

Selected Complementary Feeding Practices and Their Association With Maternal Education

Sara B. Fein, PhD^a, Judith Labiner-Wolfe, PhD^a, Kelley S. Scanlon, PhD, RD^b, Laurence M. Grummer-Strawn, PhD^b

^aCenter for Food Safety and Applied Nutrition, Food and Drug Administration, College Park, Maryland; ^bDivision of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

OBJECTIVE. As infants transition from a milk-based diet to one that includes most food groups, the timing of the transition, how infants are fed, and the quality of their diet can have important health implications. Our objective is to describe these factors for US infants.

METHODS. We analyzed data from the Infant Feeding Practices Study II. Sample sizes varied for relevant questions from ~1600 to ~2400. We analyzed the prevalence of 14 feeding practices and their association with the mothers' education and also examined participants' use of commercial baby foods.

RESULTS. Approximately 21% of the mothers introduced solid foods before 4 months; 7% introduced solids after 6 months. Twenty-nine percent of the mothers introduced >3 new foods per week to infants aged 5 to 10 months. Approximately 20% of the mothers fed juice before 6 months, fed cow's milk before 12 months, and fed infants <5 times per day after 5 months. Fourteen percent of the mothers chewed food for their infant. Approximately 15% of the mothers fed <1 serving daily of either a fruit or vegetable to infants aged ≥9 months, half added salt to their infant's food, and more than one third who added salt used noniodized salt. Approximately 20% fed reduced-fat cow's milk at 1 year. Almost half of the 10-month-old infants had eaten restaurant food in a restaurant in the previous week, 22% had eaten carry-out food, and 28% had eaten either type of restaurant food ≥2 times. The prevalence of 8 of the 14 unhealthful infant feeding practices we examined was inversely associated with maternal education.

CONCLUSIONS. Nutrition and feeding guidance should be especially targeted to mothers with a high school education or less. *Pediatrics* 2008;122:S91–S97

www.pediatrics.org/cgi/doi/10.1542/peds.2008-1315I

doi:10.1542/peds.2008-1315I

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the Food and Drug Administration.

Key Words

infant nutrition, complementary feeding, weaning, nutritional requirements, diet

Abbreviations

IFPS—Infant Feeding Practices Study
FITS—Feeding Infants and Toddlers Study

Accepted for publication Jun 4, 2008

Address correspondence to Sara B. Fein, PhD, Food and Drug Administration, Center for Food Safety and Applied Nutrition, 5100 Paint Branch Pkwy, HFS 020, College Park, MD 20740. E-mail: sara.fein@fda.hhs.gov

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275); published in the public domain by the American Academy of Pediatrics

DURING THE FIRST year of life, infants transition from a diet of breast milk and/or infant formula to one that includes solid foods and other beverages. The timing of this transition, how infants are fed, and the foods and beverages they are offered at various ages can have both short-term and long-term health implications. The short-term health implications arise from the inappropriateness of certain foods until infants reach particular developmental stages, the need to meet the high nutrient requirements of older infants, and the risks inherent in certain feeding practices. The long-term implications derive from limited evidence that dietary patterns in infancy may set the foundation for eating patterns a few years later¹ and stronger evidence that dietary patterns in childhood may influence such patterns several years later.^{2–5} Long-term effects of poor infant feeding patterns also include the effects of inadequate intake of certain nutrients, such as iron, although such nutritional deficiency is rare in the United States.⁶

The extent to which infants are fed commercial baby foods rather than foods sold for the general population is of interest, because baby foods may be more appropriate for several reasons: baby foods undergo more intense screening for contaminants⁷; they contain no additives of certain types, including sulfites; they contain no added sugar or salt^{7,8}; and they are fortified with vitamins and minerals at levels designed to help infants meet nutrient requirements.

