4%). A higher percentage of White children were viewed as gaining less weight than Black children (19.7% versus 14.1%), and a higher percentage of Black children were viewed as gaining more weight than White children (15.7% versus 9.5%). Obesity was positively correlated to perceptions of weight gain ($p < 0.001$). Among obese children, 6.79% of their mothers perceived their child's weight gain as less than others, 11.84% perceived their child's weight gain as the same as others, and 35.68% perceived their child's weight gain as more than others.

Child's birth weight. Children's birth weights were obtained from MSDH official birth records. The average weight was 3,090.46 g, or approximately 6.80 lb. Birth weight did not differ by child's age ($p = 0.2901$) but did differ significantly by gender ($p < 0.001$) and race ($p < 0.001$). The average birth weight among boys was 3,170.2 g (6.97 lb) compared to 3,011.0 g (6.62 lb) among girls. The average birth weight among White children was 3,242.5 g (7.13 lb) compared to 3,011.3 g (6.62 lb) among Black children. Obesity was positively correlated with birth weight ($p = 0.0009$). Obese children had an average birth weight of 7.00 lb, while non-obese children had an average birth weight of 6.76 lb.

Delivery method. The delivery method was obtained from MSDH official birth records. Two categories capturing vaginal birth were collapsed into one variable, and two categories of C-section were collapsed into another variable. A total of 62.26% were vaginal deliveries, while 37.74% were C-sections. Delivery method did not differ by gender, child's age, or race. Obesity was significantly correlated ($p = 0.0004$) to delivery method. Among those children who were delivered via vaginal birth, 12.06% were obese, while 18.54% of those delivered via C-section were obese.

Maternal, Child, and Parenting Variables Not Correlated with Obesity

Introduction of solid foods. The average age of introduction was 5.54 months, with a standard deviation of 2.07 months. The number of months did not differ significantly by child's age, gender, or race. Obesity was not significantly correlated with the introduction of solid foods ($p = 0.6538$).

Physical activity. The average number of hours was 3.48 hours, with a standard deviation of 1.70 hours. The number of hours did not differ significantly by child's age. However, there was a significant difference by gender ($p = 0.011$) and race ($p < 0.001$). The average number of hours among boys was 3.58 (*SD* = 1.69), and the average number of hours among girls was 3.37 (*SD* = 1.71). Among White children, the average number of hours was 3.28 (*SD* = 1.58), and the average number of hours among Black children was 3.64 (*SD* = 1.75). Obesity was not significantly correlated to physical activity ($p = 0.8898$).

Mother's weight gain. Mother's weight gain was obtained from MSDH official birth records. Mothers gained an average of 33.82 lb. Weight gained did not differ by the child's gender ($p = 0.2257$) but did differ by the child's age ($p = 0.0015$) and race ($p = 0.0004$). Among children aged 3, mother's weight gain was 43.12 lb (*SD* = 121.95), while among children aged 4, mother's weight gain was 29.37 lb (*SD* = 17.03), and among children aged 5, mother's weight gain was 28.42 lb (*SD* = 15.03). Among White children, mother's weight gain was 40.96 lb (*SD* = 96.76); among Black children, mother's weight gain was 29.37 lb (*SD* = 35.72). Obesity was not related to mother's weight gain.

Mother's tobacco use. Mother's tobacco use was obtained from MSDH official birth records. Most (61.34%) did not smoke during pregnancy, while 38.66% did. Tobacco use did not differ by race ($p = 0.1806$) but did differ by child's age ($p < 0.001$) and gender ($p = 0.043$). Among children aged 3, 73.25% of mothers reported tobacco use, while among children aged 4, 23.28% reported tobacco use, and among children aged 5, 5.4% reported tobacco use. Among girls, 52.54% of mothers reported tobacco use, and among boys, 47.46% of mothers reported tobacco use. Obesity was not related to mother's tobacco use.

