Maternal Depressive Symptoms and Child Obesity in Low-Income Urban Families

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ABSTRACT

OBJECTIVE: To characterize the relationship between maternal depressive symptoms and child weight status, obesity-promoting feeding practices, and activity-related behaviors in low-income urban families.

METHODS: We conducted a cross-sectional survey of mothers with 5-year-old children receiving pediatric care at a federally qualified community health center. We used regression analyses to examine the relationship between maternal depressive symptoms (trichotomized: none, mild, moderate to severe) and 1) child weight status; 2) obesity-promoting feeding practices, including mealtime practices and feeding styles; and 3) activity-related behaviors, including sleep time, screen time, and outdoor playtime.

RESULTS: The sample included 401 mother–child pairs (78.3% response rate), with 23.4% of mothers reporting depressive symptoms (15.7% mild, 7.7% moderate to severe). Mothers with moderate to severe depressive symptoms were more likely to have overweight and obese children than mothers without depressive symptoms (adjusted odds ratio 2.62; 95% confidence interval 1.02–6.70). Children of mildly depressed mothers were more likely to consume sweetened drinks and to eat out at restaurants and were less likely to eat breakfast than children of nondepressed mothers. Mothers with depressive symptoms were less likely to set limits, to use food as a reward, to restrict their child's intake, and to model healthy eating than nondepressed mothers. Children with depressed mothers had less sleep and outdoor playtime per day than children of nondepressed mothers.

CONCLUSIONS: Maternal depressive symptoms are associated with child overweight and obese status and with several obesity-promoting practices. These results support the need for maternal depression screening in pediatric obesity prevention programs. Further research should explore how to incorporate needed mental health support.

KEYWORDS: child; depression; feeding; mother; obesity

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WHAT'S NEW

Maternal depressive symptoms were related to early child overweight and obese status. On the basis of the results, it may be that depressive symptoms are related to child weight through parenting practices that require active engagement, a quality negatively affected by depression.

MATERNAL DEPRESSION HAS been recognized to have deleterious consequences for child health outcomes along several dimensions.[1] Depressed mothers are often less engaged and receptive to their child's needs, resulting in negative mother–child interactions and increased risk of child mental, social, emotional, and behavioral problems.[2] Maternal depression has also been associated with increased infant hospitalizations and the lower likelihood of following anticipatory guidance and safety recommendations.[3,4] It is essential to understand how maternal depression affects both child development and the child's physical health as we attempt to decrease the impact of this early source of toxic stress.[5]

Given the high prevalence of both depression[6] and obesity[7] in underserved populations, it is important to explore the relationship between depressive symptoms and weight. Although many studies have examined the co-occurrence of depression and obesity,[8] very few have examined this relationship in the context of the mother–child dyad. Ecological models for the etiology of childhood obesity highlight the need to explore child behaviors within the larger context of the family.[9] Although maternal depression has been demonstrated to negatively impact the family environment, very few studies have specifically focused on the relationship between maternal depression and child weight.

The majority of studies exploring maternal depression and child weight have focused on school-age children.[10–15] Several have found a relationship between maternal depression and increased child weight,[11–15] although results have been mixed.[10,15] The largest and most ethnically diverse of these studies found that maternal depression was indirectly related to higher child body mass index through lower parenting quality, defined as lower family cohesion and nurturance.[13] A greater understanding of these relationships in young children

from low-income minority communities is needed in order to identify modifiable behaviors for intervention.

In general, many obesity-promoting behaviors have been identified, including poor diet,[16] infrequent family meals,[17] nonresponsive parental feeding styles,[18] shorter sleep duration,[19] decreased physical activity,[20] and increased screen time.[17] Few studies have examined the relationships between these behaviors and maternal depression. Most of the work in this area has focused on nonresponsive feeding styles in mothers with infants[21,22] or on sedentary behavior.[23] No studies to our knowledge have examined all of these behaviors as they relate to maternal depression in low-income minority families with young children.

