Socioeconomic Status, Infant Feeding Practices, and Early Childhood Obesity

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(3,328 words, 3 tables)

Short title: Socioeconomic Status, Infant Feeding, and Child Obesity

Abbreviations: SES   Socioeconomic Status
ECLS-B   Early Childhood Longitudinal Study (9 months to kindergarten)
BMI   Body Mass Index
CES-D   Center for Epidemiologic Studies Depression Scale

Key Words: breastfeeding, bottle feeding, early childhood obesity, social class

What is already known about this subject:
    Children from low socioeconomic households are at greater risk of obesity. Children predominantly breastfed have a reduced risk of early childhood obesity. Yet, it is not known how feeding patterns mediate the relationship between social class and obesity.

What this study adds:
    Based on a nationally representative longitudinal study of early childhood, this study finds that healthy infant feeding practices, including predominant breastfeeding, mediates the negative association between social class and obesity at 24 months.

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ABSTRACT

Background: Children from low socioeconomic households are at greater risk of obesity. As breastfeeding can protect against obesity, disadvantaged infants are less likely to breastfeed relative to more advantaged children. Whether infant feeding patterns, as well as other maternal characteristics mediate the association between social class and obesity has not been established in available research.

Objectives: Examine the impact of infant feeding practices on child obesity and identify the mechanisms that link socioeconomic status with child obesity.

Methods: Based on a nationally representative longitudinal survey (ECLS-B) of early childhood (N = 8,030), we examine how breastfeeding practices, the early introduction of solid foods, and putting an infant to bed with a bottle mediate the relationship between social class and early childhood obesity relative to the mediating influence of other maternal characteristics (BMI, age at birth, smoking, depression, daycare use).

Results: Infants predominantly fed formula for the first six months were about 2.5 times more likely to be obese at 24 months of age relative to infants predominantly fed breast milk. The early introduction of solid foods (< 4 months) and putting the child to bed with a bottle also increased the likelihood of obesity. Unhealthy infant feeding practices were the primary mechanism mediating the relationship between socioeconomic status and early childhood obesity. Results are consistent across measures of child obesity although the effect size of infant feeding practices varies.

Conclusions: The encouragement and support of breastfeeding and other healthy feeding practices are especially important for low socioeconomic children who are at increased risk of early childhood obesity. Targeting socioeconomically disadvantaged mothers for breastfeeding support and for infant-led feeding strategies can reduce the negative association between SES and child obesity. The implications are discussed in terms of policy and practice.

INTRODUCTION

Although the rapid rise in childhood obesity during the 1980s and 1990s was less pronounced during the past decade (1,2), childhood obesity continues to be a concern among health care providers. Some have speculated that given current trends, future generations may be the first in decades to experience declining life expectancy (3). One important line of research is to examine the onset of obesity given evidence that risks for obesity begin early in life. Studies have demonstrated links between weight status in infancy and later obesity in childhood (4,5), as well as obesity in adolescence (6).

Not only is excessive weight gain during infancy and early childhood associated with the risk of later obesity, but it is also associated with early morbidity (7). In particular, children from disadvantaged backgrounds are more likely to be overweight and have poor health outcomes, and these negative outcomes are likely to continue into adulthood (8,9). Biological and environmental factors influence the risk of obesity among disadvantaged children. Children from low socioeconomic status (SES) families, for example, are more likely to have overweight mothers, which is associated with a higher risk of childhood obesity (10-13). In addition, maternal obesity and low SES are associated with reduced breastfeeding (14) and other unhealthy infant feeding styles (15). Also factors such as maternal smoking (13,16-18) and depression (19-23) are associated with childhood obesity and low SES. Thus, socioeconomically disadvantaged children are particularly at risk of obesity in early childhood (24).

Various studies have found that breastfeeding provides a protective effect against excessive childhood weight gain (24-29). Yet the very children that need this protection most are also the least likely to be breastfed. Studies document the negative association between breastfeeding and SES, as well as other potentially confounding factors that can influence

childhood obesity (24,28,30). Controlling for various background factors, studies have found an association between breastfeeding and childhood obesity (24-27,31,32), in some cases only in the short term (33), whereas other studies have found no relationship (34-37). The variation in findings appears to depend the size and scope of the data, the country context, how breastfeeding is measured, the time period data were collected, and the adjustment of potentially confounding factors.