In this study, we assessed whether mothers engaged in 14 unhealthful complementary feeding practices for infants as they transitioned from milk to a varied diet and the association between maternal education level and engaging in these practices (Table 1). The prevalence of other infant feeding practices among US mothers, including breast-feeding, the introduction of various foods, and feeding of sugary or fatty foods, is described by Grummer-Strawn et al elsewhere in this supplement.⁹

TABLE 1 Prevalence of Selected Infant Feeding Practices According to Maternal Education

Feeding Practice	Total Sample (N = 2783)		Educational Level			P
	N ^a	%	High School or Less (n = 584), %	Some College (n = 1120), %	College Graduate (n = 1079), %	
Timing of complementary feeding						
Introduced solid food before 4 mo	1609	20.9	35.8	24.5	11.4	<.001
Introduced solid food after 6 mo	1698	6.9	5.2	6.2	8.1	.17
Introduced new foods too rapidly (>3/wk) in at least 1 mo during month 5–10.5 surveys	2307	28.9	31.0	28.9	27.8	.47
Fed juice before 6 mo	1653	22.9	40.0	27.8	11.9	<.001
Introduced cow's milk by month 10.5	1588	25.9	41.9	28.5	17.5	<.001
How infant is fed						
Fed infant <5 times per d in at least 1 mo at ages 6–12 mo	2281	18.2	17.1	17.1	19.7	.26
Premasticated food for infant	2436	13.6	18.6	14.9	9.8	<.001
Diet quality						
Fed <1 fruit or vegetable per d in at least 1 mo to infants aged 9–12 mo	2104	15.4	18.9	17.4	12.1	<.001
Added salt to food of infants aged 9–12 mo	1623	50.6	55.9	49.1	49.7	.13
Used noniodized salt sometimes or always for infant's food (among salt users)	821	37.9	38.5	38.2	37.4	.94
Fed nonwhole cow's milk in month 12 (among those who fed cow's milk)	1672	20.5	29.8	23.5	14.6	<.001
Fed infant restaurant food at a restaurant ≥1 time in previous 7 d at month 10.5	1687	47.7	49.0	50.7	44.7	.08
Fed infant carry-out restaurant food ≥1 time in previous 7 d at month 10.5	1689	22.3	31.2	23.2	17.9	<.001
Fed infant restaurant food either in a restaurant or as carry out ≥2 times in previous 7 d at month 10.5	1687	28.0	35.3	28.0	25.0	.002

^a Sample sizes vary primarily because of nonreturned questionnaires and because some items relate only to infants with certain characteristics, such as those fed salt or cow's milk; a small amount of missing data was caused by item nonresponse.

METHODS

We analyzed data from the 2005–2007 Infant Feeding Practices Study II (IFPS II), a longitudinal survey of mothers of healthy singletons from late pregnancy through 12 months postpartum. The IFPS II sample was drawn from a nationally distributed but not nationally representative consumer panel. Questionnaires were sent to expectant mothers once during late pregnancy and at 1, 2, 3, 4, 5, 6, 7, 9, 10.5, and 12 months postpartum. Sample sizes vary from ~1600 to 2400 depending on the particular question and questionnaire month. The characteristics of IFPS II participants are described elsewhere in this supplement.¹⁰

Each of the 10 postnatal questionnaires included a food-frequency chart for the mother to indicate how often her infant was fed various types of food in the previous 7 days, as well as questions about feeding practices, which varied according to the approximate age of the infants when questionnaires were sent. Because some mothers did not complete each survey until several weeks after it was mailed, and a few waited several months, we analyzed all data by the age of the infants when the questionnaires were actually completed, which was determined by a question that asked the mothers to provide the date they completed the questionnaire. Using the same procedures described by Grummer-Strawn et al,⁹ we created the following age categories for analysis: 3 to

6 weeks (1 month), 7 to 10 weeks (2 months), 11 to 14 weeks (3 months), 15 to 18 weeks (4 months), 19 to 23 weeks (5 months), 24 to 28 weeks (6 months), 29 to 35 weeks (7 months), 36 to 42 weeks (9 months), 43 to 50 weeks (10.5 months), and 51 to 59 weeks (1 year). For example, if the mother completed the 4-month questionnaire when her infant was 22 weeks old, we included the data in the 5-month age group (19–23 weeks) instead of the 4-month (15–18 weeks) age group. If the mother completed 2 questionnaires in the same age category, we selected the first questionnaire she completed.

Assessment of Infant Feeding Practices

The infant feeding practices we assessed and the rationales for examining them are described below.

Timing of Complementary Feeding

1–2. *Introduce solid foods when the infant is developmentally ready, generally between 4 and 6 months of age.*^{7,11} Using data from the food-frequency charts, we classified infants as having been fed solid foods before 4 months if their mother indicated that she fed them a solid food at any time before they were 15 weeks old. We excluded infants with missing food-frequency data for month 2 or 3. Similarly, we used food-frequency data to estimate the per-

centage of infants who were not fed solid foods until after 6 months and excluded infants with missing data for either month 5 or 6.