We therefore sought to characterize the relationship between maternal depressive symptoms and early childhood weight as well as the relationship of these symptoms with obesity-promoting behaviors in low-income minority families with 5-year-old children. We hypothesized that 1) maternal depressive symptoms would be associated with child overweight and obese status at 5 years of age, and that 2) maternal depressive symptoms would be associated with obesity-promoting behaviors that rely heavily on the quality of the mother–child relationship.

METHODS

STUDY DESIGN

We performed a cross-sectional study of 401 mothers of 5-year-old children who received their pediatric primary care at a federally qualified community health center in the Bronx in New York City. Trained bilingual research assistants conducted a one-time telephone survey in either English or Spanish with participating mothers between September 2010 and September 2011. This study was approved by the Montefiore Medical Center Institutional Review Board.

STUDY SAMPLE

We sampled mothers of 5-year-old children who received their routine pediatric care during their first 3 years of life at our clinical site. This clinical cohort was representative of the general clinic population. All mothers with 5-year-old children in this cohort were mailed information about the study and were given the opportunity to opt out of being contacted. Research assistants then called the mothers to assess their eligibility for the study. We included mothers who spoke English or Spanish, who were at least 18 years old, and who had a 5-year-old child who had received their pediatric care at the clinic site. Children with severe medical problems were excluded. Research assistants obtained informed oral consent over the phone.

ASSESSMENTS

Assessments were obtained through a one-time telephone interview and medical record review.

INDEPENDENT VARIABLE

Maternal depressive symptoms were measured using the Patient Health Questionnaire-9 (PHQ-9),[24] a widely used and validated self-administered screening tool that measures depressive symptoms in the last 2 weeks. A strong concordance between telephone- and self-administration of the PHQ-9 has been demonstrated, making the telephone a reliable method for assessing depressive symptoms.[25] Depressive symptoms (on a scale of 0–27) were divided into 3 categories on the basis of the severity of the depressive symptoms: not depressed (0–4), mild (5–9), and moderate to severe (10–27).

DEPENDENT VARIABLES

CHILD WEIGHT STATUS

Measured child weight and height at the pediatric 5-year-old well child visit were obtained from the medical record. The mean (standard deviation, SD) number of months between the date of the interview and the weight and height measurements was 2.3 (4.2) months. Body mass index (BMI, kg/m^2) was calculated, and BMI percentiles were determined for each child using Year 2000 Centers for Disease Control (CDC) growth data (EpiInfo software version 3.4.1). Child weight status was classified as underweight (<5%), healthy weight (5–84.9%), overweight (85–94.9%) and obese (≥95%).[26] Child weight status was further dichotomized as BMI<85th percentile and BMI≥85th percentile.

OBESITY-PROMOTING FEEDING PRACTICES

We assessed mealtime practices and maternal feeding styles. The mealtime practices included the frequency of: 1) consuming fruits, vegetables, juice and sweetened drinks; 2) eating family meals; 3) breakfast; 4) restaurant eating. Questions assessing mealtime practices during the 7 days prior to the interview were adapted from questions from the Youth Risk Behavior survey, originally designed to assess behaviors of middle and high school aged children (http://www.cdc.gov/HealthyYouth/yrbs/index.htm). Fruit, vegetable, juice and sweetened drink consumption was dichotomized (less than every day, daily or more). Mothers reported the number of days most of the family ate a meal together. The frequency of family meals was dichotomized (<3 times per week, ≥3 times per week). Eating breakfast was dichotomized (<5 times per week, ≥5 times per week) and restaurant eating was dichotomized (<3 times per week, ≥3 times per week).

Feeding styles are strategies that parents use to regulate their child's feeding. Maternal feeding styles were assessed using 3 validated surveys: 1) Child Feeding Questionnaire,[27] designed for parents of 2 to 11 years old children to assess beliefs, attitudes and practices regarding child feeding; 2) Comprehensive Feeding Practices Questionnaire,[28] which measures feeding practices of parents with children ages 2 to 8 years old; 3) Parenting Strategies for Eating and Activity Scale,[29] which assesses parenting strategies related to children's dietary and activity-related behaviors. Table 1 summarizes the styles that were assessed and provides a sample item from each scale. Responses to the statements in all of the scales were based on a 1–5 Likert scale ranging from either "disagree" to