There are various mechanisms through which breast milk can influence infant weight gain. Recent studies have found that the bioactive substances contained in breast milk benefit infant growth and body mass (38). Other studies have demonstrated that breastfed infants are better able to self-regulate their feeding or to be more satiety-responsive, compared to bottle fed infants (39-41). It may be that bottle feeding itself, regardless of the type of milk in the bottle, is what encourages feeding behaviors conducive to weight gain (42). Past research has also suggested that breastfeeding mothers report less restrictive feeding behavior and use lower levels of control, which is linked to healthy infant weight (43,44). Thus, breast milk contains properties associated with lean body mass, and breastfeeding may encourage infant self-regulation of feeding, as well as minimize maternal control of feeding, both of which are associated with reduced early childhood obesity. Other infant feeding patterns associated with an increased risk of obesity include the early introduction of solid foods. The introduction of solid foods before 4 months of age is associated with greater weight gain in infancy and early childhood (22,45,46). In addition, research has demonstrated that prolonged bottle feeding and putting a child to bed with a bottle are associated with childhood overweight or obesity (47,48). Importantly, these feeding patterns are also associated with low SES (47,48).

Thus, breastfeeding and other healthy infant feeding practices are a potential point of intervention to help reduce the likelihood of early childhood obesity among disadvantaged children. Reductions in maternal obesity, as well as maternal smoking and treatment against maternal depression are other potential mechanisms that could be targeted to reduce the risk of obesity among low SES children. To estimate these mediating pathways, we model the relationship between SES and obesity at age 24 months and consider various maternal characteristics as mediating mechanisms. We model factors such as maternal obesity, smoking, age at birth, depression, and putting the child in daycare as potential mediators. In addition, we examine the mediating role of infant feeding practices. We also control for the potentially confounding influence of household and child characteristics associated with SES and childhood obesity. Our aim is to highlight the primary maternal-related pathways through which socioeconomic disadvantage influences early childhood obesity.

METHODS

Sample

Data for this study come from the Early Childhood Longitudinal Study (ECLS-B) of children from 9 months to kindergarten, which were collected by the National Center for Education Statistics. The ECLS-B follows a nationally representative sample of over 10,000 children, generalizable to American children born in 2001. The sample was created using a clustered sampling design from registered births in the National Center for Health Statistics vital statistics system. Interviewers conducted an in-home survey with the biological mother of the sampled child, including direct assessments of the children's physical health. The data were collected when the child was 9 months of age (wave 1) and 24 months of age (wave 2) in the

years 2001-2002 and 2003-2004 respectively. All independent variables in our study were collected when the child was 9 months of age, or collected from the birth certificate, and the dependent measure, childhood obesity, was collected at 24 months of age.

The original sample was over 10,500 children and their mothers; we excluded cases where the child's caregiver was not the biological mother, cases missing on the dependent variable, as well as multiple births beyond twins. Our final sample was based on 8,030 children. We used multiple imputation to address any remaining missing data (49). The percent of cases missing data on each variable was low, between 1 and 6 percent of the sample.

Obesity at 24 Months

At 2 years of age, the ECLS-B measured children's weight twice by having the child, while clothed, stand on a scale (the correlation between first and second weighing was r = .9). These measures were used to determine obesity based on the Centers for Disease Control and Prevention Growth Charts, as recommended by the World Health Organization for children 0 to 24 months of age (50). Based on data tables by gender for weight-for-age, we used the weight marking the 98th percentile at 24 months to indicate early childhood obesity (11.4 kg or 25 pounds for boys and 10.9 kg or 24 pounds for girls). Our dependent variable is a dichotomous measure coded 1 if the child was obese, and 0 otherwise. Previous research has demonstrated that infants at the highest end of the distribution for weight or body mass index are at the highest risk of subsequent obesity (51).

