

Current Research

Maternal and Child Characteristics Associated with Infant and Toddler Feeding Practices

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ABSTRACT

Objective To describe maternal/child characteristics associated with important practices of feeding US infants and toddlers aged 4 to 24 months.

Design Cross-sectional analysis of data collected in the 2002 Feeding Infants and Toddlers Study. Maternal/child characteristics associated with compliance to American Academy of Pediatrics feeding guidelines, and maternal/child characteristics associated with specific feeding patterns were assessed.

Subjects A national random sample of mothers (n=2,515) whose infants and toddlers aged 4 to 24 months made up the Feeding Infants and Toddlers Study cohort.

Statistical analysis Student *t* tests were used to compare the means and standard errors and were considered significant if $P < .05$. To predict if the mother/child met a particular recommendation, logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals.

Results Having a college education was the maternal characteristic associated with the largest number of positive child feeding behaviors. Mothers with a college education were significantly more likely than mothers without a college education to initiate breastfeeding and breastfeed the child to age 6 and 12 months (OR 2.8, 3.2, and 3.9, respectively). College-educated mothers were significantly more likely to comply with the American Academy of Pediatrics juice and complementary feeding recommendations (OR 1.4 and 2.0). In addition, infants and toddlers whose mother had a college education were more likely to consume fruit and less likely to consume sweet-

ened beverages and desserts or candy. Ever breastfeeding the sample child, living in the western region of the United States, and being married and older were also associated with multiple positive practices. The child being in day care was associated with decreased duration of breastfeeding at age 6 and 12 months as well as with consumption of salty snacks.

Conclusions Initiatives to improve infant and toddler feeding practices should focus on assisting mothers who have less than a college education, who are unmarried, whose child is in day care, or who are enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children.

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Infant and toddler feeding practices are significantly associated with both maternal and child characteristics (1-10). Studies from the United States and other western industrialized nations have reported breastfeeding initiation to be positively associated with maternal education, income, and being married; smoking, African American race, and very young maternal age have been found to be negatively associated (1,2,6-10). Duration of breastfeeding has been positively associated with low birth weight and mother being married (2-5,8,9). Maternal and child characteristics associated with other infant and toddler feeding practices have not been well studied in representative samples of US mothers and children, but are important in designing appropriate public health initiatives to improve child feeding practices.

The 2002 Feeding Infants and Toddlers Study (FITS) evaluated improvements needed to meet infant feeding recommendations (11). The American Academy of Pediatrics (AAP) recommends breastfeeding exclusively for approximately the first 6 months with continued breastfeeding until age 12 months (12); FITS found a breastfeeding initiation rate of 76%, with 30% at age 6 months and 16% at age 12 months (11). AAP recommends iron-fortified infant formula as the appropriate substitute for breastfeeding during the first year (13); of FITS infants fed formula, 90% was iron fortified (11). AAP guidelines recommend introduction of solid foods when the infant is developmentally ready, typically in the 4- to 6-month age range (14); for one third of FITS infants the timing of introduction of complementary feeding was inappropriate (11). AAP guidelines recommend juices be introduced in the diet of infants after age 6 months; that if introduced, 100% juices be used; and juice be limited to 4 to 6 oz daily (15); FITS found one quarter of infants were given juice before age 6 months (11). AAP recommends delaying the introduction of cow's milk until age 1 year and use of

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whole cow's milk during the second year of life (16); one third of FITS infants were introduced to cow's milk before age 12 months and 38% of FITS infants and toddlers were fed low-fat milk before age 24 months (11). In addition, potentially problematic food consumption patterns reported in FITS included low fruit and vegetable consumption and inclusion of salty snacks, desserts, and sweetened beverages (17). FITS also reported that, using the caregiver's definition of "picky eater," 50% of toddlers were perceived to be picky eaters by their caregiver (18). Fewer than one in 10 caregivers offered foods the advised 8 to 10 times before determining the child did not like that food (18).

