



Maternal characteristics influence infant feeding styles in Caribbean women

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Abstract

Objective: To examine associations between maternal characteristics and feeding styles in Caribbean mothers.

Design: Participants were mother–child pairs enrolled in a cluster randomised trial of a parenting intervention in three Caribbean islands. Maternal characteristics were obtained by questionnaires when infants were 6–8 weeks old. Items adapted from the Toddler Feeding Behaviour Questionnaire were used to assess infant feeding styles at the age of 1 year. Feeding styles were identified using factor analysis and associations with maternal characteristics assessed using multilevel linear regression.

Setting: Health clinics in St. Lucia (*n* 9), Antigua (*n* 10) and Jamaica (*n* 20).

Participants: A total of 405 mother–child pairs from the larger trial.

Results: Maternal depressive symptoms were associated with uninvolved ($\beta = 0.38$, 95 % CI (0.14, 0.62)), restrictive ($\beta = 0.44$, 95 % CI (0.19, 0.69)) and forceful ($\beta = 0.31$, 95 % CI (0.06, 0.57)) feeding and inversely associated with responsive feeding ($\beta = -0.30$, 95 % CI (-0.56, -0.05)). Maternal vocabulary was inversely associated with uninvolved ($\beta = -0.31$, 95 % CI (-0.57, -0.06)), restrictive ($\beta = -0.30$, 95 % CI (-0.56, -0.04)), indulgent ($\beta = -0.47$, 95 % CI (-0.73, -0.21)) and forceful ($\beta = -0.54$, 95 % CI (-0.81, -0.28)) feeding. Indulgent feeding was negatively associated with socio-economic status ($\beta = -0.27$, 95 % CI (-0.53, -0.00)) and was lower among mothers ≥ 35 years ($\beta = -0.32$, 95 % CI (-0.62, -0.02)). Breast-feeding at 1 year was associated with forceful feeding ($\beta = 0.41$, 95 % CI (0.21, 0.61)). No significant associations were found between maternal education, BMI, occupation and feeding styles.

Conclusion: Services to identify and assist mothers with depressive symptoms may benefit infant feeding style. Interventions to promote responsive feeding may be important for less educated, younger and socio-economically disadvantaged mothers.

Keywords
Feeding styles
Non-responsive feeding
Responsive feeding
Maternal characteristics

The increasing prevalence of childhood obesity globally is of concern as it can result in long-lasting health problems, premature mortality and morbidity⁽¹⁾. Children who are obese often continue to struggle with obesity in adolescence and adulthood. The increasing prevalence of overweight/obesity is of major concern in young children residing in low- and middle-income countries. In 2011, approximately 32 million children aged 5 years and under residing in low- and middle-income countries were reported as overweight⁽²⁾. In the Caribbean, the prevalence of childhood obesity has risen from 4.3 % in 1976 among St. Lucian children aged 5–6 years to 9.2 % in 2006–2007⁽³⁾. Similarly, the prevalence of childhood obesity, between 1990 and

1999, for children 0–5 years increased in Dominica from 6.0 % to 9.7 % and 7.1 % to 10.6 % in St. Kitts⁽⁴⁾. Data from the Barbados Children's Health and Nutrition Study showed that between 1981 and 2010, the overweight/obesity prevalence in children 8–11 years increased from 8.5 % to 32.5 %⁽⁵⁾. In 2008–2009, the overweight/obesity prevalence in six to ten year-old children residing in the North-East Health Region of Jamaica was 17.7 %⁽⁶⁾. Data obtained from the Global School-based Student Health Survey showed that for Jamaican adolescents 13–15 years, overweight/obesity estimates increased from 27.7 % in 2010⁽⁷⁾ to 35.7 % in 2017⁽⁸⁾. The increase in childhood obesity suggests that obesity prevention interventions need

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to begin in early life when healthy eating practices are first established. Parenting styles and feeding styles are distinctive but related constructs as feeding is one of the earliest tasks in parenting. Children's food choices, eating behaviour and energy intake are developed primarily by their parents⁽⁹⁾. The feeding relationship between parent and child has a discernible impact on child's food choice, eating behaviour and weight status. This feeding relationship involves both trust and interpretation of cues, hunger and fullness from the child⁽¹⁰⁾. The traditional parenting constructs and terminology used to describe parenting styles have also been applied to feeding^(11,12). Feeding styles describe how the parent relates to the child during feeding⁽¹³⁾ and may be categorised into responsive and non-responsive feeding. Responsive feeding, which is rooted in an authoritative parenting style, is described as the interaction between the caregiver and child where the caregiver provides direction using discussions, rationales, reasoning and praise to the child, identifies the child's hunger and fullness cues and administers the appropriate response^(12,14,15). Parents who practice responsive feeding also regulate their child's diet quality by administering a variety of healthy food⁽¹⁵⁾. Non-responsive feeding is largely governed by a lack of caregiver-child interchange. The caregiver may either force or pressure the child to consume more food whilst ignoring the signals of fullness displayed by the child (forceful feeding), restrict the intake or access to the quality of food the child consumes, predominantly high fat, low nutrient dense foods (restrictive feeding) or become totally unengaged during mealtime where limits on food quality or quantity are not controlled (uninvolved feeding)^(12,14,15). Both restrictive and forceful feeding styles are embedded in an authoritarian parenting style, whereas uninvolved feeding is part of an uninvolved parenting style^(12,14). Conversely, an indulgent feeding style is dominated by the child. Parents respond to the hunger and fullness signals displayed by the child however limits are not established on the food quality and quantity consumed^(12,14,15). This style of feeding is rooted in an indulgent parenting style^(12,14,15). The parent-child feeding relationship can have a lifelong effect on the development of appetite regulation and adiposity on the child⁽¹⁶⁾. There is growing evidence that suggests a positive association between non-responsive styles of feeding and overweight/obesity⁽¹⁷⁾ due to lack of support for the development of the child's ability to control their food intake. Studies have demonstrated that parents who practiced either a restrictive or indulgent style of feeding had children with higher adiposity or BMI Z-scores⁽¹⁸⁻²⁰⁾. Infant feeding styles are promising targets for overweight/obesity interventions as altering these feeding styles may help parents thwart overweight/obesity in their children.