Of course, there are other metrics for child obesity to consider. Therefore, we computed models for child obesity using child BMI at the 95th percentile as recommended by the World Health Organization (8.2 kg or 18 pounds for boys and 8.1 kg or 17.8 pounds for girls) (52). We also created a low and high measure by gender based on the International Obesity Taskforce

recommendations. Cutoffs for boys at 24 months of age are 8.4 kg (18.4 lbs) for the low measure and 9.1 kg (20.1 lbs) for the high measure. For girls, the cutoff is 8.2 kg (18.0 lbs) for the low measure and 9.0 kg (19.8 lbs) for the high measure (53).

Socioeconomic Status

Family SES was measured by a composite scale consisting of household income, parental education and occupational prestige created by the National Center for Educational Statistics. The measure is normalized with a mean of zero. This specific measure is a strong predictor of early childhood outcomes (54) and is a well-established metric of advantage and disadvantage in the social sciences (55).

Maternal Characteristics

Maternal obesity was measured by body mass index (BMI). We computed BMI using two measures from the parent survey of birth mothers. The first asked "How much did you weigh just before you became pregnant with [child in study]?" and the second was a measure of the mother's height. We used the measure of weight before pregnancy, although it was self-reported, because it had 20 percent fewer missing cases than actual maternal weight measured at the 9 month interview. The two measures were highly correlated ($r = .8$). BMI was calculated using the standard formula [(weight/height^2)*703]. Maternal age at birth was based on information provided on the birth certificate. Maternal smoking was measured by whether or not the mother reported that she currently smoked cigarettes at the 9 month interview. Responses were coded as 1=yes and 0=no. Maternal depression was constructed from questions using an abbreviated form of the Center for Epidemiologic Studies Depression Scale (CES-D). Responses to various questions about how the mother reported feeling in the past week were factored to create a depression scale ranging from low depression to high depression. The

Cronbach's alpha for the factor was 0.9. Daycare use was measured by a dichotomous variable indicating whether or not the child was regularly in daycare at the 9 month interview.

Infant Feeding Practices

Mothers were asked if they ever breastfed their child and for how many months. They were also asked (in separate questions) about formula feeding (in months), and the month they introduced solid foods. Based on responses to these questions, we constructed three dummy variables indicating feeding patterns to age six months: predominant breastfeeding, predominant formula feeding, and fed both breast milk and formula during the first six months. We initially considered other feeding cutoffs, 4 months and 9 months, and found similar patterns in terms of childhood obesity. Given the American Academy of Pediatrics recommendation that infants be breastfed exclusively for six months (56), we focused our analysis on predominant breast feeding to six months. Predominant breastfeeding was the reference category.

Following World Health Organization guidelines, we use the term "predominant" over "exclusive" because we cannot specifically ascertain if the infant received other sources of nutrients from water-based drinks, fruit juices, or vitamin supplements (57). We found, however that very few mothers indicated that other liquids were introduced prior to six months of age. To account for other sources of nutrition, we measured the early introduction of solid foods with a dichotomous measure coded 1 if the infant was fed solid foods before four months of age, and 0 if otherwise. We also considered the introduction of solid foods at six months, but this measure was not a significant predictor of childhood obesity (especially given that the majority of infants had received solid foods by six months). Finally, the mother was asked at 9 months if the child was put to bed with a bottle, which we coded as a dichotomous measure (1=yes and 0=no).

Household and Child Controls

Family structure was indicated by a dichotomous measure coded 1 if the child was living with both biological parents at 9 months, and 0 if otherwise, as well as a measure of the number of siblings in the household. Race and ethnicity of the child was reported by the parent and was used to create four dummy variables: non-Hispanic White, non-Hispanic Black, Hispanic (any race), and other racial groups. Non-Hispanic White was the reference category. Child's sex was coded 1=female and 0=male. Birth weight was measured by three dummy variables: normal birth weight (above 5.5 pounds or 2500 grams), moderate birth weight (5.5 to 3.3 pounds or 2500 grams to 1500 grams), and low birth weight (below 3.3 pounds or 1500 grams). Low birth weight was the reference category. A dichotomous measure was included to indicate whether the child was a twin (1=twin) or a singleton birth (0=singleton). Initial models also included age of the child at the 24 month survey, but because this had little variation and was not significant, it was dropped from further analyses.