The purpose of this article is to describe the maternal/child characteristics associated with compliance to AAP infant and toddler feeding recommendations, as well as with certain food consumption patterns previously identified as potentially problematic (17) in the FITS cohort.

METHODS

Details of the study design and methods for FITS have been previously reported (19,20). All survey planning, data collection, analysis, and reporting for FITS was carried out by researchers at Mathematica Policy Research, Inc, in Princeton, NJ, and Washington, DC. All data collection instruments and procedures were reviewed and approved by Mathematica's Institutional Review Board compliance officer and quality assurance system. FITS was a cross-sectional study of 3,022 infants and toddlers who were randomly selected from Experian's February to May 2002 New Parent Database, (Experian, Lincoln, NE), which contains information on 3.1 million families with newborns in the United States. Parents and caregivers of infants and toddlers aged 4 to 24 months were recruited and interviewed by telephone. Data collection consisted of up to three separate interviews, all conducted by telephone from March to July 2002. A household survey was conducted with the parent or primary caregiver (usually the mother) to establish eligibility, recruit participation, and collect information on sociodemographic characteristics (eg, household composition and income and the parent's age, education level, marital status, and employment status). To minimize respondent burden and gain/retain participation, most telephone surveys do not ask respondents to report their specific annual household income. Rather, they ask about income in categories. In FITS, income data were collected and recorded in several categories (19). This results in the need to use the median value of the category for all cases in that category to calculate mean household income. An interviewer called the household again to conduct the 24-hour dietary recall and to ask additional questions on infant feeding practices and growth and developmental milestones. Respondents were mailed an instructional booklet, which included portion size aids, before the interview. Although a second 24-hour recall was obtained for a random subsample of respondents to allow for the estimation of usual intake distributions (19), the data presented in this article are based on the single 24-hour recall completed with all study subjects. Foods were categorized according to the food group scheme described by Fox and colleagues (17). Foods classified as salty snacks included potato

chips, popcorn, cheese curls/puffs, tortilla chips, corn chips, and other types of chips and salty snacks.

For this report, only a caregiver who was a mother of a FITS infant or toddler was included in the analysis ($n=2,515$). Maternal/child characteristics were assessed for association with having met the AAP recommendation of breastfeeding initiation; breastfeeding to 6 months; breastfeeding to 12 months; whether infant formula used is iron fortified; whole cow's milk begun 12 months or after; low-fat milk not begun before 24 months; juice begun 6 months or after/must be 100% juice/gives less than 6 oz a day; and complementary feeding begun 4 months or after. Maternal/child characteristics assessed for association with the infant or toddler eating patterns were based on 24-hour recall and interview data, which included: child consumed no fruit, child consumed no vegetable, mother considers child to be picky eater, mother offered foods fewer than three times before deciding the child did not like it; child consumed salty snacks; child consumed sweetened beverages (eg, carbonated soda and fruit drinks); and child consumed desserts and candy. The number of mothers/children included in each analysis varied because it included only those whose infant or toddler had reached the age where the specific feeding practice applied. For example, the full sample of mothers was included in assessing initiation of breastfeeding, but only those mothers whose infants were aged 6 months or older were included in the analysis for duration of breastfeeding to 6 months.