3. *Introduce new foods slowly enough so that any allergic reaction or intolerance to the food can be identified.* The American Academy of Pediatrics⁷ and the American Dietetic Association¹¹ recommend that no more than 3 new foods be introduced per week. Starting at month 5, survey participants were asked, "About how often did you introduce new foods (such as a specific type of cereal, fruit, vegetable, or meat) to your baby over the past 2 weeks?" The 7 response options ranged from "no new foods in the past 2 weeks" to "more than 1 new food every day." We assessed the percentage of respondents who introduced >3 new foods per week in any month from 5 through 10.5.
4. *Do not feed juice before 6 months because of the risk that juice will displace breast milk or formula, resulting in reduced intake of protein, fat, and certain vitamins and minerals.*⁸ If respondents reported feeding juice or juice drinks to their infant at any time during months 1 through 5, we considered them to have introduced juice before 6 months. We excluded respondents with missing food-frequency data for month 4 or 5.
5. *Do not give cow's milk before 12 months, because it may adversely affect the infant's iron status.*¹² If respondents reported feeding their infant cow's milk at any time during months 2 through 10.5, we considered them to have introduced cow's milk before 12 months. We excluded infants with missing food-frequency data in month 9 or 10.5.

How Infants Are Fed

6. *Respond early and appropriately to hunger cues; children usually eat at least 5 times per day.*^{11,13} In questionnaires for months 6 through 12, the mothers were asked: "In the past 7 days, how many times was your baby usually fed in a 24-hour period?" Options were 1 or 2, 3, 4, 5, 6, 7, or ≥ 8 . If respondents reported feeding their infant <5 times per day on any of the questionnaires, we considered the feeding to have been too infrequent.
7. *Premasticating (chewing) food for infants is a practice not included in professional guidance for parents in the United States.* Because illnesses can be transferred by this practice,¹⁴ it holds some risk to the infant. Mothers were asked beginning in month 4 whether they chewed food and then gave it to the infant to eat. Those who responded "yes" to this question in any month were considered to have engaged in this practice.

Diet Quality

8. *Offer fruits and vegetables to infants daily beginning at 6 to 8 months.*⁷ Mothers were coded as feeding <1 daily serving of either a fruit or a vegetable if

they so reported on any questionnaire in month 9, 10.5, or 12.

9. *Limit the amount of salt added to foods fed to infants,⁷ because the amount of sodium naturally occurring in foods is sufficient for them.*¹⁵ Use of salt in infants' food was assessed beginning in month 9. Mothers' responses were coded as "used salt" if they reported this practice in month 9, 10.5, or 12. Infants with missing food-frequency data on the month 10.5 or 12 questionnaire were excluded from the analysis.
10. *When salt is used for the infant's food, use iodized salt because it is nearly the only food source for this nutrient other than human milk, infant formula, and fish.*¹¹ For the analysis of noniodized salt use, we limited the sample to mothers who added salt to their infant's food and categorized them as using noniodized salt if they reported doing so in any of the 3 months (9, 10.5, or 12) that the question was asked.
11. *Do not give reduced-fat cow's milk to children younger than 2 years, because children at this age should not have a fat-restricted diet.*¹² Mothers who fed cow's milk to their infants were asked what type or types of cow's milk they gave the infant in the previous 7 days: whole milk, reduced-fat (2%) milk, low-fat (1%) milk, skim (nonfat) milk, whole evaporated milk, or skim evaporated milk. We used only the month 12 data for this practice, because cow's milk is not recommended before this age. Mothers were coded as feeding non-whole milk if they marked 1 of the reduced-fat options. Only mothers who fed their infant cow's milk were included in the analysis.
- 12–14. *Limit infants' consumption of low-nutrient foods.*⁷ The Start Healthy feeding guidelines indicate that infants have little room for low-nutrient foods if they are to meet their nutritional needs without consuming excess calories.¹⁶ Although the guidelines do not specifically address restaurant-food consumption, other research has found that restaurant foods usually have added salt and are often of lower nutritional quality than foods prepared at home.^{17,18} Thus, frequent consumption of food from restaurants can be used as an indicator of a diet likely to include low-nutrient foods. In month 10.5 only, the mothers were asked, "In the past 7 days, how many times did your baby eat restaurant food at a restaurant? Include food eaten in any type of restaurant, such as a fast food, cafeteria, or table service restaurant." They were also asked, "In the past 7 days, how many times did your baby eat food delivered or conducted from a restaurant? Include food from any restaurant, such as a take-out, drive-through, or delivery restaurant." Options ranged from 0 to ≥ 8 . We assessed the percentage of infants who ate food in a restaurant at least once in the previous week, the

percentage who ate carry-out food at least once in the previous week, and the percentage who ate restaurant food of either type at least twice in the previous week.