Data Analysis

All analyses were performed in Stata 12.1. Because the dependent variable was dichotomous, logistic regression was conducted and odds ratios were obtained by exponentiating the coefficients. The reported odds represent the likelihood of a child being obese (vs. not obese) at 24 months of age for a one unit increase in some independent variable, accounting for other measures in the model. To account for missing cases, we used the *mi* function in Stata to run imputed files (20 in total) simultaneously (missing on the dependent variable was not imputed). We made adjustments for sample clustering and applied appropriate sample weighting.

We first provide descriptive statistics for the total sample, as well as by infant feeding patterns and socioeconomic status. Next, to consider how feeding patterns, as well as other

maternal characteristics mediate the relationship between SES and early childhood obesity, we estimated five regression models: first, we estimated only the association between SES and obesity; second, we added controls for household and child characteristics including parental marital status, number of siblings, race and ethnicity, gender, birth weight, and if the child was a twin; third, we included maternal measures of age at birth, BMI, smoking, depression, and use of daycare as potential mediating mechanisms; forth, we considered infant feeding practices as potential mediating factors; and fifth, we included all mediating measures in a final model to determine their independent effect on early childhood obesity. We reran all 5 models using three additional measures of child obesity to determine if results replicated across various obesity metrics.

RESULTS

Table 1 provides descriptive statistics for the entire sample, as well as by infant feeding patterns. Almost 10% of the children surveyed were obese ($\geq 98^{th}$ percentile) at 24 months of age. Of those fed predominantly breast milk the first six months, 5.6% were obese, compared to 11.7% predominantly fed formula. Household socioeconomic scores ranged from -2.1 to 2.2 with SES higher on average among predominantly breastfed infants and lowest among those predominately formula fed. Other infant feeding practices also differed by breastfeeding patterns. On average, almost 9% of predominately breastfed infants were put to bed with a bottle (at 9 months of age) compared to almost 40% of formula fed infants. The early introduction of solid foods was also more notable among predominately formula fed infants, with 29% initiating solid foods prior to 4 months of age relative to about 9% among predominantly breastfed infants.

[Table 1 about here]

Infants predominantly fed breast milk were also the least likely to have been in daycare compared to infants fed formula (about 6% relative to almost 10%). Other maternal characteristics indicate that the mothers of predominately formula fed infants were on average younger, heavier, and much more likely to smoke relative to the mothers of predominantly breastfed infants. Almost 31% of the predominately formula fed infants had mothers that smoked compared to only 5% of predominately breastfed infants. Although maternal depression scores were lowest among breastfeeding mothers, maternal depression differences by infant feeding practice were not statistically significant. Infants predominately fed formula were more likely to be African American and to have lower birth weight relative to infants predominantly fed breast milk. Twin births were also more likely to have been bottle fed than breastfed. The majority of infants predominantly fed breast milk lived with both parents at 9 months of age (92.5%) compared to about two-thirds of infants predominantly fed formula (65.4%).

In terms of SES and infant feeding patterns as shown in Table 1, children predominately fed breast milk were in the highest SES environments and experienced the healthiest feeding practices. Conversely, children predominately fed formula were in the lowest SES environments and experienced the poorest feeding practices. Those fed both breast milk and formula were somewhere in between. In Table 2, we examine further the association between low socioeconomic status and infant feeding patterns. Mothers in the lowest quintile of the SES distribution had a significantly higher percentage of predominate formula feeding, putting the infant to bed with a bottle, and introducing solid foods early (before 4 months) compared to mothers from higher socioeconomic backgrounds. Thus, as noted in Tables 1 and 2, low SES mothers were not only less likely to predominately breastfeed, but also to engage in other less

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healthy infant feeding patterns such as putting an infant to bed with a bottle, and introducing

solid foods early, relative to higher SES mothers.

[Table 2 about here]

Infants, therefore, from socioeconomically disadvantaged backgrounds appeared to

experience a number of risk factors starting at birth that put them on a trajectory towards early

childhood obesity. To examine the potentially confounding influence of these factors, and to

consider how infant feeding practices, as well as other maternal characteristics mediate the

negative relationship between SES and obesity, we next turn to our multivariate analyses

presented in Table 3.