Mothers typically have the main responsibility for child feeding, and most research pertaining to feeding styles has focused on maternal feeding attitudes, strategies and beliefs and less on fathers and other caregivers. Maternal

characteristics such as depressive symptoms, socio-economic status (SES), education, age, occupation, BMI and breast-feeding status may influence the type of feeding styles employed by the mother. Studies have reported that mothers with lower educational attainment and from lower income households were associated with higher uninvolved and forceful feeding styles, especially if the mother was also obese^(10,21). Conversely, higher educated mothers and higher income households have reported greater restrictive and indulgent feeding styles⁽²²⁻²⁵⁾. A study by Francis and Birch reported the use of feeding restriction among mothers who were overweight when compared with non-overweight mothers⁽²⁶⁾. It is suggested that mothers with higher BMI may limit the amount of food given to their children during mealtimes due to their own weight insecurities and struggles as well as concern about their children's weight status⁽²⁷⁾. Hurley and colleagues reported a positive association between maternal depressive symptoms and forceful, indulgent and uninvolved feeding styles⁽¹⁴⁾. Depressed mothers exhibit troubled feeding interaction patterns by becoming emotionally detached from their children during meal time. These characteristics limit the capability of the mother to administer the appropriate response during feeding⁽¹⁴⁾.

Breast-feeding may play a pivotal role in the development of childhood overweight/obesity and affect child growth trajectories⁽²⁸⁾. The WHO recommends exclusive breast-feeding for infants until age 6 months, following which complementary foods are introduced⁽²⁹⁾. Infants who are breastfed when compared with those who are formula fed have a decreased risk of childhood overweight⁽³⁰⁾. There is evidence suggesting that infants were more satiated responsive when consuming solid foods if they were breastfed during the first year⁽³¹⁾. Prior studies have also reported lower levels of maternal control when feeding solid foods by mothers who breastfed during the first year⁽³²⁾. This finding is further supported by other studies that found an association between breast-feeding and less maternal control (restrictive and pressure to eat) of infant feeding during the first 6-12 months⁽³³⁻³⁵⁾. Moreover, Disantis and colleagues reported that mothers who breastfed their infants and toddlers for longer periods were more likely to respond to their infants hunger and satiety cues and use less controlling feeding styles when feeding solids⁽³⁶⁾. Maternal feeding control negatively influences child appetite regulation due to the lack of responsiveness to infant feeding cues⁽³⁷⁾.

Several studies have investigated the association between parental characteristics and feeding styles however the majority of these studies were conducted in high-income countries with relatively little information examining these associations in low- and middle-income countries with even fewer studies examining this association in pre-school children⁽¹⁶⁾. Furthermore, many of these studies involved high- or middle-income groups^(17,18,20,38,39), although some



included disadvantaged/low-income groups^(10,15,16,40,41). Additionally, there has been limited research associating maternal characteristics to feeding styles during the period of complementary feeding in infancy in the Caribbean.

In this investigation, we examined the association of maternal age, educational grade level achieved, receptive vocabulary, SES, occupation, BMI, depressive symptoms and breast-feeding status with feeding styles in Caribbean mothers and their infants who were participants in a multi-island parenting intervention.

Methods

Overall study design and study participants

This is a prospective study of maternal characteristics associated with infant feeding styles. Mother–child dyads participating in the current study were part of a cluster randomised parenting trial aimed at improving parenting practices in Jamaica, St. Lucia and Antigua. Briefly, the parenting intervention was group delivered to mothers attending their routine child clinic visits, by health centre staff when children were 3 to 18 months. The intervention comprised short films that demonstrated responsive play activities and message cards which promoted child development and responsive parenting behaviours⁽⁴²⁾. The methods and results of the intervention have been previously described in detail⁽⁴²⁾ with significant benefits of the intervention to the children's cognitive development and improvement in maternal parenting knowledge scores compared with the control group.

Participants

Mother–child dyads were recruited for participation for the parenting intervention from thirty-nine child health centres in St. Lucia (*n* 9), Antigua (*n* 10) and Jamaica (*n* 20). Fourteen health centres were randomly assigned to the treatment group and fifteen to the control group. Recruitment was done at the 6 week postnatal clinics in Jamaica and St. Lucia however in Antigua enrolment occurred at the first child health clinic between 8 and 10 weeks due to low postnatal clinic attendance. In all three islands, most children attend the public health centres for well child care where they receive immunisations. A total of 601 mother–child pairs were enrolled in the parenting intervention study: 103 from St. Lucia, 102 from Antigua and 396 from Jamaica. Potential participants were ineligible if the baby was born very preterm, remained in hospital nursery > 48 h, multiple births, if the mother or primary caregiver did not attend the clinic appointment with the baby or if the baby would be placed in day-care, with no consistent caregiver. Written consent was obtained prior to participation from each mother.

