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A Comparative Analysis of Rural versus Urban Preschool Children's Sugar-Sweetened Beverage Consumption, Body Mass Index and Parent's Weight Status

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Abstract

Background: Childhood overweight and obesity continues to be a major public health concern, especially in minority, low-income, and rural populations. In order to develop health promotion interventions aimed at reducing obesity rates, there is a need to identify which populations have the highest rates of obesity and the risk factors associated with these high rates.

Methods: Data collected from low-income, preschool children and their parents in an urban community and a rural community in Alabama were analyzed and compared. Body Mass Index (BMI) was collected during school based health screenings, and information regarding parent's BMI and child's consumption of sugar-sweetened beverages (SSBs) were collected by parent report.

Results: Of the 363 children screened, 12.8% (15.2% rural and 11.9% urban) were considered overweight, and 15.8% (20.2% rural and 14.2% urban) of the sample was classified as obese. Rates of overweight and obesity for mothers were 27.6% (25.3% rural and 28.4% urban) and 48% (56.3% rural and 44.8% urban) respectively and 39.6% (53.3% rural and 34.4% urban) and 34.6% (28.3% rural and 36.9% urban) for fathers. Parents reported their child consumed 3.82 SSBs per day. Overall, mother's BMI, father's BMI and sugar-sweetened beverage consumption was positively associated with child's BMI. However, there were no significant interactions between the rural and urban groups.

Conclusion: Rates of overweight and obesity remain high in low-income, predominantly minority preschool children and their parents in two communities in Alabama. Consumption of SSBs, mother's BMI, and father's BMI are three factors impacting the weight status of low-income preschool children. These factors are significant in both rural and urban children.

Keywords

obesity, preschool child, sugar-sweetened beverages, parental BMI

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Obesity continues to be a grave public health threat that is linked to a number of chronic diseases (Blumenthal & Seervai, 2018). In the United States (U.S.), 31.8% of adults aged 20 and over are overweight and 39.8% are obese (Centers for Disease Control and Prevention, 2017). The prevalence of obesity among children 2 to 5 years old increased from 8.4% in 2011–2012 to 13.9% in 2015–2016 (Hales et al., 2018). Obesity prevalence is higher among minority and low-income individuals and those living in rural areas. In both adults and children, blacks and Hispanics have higher rates of obesity compared to whites and Asians (Hales et al., 2017). Individuals who live in the most poverty-dense counties in the U.S. are the most prone to obesity (Levine, 2011). In addition, both rural adults and children have higher rates of obesity compared to their urban counterparts, especially in the South and Northeast

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(Befort et al., 2012; Johnson & Johnson, 2015; Lundeen et al., 2018b).

Alabama is consistently ranked one of unhealthiest states in the U.S. Alabama has the fifth highest adult obesity rate (36.3%) in the nation (Centers for Disease Control and Prevention, 2019), and the prevalence of obesity among preschool-age children in Alabama was 16.3% in 2014 (Robert Wood Johnson Foundation, 2017). These high rates of obesity are not surprising considering 54 of Alabama's 67 counties are considered rural, and 17 of these rural counties have adult obesity rates between 40 and 49% (Alabama Rural Health Association, 2018). Demographic characteristics are also a contributing factor. The demographics of Alabama are rather similar to the rest of the country (United States Census Bureau, 2017). There is a lower percentage of Latino people and a higher percentage of Black people. Census data also indicates that there is lower education attainment, higher unemployment, higher disability status, lower incomes, and more people experiencing poverty and requiring food stamps to supplement their grocery shopping.

Because obesity can be difficult to treat, identifying modifiable risk factors that can be targeted to prevent obesity is important. One of the largest contributors to obesity in both children and adults is the consumption of sugar-sweetened beverages (SSBs) (de Ruyter et al., 2012; Ludwig et al., 2001; Malik et al., 2013; Schulze et al., 2004), which include non-diet soda, fruit drinks that are not 100% juice, sweet tea, sports drinks, and energy drinks. Almost half of the U.S. adult population (49.3%) reports drinking 1 or more SSBs on a daily basis (Rosinger et al., 2017). SSB intake is highest among Hispanic and non-Hispanic blacks and those who have less education, are unemployed, obese, live in a rural area, and report no physical activity (Lundeen et al., 2018a). Because parents are responsible for food availability in the home, those parents who consume high amounts of SSBs may also be affecting their child's consumption of these beverages. More than 50% of energy intake from SSBs is consumed at home among U.S. children and adolescents aged 2–19 years old (Kit et al., 2013).

