Journal of Pediatric Psychology, 40(7), 2015, 649–656
doi: 10.1093/jpepsy/jsv023
Advance Access Publication Date: 21 March 2015
Original Research Article

Racial Differences in Obesity-Related Risk Factors Between 2-Year-Old Children Born of Overweight Mothers

Bernard F. Fuemmeler,[1] PhD, MPH, Marissa Stroo,[1] BS, Chien-Ti Lee,[2] PhD, Sharnail Bazemore,[1] MS, Brooke Blocker,[1] BA, and Truls Østbye,[3,4] MD, PhD

[1]Department of Community and Family Medicine, Duke University Medical Center, [2]Department of Family, Home, and Social Sciences, School of Family Life, Brigham Young University, [3]Duke Global Health Institute, Duke University, and [4]Duke-NUS Graduate Medical School

All correspondence concerning this article should be addressed to Bernard F. Fuemmeler, PhD, MPH, Departments of Community and Family Medicine and Psychology and Neuroscience, Duke University Medical Center, DUMC 104006, Durham, NC 27710, USA. E-mail: bernard.fuemmeler@duke.edu

Received June 18, 2014; revisions received February 11, 2015; accepted February 19, 2015

Abstract

Objective Investigate racial differences in a range of obesity-related socio-behavioral risk factors in children born of obese mothers. **Methods** 142 Black and 151 White 2-year-old children and their parents were surveyed on their physical activity environment, food environment, parental role modeling, eating behaviors, feeding practices, child physical activity, dietary intake, and eating behaviors; body mass index (BMI) for parents and children (BMI *z*-score) were calculated. **Results** In bivariate analyses, Black families reported significantly more risk factors for early-childhood obesity than White families, including greater availability of soda, more television viewing, and poorer dietary intake. In multivariate analyses adjusting for maternal and socioeconomic factors, the differences between Black and White families on factors including television watching and dietary intake remained significant. **Conclusion** These data show a greater number of risk factors for obesity among Black children and their families compared with White children even after adjustment for maternal BMI and socioeconomic status.

Key words: children; home environment; obesity.

There are substantial racial/ethnic differences in the prevalence of obesity. Between the ages of 2 and 5 years, the proportion of Black children with a body mass index (BMI) at or above the 95th percentile is 11.3%, twice the proportion for White children, and these differences persist through development (3.5%; Ogden, Carroll, Kit, & Flegal, 2014). Such findings suggest obesity-related risk factors present during early childhood may give rise to the differences observed through development.

The etiology of obesity is multifactorial, involving a combination of individual, familial, and societal factors (Egger & Swinburn, 1997; Nader et al., 2012). One very important risk factor for childhood obesity is having parents who are obese. Children with obese parents are 10–12 times more likely to be obese (Reilly et al., 2005; Whitaker, Jarvis, Beeken, Boniface, & Wardle, 2010). Children of obese parents also exhibit lower levels of physical activity, have a greater preference for high-fat foods, and lower preference for healthier foods (Morgan, Okely, Cliff, Jones, & Baur, 2008; Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001). Other individual child-level risk factors include unhealthy diet, sedentary time, and eating characteristics or traits (e.g., low satiety responsiveness) (Collings et al., 2013; Fuemmeler, Lovelady, Zucker, & Ostbye, 2013). Parent modeling of health behaviors, parent feeding behaviors, or general parenting styles have also been linked to risk for obesity (Collings et al., 2013; Fuemmeler, Anderson, & Mâsse, 2011; Ostbye et al., 2013). The home environment, such as availability of healthy and unhealthy food or accessibility of safe play areas and

toys used for physical activity, have also been examined relative to childhood obesity (Ostbye et al., 2013; Sallis, Prochaska, & Taylor, 2000).

Because early childhood is a critical period for the development of obesity over the life course, and because the gap in the prevalence of obesity between racial/ethnic groups widens early in development, it is important to identify early differences in risk factors to reduce racial and ethnic disparities (Dixon, Peña, & Taveras, 2012), but this research base is still limited. Hughes et al. (2006) and Fuemmeler et al. (2012) found that specific parental feeding practices and general parenting styles differ by race and that these differences in parenting may influence risk for obesity (Fuemmeler et al.). Taveras et al. (2010) found that Black preschool-aged children watched more television (TV) and consumed higher quantities of fast food and sugar-sweetened beverages (SSB) than their White counterparts. Perrin et al. (2014) reported that compared twith White mothers, Black, non-Hispanic mothers were more likely to provide constant access to food, such as putting their child to bed with a bottle, encouraging their child to finish breast milk or formula, and "bottle prop" (i.e., lean a bottle up against a blanket instead of hold it). In their sample, Black mothers also watched greater amounts of TV with their infants than their White counterparts (Perrin et al., 2014). These studies suggest that, Black and White children differ with respect to risk factors and behaviors related to obesity later, and some of these differences are present at an early age. Despite these studies, research in this area is still limited and would benefit from a better understanding of social determinants and risk factors from a number of different levels (e.g., home environment, parents' behaviors, parenting, child eating characteristics), especially at this early developmental phase when prevention efforts may have its greatest impact.

The purpose of the current study was to evaluate racial differences in BMI *z*-score and obesity-related social and behavioral risk factors in a sample of 2-year-old Black and White children who share a common risk factor for obesity—being born to an overweight or obese mother. This provides the opportunity to examine risk factors for obesity beyond this highly influential risk factor. The study examined parental behaviors and feeding practices, the home health environment, child dietary intake, TV time and time playing outdoors, and child eating traits. These factors have been shown to be associated with childhood obesity in various populations. Studies that can identify racial differences in obesity-related risk factors have the potential to lead to clearer frameworks for obesity prevention from which to build more targeted interventions. We hypothesized that Black children would be heavier and that the obesiogenic parenting behaviors and home environment would be more common in Black families compared with their White counterparts.