[Table 3 about here]

Model 1 in Table 3 indicates a negative relationship between SES and early childhood

obesity (OR 0.76, 95% CI 0.66–0.88). Each unit increase in SES reduced the odds of obesity by

24% (1.00 - .76 = .24). The inclusion of child characteristics slightly reduced the odds of obesity

from 24% to 20% (model 2). Surprisingly, mother's BMI, age at birth, smoking, and depression

as well as child's daycare attendance modified the odds by only one percentage point (model 3,

OR 0.81, 95% CI 0.65–1.02). Of these measures, only mother's BMI and smoking increased the

likelihood of early childhood obesity, whereas the child's attendance in daycare reduced the odds.

Unhealthy infant feeding practices, by comparison, all increased the odds of child obesity

and were strong mediators of the socioeconomic link (model 4). Infants that were predominantly

fed formula were about 2.5 times more likely to be obese at 24 months than were predominately

breastfed infants. Infants fed both breast milk and formula were 1.8 times more likely to be

obese relative to predominately breastfed infants. The early introduction of solid foods increased

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the likelihood of early childhood obesity by 40%, and putting the child to bed with a bottle was associated with a 30% increased risk.

As shown in model 4, the inclusion of infant feeding practices reduced the SES coefficient from 20% to a 7% (OR 0.93, 95% CI 0.77-1.14) chance of obesity for each SES unit increase. In comparison, the inclusion of other maternal characteristics (model 3) did little to mediate the negative association between SES and early childhood obesity. Thus, based on our analyses, unhealthy infant feeding practices were the primary pathway linking SES to early childhood obesity, relative to other maternal pathways. In the full model, the association between infant feeding practices and early childhood obesity remained strong, an indication that the influence of feeding practices on obesity is independent of other maternal characteristics (see model 5).

We also report results replicating model 5 in Table 3 using three other constructions of child obesity based on child BMI, as recommended by the World Health Organization and the International Obesity Taskforce. Results are consistent with findings reported in Table 3 for all models, as infant feeding practices completely mediate the SES/child obesity link. But, as Table 4 shows, the effect size of infant feeding practices for obesity varies by obesity metrics. For example, a child predominately formula fed has a 60% greater likelihood of child obesity using the *WHO measure*, and a 147% greater likelihood with the *CDC Measure*, compared with children predominately breastfed.

[Table 4 about here]

DISCUSSION

The aim of this study was to highlight the primary maternal-related pathways through which socioeconomic disadvantage influences early childhood obesity. As did Wijlaars and

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colleagues (24), we found a negative relationship between socioeconomic status and early childhood obesity. Although limited to data from 3-month-old infants in England and Wales, Wijlaars and colleagues (24) concluded that the underpinnings for socioeconomic inequalities in obesity may be found in early infancy. Using a longitudinal sample of children in the United States, we came to a similar conclusion analyzing weight gain data at 24 months of age. As in the British sample, the authors concluded that infant feeding practices may play a part in varying socioeconomic weight trajectories (24). Based on our analyses, we found empirical support for this conclusion.

We modeled maternal factors such as obesity, smoking, age at birth, depression, and putting the child in daycare as potential factors mediating the relationship between socioeconomic status and early childhood obesity. In addition, we examined the mediating role of infant feeding practices. Controlling for potentially confounding child and household characteristics, we found that infant feeding practices were the primary mechanism mediating the role between socioeconomic status and early childhood obesity. In addition, we found the mediating influence of infant feeding to be independent of other maternal characteristics such as BMI, smoking, and depression. In concurrence with previous studies (10-13, 16-18), we found maternal obesity and smoking to be positively associated with childhood obesity. We did not find an association between maternal depression and early childhood obesity in contrast to previous research (19-23); however these studies focused primarily on clusters of risk factors, rather than the direct effect of maternal depression on early childhood obesity.