The current investigation was an addition to the ongoing study and used baseline data collected for the parenting intervention study and feeding styles data collected at age 12 months. Mothers who were participating in the trial

were asked to give informed consent to the data collection when they attended the health centre for their child's 12-month clinic visit.

Baseline measurements

Maternal characteristics and socio-economic status

Baseline data on social background, maternal educational grade attained, occupation and whether the child's father lived in the home were obtained via an interviewer administered questionnaire on enrolment. The Peabody Picture Vocabulary Test⁽⁴³⁾ and the Centre for Epidemiological Studies Depression scale⁽⁴⁴⁾ were used to assess maternal receptive vocabulary and depressive symptoms, respectively. Both instruments were previously piloted and adapted for use in the Jamaican setting. A total depressive symptoms score was determined for each mother, with higher scores signifying greater depressive symptoms. SES was measured using information obtained on household possessions, crowding (persons per room in the home) and sanitation (toilet facilities and water supply ratings).

One year follow-up measurements

Feeding styles

The Toddler Feeding Behaviour Questionnaire, a twenty-seven-item scale assessing caregiver feeding styles developed by Hurley *et al.* (2013)⁽⁴⁵⁾, was used to determine the five dimensions of toddler feeding based on existing parenting and feeding theories: responsive, restrictive, indulgent, uninvolved and forceful feeding. The questionnaire utilised items adapted from semi-structured interview questions developed by Sacco *et al.* (2007)⁽¹⁵⁾, the Child Feeding Questionnaire⁽⁴⁶⁾ and Infant Feeding Questionnaire⁽¹⁴⁾. Uninvolved, indulgent, forceful and responsive feeding was measured with items associated with caregiver behaviour, whereas restrictive feeding was assessed with items pertaining to caregiver attitudes. Each item had a five-point response scale: never (0), seldom (1), half of the time (2), most of the time (3) and always (4). Items within the uninvolved feeding dimension were reverse coded.

The questionnaire was evaluated by the study investigators and based on relevance of individual items, five items were excluded (How often can you tell when toddler is full?; How often do you eat with toddler?; How often do you praise toddler for eating?; How often do you encourage toddler to try a new food?; How often are you concerned that toddler is eating too much?). The remaining twenty-two items were reworded if necessary so they would be better understood then piloted among mothers attending an outpatient clinic to determine the ease of comprehension of items. One question was dropped due to the mothers continued misunderstanding of the item even after modification of wording (Do you reward your baby with a present or gift (that is not food) if he/she eats?). Test–retest reliability of the



questionnaire was then assessed. The questionnaire was administered to twenty mothers with children within the study age group and then re-administered to the same mothers 2 weeks later. Intra-class correlation coefficients for the individual items varied between 0.621 and 0.969 indicating good questionnaire test–retest reliability.

The twenty-one item feeding style questionnaire was administered to mothers at infant age 12 months. Factor analysis was used to identify underlying constructs in the feeding styles on the complete data set ($n = 405$) using Eigen values >1 and a five-factor solution. An oblique rotation was employed to evaluate factor structure, and items with factor loading of 0.40 or above were considered to load on a factor. One question (Do you immediately get something else for the baby if he/she does not like what is given?) was excluded from further analysis because it did not load in an interpretable way. The analysis was repeated without the item, and responses related to the identified factors were saved in the form of standardised factor scores.

Maternal and infant characteristics

Maternal height (cm) and weight (kg) were collected using a portable stadiometer and digital scale following standardised protocols. BMI (BMI, kg/m^2) was calculated for each mother using these measurements. Infant weight (kg) and length (cm) were obtained from health records for each child. Sex-specific weight-for-length Z-scores (WLZ) was calculated using the WHO Anthro program (v.3.1.0).

Breast-feeding

Mothers provided information on current breast-feeding status (Are you feeding your baby any breastmilk?). Breast-feeding status was dichotomised into (1) breast-feeding and (2) not breast-feeding.

Statistical analysis

Frequencies, percentages, means and SD were computed for maternal and infant descriptive statistics. To determine the internal validity of the feeding style questionnaire, Cronbach's alpha coefficients (α) were computed for each feeding style factor. Reliability values greater than or equal to 0.7 were considered acceptable. A theoretical approach was used to select the explanatory variables for the analysis from a review of the literature. Maternal characteristics that were reported to have an influence on or were correlated with feeding styles in these prior studies were selected as the variables of interest for the current study. They are maternal depressive symptoms, SES, BMI, education, age, receptive vocabulary, occupation and breast-feeding status. SES factor scores for each mother were derived by principal component analysis of sanitation, household possessions and crowding. The generated factor scores, in addition to maternal age, depressive symptoms, and receptive vocabulary scores were categorised by tertiles for further exploratory analyses. Pearson Chi-squared

test (χ^2) and Wilcoxon rank sum test were used to compare maternal characteristics by country. Maternal depressive symptoms and receptive vocabulary scores were normalised using the square-root and squared transformations, respectively. Multilevel linear regression, accounting for clustering of the mother–child dyads at the country and health centre level, was used to examine the association between feeding styles and maternal characteristics by calculating the regression (β) coefficients (change in feeding style factor scores per change in maternal characteristic scores). Variables that were associated with feeding style were categorised (low, middle and high) to identify possible targets for intervention and adjusted analyses conducted with demographic characteristics and intervention group assignment included in the models. Statistical analysis was performed using STATA Statistical Program version 12.0 (StataCorp., 2001) and SPSS Statistics for Windows version 17.0 (SPSS Inc.), with statistical significance assessed at $P < 0.05$.