Table 1. Assessment of Child Obesity-Promoting Maternal Feeding Styles

Feeding Style	Definition	Sample Questionnaire Item
Restriction[27]	Restrict the quantity or quality of the child's intake even if the child is hungry	"If I did not guide or regulate my child's eating, s/he would eat too many junk foods"*
Pressuring[27]	Encourage the child to eat more even if the child is not hungry	"My child should always eat all of the food on his/her plate"*
Limit setting[29]	Limit the child's consumption of unhealthy foods and screen time	"I limit the number of snacks my child eats"*
Monitoring[28,29]	Keep track of the foods the child consumes or the activity the child does	"How much do you keep track of the high fat foods your child eats?"†
Food as a reward[28]	Use food to encourage good behaviors or discourage bad behaviors	"I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior"*
Emotional regulation[28]	Use food to regulate the child's emotions	"Do you give this child something to eat or drink if s/he is upset even if you think s/he is not hungry?"†
Modeling[28]	Model healthy eating in front of the child	"I try to eat healthy foods in front of my child, even if they are not my favorite"*
Reinforcement[29]	Praise healthy habits by giving positive reinforcement	"How often do you praise your child for eating a healthy snack?"†
Involvement[28]	Involve the child in meal planning, cooking and grocery shopping	"I encourage my child to participate in grocery shopping"*
Healthy environment[28]	Quality of the food in the home	"I keep a lot of snack food (potato chips, Doritos, cheese puffs) in my house"*

*Reponses based on a 1–5 Likert scale ranging from "disagree" to "agree."
†Reponses based on a 1–5 Likert scale ranging from "never" to "always."

"agree" or "never" to "always." Responses were scored 1 to 5, and mean scores for the questions in each scale were generated. Higher mean scores correspond to increased use of the feeding style described.

OBESITY-PROMOTING ACTIVITY-RELATED BEHAVIORS

We assessed sleep time, screen time, and outdoor playtime. We assessed the child's average daily sleep time by determining the typical time that their child went to sleep and woke up on weekdays and weekends. The child's average number of hours of sleep per night was then calculated: [(weekday hours × 5) + (weekend hours × 2)]/7.

Home screen time was assessed by asking, "On a typical weekday, Monday through Friday, about how many hours of television does [child] watch at home per day?" A similarly worded question was used to assess time spent playing video games or using the computer. The same 2 questions were also asked about the weekend days. We combined data from both questions to compute weekday and weekend hours of home screen time. Average daily home screen time was then calculated: [(weekday hours × 5) + (weekend hours × 2)]/7.

Outdoor playtime was measured using the Outdoor Playtime Recall Questions scale,[30] which determined the number of minutes the child typically spent playing outdoors each day in the last month during the week and on the weekend. We then calculated the average number of minutes of outdoor playtime per day: [(weekday minutes × 5) + (weekend minutes × 2)]/7. Outdoor playtime per day was converted into hours for subsequent analyses.

POTENTIAL CONFOUNDERS

MATERNAL CHARACTERISTICS

Maternal age, race (white, nonwhite), educational level (less than high school education, high school or more),

marital status (married, not married), and employment status (working, not working) were assessed. Maternal BMI (kg/m^2) was calculated using self reported maternal weight and height and categorized on the basis of the Centers for Disease Control and Prevention classifications of adult BMI: underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9), and obese (≥30).[31]

CHILD CHARACTERISTICS

Child characteristics included gender, full term (less than 37 weeks gestational age, 37 weeks or greater gestational age), only child (only child, has siblings), birth weight (kilograms), and insurance status (no insurance/Medicaid, commercial).