Table 1. Demographic Information Compared by Region.

	Region		
Demographic	Rural	Urban	Total
Family martial status			
Single	64%	49.7%	53.4%
Married	32%	24.8%	26.7%
Divorced	0%	4.9%	3.6%
Widowed	0%	0.3%	0.3%
Family yearly income			
<$15,999	51%	36.7%	40.4%
$16,000–$23,999	23%	18.2%	19.4%
$24,000–$31,999	10%	11.5%	11.3%
>$32,000	12%	18.5%	16.8%
Education of head of house			
<High School	4%	3.8%	3.9%
High School	45%	30.4%	34.2%
>High School	47%	51.7%	50.5%

Note. All remaining percentages result from lack of response.

Parental obesity has also been identified as a predominant risk factor for childhood obesity (Maffeis, 2000), and children's BMI is significantly correlated with both mother's and father's BMI (Bahreynian et al., 2017; Devakumar et al., 2016; Fuiano et al., 2015; Lindkvist et al., 2015; Tchicaya & Lorentz, 2014). Children living in a household with only one obese parent were 6.51 times more likely to be overweight or obese compared to those children who live in a household with two normal weight parents (Tchicaya & Lorentz, 2014). Twin, adoption, and family studies indicate that genetics accounts for 25% to 40% of inter-individual difference in adiposity (Bouchard, 1976). Although genetic factors may play a role in determining the weight status of children (Wardle et al., 2008), parents can also indirectly influence unhealthy dietary, physical activity, or sedentary behaviors in their children (Maffeis, 2000). Children of parents who report no physical activity or an unbalanced diet have higher BMIs (Tchicaya & Lorentz, 2014).

Although there is evidence that parental obesity is associated with childhood obesity, few, if any, of these studies have focused on low-income, predominantly minority preschool-age children in the United States. Likewise, several studies have examined the relationship between SSBs on obesity in children, but no studies have looked at the prevalence of overweight and obesity in low-income preschool children and its association with both parental BMI and consumption of SSBs. Accordingly, this study explored the association between parental BMI and children's BMI and consumption of SSBs in a sample of predominantly low-income, minority preschool children in both urban and rural communities. The aims of this study were to determine the prevalence of overweight, obesity, and consumption of SSBs and investigate the relationship between parental BMI, child's BMI, and consumption of SSBs in a sample of low-income preschool children in both urban and rural areas.

Methods

Study Population

The study population was preschool children of predominantly minority, low socioeconomic status from vulnerable populations in rural and urban areas in the state of Alabama. All children enrolled in the preschool programs were provided the opportunity to participate in school health fairs where the screenings occurred. This sample consisted of 363 preschool children (187 males, 176 females)

between the ages of four and five that were enrolled in the Pre-K programs in one urban and one rural community in Alabama. Ninety-five of these students were from a rural community (45 males, 50 females) while 268 were from the urban sample (142 males, 126 females). Of the children screened whose parents reported race information, 68.3% identified as black, 8.8% as Hispanic, 9.8% as white, and less than 1% identified as Asian or Native American. For additional demographic information please see Table 1. The Institutional Review Board of the university system provided approval for the study. Informed written consent was obtained from participants' legal guardians before they were allowed to participate in the health screenings.

Procedure

Appropriate screening of preschool children following recommendations developed by the American Diabetes Association (American Diabetes Association, 2004) can be expected to result in earlier identification of those children at-risk for the development of obesity and associated cardiovascular risk factors. Early screening programs can help reduce the risk of short and long-term complications. In this study, the local preschool screenings have been well-established for the last twelve years and have an 85–95% student participation rate. The school nurses closely monitor the follow-up by parents whose children are identified as having unmet health needs.