SUDAAN (version 9.0, 2004, Research Triangle Institute, Research Triangle Park, NC) was used to calculate means and standard errors, taking into account the complex design and sampling weights. Statistical Analysis Software (version 8.2, 2001, SAS Institute, Inc, Cary, NC), using the Bonferroni adjustment for *t* tests to compare the means and standard errors at .05 and .01 levels of probability (21). To predict if the mother/child met an AAP recommendation or if the child had a specific eating pattern, logistic regression was used. Whether or not the recommendation was met or whether or not the child had a specific eating pattern was the dependent variable and the independent variables were: mother's age, marital status, education, work status, race/ethnicity; household income, region of residence, and urbanicity; number of children younger than age 18 years in the household; child's sex; child receiving Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) assistance; child as first born; child is in day care; child's birth weight; child has a reported allergy; and child has a long-term medical problem. A high school education/some college, non-Hispanic white race/ethnicity, and northeast region were used as the reference group for each of these maternal characteristics, respectively. High school/some college were grouped together and compared with the extremes of less than high school or completed college education. For most independent variables, data were missing for fewer than 5% of the observations. To avoid losing the observations with missing data, we imputed the weighted mean value of the observations with valid data. For the household income variable, data were missing for almost 15% of the observations. As with most survey experience, there is higher item nonresponse for income data compared with other sociodemographic data.

We accounted for these limitations as best we could, by including a missing variable for income in the regressions and by treating income as a continuous variable (although it was constructed from categorical data). In addition to imputing the weighted mean, we also included a binary variable that indicated if this variable was missing. The standard errors were computed using SUDAAN and an independent variable was considered significant if $P < .05$. Odds ratios (ORs) and their 95% confidence intervals were calculated. The same approach was used for all regressions controlling for the same factors.

RESULTS

Sociodemographic characteristics of FITS mothers/children ($n=2,515$) are shown in Table 1. Mean maternal age was 29 years and mean annual household income was \$53,875. The majority of mothers were non-Hispanic white (83%), married (82%), and 40% had completed college. Nearly half lived in an urban area. A little more than half of mothers were working (55%) and 45% of the sampled children were in day care.

Tables 2 through 5 show maternal/child characteristics associated with following AAP infant feeding recommendations (12-16). Tables 2 and 3 show statistical comparison for group differences. Tables 4 and 5 show the results of logistic regression, which assess each maternal/child characteristic while controlling for others. Results of regression analysis found breastfeeding initiation was positively associated with having a college education (OR 2.8), living in the western region of the United States (OR 3.4) ($P < .01$) and being married (OR 1.7; $P < .05$); it was negatively associated with having less than a high school education (OR 0.4, $P < .01$). Breastfeeding duration to age 6 months was positively associated with being married (OR 2.0), having a college education (OR 3.2), living in the western region of the United States (OR 1.9), birth weight (OR 1.5) ($P < .01$), and Hispanic (OR 1.6) or non-Hispanic African American ethnicity (OR 2.1) ($P < .05$); it was negatively associated with the child being in day care (OR 0.6; $P < .01$) or receiving WIC (OR 0.6, $P < .05$). Continued breastfeeding until age 12 months was positively associated with a college education (OR 3.9; $P < .01$) and birth weight (OR 1.5; $P < .05$) and negatively associated with the child being in day care (OR 0.4; $P < .01$). Use of iron-fortified formula was positively associated with receiving WIC (OR 4.3) and the child having a long-term medical problem (OR 44.8) ($P < .01$); it was negatively associated with being married (OR 0.1) and having additional children younger than age 18 years in the household (OR 0.6) ($P < .05$).

Mothers living in the western region of the United States (OR 2.8), mothers who had ever breastfed the child (OR 2.0) ($P < .01$) and mothers whose child had a long-term medical problem (OR 6.9; $P < .05$) were significantly more likely to delay introduction of cow's milk until age 12 months. Not introducing reduced-fat milk was positively associated with urban mothers (OR 1.6; $P < .05$) and negatively associated with living in the Midwest (OR 0.2) and West (OR 0.4) ($P < .01$ and $P < .05$, respectively). Meeting the AAP juice recommendation was positively associated with having a college education (OR 1.4) and negatively associated with birth weight (OR 0.8) ($P < .05$). Appropriate timing of introducing complementary foods

Table 1. Maternal and child characteristics of participants in the 2002 Feeding Infants and Toddlers Study ($n=2,515$)