Method

Participants

Participants were recruited from three large obstetrics clinics in the Southeastern United States for a larger behavioral randomized controlled trial, Active Mother's Postpartum (AMP) (Ostbye et al., 2008, 2009). AMP was designed to enhance weight loss in postpartum women who were overweight or obese before pregnancy. Eligibility was based on BMI ≥ 25 measured at the 6-week postpartum obstetrics appointment. Women who did not speak English or were aged <18 years were excluded from participation. Participants were randomized at 6–8 weeks postpartum to either the AMP intervention ($n = 225$) or the attention control group ($n = 225$). The 9-month AMP intervention included follow-up assessments (at 12 and 24 months postpartum) and focused on improving maternal lifestyle behaviors. The intervention did not specifically involve the adoption of any specific parenting styles or efforts to improve the health of their newborn infant. The results showed a mean weight loss at 1-month postintervention (12 months postpartum) of 0.90 kg ($SD = 5.1$ kg) in the intervention group and 0.36 kg ($SD = 4.9$ kg) in the control group; this was not statistically significant. There were also no significant group differences in improvement in diet or increased physical activity (see Østbye et al., 2009).

At the end of their final AMP follow-up (24 months postpartum), and on their return to the lab, mothers and their 2-year-old children were invited to participate in an observational study, "*AMP Too for Twos!* (AMP2)." Of the 450 participants from the main AMP study, 309 agreed to participate. For the purposes here, participants who reported a race/ethnicity other than non-Hispanic Black or White were excluded ($n = 16$). As part of AMP2, resident partners ($n = 248$) of the mothers were also contacted and invited to participate in a mail-in survey: 211 were completed. The University's institutional review board approved all study procedures.

Measures

Child Anthropometrics

At 2 years of age, child weight and standing height were measured using a Seca portable stadiometer and Tanita BWB-800 scale. Age- and gender-adjusted BMI *z*-scores were calculated using the Centers for Disease Control and Prevention SAS macro (Centers for Disease Control and Prevention, 2010).

Parental Health Behaviors

Percent of kilocalories from fat in maternal and partner diets was measured using the National Cancer Institute's (NCI) Percentage Energy from Fat Screener (National Cancer Institute), which consists of 17 items; each item measured a Likert scale assessing how often certain foods are consumed/prepared and a self-report question ranking fat in diet as high, medium, or low. In previous studies, the self-administered NCI fat screener has been shown to significantly correlate with interviewer-administered 24-hr dietary recalls (Thompson et al., 2008; Williams et al., 2008). Dietary screeners are useful in situations that do not require assessment of total energy intake, and although not as accurate as 24-hr recalls, they are used extensively to characterize a population's median intake or compare population subgroups in terms of higher or lower intakes.

A brief self-report food frequency questionnaire assessed the frequency of SSB, including (1) non-diet sodas and (2) other SSB. The two items were combined and dichotomized into none versus any. The specific questions are widely used by public health programs, and were based on the Women Infants and Children diet survey.

Mothers and their partners were also asked to report the number of hours they spend per day watching TV. Amount of TV viewing is positively correlated with BMI, percentage of fat, light-intensity physical activity and is negatively correlated with cardiorespiratory fitness and moderate to vigorous physical activity (Pettee, Ham, Macera, & Ainsworth, 2009).

Parent Feeding Practices

The Parental Feeding Style Questionnaire (PFSQ; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002) is a 27-item measure rated on a Likert scale ranging from 1 (*Never*) to 5 (*Always*). Both internal consistency reliability and validity have been established with the

PFSQ. The measure yields four subscales: Control Feeding (CF; 10 items), Emotional Feeding (EM; 5 items), Encouragement Feeding (EN; 8 items), and Instrumental Feeding (IF; 4 items). Sample items from each subscale include the following: "I allow my child to choose, which foods to have for meals" (CF); "I give my child something to eat to make him/her feel better when s/he is feeling upset" (EM); "I encourage my child to eat a variety of foods" (EN); "I reward my child with something good to eat when s/he is well behaved" (IF). Higher scores indicate a greater parental endorsement of the feeding practice measured by the respective subscale. In this sample, Cronbach's α for the CF, EM, EN, and IF subscales were 0.77 (0.79 for Whites; 0.77 for Blacks), 0.84 (0.82 for Whites; 0.85 for Blacks), 0.77 (0.73 for Whites; 0.80 for Blacks), and 0.63 (0.65 for Whites; 0.61 for Blacks), respectively. All of the four items were correlated with the total at a value of ≥ 0.32, suggesting no item discriminated poorly (Nunnally & Bernstein, 1994).

Home Health Environment

Mothers were asked to report how often healthy snacks (e.g., raisins, pretzels, or Cheerios), vegetables (e.g., fresh, canned, or frozen), fruit (e.g., fresh, canned, or frozen), soda or sugary beverages (e.g., Coke, Pepsi, Hi-C, and Sunny D; not including 100% fruit juices or diet drinks). They also reported on how often toys that encouraged physical activity were available in or around their homes (e.g., balls, tricycle). All of these items were rated on a 5-point Likert scale ranging from 0 (*Never*) to 4 (*Always*). Mean response to the fruits and vegetable questions were calculated and combined into one item. The items were all dichotomized into often or always (≥ 3) responses versus all other.

Child Dietary Intake

Child dietary intake was assessed similarly to the Feeding Infants and Toddlers Study (Ziegler, Briefel, Clusen, & Devaney, 2006). The primary caregiver (in nearly all cases, the mother) completed a 24-hr dietary recall by telephone on two randomly selected days over a 2-week period. Before the call, mothers were given a packet with two-dimensional visuals including examples of age-appropriate food portions and eating implements (e.g., "sippy-cups" and small bowls). If children attended daycare, mothers were given a form for the daycare provider to record the child's dietary intake (type and amount of food eaten). Recalls were completed using the Nutrition Data System for Research (University of MN) (Moshfegh et al., 2008; Ziegler et al., 2006), which yields an estimate of energy intake, percent energy from fat, added sugars (in grams), and servings of sweet drinks (soda, sweet tea, etc.). Diet recall data were available for 226 of the 293 (77%) children. There were no differences in primary demographic characteristics (maternal education and child's race) between mothers who provided dietary information and those who did not (Fuemmeler et al., 2013).