STATISTICAL ANALYSIS

Data analyses were performed by SPSS statistical software version 18.0 (SPSS Inc, Chicago, Ill). Unadjusted analysis of the relationships between maternal depressive symptom severity divided into 3 categories (not depressed, mild, moderate to severe) and 1) child weight status, 2) obesity-promoting feeding practices, 3) obesity-promoting activity-related behaviors, were analyzed using 1-way ANOVA and chi-square analyses. Logistic regression analyses were used to determine the relationship between depressive symptom severity (not depressed, mild, moderate to severe) and child weight status, controlling for potential confounders and using not depressed as the reference variable. All analyses using child weight status were done on a sample size of 288, since 28% of the sample did not have 5-year old weights and heights recorded in the medical record. The relationships between maternal depressive symptoms and obesity-promoting practices were analyzed using linear regression for continuous dependent variables and logistic regression for categorical outcomes. All analyses were

Table 2. Family Characteristics Based on Maternal Depressive Symptom Severity

Characteristic	Study Sample (n = 401)	No Depression (n = 307)	Mild Depression (n = 63)	Moderate to Severe Depression (n = 31)	P
Child characteristics					
Male, n (%)	219 (54.6)	168 (54.7)	33 (52.4)	18 (58.1)	.87
Full term, n (%)	346 (86.5)	267 (87.3)	51 (81.0)	28 (90.3)	.33
Only child, n (%)	93 (23.4)	73 (24.1)	14 (22.2)	6 (19.4)	.81
Birth weight, mean ± SD, kg	3.13 ± 0.7	3.16 ± 0.7	2.98 ± 0.6	3.17 ± 0.7	.20
Insurance					.08
No insurance	27 (6.7)	17 (5.5)	5 (7.9)	5 (16.1)	
Medicaid	261 (65.1)	196 (63.8)	44 (69.8)	21 (67.7)	
Commercial	113 (28.2)	94 (30.6)	14 (22.2)	5 (16.1)	
Child weight status†					.17
Underweight (BMI% <5), n (%)	15 (5.2)	13 (5.9)	1 (2.1)	1 (4.8)	
Normal (BMI% 5–84.9), n (%)	166 (57.6)	132 (60.0)	26 (55.3)	8 (38.1)	
Overweight (BMI% 85–94.9), n (%)	41 (14.2)	25 (11.4)	10 (21.3)	6 (28.6)	
Obese (BMI% ≥95), n (%)	66 (22.9)	50 (22.7)	10 (21.3)	6 (28.6)	
Maternal characteristics					
Age, mean ± SD, years	32.8 ± 6.1	32.7 ± 6.2	33.0 ± 6.2	32.4 ± 5.5	.88
Nonwhite, n (%)‡	359 (89.8)	274 (89.3)	56 (90.3)	29 (93.5)	.38
Hispanic	200 (49.9)	156 (50.8)	31 (49.2)	13 (41.9)	
Black	138 (34.4)	102 (33.2)	23 (36.5)	13 (41.9)	
Asian	17 (4.2)	12 (3.9)	2 (3.2)	3 (9.7)	
Other	4 (1.0)	4 (1.3)	0 (0)	0 (0)	
Education, less than high school, n (%)‡	50 (12.5)	31 (10.1)	12 (19.4)	7 (22.6)	.03*
Marital status, married, n (%)	176 (43.9)	144 (46.9)	21 (33.3)	11 (35.5)	.09
Working, n (%)	243 (60.6)	191 (62.2)	42 (66.7)	10 (32.3)	.003*
Maternal weight status§					.27
Underweight (BMI <18.5), n (%)	2 (0.5)	2 (0.7)	0 (0)	0 (0)	
Normal (BMI 18.5–24.9), n (%)	115 (29.9)	92 (31.3)	17 (28.8)	6 (19.4)	
Overweight (BMI 25–29.9), n (%)	124 (32.3)	99 (33.7)	13 (22.0)	12 (38.7)	
Obese (BMI ≥30), n (%)	143 (37.2)	101 (34.4)	29 (49.2)	13 (41.9)	

BMI = body mass index.
*Significant at $P < .05$.
†n = 288 with complete child BMI data (no depression n = 220; mild n = 47; moderate to severe n = 21).
‡n = 400 with complete maternal data (no depression n = 307; mild n = 62; moderate to severe n = 31).
§n = 384 with complete maternal BMI data (no depression n = 29; mild n = 59; moderate to severe n = 31).

adjusted for child gender, being an only child, insurance status and maternal age, education, race, marital status, and employment status.