Mother's diabetes. Mother's diabetes data was obtained from MSDH official birth records. Only 43 mothers (2.49%) were reported to have diabetes during the pregnancy. Diabetes did not differ by the child's gender, age, or race. While obesity was significantly correlated to mother's diabetes, this finding is not considered reliable given the low number (n = 43) included.

Gestation. The obstetric estimate of gestation was obtained from MSDH official birth records. The mean number of weeks was 38.03. Gestation did not differ by gender, child's age, or race. Obesity was not significantly correlated to gestation ($p = 0.9213$).

Discussion

Obesity was present in 14.12% of the 1,728 children in this study. Differences were not noted by age or gender, but they were significant by race, with 16.73% of Black children and 9.22% of White children measuring as obese ($p < 0.0001$). These findings are consistent with national data indicating Black children have a higher probability of becoming obese than do their non-Hispanic and non-Black peers, which has held true for more than a decade (Rossen, 2012). Compared to White children, Black children have BMI trajectory profiles associated with higher risks for subsequent obesity, including a younger age of onset and classification. These disparities are noted by the preschool years, with a particular increase in prevalence noted in Black females (Wang, Gortmaker, & Taveras, 2011; Wen et al., 2012). Prior Mississippi studies on childhood obesity have found that a high percentage of students are already overweight by the first grade, with the prevalence trending an increase with each subsequent grade (Molaison et al., 2008).

The higher obesity rate in Mississippi's preschool children at 14.2%, as compared to the national rate of 13.9%, could be connected to the rurality and lower socioeconomic status of the state. Though modest declines in obesity prevalence for most racial groups of low-income children ages 2 to 4 years have been reported, the prevalence rate for obesity still remains higher for low-income children (Pan et al., 2015). Unfortunately, no measures of parental or household income or other measures of socioeconomic status were collected in this study. Evidence suggests children who live in more metropolitan or urban areas are less likely to be overweight and obese due to greater access to healthy food options and healthy eating information (Hansstein, 2016; Kimbo, Brooks-Gunn, & McLanahan, 2007). Nationally, both gender and age differences have been associated with higher prevalence rates for obesity (BMI $\geq$ 95th percentile) and severe obesity (BMI $\geq$ 1.2 x 95th percentile) linked to boys and varying by age group (Lo et al., 2014).

Obesity was negatively correlated with breastfeeding. This finding is consistent with national examinations of breastfeeding and childhood obesity that indicate breastfeeding increases the likelihood of being normal weight by 5.2% ($p < 0.001$) and decreases the likelihood of being obese by 8.6% ($p < 0.001$) (Hansstein, 2016). High birth weight status has been connected to childhood obesity, with reports showing children with high birth weights were 2.5 times as likely to be overweight or obese (Kimbro, Brooks-Gunn, & McLanahan, 2007). In addition, this study also found significant correlations between obesity and hours of sleep, hours of child's screen time, parent's perception of the child's weight gain in the first year, mother's diabetes, and the method of delivery.

Obesity was not correlated with the physical activity of the child, timing of the introduction of solid foods, mother's tobacco use during pregnancy, mother's weight gain during pregnancy, or gestational age of the child at delivery. Kimbro, Brooks-Gunn, and McLanahan (2007) also found no significant correlation between physical activity and childhood obesity. However, Hillier, Pedula, Vesco, Oshiro, and Ogasawara (2016) found that excessive maternal weight gain (>40 lb) was associated with a more than 15% increased risk of childhood overweight and obesity among normal birth weight children, a finding that was not supported in this analysis.

This study was limited to a random sample of children ages 3 to 5 years from a random sample of licensed childcare facilities across the state. As such, it did not include children who are in unlicensed childcare or at home. Differences by age, gender, and race were examined, but not combined factors such as gender and race. The study included a number of maternal, child, and parenting factors recently associated with childhood obesity. It is likely that other factors individually or collectively played a role in these findings, as nationally representative samples suggest the relationship between collective health factors and other life variables seem to influence overweight and obesity differently across genders and age categories (Balistreri & Van Hook, 2011).