Child TV Time and Time Playing Outdoors

Parents were asked to report on the number of hours their child watches TV and plays outside on weekdays and weekends. Weekday and weekend TV time was dichotomized to identify children who spent >2 hr per day watching TV, as recommended by American Academy of Pediatrics (2014).

Child Eating Characteristics

The Children's Eating Behavior Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001) contains 35 items measured on a Likert scale ranging from 1 (*Never*) to 5 (*Always*) and yields eight subscales. For this study, we restricted our analyses to the following subscales: Food Responsiveness (FR), Enjoyment of Food (EF), Desire to Drink (DD), and Satiety Responsiveness plus Slowness in Eating (SR). The SR subscales were combined as they have been shown to load onto the same factor (Wardle, Guthrie, Sanderson, & Rapoport, 2001). The *EF*, *FR*, and *DD* domains reflect a general avidity toward eating and food, with higher scores indicating greater avidity. Sample items include the following: "If allowed, my child would eat too much" (FR); "My child loves food" (EF); and "If given the chance, my child would always be having a drink" (DD). The *SR* domain reflects how easily a child reaches satiety (e.g., "My child cannot eat a meal if he/she has had a snack just before"). The CEBQ has been shown to have high internal consistency, good test–retest reliability, stability over time (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; Wardle, Guthrie, Sanderson, & Rapoport, 2001). Furthermore, the four subscales of CEBQ have been correlated with weight (Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009), indicating good convergent validity. In this sample, Cronbach's αs for the *EF*, *FR*, *DD*, and *SR* subscales were .86 (.85 for Whites; .87 for Blacks), .79 (.65 for Whites; .84 for Blacks), .85 (.84 for Whites; .83 for Blacks), and .73 (.70 for Whites; .74 for Blacks), respectively.

Other Variables

Within the survey, parents also reported on their age, marital status, level of education, household income, and their child's sex and race. Mothers reported Child's birth weight and gestational weeks when they first enrolled in the AMP study (6–8 weeks postpartum). Mother's and child's weights and heights were measured at the study visit. Weights and heights of the mothers' partners were self-reported.

Statistical Analysis

The detailed demographic characteristics for all participants and stratified by race (i.e., Black vs. White) were tabulated. Next, multiple linear regressions or logistic regression models were developed to assess racial differences (White as the reference group) in each risk factor adjusted for maternal age, education, household income, marital status, maternal BMI, child gender, and AMP study arm (treatment vs. control). In adjusted models that examined differences with respect to partner behaviors, partner's BMI was used instead of maternal BMI.

Results

Table I shows the sample characteristics of the 293 children participating in the study. Table II provides the percentages and means and standard deviations for the behavioral and social risk factors for the overall sample and for Blacks and Whites separately. Table III presents the results adjusted for covariates.

Sample Characteristics

Compared with White children, Black children had mothers who were younger ($M = 31.50$ years, $SD = 5.65$ vs. $M = 34.04$ years, $SD = 4.84$), less likely to be married (48.6% vs. 96.7%), had a higher BMI ($M = 35.70$, $SD = 8.08$ vs. $M = 30.52$, $SD = 5.85$), less likely to have a college degree (40.1% vs. 72.2%), and less likely to have a household income $\geq$ \$60,000 (23.9% vs. 61.9%). Birth weight was lower in Blacks than Whites ($M = 6.57$ lbs., $SD = 1.59$ vs. $M = 7.27$ lbs., $SD = 1.24$). Black children had similar BMI *z*-scores as White children ($M = 0.52$, $SD = 1.07$ vs. $M = 0.46$, $SD = 0.84$).

Table I. Parent and Child Characteristics Overall and by Race

Sample characteristics	Overall ($n = 293$)	Black ($n = 142$)	White ($n = 151$)	M Difference (or χ^2)	p
Maternal age at survey- $M \pm SD$	32.81 ± 5.39	31.50 ± 5.65	34.04 ± 4.84	−2.53	<.001
Marital status					
Married (%)	215 (73.4%)	69 (48.6%)	146 (96.7%)	(86.67)	<.001
Cohabitated (%)	33 (11.3%)	31 (21.8%)	2 (1.3%)	(30.79)	<.001
Maternal education-college degree (%)	166 (56.7%)	57 (40.1%)	109 (72.2%)	(30.60)	<.001
Household income				(69.17)	<.001
1 = Up to $15,000	20 (7.0%)	18 (13.0%)	2 (1.4%)	–	–
2 = $15,001–$30,000	62 (21.8%)	51 (37.0%)	11 (7.5%)	–	–
3 = $30,001–$45,000	42 (14.7%)	23 (16.7%)	19 (12.9%)	–	–
4 = $45,001–$60,000	37 (13.0%)	13 (9.4%)	24 (16.3%)	–	–
5 = $60,001 or more	124 (43.5%)	33 (23.9%)	91 (61.9%)	–	–
Mother's BMI	33.0 ± 7.47	35.7 ± 8.08	30.5 ± 5.85	5.18	<.001
Partner's BMI	28.5 ± 5.05	29.1 ± 5.66	28.2 ± 4.65	0.93	.21
Toddler BMI z-score - $M \pm SD$	0.49 ± 0.96	0.52 ± 1.07	0.46 ± 0.84	0.05	.63
Toddler Birth Weight - $M \pm SD$	6.94 ± 1.46	6.57 ± 1.59	7.27 ± 1.24	−0.70	<.001
Gestation in weeks - $M \pm SD$	38.5 ± 2.08	38.3 ± 2.49	38.6 ± 1.59	−0.27	.27
Toddler gender				(0.23)	.63
Male	165 (56.3%)	82 (57.8%)	83 (55.0%)	–	–
Female	128 (43.7%)	60 (42.3%)	68 (45.0%)	–	–