RESULTS

STUDY SAMPLE

A total of 789 mothers with 5-year-old children were identified from the clinical cohort. We were unable to contact 251 mothers (31.8%) due to incorrect contact numbers. Of the 538 mothers assessed for eligibility, we excluded 4 (0.7%) who had died, 10 (1.8%) whose children had severe medical problems, 9 (1.6%) who did not speak English or Spanish and 3(0.6%) with missing PHQ-9 scores. Of these 512 remaining mothers, 111 (21.7%) refused to complete the telephone interview. The remaining 401 (78.3%) mothers were included in these analyses. Compared to the participants, mothers who refused had similar racial/ethnic backgrounds (88.9% vs. 89.8% minority; $P = .86$) but were more likely to have commercial insurance (39.6% vs. 28.2%; $P = .03$). Twenty-five (6.2%) of the 401 interviews were conducted in Spanish.

MATERNAL DEPRESSIVE SYMPTOMS

Sample characteristics are provided in Table 2. Ninety-four mothers (23.4%) reported depressive symptoms on the basis of their PHQ-9 scores (≥5). Of these mothers,

Table 3. Relationship Between Maternal Depressive Symptoms and Child Weight Status, With Child Overweight/Obese (BMI ≥85%)†

Depression Category	n (%)	Unadjusted		Adjusted‡	
		OR	95% CI	AOR	95% CI
None	75 (34.1)	Ref	Ref	Ref	Ref
Mild	20 (42.6)	1.43	0.75–2.72	1.41	0.73–2.74
Moderate to severe	12 (57.1)	2.58	1.04–6.39*	2.62	1.02–6.70*

BMI = body mass index; OR = odds ratio; AOR = adjusted odds ratio.
*Significant at $P < .05$.
†n = 288 with complete child BMI data (no depression n = 220; mild n = 47; moderate to severe n = 21).
‡Models adjusted for child gender, being an only child (no, yes), insurance status (no insurance/Medicaid, commercial), maternal age, education (less than high school, high school or more), race (white, nonwhite), marital status (married, not married), and employment status (working, not working).

Table 4. Maternal Depressive Symptoms and Mealtime Practices

Mealtime Practice	Depression Category	n (%)	AOR†	95% CI
Child fruit consumption (daily or more)	None	193 (62.9)	Ref	Ref
	Mild	38 (60.3)	0.89	0.50–1.60
	Moderate to severe	20 (64.5)	1.12	0.51–2.50
Child vegetable consumption (daily or more)	None	143 (46.6)	Ref	Ref
	Mild	28 (44.4)	0.95	0.54–1.68
	Moderate to severe	19 (61.3)	1.95	0.89–4.28
Child juice consumption (daily or more)	None	207 (67.4)	Ref	Ref
	Mild	43 (8.3)	0.89	0.49–1.62
	Moderate to severe	25 (80.6)	2.13	0.83–5.48
Child sweetened drinks consumption (daily or more)	None	64 (20.8)	Ref	Ref
	Mild	26 (41.3)	2.91	1.57–5.37*
	Moderate to severe	10 (32.3)	1.73	0.75–4.02
Family meals (3 or more times per week)	None	274 (89.3)	Ref	Ref
	Mild	51 (81.0)	0.49	0.23–1.03
	Moderate to severe	26 (83.9)	0.53	0.18–1.52
Child breakfast consumption (5 or more times per week)	None	285 (92.8)	Ref	Ref
	Mild	53 (84.1)	0.38	0.17–.87*
	Moderate to severe	27 (87.1)	0.48	0.15–1.58
Restaurant eating (3 or more times per week)	None	30 (9.8)	Ref	Ref
	Mild	11 (17.5)	2.43	1.09–5.41*
	Moderate to severe	5 (16.1)	2.27	0.75–6.88

AOR = adjusted odds ratio; CI = confidence interval.
*Significant at $P < .05$.
†Adjusted for child gender, being an only child (no, yes), insurance status (no insurance/Medicaid, commercial), maternal age, education (less than high school, high school or more), race (white, nonwhite), marital status (married, not married), and employment status (working, not working).