In addition to assessing the overall prevalence of each of these feeding practices among IFPS II participants, we used χ^2 tests to determine if the prevalence of each practice was associated with the education level of the mothers, which we categorized as high school or less, some college, or college graduate.

Use of Commercial Baby Foods

Another aspect of complementary feeding practices we examined was infants' consumption of commercial baby foods and of foods fortified at levels developed for persons older than 2 years, which we analyzed according to infant age. In the month 5 through month 12 questionnaires, the mothers were asked, "For each food category listed below, about how much of the food fed to your baby over the past 7 days was commercial baby food?" (A definition and examples were given.) In another item on these questionnaires, mothers were asked whether they had fed their infants juice fortified with calcium; those who responded positively were considered to have fed their infant foods that were fortified at adult levels.

Statistical Analyses

SAS software (SAS Institute, Inc, Cary, NC) was used for all analyses. Procedures used included frequencies and cross tabulations with χ^2 tests.

RESULTS

Timing of Complementary Feeding

As shown in Table 1, 21% of the mothers began feeding their infants solid foods before they were 4 months old, and 7% waited until they were older than 6 months. Mothers who had an educational level high school or less were most likely to introduce solids before infant age 4 months, but introducing solid foods after 6 months was not related to education.

Although most mothers introduced new foods at least a few days apart as recommended, ~10% of the mothers introduced new foods faster than recommended when their infants were 5 months old, 16% did so when their infants were 9 months old, and 13% did so when they were 10.5 months old (data not shown). On at least 1 questionnaire while their infants were aged 5 to 10.5 months, 29% of the mothers indicated that they introduced new foods too rapidly. This practice was not related to education (Table 1).

More than 1 in 5 mothers fed their infants juice before 6 months, and 26% introduced cow's milk before 10.5 months. Both of these practices were more likely to be practiced by mothers with a high school education or less than among those who had more education (Table 1).

How Infants Are Fed

Most infants were fed at least 5 times per day from the age of 6 to 12 months; the percentage fed <5 times per

day increased from 6% in month 6 to 14% in month 12. Infants were fed a median of 7 times per day through the 10.5-month survey and a median of 6 times per day at the 12-month survey (data not shown). Eighteen percent of the mothers reported feeding their infant <5 times per day in at least 1 of these surveys; their likelihood of doing so was not related to education (Table 1).

Fourteen percent of the mothers reported prechewing food for their infant, and the likelihood of their doing so was inversely related to education. Nearly 20% of the mothers with a high school education or less said that they sometimes chewed up food and then gave it to the infant to eat, compared with 10% of college graduates (Table 1).

Diet Quality

Approximately 15% of the mothers reported feeding their infants <1 daily serving of either a fruit or a vegetable at 9, 10.5, or 12 months. This practice was inversely related to education. Approximately 51% added salt to their infant's food at month 9, 10.5, or 12, and 38% of those who added salt sometimes or always used noniodized salt. Neither salt-feeding pattern was related to education. At 12 months, 20% of the mothers fed their infants cow's milk with a reduced-fat content, a practice inversely related to education (Table 1).

Among infants aged 10.5 months, 48% had eaten restaurant food at a restaurant at least once in the previous 7 days, 22% had eaten carry-out food from a restaurant at least once, and 28% had eaten either type of restaurant food at least twice. Infants' consumption of carry-out food and their overall consumption of restaurant food were both inversely related to maternal education, but their consumption of food in a restaurant was not (Table 1).

The prevalence of 8 of the 14 unhealthful infant feeding practices listed in Table 1 differed significantly according to the mother's education, with mothers having a high school education or less being most likely to engage in the practices and those who were college graduates being least likely to do so.