In support with previous research we found that low SES mothers were the least likely to breastfeed (14,24,30), thus our findings add additional support to the volume of literature demonstrating that breastfeeding has a protective effect against childhood and adolescent obesity

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(24-29, 31,32). We found, independent of other maternal and child characteristics, infants predominately formula fed for at least six months more likely to be obese at 24 months of age, relative to infants predominately breastfed. However, other feeding practices, such as the early introduction of solid foods and putting the infant to bed with a bottle, also mediated the relationship between SES and obesity; this mediating role builds upon previous research that found a negative relationship between these feeding practices and childhood obesity (45-48). Thus, not only is formula feeding associated with low SES, but it appears to cluster with other unhealthy feeding practices that promote early childhood obesity.

Our findings lend support to both the clustering of unhealthy feeding practices among low socioeconomic mothers, and the protective effect of breastfeeding in reducing the risk of early childhood obesity. Studies by Brown and Lee (58) demonstrated that maternal control of feeding and early restrictive feeding practices influence infant weight. Various studies have indicated that breastfeeding is associated with lower maternal control of infant feeding (59-60,43) and that breastfeeding encourages infant feeding self-regulation (39-41). Li and colleagues (39,40,42), as well as Brown and Lee (41) have found bottle feeding to inhibit infant satiety responsiveness, as does the early introduction of solid foods (41). In particular, maternal expectations that infants drain the bottle have been linked to later infant or child obesity (39,40).

Thus, from an applied perspective, health professionals should emphasize not only breastfeeding, but also the importance of infant-led feeding. Particularly among low SES mothers, an awareness of following infant cues of satiety is needed, whether or not the mother chooses to bottle or breastfeed. A multi-pronged approach is needed to not only encourage breastfeeding, but also discourage infant feeding practices that inhibit satiety responsiveness such as early initiation of solid foods and controlled bottle feeding (39,41). Studies indicate that

various interventions, including life-style modification, nutritional education, and increased physical activity are effective in preventing childhood obesity (61,62), however, the earliest possible intervention is the promotion and support of predominant breastfeeding (62), especially for infants from low socioeconomic households. Given that breastfeeding is associated with other healthy feeding practices that promote infant self-regulation, it is a practice that should be supported by health professionals, particularly among at risk populations.

As we have shown, some common intervention strategies—such as reducing mother's BMI—may have direct links to child obesity but do little to mediate the enduring relationship between SES and child weight. As a target for intervention to reduce the risk of early childhood obesity among economically disadvantaged children, focusing on healthy infant feeding practices would be more effective than attempting to address other maternal factors such as maternal obesity, smoking, or depression. Thus, it is critical that healthcare providers caring for low income and otherwise disadvantaged children encourage, support, and protect breastfeeding in an effort to prevent childhood obesity. Encouraging improved infant feeding patterns can thus provide a protective effect against childhood obesity and is a more feasible intervention strategy for healthcare providers compared to the more immutable nature of socioeconomic status and other maternal risk-factors.

There are several limitations to the data that need to be considered when interpreting our findings. The data were based primarily upon maternal self-reports. In particular, given the large percentage of missing data in maternal actual weight, we relied upon maternal self-reporting of pre-pregnancy weight to determine maternal BMI, rather than the measure taken at the date of interview. Although the two measures were correlated, this may have increased measurement error and weakened the effect of maternal BMI on childhood obesity in our models.

Further, maternal reporting of the length of breastfeeding and formula feeding were subject to recall, creating an additional source of error in the analyses.

We were also not able to determine exclusive breastfeeding or formula feeding, only the predominant feeding method based on maternal reports of length of feeding in months. We could not determine what other liquids the infant may have received in addition to breast milk or formula. Also, the measure indicating if the child was put to bed with a bottle did not include information regarding feeding the infant to sleep – either by bottle or breast. Thus, it was not possible to separate the effect of being put to bed with a bottle, from being fed to sleep. Although supplementary analyses revealed that the contents of the bottle were not important predictors of child obesity (e.g. water, juice, milk, other substance), we could not isolate breast milk from cow milk. Future research is needed to refine such measures of infant feeding and further clarify their mediating role between socioeconomic status and early childhood obesity.