63 (15.7%) had mild depressive symptoms and 31 (7.7%) had moderate to severe depressive symptoms. Mothers with depressive symptoms were significantly more likely to have less than a high school education and less likely to be working than mothers without depressive symptoms.

MATERNAL DEPRESSIVE SYMPTOMS AND CHILD WEIGHT STATUS

Mothers with moderate to severe depressive symptoms were more likely to have an overweight or obese 5-year-old child (adjusted odds ratio [AOR] 2.62, 95% confidence interval [CI] 1.02–6.70) than mothers without depressive symptoms. Mothers with mild depressive symptoms were also found to have greater odds of having an overweight or obese child, although this difference was not statistically significant (AOR 1.41, 95% CI .73–2.74) (Table 3).

MATERNAL DEPRESSIVE SYMPTOMS AND OBESITY-PROMOTING FEEDING PRACTICES

MEALTIME PRACTICES

Maternal depressive symptoms were associated with several mealtime practices (Table 4). Mothers with mild depressive symptoms were more likely to have children who consumed sweetened drinks daily (AOR 2.91, 95% CI 1.57–5.37), did not eat breakfast regularly (AOR .38, 95% CI 0.17–0.87), and ate out in restaurants 3 or more times per week (AOR 2.43, 95% CI 1.09–5.41) than mothers without depressive symptoms. We did not find significant relationships between maternal depressive symptoms and child vegetable and fruit consumption and family meals.

MATERNAL FEEDING STYLES

Maternal mild and moderate to severe depressive symptoms were associated with several feeding styles (Table 5). Mothers with mild and moderate to severe depressive symptoms were significantly less likely to set limits around eating, to use food as a reward, and to model healthy eating than mothers without depressive symptoms. Mothers with moderate to severe depressive symptoms were less likely to restrict their child's intake than mothers without depressive symptoms.

MATERNAL DEPRESSIVE SYMPTOMS AND CHILD ACTIVITY-RELATED BEHAVIORS

Mothers with mild and moderate to severe depressive symptoms were significantly more likely to have children with shorter average daily sleep time compared to mothers without depressive symptoms. Children of mothers with moderate to severe depressive symptoms were also more likely to have a lower average daily outdoor playtime (Table 6).

DISCUSSION

In this study of low-income mothers, we found that mothers with moderate and severe depressive symptoms were more likely to have an overweight or obese child compared to mothers without depressive symptoms. Mothers with depressive symptoms were more likely to have children with higher sweetened drink consumption, more frequent restaurant eating, and fewer regular breakfasts than children with mothers without depressive symptoms. Mothers with depressive symptoms were also less likely to set limits around eating, to use food as a reward,

Table 5. Maternal Depressive Symptoms and Maternal Feeding Styles

| Feeding Style† | Depression Category | Score, Mean ± SD | Adjusted ‡ | |
			B (SE)	95% CI
Restriction	None	4.51 ± 0.80	Ref	Ref
	Mild	4.43 ± 0.84	−0.07 (0.12)	−0.31 to 0.17
	Moderate to severe	4.08 ± 1.29	−0.41 (0.16)	−0.73 to −0.09*
Pressuring	None	3.24 ± 1.19	Ref	Ref
	Mild	3.15 ± 1.10	−0.16 (0.16)	−0.48 to 0.16
	Moderate to severe	3.13 ± 1.15	−0.27 (0.22)	−0.71 to 0.16
Limit setting	None	4.50 ± 0.62	Ref	Ref
	Mild	4.10 ± 0.99	−0.43 (0.11)	−0.64 to −0.23*
	Moderate to severe	3.94 ± 0.91	−0.56 (0.15)	−0.86 to −0.27*
Monitoring	None	4.23 ± 0.68	Ref	Ref
	Mild	4.05 ± 0.81	−0.17 (0.10)	−0.37 to 0.03
	Moderate to severe	4.04 ± 0.84	−0.24 (0.14)	−0.52 to 0.04
Food as a reward	None	2.39 ± 1.29	Ref	Ref
	Mild	2.02 ± 1.21	−0.47 (0.18)	−0.82 to −0.12*
	Moderate to severe	2.07 ± 1.16	−0.51 (0.24)	−0.99 to −0.04*
Emotional regulation	None	2.02 ± 0.79	Ref	Ref
	Mild	2.15 ± 0.80	.13 (0.11)	−0.10 to 0.35
	Moderate to severe	1.97 ± 1.00	−0.08 (0.15)	−0.38 to 0.23
Modeling	None	4.57 ± 0.68	Ref	Ref
	Mild	4.15 ± 1.13	−0.46 (0.11)	−0.68 to −0.25*
	Moderate to severe	4.26 ± 0.85	−0.38 (0.15)	−0.67 to −0.09*
Reinforcement	None	4.26 ± 1.06	Ref	Ref
	Mild	4.30 ± 0.83	−0.04 (0.15)	−0.33 to 0.25
	Moderate to severe	4.17 ± 1.23	−0.17 (0.20)	−0.56 to 0.23
Involvement	None	4.40 ± 0.90	Ref	Ref
	Mild	4.33 ± 0.94	−0.08 (0.13)	−0.32 to 0.18
	Moderate to severe	4.18 ± 1.03	−0.25 (0.17)	−0.59 to 0.08
Healthy environment	None	4.47 ± 0.68	Ref	Ref
	Mild	4.38 ± 0.69	−0.09 (0.10)	−0.28 to 0.10
	Moderate to severe	4.32 ± 0.66	−0.16 (0.13)	−0.41 to 0.10