Results

The participants included a total of 405 mothers interviewed at 12 months: 239 in Jamaica, 83 St. Lucia and 83 Antigua.

Descriptive characteristics

Maternal characteristics are described in Table 1. Overall, 51% of mothers were between 15 and 24 years of age. Approximately fifty-six per cent of mothers completed high school or a higher level of education with sixty-six per cent having semi-skilled or higher jobs. In total, 23% of mothers were overweight and 31% obese. Fifty-four per cent of mothers reported they were breast-feeding at 1 year. Overall, 54.6% of fathers lived in the home with the mother and child. There were no significant differences in maternal educational level and BMI by country. The percentage of mothers who were young, currently breastfed or had unskilled jobs was highest in Jamaica and the mothers had greater depressive symptoms, lower receptive vocabulary and SES factor scores. Gross Domestic Product (GDP) per capita was also lowest in Jamaica, \$5209.85 USD⁽⁴⁷⁾ compared with St. Lucia and Antigua with \$9086.00 USD⁽⁴⁸⁾ and \$13272.44 USD⁽⁴⁹⁾, respectively.

Of the 405 infants recruited at 12 months, 196 (48.4%) were boys and 209 (51.6%) girls. Mean infant weight and WLZ scores were 9.66 ± 1.30 (kg) and 0.26 ± 1.29 , respectively. No significant differences in weight by country were observed.

Factor analysis

Five factors were extracted from factor analysis and items within each factor appeared thematically similar (Table 2). The identified factors are as follows: Factor 1, Uninvolved

Table 1 Characteristics of 405 infant feeding study participants in Jamaica, Antigua and St. Lucia†

Characteristics	Jamaica (n 239)		Antigua (n 83)		St. Lucia (n 83)		Total (n 405)	
	Mean/n	SD/%	Mean/n	SD/%	Mean/n	SD/%	Mean/n	SD/%
<i>Maternal characteristics</i>								
<i>Age*</i>								
15–24 years	137	57.3	35	42.2	34	41.0	206	50.9
25–34 years	73	30.5	41	49.4	33	39.8	147	36.3
≥ 35 years	29	12.1	7	8.4	16	19.2	52	12.8
<i>Highest grade level</i>								
≤ Grade 10	102	42.7	40	48.2	35	42.2	177	43.7
≥ Grade 11	137	57.3	43	51.8	48	57.8	228	56.3
<i>Occupation*</i>								
Never worked/unskilled	86	36.0	23	27.7	26	31.4	135	33.4
Semi-skilled	108	45.2	32	38.6	39	47.0	179	44.2
Skilled or higher	45	18.8	28	33.7	18	21.7	91	22.4
<i>BMI (kg/m²)‡</i>								
Underweight/normal (≤24.9)	111	46.8	32	41.6	36	49.3	179	46.3
Overweight (25–29.9)	56	23.6	15	19.5	17	23.3	88	22.7
Obese (30 and over)	70	29.6	30	38.9	20	27.4	120	31.0
<i>Breast-feeding status at 1 year</i>								
Breast-feeding	151	63.2	36	43.4	34	41.5	221	54.7
Not breast-feeding	88	36.8	47	56.6	49	58.5	184	45.3
Receptive vocabulary score*	145.82	26.58	162.30	27.64	157.59	28.52	151.61	28.05
Depressive symptoms score*	16.05	10.82	12.64	10.64	12.59	0.87	14.64	10.71
SES factor score*	−0.29	1.01	0.57	0.72	0.28	0.87	0.00	1.00
<i>Paternal characteristics</i>								
<i>Father's presence</i>								
Does not live in the home	128	53.6	28	33.7	28	33.7	184	45.4
Lives in the home	111	46.4	55	66.3	55	66.3	221	54.6

SES, socio-economic status.

* $P < 0.05$ (country differences using χ^2 or Wilcoxon rank-sum test).†Values are *n* and %, mean and SD for categorical and continuous variables.

‡387 (numbers different due to missing data).

Feeding; Factor 2, Restrictive Feeding; Factor 3, Indulgent Feeding; Factor 4, Forceful feeding and Factor 5, Responsive Feeding. The internal validity of the feeding style factors, assessed by Cronbach's α , ranged from 0.70 to 0.79 (Responsive feeding, $\alpha = 0.70$; Uninvolved feeding, $\alpha = 0.79$; Forceful feeding, $\alpha = 0.70$; Restrictive feeding, $\alpha = 0.73$; Indulgent feeding, $\alpha = 0.75$), indicating acceptable consistency and that items within each factor measured the same underlying feeding style.