Table II. Descriptive Statistics of Risk Factors for Childhood Obesity Overall and by Race

Risk factors of childhood obesity	Overall ($n = 293$)	Black ($n = 142$)	White ($n = 151$)	M difference (or χ^2)	p
Home environment					
Healthy snacks in home (often/always)	258 (88.4%)	110 (77.5%)	148 (98.7%)	(31.87)	**<.001**
Fruits and vegetables in home (often/always)	260 (89.0%)	120 (84.5%)	140 (93.3%)	(5.82)	**.016**
Soda in home (often/always)	106 (36.2%)	60 (42.3%)	45 (30.6%)	(4.41)	**.036**
Toys for physical activity (often/always)	277 (94.5%)	129 (90.9%)	145 (98.6%)	(7.28)	**.007**
Maternal behaviors					
TV hours per day	2.40 ± 1.36	2.89 ± 1.52	1.94 ± 1.01	0.94	**<.001**
% Kcal from fat (NCI)	31.9 ± 5.80	34.3 ± 6.29	29.7 ± 4.26	4.53	**<.001**
Consuming sweet beverages (Yes)	177 (60.6%)	113 (79.6%)	64 (42.7%)	(41.63)	**<.001**
Partner behaviors					
TV hours per day	2.86 ± 1.41	3.57 ± 1.51	2.45 ± 1.18	1.11	**<.001**
% Kcal from fat (NCI)	32.4 ± 3.7	33.5 ± 3.6	31.8 ± 3.58	1.65	**.002**
Consuming sweet beverages (Yes)	152 (75.6%)	66 (89.2%)	86 (67.7%)	(11.69)	**.001**
Parent feeding practices					
Control (C)	3.87 ± 0.54	3.84 ± 0.56	3.90 ± 0.53	0.05	.404
Emotional (EM)	1.65 ± 0.63	1.68 ± 0.71	1.62 ± 0.54	0.06	.421
Encouragement (EN)	3.93 ± 0.56	3.83 ± 0.63	4.03 ± 0.47	0.20	**.003**
Instrumental (I)	1.71 ± 0.60	1.75 ± 0.64	1.68 ± 0.56	0.07	.302
Toddler behaviors					
TV hours per weekday >2 hr	214 (75.4%)	86 (63.7%)	128 (85.9%)	(18.80)	**<.001**
TV hours per weekend >2 hr	208 (72.7%)	78 (57.4%)	130 (86.7%)	(30.90)	**<.001**
Hours playing outside on weekday	2.48 ± 1.60	2.72 ± 1.83	2.26 ± 1.30	0.46	**.015**
Hours playing outside on weekend	2.97 ± 1.52	3.08 ± 1.77	2.87 ± 1.24	0.21	.243
Average energy	1237.4 ± 317.4	1271.5 ± 360.6	1207.2 ± 271.7	64.29	.136
% energy from fat	31.43 ± 6.41	32.17 ± 6.38	30.77 ± 6.38	1.40	.101
Average servings of sweetened drinks	0.32 ± 0.57	0.51 ± 0.70	0.16 ± 0.35	0.12	**<.001**
Average added sugars (g)	35.0 ± 24.4	38.9 ± 30.0	31.6 ± 17.5	7.32	**.029**
Toddler eating characteristics					
Food responsiveness (FR)	2.30 ± 0.78	2.46 ± 0.94	2.15 ± 0.56	0.31	**.001**
Enjoyment of food (EF)	3.76 ± 0.74	3.79 ± 0.82	3.73 ± 0.66	0.06	.488
Desire to drink (DD)	3.40 ± 1.02	3.65 ± 1.01	3.16 ± 0.97	0.49	**<.001**
Satiety responsiveness/slowness in eating (SR)	2.97 ± 0.50	2.87 ± 0.54	3.08 ± 0.44	0.21	**<.001**

Bold text indicates $p < .05$.

Home Environment and Parent Behaviors

Compared with White children, Black children had less access to healthy snacks in the home (78% vs. 99% often or always had access), fruits and vegetables in the home (85 vs. 93%), greater availability of soda in the home (42% vs. 31%), and had less access to toys for physical activity in the home (91% vs. 99%). As for maternal and partner behaviors, compared with White children, Black children had parents who watched more hours of TV per day

Table III. Comparison Between Black and White (Referent) Toddlers on Social and Behavioral Factors[a]

Social and behavioral factors	*b (SE)*	B	OR (95% CI)	*p*
Home environment				
Healthy snacks in home			0.13 (0.03–0.62)	**<.01**
Fruits and vegetables in home			0.70 (0.26–1.90)	.48
Soda in home			1.45 (0.77–2.71)	.25
Toys for physical activity			0.25 (0.56–1.15)	.08
Maternal behaviors				
TV hours per day	0.55 (0.19)	0.20		**<.01**
% Kcal from fat (NCI)	2.01 (0.78)	0.17		**<.01**
Consuming sweet beverages			2.10 (1.10–3.99)	**<.05**
Partner behaviors[b]				
TV hours per day	0.75 (0.21)	0.25		**<.001**
% Kcal from fat (NCI)	0.86 (0.60)	0.15		.15
Consuming sweet beverages			2.69 (1.08–6.68)	**.03**
Parent feeding practices				
Control (C)	−0.05 (0.08)	−0.05		.53
Emotional (EM)	−0.07 (0.09)	−0.06		.42
Encouragement (EN)	−0.16 (0.08)	−0.15		**.05**
Instrumental (I)	−0.02 (0.09)	−0.02		.79
Toddler behaviors				
TV hours per weekday >2 hr			0.34 (0.16–0.71)	**<.01**
TV hours per Weekend >2 hr			0.24 (0.12–0.49)	**<.001**
Average energy	60.1 (55.6)	0.09		.28
% Kcal from fat (Nutrition Data System)	0.28 (1.12)	0.02		.80
Average servings of sweet drinks	0.11 (0.03)	0.31		**<.001**
Average added sugars	8.97 (4.24)	0.18		**<.05**
Hours playing outside on weekday	0.25 (0.23)	0.08		.28
Hours playing outside on weekend	−0.11 (0.22)	−0.04		.60
Toddler eating characteristics				
Food responsiveness (FR)	0.32 (0.11)	0.21		**<.01**
Enjoyment of food (EF)	0.17 (0.11)	0.12		.11
Desire to drink (DD)	0.36 (0.15)	0.18		**<.05**
Satiety responsiveness/slowness in eating (SR)	−0.24 (0.08)	−0.24		**<.01**