SD = standard deviation; SE = standard error; CI = confidence interval.
*Significant at $P < .05$.
†Scores ranged from 1 to 5.
‡Adjusted B (SE): models adjusted for child gender, being an only child (no, yes), insurance status (no insurance/Medicaid, commercial), maternal age, education (less than high school, high school or more), race (white, nonwhite), marital status (married, not married), and employment status (working, not working).

to restrict their child's intake, and to model healthy eating. Furthermore, children of mothers with depressive symptoms slept fewer hours per day and had less outdoor playtime than those with mothers without depressive symptoms.

Our findings correspond well with the ecological model of early child obesity that places the child within the greater context of the family environment.[9] Our study begins to expand our current understanding of maternal depression and the mother–child relationship. In particular, our results found that maternal depressive symptoms are related to both child weight and several parenting practices that require active engagement by the parent, a quality that is known to be negatively affected by depression.

Depressed mothers are often less responsive to their child and choose strategies for coping that require less cognitive effort.[2] Symptoms such as loss of interest, fatigue, low energy, and poor concentration likely contribute to decreased involvement with the child.[2] Feeding practices, such as preparing daily breakfast, modeling healthy eating, and setting limits on their child's diet, all require active maternal involvement, possibly explaining why these practices were less common among depressed mothers. These findings correspond well with prior research examining the relationship between permissive parenting and child obesity.[18,32] Permissive parenting, which occurs when the parent places few demands and neglects to set limits on the child's behavior, has been positively associated with child obesity.[18] Specifically, interactions between maternal depression and permissive parenting have been shown to increase the likelihood of child obesity.[32] Future studies will be needed to explore whether the quality of mother–child interactions mediates the relationship between maternal depression and child weight. Because increased restriction and the use of food as a reward have been associated with higher child weight, further study is needed to explore how these practices differ in the context of maternal depressive symptoms.

In addition to feeding practices, we found that children of depressed mothers spent less time sleeping than those of mothers without depressive symptoms, a finding that may not be surprising given that healthy sleep patterns depend on the bidirectional relationship between mothers and children. Inadequate sleep has been linked to increased risk of child obesity,[19] making it important to further explore the relationship between maternal depression and

Table 6. Maternal Depressive Symptoms and Child Activity-Related Behaviors

Activity	Depression Category	Time, Mean ± SD	Adjusted†	
			B (SE)	95% CI
Average daily sleep time (h)	None	10.37 ± 0.88	Ref	Ref
	Mild	10.12 ± 0.82	−0.27 (0.12)	−0.51 to −0.03*
	Moderate to severe	9.91 ± 0.75	−0.51 (0.17)	−0.84 to −0.18*
Average daily screen time (h)	None	3.11 ± 1.29	Ref	Ref
	Mild	3.41 ± 1.51	0.24 (0.19)	−0.12 to 0.61
	Moderate to severe	3.62 ± 1.77	0.36 (0.25)	−0.14 to 0.86
Average daily outdoor time (h)	None	1.22 ± 1.11	Ref	Ref
	Mild	1.14 ± 1.25	−0.09 (0.16)	−0.40 to 0.23
	Moderate to severe	0.64 ± 0.76	−0.58 (0.22)	−1.01 to −0.15*

SD = standard deviation; SE = standard error; CI = confidence interval.