Maternal characteristics and feeding styles

The unadjusted multilevel linear regression analyses investigating maternal characteristics and feeding styles are presented in Table 3. All models were controlled for clustering of the mother–child dyads with country at level 2 and health centre at level 1. There were significant associations between maternal receptive vocabulary, age, SES, depressive symptoms, breast-feeding and feeding styles. Maternal educational grade, BMI and occupation were not associated with any of the feeding styles. Maternal depressive symptoms were associated with higher scores on uninvolved, restrictive and forceful feeding styles and lower responsive feeding. There were negative associations between maternal receptive vocabulary and all non-responsive feeding styles and positive association with responsive feeding. Maternal age and SES were

negatively associated with indulgent feeding style scores. Breast-feeding at 1 year was positively associated with forceful feeding.

The associations of feeding styles with maternal depressive symptoms, receptive vocabulary, age, breast-feeding and socio-economic status were further explored (see Tables 4 and 5) using these variables grouped into tertiles comparing feeding styles in the middle and upper tertiles with the lowest tertile as the referent and breast-feeding compared with no breast-feeding (Table 5). Models were adjusted for other maternal and child characteristics: maternal age, SES factor score, BMI, infant gender, WLZ at 12 months and intervention group. The parenting intervention had no effect on maternal feeding styles.

Mothers 25 years and older, when compared with younger mothers, were less likely to practice indulgent feeding after adjusting for maternal and infant covariates (25–34 years: $\beta = -0.21$, 95 % CI (−0.43, −0.01); 35 years and older: $\beta = -0.32$, 95 % CI (−0.63, −0.02)) (Table 4). There were no significant associations with maternal age and uninvolved, restrictive, forceful or responsive feeding scores.

Moderate and higher socio-economic scores were associated with lower scores for indulgent feeding styles (moderate: $\beta = -0.31$, 95 % CI (−0.55, −0.06); high: $\beta = -0.27$, 95 % CI (−0.53, −0.00)) in adjusted models (Table 4). There were no significant associations between

Table 2 Factor loading matrix of twenty infant feeding style items as grouped by factor

Individual feeding style items	Component factor loading				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Do you know what your baby eats during the day?	0.817	0.018	-0.070	0.004	-0.020
Do you know when your baby eats during the day?	0.774	-0.066	-0.071	0.007	-0.056
Do you know what kind of food your baby is given?	0.813	0.100	0.044	0.006	-0.126
Do you decide what amount of food your baby is offered/given to eat?	0.672	0.025	0.084	-0.003	-0.209
If I do not monitor what my baby eats he/she will eat too much	-0.003	0.512	0.132	-0.208	0.062
Are you concerned your baby will become overweight?	-0.011	0.830	-0.086	0.078	0.034
Are you concerned your baby eats too many greasy or fatty foods?	0.072	0.658	0.039	0.151	-0.068
Are you concerned your baby may need to be put on a diet if he/she eats too much?	0.005	0.743	0.096	-0.005	-0.005
Do you promise you baby sweets if he/she behaves well?	0.129	0.140	0.807	0.073	0.087
Do you offer your baby sweets if he/she eats his/her food?	0.018	0.103	0.843	-0.023	0.027
Do you allow your baby to eat while watching TV or playing?	-0.108	0.017	0.433	0.197	-0.014
Do you let your baby eat whatever he/she wants?	-0.025	-0.046	0.546	0.197	-0.090
I have to shout to get my baby to eat enough	0.090	-0.030	0.073	0.720	0.053
If my baby is not hungry I make him/her eat anyway	0.045	0.062	0.170	0.404	0.160
I try hard to get my baby to eat a new food the first time it is given	-0.097	0.076	0.128	0.668	0.022
I have to force my baby to get him/her to eat	-0.013	-0.075	0.081	0.772	-0.130
I talk to my baby when I am feeding him/her	-0.244	-0.103	0.024	-0.185	0.651
I say positive things to my baby while he/she is eating	-0.177	-0.071	-0.072	-0.050	0.663
I arrange baby's food to make it more interesting while he/she eating	-0.025	0.117	0.020	0.097	0.635
I talk to my baby about the food he/she is eating	-0.002	0.038	0.023	0.183	0.717

socio-economic status and uninvolved, restrictive, forceful or responsive feeding styles.

Mothers with mild to moderate and elevated depressive symptoms scored higher on the uninvolved (mild-moderate symptoms: $\beta = 0.22$, 95 % CI (0.06, 0.40); elevated symptoms: $\beta = 0.38$, 95 % CI (0.14, 0.62)), restrictive (mild-moderate symptoms: $\beta = 0.28$, 95 % CI (0.04, 0.52); elevated symptoms: $\beta = 0.44$, 95 % CI (0.19, 0.69)) and forceful (mild-moderate symptoms: $\beta = 0.28$, 95 % CI (0.04, 0.53); elevated symptoms: $\beta = 0.31$, 95 % CI (0.06, 0.57)) factor scores than mothers with few depressive symptoms, after adjusting for covariates (Table 5). Conversely, responsive feeding was lower in mothers with depressive symptoms (mild-moderate symptoms: $\beta = -0.31$, 95 % CI (-0.56, -0.06); elevated symptoms: $\beta = -0.30$, 95 % CI (-0.56, -0.05)). There were no significant associations with maternal depressive symptoms and indulgent feeding for mothers in either category.