Note. [a]Models control for mothers age, educational attainment, household income, marital status, mother's BMI and AMP group assignment.
[b]Models assessing partner's behaviors include all of the same covariates as in other models, but include partner's BMI rather than mother's BMI.
Bold text indicates $p < .05$.

(2.89 vs. 1.94, Cohen's $d = 0.74$ for mothers; 3.57 vs. 2.45, Cohen's $d = 0.83$ for partners), consumed a greater percentage of energy from fat (34% vs. 30% for mothers, Cohen's $d = 0.86$; 34% vs 32% for partners, Cohen's $d = 0.47$), and were more likely to consume SSB (80% vs. 43% for mothers; 89% vs. 68%, for partners). These differences were all statistically significant. With the exception of White parents endorsing more encouraging-type feeding practices (4.03 vs. 3.83, Cohen's $d = 0.36$), no other statistically significant differences were observed in parental feeding practices.

Child Behaviors and Eating Characteristics

With respect to TV time and time playing outdoors, White children watched significantly more than the recommended 2 hr of TV on weekdays and weekends than Black children (86% vs. 64% on the weekdays and 87% vs. 57% on the weekends). White children, however, spent significantly fewer hours playing outside on weekdays (2.3 vs. 2.7 hr, Cohen's $d = -0.29$), but similar amounts to Black children on the weekends (2.9 vs. 3.1 hr, Cohen's $d = -0.14$).

With respect to diet, White and Black children were reported by their parents to have similar energy intake (1,271 average daily kcal for Blacks vs. 1,207 average daily kcal for Whites, Cohen's $d = 0.20$). The composition of daily diet was similar between the two groups with respect to the average percent energy from fat (32% for Blacks vs. 31% for Whites, Cohen's $d = 0.22$); however, compared with White children, Black children consumed significantly more servings of sweetened drinks (0.51 average daily servings vs. 0.16 average daily servings, Cohen's $d = 0.64$) and more grams of added sugar (38.9 vs. 31.6, Cohen's $d = 0.30$).

With respect to child eating characteristics, Black children had significantly higher scores on scales representing avidity toward food, such as DD (3.7 vs. 3.2, Cohen's $d = 0.49$) and the FR (2.5 vs. 2.2, Cohen's $d = 0.40$), and significantly lower scores on the scale measuring responsiveness to satiety cues (2.9 vs. 3.1, Cohen's $d = -0.43$).

Adjusted Analyses

In the adjusted analyses (Table III), racial differences remained for several of the home environment, parenting, and child behaviors, except for fruits and vegetables in the home, availability of soda in the home, toys for physical activity in the home, and hours playing outside on the weekday. Compared with White children, Black children were less likely to have healthy snacks in the home ($OR = 0.13$, 95% CI: 0.03–0.62, p values $< .01$). Parents of Black children, compared with White children, watched more hours of TV per day ($b = 0.55$ for mothers and 0.75 for partners; p values $< .001$), consumed more kilocalories from fat ($b = 2.01$for mothers; $b = 0.86$, p values $< .01$), and were more likely to consume SSB ($OR = 2.10$, 95% CI: 1.10–3.99 for mothers and $OR = 2.69$, 95% CI: 1.08–6.68 for partners, p values $< .001$). With respect to feeding practices, Black parents endorsed less encouraging feeding practices

($b = -0.16$, p values = .05), but no other differences were significant. Black children were less likely to exceed the recommended 2 hrs of TV on the weekday and weekend ($OR = 0.34$, 95% CI: 0.16–0.71, $p < .01$; $OR = 0.24$, 95% CI: 0.12–0.49) compared with White children; however, their average servings of SSB and energy intake of added sugars was greater than their White counterparts ($b = 0.11$ for servings of sweet drinks and 8.97 for added sugars; p values < .001). With respect to eating characteristics, Black children had higher scores on FR and DD and lower scores on satiety responsiveness ($b = 0.32$ for FR, $b = 0.36$ for DD, and $b = -0.24$ for SR, p values < .05), eating characteristics associated with greater weight gain in childhood.

Discussion

In this sample of 2-year-old children, there were a series of differences in a wide range of social and behavioral risk factors for childhood obesity. These factors included aspects of the home health environment, parent diet and sedentary behaviors, the quality of children's dietary intake, and child eating characteristics that may increase children's risk for obesity. For nearly all these factors, Black children were at a disadvantage relative to their White counterparts. These differences remained after controlling for potential confounders, in particular maternal BMI and socioeconomic indicators. The study is unique in that these differences were examined among a sample of children whose mothers were obese postpartum. Thus, all children, both Black and White, shared a common risk factor for childhood obesity (Lawrence et al., 2014; Schack-Nielsen, Michaelsen, Gamborg, Mortensen, & Sorensen, 2010) and the observations here reflect differences that are not necessarily attributable only to maternal obesity.

The overall findings of this study point to a number of differences in likely "obesiogenic factors" during early childhood. Compared with White mothers, Black mothers reported less availability of healthy snacks in the home. The health behaviors of mothers and fathers also differed, with more time spent watching TV and greater dietary fat intake among Black mothers and fathers compared with their White counterparts. Black 2-year-olds consumed more servings of SSB and more added sugars than White 2-year-olds. Black children also had higher scores on measures of eating behavior traits that have been associated with a higher BMI in childhood, such as higher in FR, DD, and lower in satiety responsiveness. The only finding that deviated from this consistent pattern was that, compared with White children, fewer Black children watched >2 hr of TV. Still, TV viewing was high in both groups with >50% exceeding the recommended amount in each group.