Even with data limitations, this nationally representative, longitudinal study contributes to the growing body of literature supporting the link between infant feeding practices and early childhood obesity, particularly as a way to mediate the negative relationship between socioeconomic status and obesity. Early interventions in infant feeding among low SES populations can help divert at-risk children onto a healthy trajectory by supporting feeding practices that encourage infant-led feeding and reduce maternal control or feeding regulation. Breastfeeding is one practice that health promoters can encourage that not only provides protection against the risk of early childhood obesity, but is associated with other healthy protective feeding practices for young children.

CONFLICT OF INTEREST

We have no financial relationships relevant to this article nor do we have conflicts of interest to disclose.

ACKNOWLEDGEMENTS

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TABLES

TABLE 1 Sample Characteristics and Associations with Infant Feeding First Six Months

Sample Characteristics[a]	Total Sample[b] (N = 8030)	Predominately BreastFed 6+ mo[b] 15% (N = 1225)	Predominately Formula Fed 6+ mo[b] 31% (N = 2495)	Breast & Formula Fed 6+ mo[b] 54% (N = 4310)
Obese 24 months	9.6	5.6[c]	11.7	9.6
Socioeconomic status	-0.0 (0.9)	0.4[c] (0.8)	-0.4 (0.7)	0.1 (0.8)
Put to bed with bottle	31.5	8.7[c]	39.9	33.1
Solid foods < 4 months	20.8	8.7[c]	29.2	19.4
Mother BMI	24.7 (5.7)	23.7[c] (4.5)	25.4 (6.3)	24.6 (5.6)
Mother's age at birth	27.6 (6.4)	29.6[c] (5.9)	25.9 (6.4)	28.0 (6.3)
Mother smokes	19.8	5.1[c]	30.7	17.8
Maternal depression	0.00 (1.0)	-0.04 (0.9)	0.02 (1.0)	0.01 (0.9)
Infant in daycare	9.0	5.9[c]	9.3	9.7
Race and ethnicity				
White	42.6	49.6[c]	39.7	42.3
Black	15.6	4.7[c]	26.4	12.4
Hispanic	20.3	18.9[c]	17.1	22.6
Other	21.5	26.8[c]	16.8	22.7
Female	48.6	49.4	48.2	48.6
Birth weight				
Low	9.7	2.6[c]	12.3	10.2
Moderate	15.4	9.7[c]	18.7	15.1
Normal	74.9	87.7[c]	69.0	74.7
Twin	15.8	7.0[c]	17.6	17.2
Live with both parents	78.7	92.5[c]	65.4	82.5
Number of siblings	1.1 (1.1)	1.1[c] (1.2)	1.2 (1.2)	1.0 (1.1)

[a] All measures when child 9 months unless otherwise indicated.

[b] Values are percentages for categorical variables and mean (SD) for continuous variables.

[c] Mean comparison tests indicate means for predominantly fed breast milk differ significantly at p < .05 from predominantly formula fed and combined feeding.

TABLE 2 Associations between Feeding Practices and Socioeconomic Status

Feeding Practice[a]	Total Sample[b] (N = 8030)	Low SES[b] (20%) (N = 1527)	Middle to High SES[b] (80%) (N = 6502)
Predominately Formula fed	31.1	47.9[c]	27.2
Put to bed with bottle	31.5	47.9[c]	27.6
Solid foods < 4 months	20.8	23.4[c]	20.2

[a] All measures when child 9 months unless otherwise indicated.
[b] Values are percentages for categorical variables.
[c] Mean comparison tests indicate means for Low SES differ significantly at $p < .05$ from Middle to High SES.

TABLE 3 Socioeconomic Status and Infant Feeding Factors Predicting Odds of Obesity at 24 Months of Age (N = 8030)