Use of Commercial Baby Foods

At months 6 through 9, a majority of the mothers reported that all or most fruits and vegetables fed to their infant were via commercial baby food, whereas more than half used commercial baby food meats or combination dinners only in month 9. By the end of the first year, the majority of the mothers indicated that all or most of the food in each food group was not commercial baby food. Less than 42% of the infants were fed primarily commercial baby juice at peak usage (9 months), and by 12 months, only 25% were. Less than 6% of the infants were fed juice fortified with calcium through the age of 7 months, but by month 12, 25% were (Table 2).

DISCUSSION

Our findings suggest that a minority of mothers followed unhealthful patterns of complementary feeding, but the mothers with less education were more likely than higher-educated mothers to do so. A somewhat consistent per-

centage of mothers (20%–29%) failed to follow 4 of the timing recommendations for complementary feeding: they introduced solid foods before 4 months, introduced new foods too rapidly, fed juice before 6 months, and introduced cow's milk before 12 months. All of these practices except introducing new foods too rapidly were more common among lower-educated mothers than higher-educated mothers. Seven percent of the mothers introduced solid food after 6 months, and this practice was not related to education. The AAP revised the recommendation not to feed nonwhole cow's milk to children <2 years old after these data were collected, and it now includes some instances when use of reduced fat milk is considered appropriate.¹⁹ The results reported here can serve as a measure of the practice just before the recommendation was changed.

Less than 20% of the mothers fed their infants <5 times per day at ages 6 through 12 months, and ~14% premeasured food for their infant. The latter practice but not the former was related to education. Rates of nonadherence to infant feeding practices indicating aspects of diet quality varied greatly. Only ~15% of the mothers did not feed their infant at least 1 serving per day of either fruits or vegetables in at least 1 month at ages 9 through 12 months; approximately half of them added salt to their infant's food, of whom more than one third used noniodized salt at least sometimes; 20% fed nonwhole cow's milk to their 1-year-old infant; and 28% fed their infant restaurant food at least twice in the week during which this practice was measured, with nearly half of the infants eating in a restaurant at least once in the week.

Overall, we found a significant inverse association

between maternal education and the prevalence of 8 of the 14 unhealthful infant feeding practices we examined. It may be that information about the transition to complementary foods is conveyed in ways that are less accessible to lower-education mothers, such as in written materials, whether in pamphlets from a doctor, books, or Web materials. Nonadherence to other maternal and child health recommendations has also been found to be inversely associated with socioeconomic status,²⁰ of which education is a key indicator, which suggests that extra effort is needed to reach this population.

The Feeding Infants and Toddlers Study (FITS) conducted in 2002²⁰ examined a number of the practices described in this analysis. Precise comparisons between our results and those from the FITS are not possible, because the methods of collecting dietary intake data in the 2 studies were different and because the FITS sample was more representative of the US population than the IFPS II. The FITS used 24-hour recall for 1 or 2 days and a cross-sectional sample beginning with 4-month-old infants, whereas the IFPS II used food frequency over a 7-day period and obtained data nearly monthly from the same infants from birth through 12 months. The longitudinal design of the IFPS II allowed us to examine feeding practices over several months to identify specific feeding practices, whereas the FITS results were based on 1 measurement. If results from the 2 studies are consistent, foods less likely to be fed daily would show lower frequency in the 24-hour versus the 7-day measure, but those fed daily should be approximately the same. In addition, feeding practices that are more frequent among lower-educated mothers would tend to

TABLE 2 Percentage of Infants Who Received Commercially Prepared Baby Foods (According to Food Type and Infants' Age) and Percentage of Infants Who Received Juice Fortified With Calcium (According to Infants' Age)