Maternal receptive vocabulary was negatively associated with uninvolved, restrictive, indulgent and forceful feeding styles, after controlling for maternal age, SES, BMI, infant gender and weight (Table 5). Mothers with receptive vocabulary scores average and higher were less likely to practice either uninvolved (average scores: $\beta = -0.24$, 95 % CI (-0.47, -0.01); high scores: $\beta = -0.31$, 95 % CI (-0.57, -0.06)), restrictive (average scores: $\beta = -0.27$, 95 % CI (-0.52, -0.03); high scores: $\beta = -0.30$, 95 % CI (-0.56, -0.04)), indulgent (average scores: $\beta = -0.18$, 95 % CI (-0.43, -0.06); high scores: $\beta = -0.47$, 95 % CI (-0.73, -0.21)) or forceful (average scores: $\beta = -0.27$, 95 % CI (-0.52, -0.02); high scores: $\beta = -0.54$, 95 % CI (-0.81, -0.28)) feeding styles, when compared with mothers with low receptive vocabulary scores. There was no significant association with receptive vocabulary and responsive feeding (Table 5).

Mothers who continued to breastfeed at 1 year, when compared with mothers who did not, had higher forceful feeding scores ($\beta = 0.41$, 95 % CI (0.21, 0.61)) after controlling for maternal and infant covariates (Table 5). There were no significant associations with breast-feeding and uninvolved, restrictive, indulgent or responsive feeding (Table 5).

Discussion

We found that maternal depressive symptoms, receptive vocabulary, socio-economic status and age were associated with one or more non-responsive infant feeding styles that could influence risk of childhood overweight/obesity in three Caribbean countries.

Our results show an inverse association between maternal age and socio-economic status with an indulgent feeding style. Mothers 25 years and older and those from moderate and high economic backgrounds were less likely to practice this style of feeding when compared with younger mothers or mothers from poor settings. Limited evidence was found examining this association with maternal age; however, studies suggest that mothers may employ indulgent feeding as a mechanism to manage their child's behaviour especially for those infants that are seen as having difficult temperaments such as infants perceived to be fussy^(14,45,50,51). Young mothers may also be more influenced by advice and pressure from other relatives, including the child's father, to indulge the child's preferences especially if there are concerns with low infant weight gain^(52,53). Non-maternal caregivers may participate in the feeding and care of the young child and may influence the child's feeding behaviour directly or indirectly.

Table 3 Multilevel linear regression analyses between maternal characteristics and feeding styles (*n* 405)†

Maternal characteristics§	Feeding styles‡									
	Uninvolved feeding		Restrictive feeding		Indulgent feeding		Forceful feeding		Responsive feeding	
	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI
Age	-0.00	-0.02, 0.01	-0.01	-0.03, 0.00	-0.03***	-0.04, -0.01	-0.01	-0.02, 0.01	0.01	-0.01, 0.02
Socio-economic status	-0.06	-0.16, 0.04	-0.09	-0.19, 0.01	-0.18***	-0.28, -0.08	0.02	-0.08, 0.12	-0.02	-0.12, 0.07
Education	0.05	-0.14, 0.25	-0.09	-0.28, 0.11	-0.04	-0.39, 0.31	0.02	-0.17, 0.21	-0.01	-0.21, 0.19
Receptive vocabulary	-0.00*	-0.01, -0.00	-0.01***	-0.01, -0.00	-0.01***	-0.01, -0.00	-0.01***	-0.01, -0.00	0.01*	0.00, 0.02
BMI	-0.01	-0.02, 0.00	0.00	-0.01, 0.02	-0.00	-0.02, 0.01	0.00	-0.01, 0.02	0.01	-0.01, 0.02
Depressive symptoms	0.10**	0.04, 0.17	0.09**	0.03, 0.16	0.04	-0.02, 0.11	0.09**	0.03, 0.16	-0.07*	-0.13, -0.01
Occupation	0.00	-0.13, 0.13	-0.16	-0.29, 0.20	-0.08	-0.21, 0.05	-0.08	-0.21, 0.05	0.02	-0.11, 0.15
Breast-feeding	-0.04	-0.24, 0.16	0.09	-0.10, 0.29	-0.08	-0.27, 0.11	0.42***	0.23, 0.61	0.14	-0.05, 0.34

* $P \leq 0.05$.

** $P \leq 0.01$.

*** $P \leq 0.001$.

†Model controlled for clustering at the country and clinic level.

‡Continuous feeding style variables include uninvolved, restrictive, indulgent, forceful and responsive. Feeding style variables were saved as standardised factor scores.

§Maternal characteristics include age, socio-economic status, education, receptive vocabulary, depression, BMI, occupation and breast-feeding status. Receptive vocabulary and depressive symptom scores were normalised using the squared and square-root transformations, respectively.

Table 4 Multilevel linear regression analyses between maternal age, socio-economic status and feeding styles (*n* 405)†

Maternal characteristics	Feeding styles									
	Uninvolved feeding		Restrictive feeding		Indulgent feeding		Forceful feeding		Responsive feeding	
	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI
‡25–34 years	-0.07	-0.30, 0.14	-0.28	-0.50, 0.05	-0.21*	-0.43, -0.01	-0.14	-0.37, 0.08	-0.02	-0.25, 0.21
‡35 years and over	-0.09	-0.39, 0.21	-0.24	-0.55, 0.07	-0.32*	-0.63, -0.02	-0.18	-0.50, 0.14	0.06	-0.26, 0.37
§Moderate socio-economic status	-0.04	-0.28, 0.20	-0.00	-0.25, 0.25	-0.31*	-0.55, -0.06	0.11	-0.15, 0.36	0.06	-0.19, 0.31
§High socio-economic status	-0.06	-0.30, 0.19	-0.20	-0.46, 0.06	-0.27*	-0.53, -0.00	0.07	-0.20, 0.34	0.05	-0.21, 0.31

* $P \leq 0.05$.