Screenings were performed at on-site health fairs conducted at preschools in disadvantaged areas around the city and in one centralized preschool in a rural county. The health fairs were organized into a series of health assessment stations that included vital signs, finger stick, head-to-toe exam, vision screening, dental screening, and hearing screening. Height, weight, blood pressure, respirations, and pulse were obtained by senior-level nursing students and fourth-year medical students and were reviewed by nursing and medical school faculty. The casual blood glucose and total cholesterol were obtained by finger stick either by nursing faculty or senior-level nursing students trained on the appropriate method of obtaining the blood sample and running the Cholestech machines. Children who exhibited any risk factor results beyond the normal parameters were referred to their primary health care provider.

Table 2. BMI Rates of Mothers, Fathers, and Children Compared by Region.

	Mothers		Fathers		Child	
	Total		Total		Total	
Overweight	27.6%		39.6%		15.2%	
Obese	48%		34.6%		15.8%	
	Rural	Urban	Rural	Urban	Rural	Urban
Overweight	25.3%	28.4%	53.3%	34.4%	15.2%	11.9%
Obese	56.3%	44.8%	28.3%	36.9%	20.2%	14.2%

Measures

The instrument used in the present study included a parent self-report questionnaire which asked the parent or primary caregiver information about family demographics (i.e., family income, parent/caregiver level of education, ethnicity), child's daily consumption of SSBs (i.e., how many beverages per day), and parents' height and weight. This questionnaire was sent home to parents prior to the health screenings. Children's height and weight were measured during the preschool health screenings. Body mass index (BMI) was then calculated using the Center for Disease Control's (CDC) Children's BMI Tool for Schools (Centers for Disease Control and Prevention, 2011). This calculator computes BMI and BMI percentiles for individual children in a group using height and weight measurements, sex, date of birth, and date of measurement information that is entered. BMI was then coded into the three categories of normal (≥5th percentile to <85th percentile), overweight (≥85th percentile to <95th percentile), and obese (≥95th percentile). The parent BMI was calculated utilizing the online BMI calculator available from the National Heart, Lung, and Blood Institute (Heart, Lung, & Blood Institute, 2019).

Data Analysis and Results

Descriptive statistics of each variable of interest were calculated for the entire sample and for each location (urban vs rural). Correlations were then calculated for each of the variables of interest. Variables were mean centered and interaction terms calculated based on those centered variables. A series of multivariate regressions were then calculated to look for interactions.

Descriptive analysis of children's and parental BMI revealed that 15.8% (20.2% rural & 14.2% urban) of the sample was classified as obese and 12.8% (15.2% rural &11.9% urban) were considered overweight. Rates of overweight and obesity for mothers were 27.6% (25.3% rural & 28.4% urban) and 48% (56.3% rural & 44.8% urban) respectively and 39.6% (53.3% rural & 34.4% urban) and 34.6% (28.3% rural & 36.9% urban) for fathers (See Table 2). The child sample had a mean BMI of 16.36 (SD = 1.97), and a mean BMI percentile of 62.5 (SD = 29.7). Rural children had a mean BMI of 16.65 (SD = 1.86), and a mean BMI percentile of 67.23 (SD = 27.01) while urban students had a mean BMI of 16.25 (SD = 2.00), and a mean BMI percentile of 60.79 (SD = 30.51). Although rates of overweight and obesity were higher in rural children compared to their urban counterparts, a t-test showed that the rural children did not have significantly higher BMIs than the urban group, $t(360) = 1.72$, $p = .087$. Parents reported that their child consumed an average of 3.82 (SD = 2.19) SSBs per

day. There were no significant differences between the groups in consumption. Other demographic investigations showed that children of single parents had significantly higher ($t(306) = 3.08$, $p = .002$) sugary sweetened beverage consumption ($M = 3.74$; SD = 1.79) compared to children of married parents ($M = 3.08$; SD = 1.89). In addition, the household income was negatively correlated with SSB consumption whereas the higher level of income resulted in less consumption, $r(338) = -.242$, $p < .001$.

Correlational & Regression Analysis

Consumption of SSBs, children's, father's, and mother's BMI were all correlated (see Table 3). Mother's, father's, and SSB consumption were all positively correlated with child's BMI. As mother's and father's BMIs increased and SSB consumption increased, the child's BMI also increased. In addition, mother's and father's BMI were positively correlated. Mother's BMI was also positively associated with SSB consumption. A series of interaction terms were created combining region and the three continuous variables mentioned above, to see if region had any effect on these correlations. None of these interactions significantly predicted child's BMI suggesting there was no significant difference between rural or urban regions.