Type of Food	Age, mo ^a					
	5 (n = 2100) ^b	6 (n = 2023)	7.5 (n = 1978)	9 (n = 1902)	10.5 (n = 1773)	12 (n = 1765)
Fruit						
All or mostly commercial baby food	30.0	59.3	75.0	68.2	49.6	22.2
Some or no commercial baby food	4.9	9.9	15.7	27.8	48.0	73.7
Not fed	65.1	30.8	9.3	4.0	2.4	4.1
Vegetables						
All or mostly commercial baby food	30.0	62.8	77.3	69.2	49.1	22.8
Some or no commercial baby food	4.0	8.7	14.6	27.1	48.4	73.4
Not fed	66.0	28.5	8.1	3.7	2.5	3.8
Meat, chicken, combination dinners						
All or mostly commercial baby food	4.2	17.0	39.5	54.1	44.2	22.6
Some or no commercial baby food	1.3	3.2	7.1	21.0	42.9	68.7
Not fed	94.5	79.8	53.4	24.9	12.9	8.7
Fruit and vegetable juice						
All or mostly commercial baby food	13.4	24.7	38.3	41.5	38.0	24.9
Some or no commercial baby food	3.9	7.3	11.3	19.4	29.6	49.7
Not fed	82.7	68.0	50.4	39.1	32.4	25.4
Juice fortified with calcium						
Yes	2.0	2.9	5.8	10.0	14.7	26.0
No	2.5	5.2	7.2	10.2	12.3	15.8
Not sure	2.0	3.7	7.1	11.2	15.6	18.8
Not fed juice or fed only baby juice	93.5	88.2	80.0	68.5	57.4	39.4

^a These questions were not asked in earlier months.

^b Numbers vary slightly because of missing data.

have lower prevalence in the IFPS II than in the FITS, because lower-educated mothers were underrepresented in the IFPS II.

IFPS II and FITS results were consistent on all of the unhealthy feeding practices that could be compared: the introduction of solid foods before 4 months, the introduction of solid foods after 6 months,²² the feeding of juice or juice drinks before 6 months,²³ the feeding of cow's milk before 12 months,²² no daily feeding of fruits or vegetables,²³ and the feeding of food from a restaurant.¹⁸ Results from the FITS also showed an identical median number of times that the infant was fed daily¹³ and a similar pattern of moving away from baby foods to table foods by 12 months.²³ The 2 studies also both revealed that lower-educated mothers were more likely to engage in unhealthy infant feeding practices.²⁴

As infants' diets change from mostly baby foods that are specially formulated to meet their high nutritional needs to mostly table foods, parents may need to take care that their infant's diet does not become reduced in variety or nutritional value. The IFPS II did not ask about specific fruits and vegetables fed to infants, but the FITS showed that as infants were more frequently fed non-baby-food vegetables, their consumption of deep-yellow vegetables, such as carrots, decreased and their consumption of starchy vegetables, such as white potatoes, increased.²³ The FITS also showed that infants aged 9 to 11 months who consumed a greater percentage of calories from table foods, compared with those who consumed a smaller percentage of calories from table foods, had increased calorie and sodium intake and decreased intake of iron and vitamins A and C.²⁵

Premastication of food for infants has been understudied. Research conducted ~20 years ago in Omaha, Nebraska, with a nonrandom sample of black mothers and grandmothers caring for young children showed that 65% premasticated food for the infant, and 90% said they knew of the practice.²⁶ Our estimate from a nationally distributed sample showed a much lower overall prevalence of this practice (14%), and although the practice was inversely related to education, 10% of the college graduates in the sample engaged in it. We found only 1 report in the literature of disease transmittal as the result of premastication,¹⁴ suggesting either that disease is not often transmitted through premasticated food or that practitioners do not ask about premastication as a possible mechanism of transmission for diseases that they observe among infants.

The strengths of this study include the IFPS II's large sample size of infants at each age, its frequent collection of dietary intake data over the infants' entire first year of life, and its examination of a large number of practices related to infant feeding in addition to dietary intake, which give the data a richness not found in most infant diet research.

Study limitations include the IFPS II's exclusion of non-English speakers and its underrepresentation of mothers from minority groups and those of lower socioeconomic status, its collection of data on infants' consumption of broad food groups rather than individual foods, and its lack of data on serving sizes. Together,

these characteristics of the IFPS II limited the extent to which our results can be generalized to the US population.

CONCLUSIONS

Our results showed that a noteworthy percentage of US mothers engaged in unhealthy infant feeding practices that may cause their infants to form dietary patterns that are of concern in early childhood and possibly throughout their lives. We also found that lower-educated mothers were more likely to engage in the unhealthy infant feeding practices, indicating that nutrition and feeding guidance for mothers of infants needs to be especially targeted to lower-educated mothers.

ACKNOWLEDGMENTS

This study was funded by the Food and Drug Administration, Centers for Disease Control and Prevention, Office of Women's Health, National Institutes of Health, and Maternal and Child Health Bureau in the US Department of Health and Human Services.

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