Our results concur with findings by Wang and Zhang (2006), who observed that weight differences between Blacks and Whites have been widening over time, even as the relationship between socioeconomic status (SES) and obesity has been weakening. Thus, while SES clearly does play a role in obesity, it cannot fully explain the racial differences in obesity risk factors (Dixon et al., 2012). Different historical, cultural, and socio-environmental contexts beyond SES must also be contributing to the differences observed between Black and White children (Kumanyika, 2008).

A particularly concerning finding in this study was the amount *of SSB and added sugar* that these young children were reported to be consuming. A recent study using the Early Childhood Longitudinal Survey—Birth Cohort ($n = 9{,}600$) showed that at age 2 years SSB intake was not associated with childhood obesity at that age, but children drinking more than one serving a day at age 2 years (9.3% in their sample) demonstrated greater increases in BMI through age 4 years than their counterparts consuming less than one serving daily (DeBoer, Scharf, & Demmer, 2013). In our sample, 17% of Black children consumed more than one serving per day compared with 5% of White children ($\chi^2 = 8.51$, $p < .05$; data not shown). Overall sugar intake was also greater among Black children compared with White children. Our findings of racial differences in sugar intake are consistent with studies of both younger (Taveras et al., 2010) and older children (Giammattei, Blix, Marshak, Wollitzer, & Pettitt, 2003) and point to a need to better understand what may be contributing to these differences at this early age.

The home environment and parenting factors play a role in diet and physical activity especially at a young age (Ostbye et al., 2013). Having an obese parent can moderate the effects of obesity risk factors on BMI in the preschool age (Fuemmeler et al., 2013), which makes studying risk factors among obese parents particularly relevant. What the current study highlights is that obesity risk factors show variation between Black and White children. In this sample, Black parents reported less healthy lifestyle behaviors than their White counterparts and SES did not fully explain this. What this study is not able to determine is the types of beliefs and values linked to culture that may be influencing these different patterns. Qualitative studies are needed to better understand historical and cultural factors contributing to these values and the differences in obesity risk factors observed here and in other studies (Hughes et al., 2013).

There are few studies to which we can compare our results regarding the differences between Black and White children on eating characteristics. These eating characteristics reflect self-regulation of eating, especially the satiety responsiveness subscale, which measures a child's ability to respond to internal satiety cues. We found that Black and White children differed in eating characteristics. The standardized beta coefficients from the adjusted models suggest that these differences were small for FR and DD and medium for satiety responsiveness. The extent to which these differences relate to a greater risk of obesity over development remains to be investigated; however, Black children may be at greater risk for poorer regulation of eating starting at an early age. More research focusing on minority preschool-age children's ability to regulate their energy intake is warranted.

With respect to parent feeding practices, we found few differences. The exception was "encouragement," with Black mothers reporting *less* of this type of feeding practice. It may be that the differences between the two groups reflect difference in normative expectations or beliefs. For instance, some of the encouragement items reflect praising and encouraging children to eat new foods or try a variety of foods. This may be viewed as more valued among White mothers; whereas among Black mothers, the expectation is to eat what has been provided. Encouraging food variety and offering new foods during the preschool years helps shape a child's acceptance of a diverse diet, including eating more fruits and vegetables (Cooke, Carnell, & Wardle, 2006). Research on parent feeding practices has only recently begun to include racially/ethnically diverse samples (Hurley, Cross, & Hughes, 2011); thus, it will be important for future research to identify the different ways parents of different cultures encourage their children to try new foods. Such findings will prove useful in improving exposure-based interventions designed to encourage food acceptance in preschool-age children.

The findings should be interpreted within the context of some limitations. First, participants were toddlers of mothers who volunteered for a large randomized clinical trial to prevent weight gain. All women were obese and thus these findings may not generalize to

women in the recommended BMI range. Also, participants who volunteer for obesity studies may differ than the general population. Of note, however, our participants were fairly comparable with the county population from which the study sample arose with respect to maternal age at birth (71%, 21–34 years of age in the county; 71% in the study sample) and to education (45% with a bachelor's degree or higher in the county; 57% in the study sample). Black women were overrepresented in the in the sample (39% in the county; 49% in the study sample), Whites were approximately representative (53% in the county; 51% in the study sample), and Hispanic mothers were underrepresented (14% in the county; 6% in the study sample). The low representation of Hispanics was expected given that English language proficiency was one of the criteria for inclusion in the trial. The nearly equal numbers of Black and White participants, however, allowed for comparisons among children that shared a common risk factor.

All measures relating to the mother and the child were reported by the mother herself. Such single-source methodology may introduce bias toward observing stronger associations than there may otherwise be. Another limitation was that direct measures of the parents' or child's physical activity (e.g., accelerometers) levels were not performed. Our measure of TV viewing, while a meaningful predictor of weight, should not be directly interpreted as physical inactivity. Studies of race differences using direct measures of physical activity for both parents and their children would add to this growing literature. The mainly null findings regarding differences in home environment should also be interpreted with caution. Future studies should use home visits to assess availability and accessibility of healthy and unhealthy foods. Also, of note is that study staff measured heights and weights for mothers and their children, but the partner's measurements self-reported. Notable in this study was the use of 24-hr dietary recall to assess energy intake as well as intake of sugary beverages. Although less precise than doubly labeled water for assessing energy expenditure, this strategy is often used in epidemiologic studies and allows for the assessment of components of dietary quality relevant to childhood obesity and chronic disease (e.g., grams of sugar, percent energy from fat; Nicklas et al., 2004).