†Model controlled for clustering at the country and clinic level.

‡Multilevel linear regression analysis adjusted for maternal educational grade, socio-economic status (SES) factor score, BMI, infant gender, WLZ at 12 months and intervention group, compared with maternal age 15–24 years (referent).

§Multilevel linear regression analysis adjusted for maternal age, educational grade, BMI, infant gender, WLZ at 12 months and intervention group, compared with low socio-economic status (referent).

**Table 5** Multilevel linear regression analyses between maternal receptive vocabulary, depressive symptoms, breast-feeding status and feeding styles (n 405)†

Maternal characteristics	Feeding styles														
	Uninvolved feeding			Restrictive feeding			Indulgent feeding			Forceful feeding			Responsive feeding		
	β	95% CI		β	95% CI		β	95% CI		β	95% CI		β	95% CI	
‡Average receptive vocabulary	-0.24*	-0.47, -0.01		-0.27*	-0.52, -0.03		-0.18*	-0.43, -0.06		-0.27*	-0.52, -0.02		0.18	-0.07, 0.43	
‡High receptive vocabulary	-0.31*	-0.57, -0.06		-0.30*	-0.56, -0.04		-0.47***	-0.73, -0.21		-0.54***	-0.81, -0.28		0.18	-0.08, 0.14	
§Mild-moderate depressive symptoms	0.22*	0.06, 0.40		0.28*	0.04, 0.52		0.14	-0.10, 0.38		0.28*	0.04, 0.53		-0.31*	-0.56, -0.06	
§Elevated depressive symptoms	0.38**	0.14, 0.62		0.44***	0.19, 0.69		0.04	-0.21, 0.29		0.31*	0.06, 0.57		-0.30*	-0.56, -0.05	
Breast-feeding	0.01	-0.18, 0.21		0.10	-0.10, 0.30		-0.10	-0.30, 0.10		0.41***	0.21, 0.61		0.10	-0.11, 0.30	

* $P \leq 0.05$.** $P \leq 0.01$.*** $P \leq 0.001$.

†Model controlled for clustering at the country and clinic level.

‡Multilevel linear regression analysis adjusted for maternal age, socio-economic status (SES) factor score, BMI, infant gender, WLZ at 12 months and intervention group, compared with low receptive vocabulary (referent). Receptive vocabulary scores were transformed using the squared transformation.

§Multilevel linear regression analysis adjusted for maternal age, educational grade, socio-economic status (SES) factor score, BMI, infant gender, WLZ at 12 months and intervention group, compared with no or few depressive symptoms (referent). Depressive symptoms scores were transformed using the square-root transformation.

||Multilevel linear regression analysis adjusted for maternal age, educational grade, socio-economic status (SES) factor score, BMI, infant gender, WLZ at 12 months and intervention group, compared with not currently breast-feeding (referent).

Approximately fifty-five per cent of fathers in our study resided in the home with the mother and child. A prior study by Smith *et al.* (2018) of the same cohort of mother-child dyads as the present investigation reported that fathers who lived in the home encouraged healthier eating practices and influenced positive nutritional decisions⁽⁵⁴⁾.

The finding of less use of indulgent feeding in higher socio-economic homes than poorer ones is consistent with other studies that have examined non-responsive feeding styles^(9,12,15,52,53,55-58). For socio-economically disadvantaged mothers, the access to nutritious yet affordable food is difficult⁽⁵⁹⁾. When food is financially affordable, mothers may indulge the infant's food preference thus resulting in more positive emotions between them⁽⁶⁰⁾. Mothers with lower SES will have additional life stressors and economic pressures than middle class families that are of greater priority than feeding which will impact the child's feeding environment^(56,59). A study among lower income mothers in the USA reported that during times of financial hardship, mothers were more likely to purchase foods that are preferred by their family than higher income mothers as they could not afford to purchase food that might be wasted if their family members refuse such food^(61,62). Hughes *et al.* (2008) have reported the use of indulgent feeding in disadvantaged families, as food is viewed as an affordable means of comfort for children residing in stressed environmental conditions⁽⁵⁶⁾.

Moderate and elevated maternal depressive symptoms were associated with less use of responsive feeding. This finding is similar to previous studies which demonstrated that increased depressive symptoms are associated with non-responsive feeding styles⁽¹⁴⁾. Non-depressed mothers may be more receptive to their child's signals and therefore be more responsive during feeding. They are more inclined to model healthy and positive feeding practices and are actively involved with their child during meal time⁽⁶³⁾. Mothers who experience greater symptoms of depression may become emotionally detached from their children during feeding, thereby impacting the parent-child feeding interaction⁽¹⁴⁾.

Mothers, who were in the mid and higher tertiles for depressive symptoms, were also more likely to practice greater uninvolved, restrictive and forceful feeding practices. This finding is consistent with previous studies which demonstrated that increased depressive symptoms are associated with non-responsive feeding styles⁽¹⁴⁾. Mothers with depressive symptoms may restrict the intake of food by their child due to the possible misinterpretation and oversight of hunger and feeding cues displayed by the child⁽¹⁴⁾. Further evidence suggests that mothers who feel mentally defeated restrict the intake of food to their child as a form of punishment⁽¹⁴⁾.