Factors	Model 1 OR (95% CI)		Model 2 OR (95% CI)		Model 3 OR (95% CI)		Model 4 OR (95% CI)		Model 5 OR (95% CI)	
Socioeconomic Status	0.76 ***	(0.66–0.88)	0.80 *	(0.64–1.00)	0.81 ^{t}	(0.65–1.02)	0.93	(0.77–1.14)	0.91	(0.74–1.12)
Race and Ethnicity										
White (reference)										
Black			0.90	(0.60–1.34)	0.92	(0.61–1.40)	0.86	(0.57–1.30)	0.87	(0.57–1.33)
Hispanic			1.45 ^{t}	(0.98–2.16)	1.51 *	(1.02–2.25)	1.59 *	(1.07–2.35)	1.57 *	(1.06–2.32)
Other			0.93	(0.57–1.53)	0.92	(0.56–1.51)	0.93	(0.57–1.53)	0.93	(0.56–1.53)
Female			0.92	(0.76–1.12)	0.91	(0.76–1.10)	0.95	(0.78–1.14)	0.94	(0.78–1.13)
Birth Weight										
Low (reference)										
Moderate			1.57	(0.87–2.84)	4.20 ***	(2.85–6.19)	3.99 ***	(2.69–5.92)	1.62	(0.90–2.92)
Normal			4.00 ***	(2.72–5.89)	1.62	(0.90–2.90)	1.56	(0.86–2.83)	4.18 ***	(2.82–6.20)
Twin			0.89	(0.67–1.18)	0.89	(0.67–1.18)	0.82	(0.61–1.10)	0.82	(0.61–1.10)
Live with Both Parents			1.01	(0.77–1.31)	0.96	(0.74–1.25)	1.08	(0.83–1.40)	1.00	(0.77–1.31)
Number of Siblings			0.93	(0.84–1.04)	0.88 *	(0.79–0.98)	0.93	(0.83–1.04)	0.87 *	(0.78–0.97)
Infant in Daycare					0.64 *	(0.43–0.94)			0.60 *	(0.40–0.88)
Mother BMI					1.03 ***	(1.02–1.05)			1.03 ***	(1.01–1.04)
Mother Age at Birth					1.02	(1.00–1.04)			1.02 *	(1.00–1.04)
Mother Smokes					1.32 *	(1.04–1.67)			1.12	(0.88–1.42)
Maternal Depression					0.97	(0.87–1.08)			0.96	(0.87–1.07)
Infant Feeding (first 6 months)										
Predominately Breast Fed (reference)										
Predominately Formula Fed							2.48 ***	(1.69–3.65)	2.47 ***	(1.67–3.65)
Breast Milk and Formula							1.83 ***	(1.34–2.50)	1.84 ***	(1.34–2.52)
Solid Foods < 4 Months							1.41 **	(1.15–1.73)	1.40 **	(1.14–1.72)
Put–bed with Bottle							1.32 *	(1.05–1.67)	1.36 **	(1.08–1.70)

OR: odds ratio

95% CI: 95% confidence interval

*** $p < .001$, ** $p < .01$, * $p < .05$, ^{t} p<.10.

TABLE 4 Socioeconomic Status and Infant Feeding Factors Predicting Odds of Obesity at 24 Months of Age Across Obesity Measures

Factors	CDC Measure OR (95% CI) (N=8030)		WHO Measure OR (95% CI) (N=7880)		IOTF Low Measure OR (95% CI) (N=7880)		IOTF High Measure OR (95% CI) (N=7880)	
Socioeconomic Status	0.91	(0.74–1.12)	0.96	(0.85–1.07)	0.98	(0.87–1.11)	0.84	(0.70–1.10)
Infant Feeding (first 6 months)								
Predominately Breast Fed (reference)								
Predominately Formula Fed	2.47 ***	(1.67–3.65)	1.60 ***	(1.27–2.02)	1.71 ***	(1.36–2.15)	2.17 ***	(1.44–3.26)
Breast Milk and Formula	1.84 ***	(1.34–2.52)	1.26 **	(1.07–1.48)	1.30 **	(1.08–1.56)	1.56 **	(1.14–2.15)
Solid Foods < 4 Months	1.40 **	(1.14–1.72)	1.21 *	(1.04–1.41)	1.27 **	(1.09–1.49)	1.34 **	(1.08–1.65)
Put–Bed with Bottle	1.36 **	(1.08–1.70)	1.16 *	(1.00–1.33)	1.21 *	(1.02–1.42)	1.32 **	(1.08–1.61)

OR: odds ratio

95% CI: 95% confidence interval

*** $p < .001$, ** $p < .01$, * $p < .05$

Note: The sample is reduced from 8030 to 7880 due to missing on the dependent variable.