Taken together, these data support the growing consensus that racial disparities exist in obesity-related risk factors beginning at an early age. Consistent racial differences, for most factors showing that Black children are worse off than their White counterparts, were observed. Continued research using mixed methods (qualitative and quantitative) is needed to inform well-designed interventions. The need for more research, however, must be balanced with the alarming findings from this and other studies that document the high level of sugary and sweetened beverage intake during the early years of development. Both Black and White parents should be advised to refrain from providing their young 2-year-old children with added dietary sugar. Clinicians also need to be aware of racial differences in obesity-related risk factors and greater attention is needed to develop methods to support clinicians when intervening with families of different racial ethnic backgrounds. Such approaches could help to mitigate the public health burden of childhood obesity and the notable disparities observed between Black and White families.

Funding

National Institute of Diabetes and Digestive and Kidney Diseases at the National Institutes of Health (R01 DK064986 to T.O.; R01 DK064986S to T.O. and B.F.F.); and the National Cancer Institute at the National Institutes of Health (K07CA124905 to B.F.F.).

Conflicts of interest: None declared.

References

American Academy of Pediatrics. 2014. Media and children. Retrieved from http://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/pages/media-and-children.aspx. Retrieved February, 24, 2014.

Ashcroft, J., Semmler, C., Carnell, S., van Jaarsveld, C. H., & Wardle, J. (2008). Continuity and stability of eating behaviour traits in children. *European Journal of Clinical Nutrition*, *62*, 985–990. doi: 10.1038/sj.ejcn.1602855

Centers for Disease Control and Prevention. (2010). A SAS program for the CDC growth Charts. Retrieved from http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm. Retrieved April 7, 2010.

Collings, P. J., Brage, S., Ridgway, C. L., Harvey, N. C., Godfrey, K. M., Inskip, H. M., … Ekelund, U. (2013). Physical activity intensity, sedentary time, and body composition in preschoolers. *The American Journal of Clinical Nutrition, 97*, 1020–1028. doi: 10.3945/ajcn.112.045088

Cooke, L., Carnell, S., & Wardle, J. (2006). Food neophobia and mealtime food consumption in 4–5 year old children. *The International Journal of Behavioral Nutrition and Physical Activity, 3*, 14. doi: 10.1186/1479–5868–3–14

DeBoer, M. D., Scharf, R. J., & Demmer, R. T. (2013). Sugar-sweetened beverages and weight gain in 2- to 5-year-old children. *Pediatrics, 132*, 413–420. doi: 10.1542/peds.2013–0570

Dixon, B., Peña, M., & Taveras, E. M. (2012). Lifecourse approach to racial/ethnic disparities in childhood obesity. *Advances in Nutrition: An International Review Journal, 3*(1), 73–82. doi: 10.3945/an.111.000919

Egger, G., & Swinburn, B. (1997). An "ecological" approach to the obesity pandemic. *British Medical Journal, 315*, 477–480.

Fuemmeler, B. F., Anderson, C. B., & Mâsse, L. C. (2011). Parent-child relationship of directly measured physical activity. *Int J Behav Nutr Phys Act, 8*, 17.

Fuemmeler, B. F., Lovelady, C. A., Zucker, N. L., & Ostbye, T. (2013). Parental obesity moderates the relationship between childhood appetitive traits and weight. *Obesity (Silver Spring), 21*, 815–823. doi: 10.1002/oby.20144

Fuemmeler, B. F., Yang, C., Costanzo, P., Hoyle, R. H., Siegler, I. C., Williams, R. B., & Ostbye, T. (2012). Parenting styles and body mass index trajectories from adolescence to adulthood. *Health Psychol, 31*, 441–449. doi: 10.1037/a0027927

Giammattei, J., Blix, G., Marshak, H. H., Wollitzer, A. O., & Pettitt, D. J. (2003). Television watching and soft drink consumption: Associations with obesity in 11- to 13-year-old schoolchildren. *Archives of Pediatrics and Adolescent Medicine, 157*, 882–886. doi: 10.1001/archpedi.157.9.882

Hughes, S. O., Anderson, C. B., Power, T. G., Micheli, N., Jaramillo, S., & Nicklas, T. A. (2006). Measuring feeding in low-income African–American and Hispanic parents. *Appetite, 46*, 215–223. doi: 10.1016/j.appet.2006.01.002

Hughes, S. O., Frankel, L. A., Beltran, A., Hodges, E., Hoerr, S., Lumeng, J., … Kremers, S. (2013). Food parenting measurement issues: Working group consensus report. *Childhood Obesity, 9*(Suppl), S95–S102. doi: 10.1089/chi.2013.0032

Hurley, K. M., Cross, M. B., & Hughes, S. O. (2011). A systematic review of responsive feeding and child obesity in high-income countries. *The Journal of Nutrition, 141*, 495–501. doi: 10.3945/jn.110.130047

Kumanyika, S. K. (2008). Environmental influences on childhood obesity: Ethnic and cultural influences in context. *Physiology and Behavior, 94*(1), 61–70. doi: 10.1016/j.physbeh.2007.11.019

Lawrence, G. M., Shulman, S., Friedlander, Y., Sitlani, C. M., Burger, A., Savitsky, B., … Hochner, H. (2014). Associations of maternal prepregnancy and gestational body size with offspring longitudinal change in BMI. *Obesity (Silver Spring), 22*, 1165–1171. doi: 10.1002/oby.20643

Morgan, P. J., Okely, A. D., Cliff, D. P., Jones, R. A., & Baur, L. A. (2008). Correlates of objectively measured physical activity in obese children. *Obesity (Silver Spring), 16*, 2634–2641. doi: 10.1038/oby.2008.463

Moshfegh, A. J., Rhodes, D. G., Baer, D. J., Murayi, T., Clemens, J. C., Rumpler, W. V., … Cleveland, L. E. (2008). The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. *American Journal of Clinical Nutrition, 88*, 324–332. doi: 88/2/324 [pii]

Nader, P. R., Huang, T. T., Gahagan, S., Kumanyika, S., Hammond, R. A., & Christoffel, K. K. (2012). Next steps in obesity prevention: Altering early life systems to support healthy parents, infants, and toddlers. *Childhood Obesity, 8*, 195–204. doi: 10.1089/chi.2012.0004