Another limitation is that the information collected on many of the variables included in this study came solely from the mother's self-report. Information the mothers provided at birth (e.g., tobacco use) and through the six questions in the survey were not confirmed by any other source. Also, the sample size limited the analysis of the variables in relation to correlation with mother's diabetes, but this finding was not considered reliable given the low number ($n = 43$) of mothers whose birth records indicated that they had diabetes. However, evidence exists to support a link between gestational diabetes and a greater prevalence for developing childhood overweight and obesity during the first decade of life ($p < 0.0001$), with the risk of childhood overweight and obesity nearly 30% or higher with a maternal diagnosis of gestational diabetes (Hillier et al., 2016).

Additional analyses need to be conducted to more thoroughly explore the relationships between childhood obesity and maternal, child, and parenting factors. For example, do the differences in weight status classification (i.e., overweight, normal weight, or underweight) vary significantly by age, gender, or race? Do the maternal, child, and parenting variables correlate differently to the different weight status classifications? Also, how do the maternal, child, and parenting variables correlate with each other? For example, does breastfeeding, or the length of time one breastfeeds, correlate with other maternal health variables such as tobacco use or other child variables such as sleeping or the introduction of solid foods? Are sleeping and screen time associated and, thereby, impacting the child's weight status? Future research could be conducted on these same children over time or new cohorts of pre-kindergarten children as new policies and interventions are enacted.

While prevention is ideal, resolution of unhealthy weights at a young age is highly desirable, since early intervention and correction lessen long-term exposure to chronic weight-related illnesses and may instill healthy eating and activity habits that extend to later childhood and adulthood. Preschoolers are in a unique developmental period of cognitive growth, and increasing social exposures to new, non-family environments (such as Head Start and licensed preschools) can make them receptive to positive messages from both family and school.

In addition to the physical health-related outcomes associated with childhood obesity, childhood obesity is associated with psychosocial and academic risks. Obese children are more likely to experience low self-esteem, depression, anxiety, behavioral problems, and poor body image;

endure teasing, social discrimination, and emotional distress; and often underachieve academically (Daniels, 2006; Kihm & Rolling, 2014; Kuhl et al., 2012; Lang, 2012; Larsen et al., 2006). Obese children miss four times as much school as their normal-weight peers and score significantly lower in kindergarten-level math and reading test scores when compared to non-overweight children (Datar et al., 2004; Satcher, 2005).

State-specific obesity prevalence surveillance has been highlighted as key in determining the need for and impact of state- and local-level obesity-prevention strategies (CDC, 2013). For this reason and the many negative health-related obesity associations listed earlier, it is imperative to continue surveillance of the substantially high obesity prevalence in our preschoolers and children, which will have a significant impact on early onset of obesity-related illnesses, the longevity of lifetime exposure to those illnesses, as well as adult obesity and other morbidities (Harbaugh et al., 2011; Ogden, Carroll, Kit, & Flegal, 2014; Wang, Gortmaker, & Taveras, 2011). Some states have witnessed a recent, slight decline in childhood obesity in their youngest children, with explanations focusing on many potential levels. Among those levels, day care, school food policies, and media messages have been identified as influential (Farley & Dowell, 2014).

Though Mississippi children have historically been among the most obese children in the nation, the recent MSDH Physical Activity in the Child Care Setting (PACCS) initiative has targeted the reduction of high-prevalence obesity among 2- to 5-year-olds through the implementation of guidance and standards for childcare facilities to better their physical activity and nutrition environments (MSDH, 2017). With an increasing number of children in this age range spending their days in childcare facilities, it is logical to target childcare facilities' physical activity opportunities and nutritional content of meals. These standards have been nationally recognized for their focus on child nutrition, outdoor exposure, and limits on screen time. These standards are currently influencing state policy, which require daily, structured physical activity in all licensed facilities; an action plan to help facilities work toward the improved goals and requirements for physical activity; and an Allies for Quality Care program, which will provide direct assistance for selected childcare facilities to improve their learning environments and nutritional offerings for Mississippi's youngest children (Mississippi State Department of Health, 2017).

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