*Significant at $P < .05$.

†Adjusted B (SE): models adjusted for child gender, being an only child (no, yes), insurance status (no insurance/Medicaid, commercial), maternal age, education (less than high school, high school or more), race (white, nonwhite), marital status (married, not married), and employment status (working, not working).

child sleep patterns. We also found that children of depressed mothers spent less time playing outdoors, which was similar to other studies demonstrating decreased associations with leisure activities.[13] We did not find associations with screen time, despite previous studies that have shown this link.[13,23] Perhaps this may be a result of assessing only home screen time in our study. Future studies are needed to further elucidate the relationships between maternal depressive symptoms and screen time, specifically in low-income minority populations.

There were several limitations to our study. Our results are based on low-income, primarily Hispanic and black mothers in the Bronx, and they therefore may not be generalizable to other racial, ethnic, or geographic groups. However, because minority, low-income families are known to be at the highest risk of both obesity and maternal depression,[6,7] it is important to explore these relationships in this high risk group in order to develop culturally specific preventive strategies. Future studies should examine ethnic, racial and educational attainment differences in more detail. Although we were able to control for education level, employment, and insurance status, future studies should include a more detailed assessment of household income, because income variations may be related to depressive symptoms and child overweight status. Another limitation was that some of the children did not have measured 5-year-old weights and heights in their medical record and therefore were not included in the analyses using weight status. Our study utilized a validated screening tool to assess maternal depressive symptoms. It was unknown whether the mothers had a formal diagnosis of major depressive disorder or other psychiatric illnesses. Given the overlap among different mental illnesses,[33] future studies should examine the relationship between child weight and maternal anxiety and other comorbid conditions. Given the relatively low prevalence of moderate to severe depressive symptoms, future studies should include larger sample sizes.

While exploring the relationship between maternal depressive symptoms and childhood obesity, it is important to understand that the factors involved are likely very complex.[34] Future studies should explore other sources of early toxic stress such as domestic violence, substance abuse and food insecurity in order to understand their role in the relationship between maternal depression and child weight. Another limitation is that the majority of the variables were maternal report, which potentially could represent a threat to validity given that the presence of depressive symptoms may impact a mothers' ability to accurately report the frequency of child behaviors. In addition, maternal report of feeding and activity related variables may not include behaviors occurring outside of the home or in child care settings. Future assessments of mealtime practices should use questions specifically designed for parents of young children. Finally, the cross-sectional design of this study precludes us from establishing causality between maternal depressive symptoms and early childhood obesity. Longitudinal studies beginning in infancy are needed to determine the impact of maternal depression on the development of child obesity.

CONCLUSIONS

Our results demonstrate a relationship between maternal depressive symptoms and early childhood obesity. Several obesity-promoting behaviors were related to maternal depressive symptoms, representing potential modifiable targets for intervention in low-income, ethnically diverse populations. Although many studies have focused on the co-occurrence of depression and obesity, only a few have looked at this relationship in the context of the mother–child dyad. In recent years, the American Academy of Pediatrics has stressed the importance of addressing maternal mental health within routine pediatric care.[35] Our study results support these initiatives and further expand their need given the nation's current obesity epidemic. The benefits of colocating mental health specialists into pediatric primary care settings[36] could go beyond the prevention of child social-emotional and developmental problems but also may represent an opportunity for early childhood obesity prevention. In addition, studies have shown that children of depressed mothers have higher failure rates in weight-intervention programs,[37] signaling that mental health screening and treatment may help

improve child outcomes among already overweight and obese children.

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