National Cancer Institute. (2013). Fat screener. Retrieved from http://riskfactor.cancer.gov/diet/screeners/fat/percent_energy.pdf

Nicklas, T. A., Demory-Luce, D., Yang, S. J., Baranowski, T., Zakeri, I., & Berenson, G. (2004). Children's food consumption patterns have changed over two decades (1973–1994): The Bogalusa heart study. *Journal of the American Dietetic Association, 104*, 1127–1140. doi: 10.1016/j.jada.2004.04.029

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York, NY: McGraw-Hill.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA, 311*, 806–814. doi: 10.1001/jama.2014.732

Ostbye, T., Krause, K. M., Brouwer, R. J., Lovelady, C. A., Morey, M. C., Bastian, L. A., … McBride, C. M. (2008). Active Mothers Postpartum (AMP): Rationale, design, and baseline characteristics. *Journal of Women's Health (Larchmt), 17*, 1567–1575. doi: 10.1089/jwh.2007.0674

Ostbye, T., Krause, K. M., Lovelady, C. A., Morey, M. C., Bastian, L. A., Peterson, B. L., … McBride, C. M. (2009). Active Mothers Postpartum: A randomized controlled weight-loss intervention trial. *American Journal of Preventive Medicine*, *37*, 173–180. doi: S0749–3797(09)00378-X [pii]10.1016/j.amepre.2009.05.016

Ostbye, T., Malhotra, R., Stroo, M., Lovelady, C., Brouwer, R., Zucker, N., & Fuemmeler, B. (2013). The effect of the home environment on physical activity and dietary intake in preschool children. *International Journal of Obesity (London)*, *37*, 1314–1321. doi: 10.1038/ijo.2013.76

Perrin, E. M., Rothman, R. L., Sanders, L. M., Skinner, A. C., Eden, S. K., Shintani, A., … Yin, H. S. (2014). Racial and ethnic differences associated with feeding- and activity-related behaviors in infants. *Pediatrics, 133*, e857–e867. doi: 10.1542/peds.2013–1326

Pettee, K. K., Ham, S. A., Macera, C. A., & Ainsworth, B. E. (2009). The reliability of a survey question on television viewing and associations with health risk factors in US adults. *Obesity (Silver Spring), 17*, 487–493. doi: 10.1038/oby.2008.554

Reilly, J. J., Armstrong, J., Dorosty, A. R., Emmett, P. M., Ness, A., Rogers, I., … Sherriff, A.; Avon Longitudinal Study of Parents, Children Study Team. (2005). Early life risk factors for obesity in childhood: Cohort study. *British Medical Journal, 330*, 1357. doi: 10.1136/bmj.38470.670903.E0

Sallis, J. F., Prochaska, J.J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise*, *32*, 963–975.

Schack-Nielsen, L., Michaelsen, K. F., Gamborg, M., Mortensen, E. L., & Sorensen, T. I. (2010). Gestational weight gain in relation to offspring body mass index and obesity from infancy through adulthood. *International Journal of Obesity (London), 34*, 67–74. doi: 10.1038/ijo.2009.206

Taveras, E. M., Gillman, M. W., Kleinman, K., Rich-Edwards, J. W., & Rifas-Shiman, S. L. (2010). Racial/ethnic differences in early-life risk factors for childhood obesity. *Pediatrics*, *125*, 686–695. doi: 10.1542/peds.2009–2100

Thompson, F. E., Midthune, D., Williams, G. C., Yaroch, A. L., Hurley, T. G., Resnicow, K., … Nebeling, L. (2008). Evaluation of a short dietary assessment instrument for percentage energy from fat in an intervention study. *The Journal of Nutrition, 138*, 193S–199S.

Wang, Y. & Zhang, Q. (2006). Are American children and adolescents of low socioeconomic status at increased risk of obesity? Changes in the association between overweight and family income between 1971 and 2002. *The American Journal of Clinical Nutrition*, *84*, 707–716.

Wardle, J., Guthrie, C., Sanderson, S., Birch, L., & Plomin, R. (2001). Food and activity preferences in children of lean and obese parents. *International Journal of Obesity and Related Metabolic Disorders*, *25*, 971–977. doi: 10.1038/sj.ijo.0801661

Wardle, J., Guthrie, C. A., Sanderson, S., & Rapoport, L. (2001). Development of the children's eating behaviour questionnaire. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *42*, 963–970.

Wardle, J., Sanderson, S., Guthrie, C.A., Rapoport, L., & Plomin, R. (2002). Parental feeding style and the inter-generational transmission of obesity risk. *Obesity Research, 10*, 453–462. doi: 10.1038/oby.2002.63

Webber, L., Hill, C., Saxton, J., Van Jaarsveld, C. H., & Wardle, J. (2009). Eating behaviour and weight in children. *International Journal of Obesity (Lond), 33*(1), 21–28. doi: 10.1038/ijo.2008.219

Whitaker, K. L., Jarvis, M. J., Beeken, R. J., Boniface, D., & Wardle, J. (2010). Comparing maternal and paternal intergenerational transmission of obesity risk in a large population-based sample. *The American Journal of Clinical Nutrition, 91*, 1560–1567. doi: 10.3945/ajcn.2009.28838

Williams, G. C., Hurley, T. G., Thompson, F. E., Midthune, D., Yaroch, A. L., Resnicow, K., … Hebert, J. R. (2008). Performance of a short percentage energy from fat tool in measuring change in dietary intervention studies. *The Journal of Nutrition, 138*, 212S–217S.

Ziegler, P., Briefel, R., Clusen, N., & Devaney, B. (2006). Feeding Infants and Toddlers Study (FITS): Development of the FITS survey in comparison to other dietary survey methods. *Journal of the American Dietetic Association, 106*(Suppl 1), S12–S27. doi: 10.1016/j.jada.2005.09.033