Discussion

Results of this study indicate the obesity rate in an urban and rural sample of low-income preschool-age children in Alabama is slightly higher than the national average (15.8% vs 13.9%) but is lower than the rate for the state as a whole (16.3%). However, as is consistent with previous studies, there was a higher rate of both overweight and obesity in rural children compared to their urban counterparts. The rate of overweight (27.6%) mothers in this sample was lower than the national (31.8%) rate, but the rate of obesity (48%) for mothers was higher than both the national (39.8%) and state (36.3%) rates for adults. The opposite was found in fathers where the rates for overweight (39.6%) were higher than the national rate but the obesity rate (34.6%) in fathers was lower than both the national and state rates for adults.

Previous studies have shown an association between obesity and parental weight status in children, but the majority of these studies have been conducted outside the U.S. or only looked at the association between the mother's BMI and the child's BMI. In studies looking at the correlation between both the paternal and maternal BMI with the child's BMI, the majority found that there was a greater maternal association with the child's BMI (Danielzik et al., 2002; Linabery et al., 2013; Patro et al., 2013; Svensson et al., 2011). In this study, we found both the mother's and the father's BMI was associated with the child's BMI and this was true for both the rural and urban samples. Genetic and environmental factors are known contributors to overweight and obesity (Bahreynian et al., 2017; Jiang et al., 2013; Semmler et al., 2009). However, the relative contributions of genetics and environment to the development of obesity is not clear (Barness et al., 2007). Because an association between the parental BMI and the child's BMI was found in both samples, it would appear in our study that environmental factors, such as socioeconomic status and dietary patterns, play a significant role in the development of childhood obesity since both samples consisted of low-income, predominantly black children and parents.

Table 3. Correlations between BMI Variables and SSB Consumption.

	Child's BMI	Father's BMI	Mother's BMI
Child's BMI			
Father's BMI	.170*		
Mother's BMI	.117*	.241**	
SSBC	.114*	−.005	.140*

Note. *$p < .05$, **$p < .01$.

As with parental BMI, increased consumption of SSBs is a known risk factor for overweight and obesity in children. A meta-analysis of cohort studies in children reported a significantly increased risk of being overweight or obese with consumption of one or more daily servings of SSBs (Te Morenga et al., 2012). In this study, both rural and urban children consumed almost four SSBs per day on average, and an association between SSB consumption and increased BMI was found in both groups. There have been studies which have looked at the availability of SSBs in urban vs rural communities (Adachi-Mejia et al., 2013) or the consumption of SSBs by urban vs rural adolescents (Wattelez et al., 2019), but the association between SSB consumption and BMI in rural, preschool-age children compared to their urban counterparts has not been previously studied.

Two other findings in this study were that marital status and family income impacted weight status of children. Children of single mothers were more likely to consume more SSBs than children of married parents. This is an important factor as there are few studies that examine marital status as a predictor of SSB consumption. One systematic review did report that single parenthood was associated with higher SSB consumption (Mazarello Paes et al., 2015). Also, in this study, higher income level resulted in less SSB consumption, which is consistent with findings in other studies (Cullen et al., 2002; De Coen et al., 2012; Drewnowski & Specter, 2004; Vereecken et al., 2004). Low-income families tend to have diets that are high-fat, high-sugar, and less nutrient dense.

Conclusions

In this sample of low-income preschool children, high rates of overweight and obesity are common, and there is no

difference between rural and urban samples. This study supports previous findings that reported positive associations between parental BMI and the BMI of their children and highlights the importance of assessing familial risk factors when examining weight status in children. The results of this study also indicate that regular SSB consumption increases the risk for overweight and obesity in low-income, preschool children. This study builds upon the current body of knowledge by demonstrating that maternal BMI was associated with increased SSB consumption in their children, which is a known risk factor for childhood obesity.

Interventions aimed at reducing the rate of overweight and obesity would have the greatest impact if they are targeted to parents of preschool children who are low-income, overweight or obese, and single parents. Those interventions which target parent, child, and environmental-level factors are most likely to have the greatest impact on reducing SSB consumption in children. Additionally, health professionals should incorporate education regarding healthy alternatives to SSBs to parents and the impact these beverages have on the weight of their children at well-child visits.

Declaration of Conflicting Interests

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