Characteristic	Sample members
	<i>mean ± SE^a</i>
Age of mother (y)	29.9 ± 0.16
Income (\$)	53,875 ± 751
No. of children in household younger than 18 y	1.9 ± 0.03
Child's birth weight (kg)	3.4 ± 0.01
	%
Married	81.9 ± 1.0
11th grade education or less Completed college	6.9 ± 0.7
Mother currently working	40.0 ± 1.3
Mother's race/ethnicity	54.9 ± 1.3
Hispanic	9.7 ± 0.8
Non-Hispanic African American	7.3 ± 0.6
Non-Hispanic white	82.9 ± 0.8
Income	
130% or less than FPL ^b	10.5 ± 0.9
185% or less than FPL ^b	23.6 ± 1.2
Region of residence	
Northeast	18.6 ± 1.0
Midwest	26.6 ± 1.2
South	34.8 ± 1.2
West	20.1 ± 1.1
Urban ^c	46.4 ± 1.3
Rural ^c	18.6 ± 1.0
Child is female	47.4 ± 1.3
Child receiving WIC ^d	24.9 ± 1.1
Child is first born	56.4 ± 1.3
Child ever breastfed	77.0 ± 1.1
Child is in day care	45.0 ± 1.3
Child is Hispanic	12.8 ± 0.9
Child is non-Hispanic	
African American	7.1 ± 0.6
Child is non-Hispanic white	80.1 ± 0.9
Child has an allergy	5.5 ± 0.7
Child has a long-term medical problem	2.3 ± 0.3

^aSE=standard error.

^bFPL=federal poverty level. Poverty status is calculated using annual household income and family size in comparison to federal poverty thresholds for 2002. In 2002, the poverty threshold for a family of four was \$18,392.

^cRemaining 35% are suburban.

^dWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

was positively associated with college education (OR 2.0), living in the western region of the United States (OR 2.1), ever breastfed (OR 1.7) ($P < .01$), maternal age (OR 1.05) child being first born (OR 1.4), and negatively associated with the child having a long-term medical problem (OR 0.4) ($P < .05$).

Tables 6 through 9 show maternal/child characteristics associated with infant and toddler food consumption patterns. Tables 6 and 7 show statistical comparison for group differences. Tables 8 and 9 show the results of logistic regression. Mothers who had either a college education (OR 0.6) or less than an 11th grade education (OR 0.5), and ever breastfed their child (OR

Table 2. Maternal/child characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with following American Academy of Pediatrics breastfeeding and infant formula recommendations