Uninvolved feeding has also been documented in mothers who suffer from depressive symptoms. As a stress-reducing and coping mechanism, depressed mothers



who exhibit uninvolved feeding become unengaged with their child during mealtime and place fewer demands on what, when and how much their child eats⁽⁶³⁾.

A forceful or pressuring feeding style has also been observed in mothers who exhibit elevated depressive symptoms⁽⁶⁴⁾. Mothers who perceive their child as unable to determine their own hunger or satiety force them to eat in an attempt to ensure satisfactory weight gain⁽⁶⁵⁾. Depressed mothers whose children refuse food or are perceived as picky or fussy were more likely to practice forceful feeding, often due to feelings of frustration and anger^(14,64). Similar to restrictive feeding, forceful feeding has been shown to impede the child's ability to control the amount of food they intake^(66,67).

Contrary to expectation, we did not find a relationship between maternal education with feeding styles that has been shown in previous studies^(22,68). Although no association was observed, further findings from our investigation demonstrated a significant association between maternal receptive vocabulary with non-responsive feeding. Additional statistical analysis yielded a strong correlation (Pearson correlation coefficient, $r = 0.67$) between maternal receptive vocabulary and educational grade. Receptive vocabulary may be considered a proxy for education and may be a better measure of educational attainment than school grade attained in this setting. The findings from our study demonstrated that mothers with average and high maternal receptive vocabulary scores were less likely to practice uninvolved, restrictive and forceful feeding styles than women with lower vocabulary scores. Previous work has shown that mothers with lower than average education level are more likely to model unhealthy feeding practices and make poor food choices⁽⁶⁸⁾. Maternal attentiveness to overweight/obesity risk factors, favourable feeding behaviour and nutrition knowledge are enhanced by education⁽²²⁾.

Further findings from our study showed a positive association between breast-feeding at 1 year and a forceful feeding style. This finding is inconsistent with previous studies that report a positive relationship with responsive feeding and an inverse relationship with controlling feeding styles^(33–35). Mothers may force their infants to eat if they are concerned with inadequate infant weight gain or if they perceive their child has a lower fat mass in comparison with other children within the same age group^(46,69).

The parenting intervention trial, from which participants were recruited, reported significant benefits for child cognitive development and benefits to parenting knowledge. No other maternal or child benefits were noted by the authors⁽⁴²⁾. From the adjusted multilevel regression analyses, the parenting intervention had no influence on maternal feeding styles. The parenting trial targeted child development and responsive parenting, but this did not translate to responsive feeding. There were no activities or messages in the intervention that were specific towards infant feeding or their styles⁽⁴²⁾. Inclusion of responsive feeding and nutrition in future interventions that address

parenting may benefit mothers' ability to recognise and respond to their child's hunger and fullness cues appropriately.

There were limitations to the present study. A consecutive sample of mother–child dyads within the larger parenting trial was re-consented for the 12-month interviews. As a result, the sample met the criteria for the trial but was not randomly selected. Mothers who accessed the health centres were predominantly of low/moderate socio-economic status. This may limit the generalisability of the findings. Infant feeding styles were determined by maternal report that may be subject to both random error and bias. Social desirability may have been an issue as mothers may want to present attitudes and behaviour they aspire to rather than actual behaviour, despite the questionnaire being completed voluntarily and response confidentiality maintained. Another limitation is that the questionnaire targeted mothers. Whereas mothers are frequently the primary caregivers in this cultural setting, the influence of the father and other caregivers should not be disregarded. Another potential limitation is the lack of other measures of breast-feeding such as breast-feeding duration and exclusivity, which would have further enriched our findings and added complementary data. Several strengths of the investigation were identified. The questionnaire had good test–retest reliability (0.621–0.969) for this population and acceptable internal validity of factors (Cronbach's $\alpha = 0.70–0.79$). Furthermore, the analysis yielded factors consistent with the original questionnaire from which this instrument was revised. The instrument may be useful in future infant feeding style research in Caribbean families.

Conclusion

The findings from this investigation provide probably the first information of the association of maternal characteristics and infant feeding style in a cohort of mothers in the Caribbean. There is limited research on the maternal characteristics–feeding style relationship observed in low- and middle-income populations residing outside of the USA. With the information gathered from the current study, interventions to improve infant feeding practices could be designed to address not only infant and childhood risk factors but also maternal feeding style as well as wider maternal well-being. The results reinforce the need for interventions to assist depressed mothers by incorporating screening assessments for depressive symptoms and providing counselling support as a regular part of the health care services provided during postnatal and child health clinics. In addition, support should be provided to help mothers practice responsive infant feeding, such as responding to the infant's cues, talking to the baby about the food he/she is eating and giving positive reinforcement to baby during mealtime. Our results suggest that



these services could be targeted to mothers with less education as well as to younger, socio-economically disadvantaged mothers. Several areas have been identified where more work is needed using qualitative research techniques to add to our knowledge of the maternal determinant–feeding style interaction. Continued work may also include more detailed evaluations of breast-feeding and maternal well-being including stress, along with direct feeding observations which increases the validity of the findings.

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