Characteristic	Initiated Breastfeeding		Breastfeeding at 6 Months		Breastfeeding at 12 Months		Uses Iron-Fortified Infant Formula (Among Formula Users)	
	Met guidelines (n=1,964)	Did not meet guidelines (n=549)	Met guidelines (n=734)	Did not meet guidelines (n=1,260)	Met guidelines (n=145)	Did not meet guidelines (n=689)	Met guidelines (n=1,278)	Did not meet guidelines (n=76)
Age of mother (y)	30.2**	28.9	31.3**	29.4	32**	30.2	29.1	30.9
Income (\$)	56,374**	45,584	59,885**	50,332	61,014**	53,103	52,840	52,111
No. of children in household younger than 18 y	1.8	1.9	1.9	1.8	2.1	1.8	1.8	2.2
Child birth weight (kg)	3.4	3.4	3.5*	3.4	3.5	3.4	3.4	3.3
	← % →							
Married	85.5**	69.8	91.9**	76.7	93**	80.5	77.0**	94.0
11th grade education or less	4.8**	14.0	2.9**	8.9	4.8	6.9	8.3	7.5
Completed college	46.2**	19.7	58.6**	29.4	66.7**	36.1	35.5	38.9
Mother currently working	53.8	58.9	50.6**	59.5	44.7	60.9	53.9	53.3
Mother's race/ethnicity								
Hispanic	10.4	7.4	10.3	9.4	12.5**	9.1	9.6	13.1
Non-Hispanic African American	6.6 ^a	9.8	6.8	7.6	4.1	7.0	8.9**	2.7
Non-Hispanic white	83	82.7	82.8	83	83.3	83.9	81.5 ^a	84.2
Income								
130% or less than FPL ^b	8.2**	17.8	5.5**	13.7	3.5**	10.8	12.4	10.6
185% or less than FPL ^b	20.1**	35.2	15.1**	28.1	13.2 ^a	24.5	26*	16.2
Region of residence								
Northeast	17.9	21	17.7	19	16.8	17.9	20.2*	11.1
Midwest	25.9	28.7	26.3	27.1	26.4	27.1	25.5	25.2
South	33*	40.8	31 ^a	36.2	28.6	36.2	35.6	39.3
West	23.3**	9.4	25**	17.7	28.2 ^a	18.8	18.7	24.5
Urban	49.7**	35.1	52.4**	42.7	59.9**	42.3	47.7	39.1
Rural	16.3**	26.2	13.7**	21.2	10.3**	19.6	19	22.8
Child is female	48	45.5	49.6	45.9	54.7 ^a	45.1	48	57.2
Child received WIC ^c	21.6**	36.2	14**	30	14.2*	22	35.9**	17.8
Child is first born	57.7 ^a	52.2	53.9	58.7	51.1	59.1	57.7	50.8
Child is in day care	43.4*	50.9	39**	50.9	31.0**	52.9	44.4	39.4
Child is Hispanic	13.9*	8.9	13.7	11.8	16.0	11.8	13.5	12.8
Child is non-Hispanic								
African American	6.1**	10.7	6.6	7.5	3.8 ^a	6.8	8.8*	4
Child is non-Hispanic white	80	80.5	79.7	80.7	80.2	81.4	77.8	83.2
Child has an allergy	4.9 ^a	7.6	4.7	6.2	6.7	5.8	6 ^a	2.5
Child has a long-term medical problem	2.3	2.3	2.4*	2.1	3.1	1.8	4**	0

^a<.10 Borderline significance.

^bFPL=federal poverty level. Poverty status is calculated using annual household income and family size in comparison to federal poverty thresholds for 2002. In 2002, the poverty threshold for a family of four was \$18,392.

^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

*Significantly different from those who did not meet the guidelines at $P<.05$.

**Significantly different from those who did not meet the guidelines at $P<.01$.

0.6) were less likely to have children who consumed no fruit ($P<.05$). No maternal/child characteristics were significantly different for having a child who consumed no vegetables. Child receiving WIC was negatively associated with child being perceived by the mother as a picky eater (OR 0.6; $P<.05$). Mother offering foods

fewer than three times was positively associated with less than a high school education (OR 2.5), child being female (OR 1.5) ($P<.05$), and non-Hispanic African American race/ethnicity (OR 3.2; $P<.01$). Child being in day care was positively associated with consuming salty snacks (OR 1.7; $P<.05$). Mother completing col-

Table 3. Maternal/child characteristics of participants in 2002 Feeding Infants and Toddlers Study (n=2,515) associated with following American Academy of Pediatrics infant feeding guidelines

Characteristic	Delayed Introduction of Cow's Milk Until 12 Months		Did Not Introduce No-Fat or Reduced-Fat Milk		Met Juice Consumption Recommendation ^a		Delayed Complementary Feeding Until 4 Months	
	Met guidelines (n=639)	Did not meet guidelines (n=186)	Met guidelines (n=638)	Did not meet guidelines (n=196)	Met guidelines (n=2,013)	Did not meet guidelines (n=502)	Met guidelines (n=1,843)	Did not meet guidelines (n=655)
Age of mother (y)	30.7*	29.3	30.6	30.1	30.2*	29.3	30.5**	28.1
Income (\$)	55,898**	49,105	55,038	52,548	56,225**	47,658	55,884**	47,952
No. of children in household younger than 18 y	1.8	1.9	1.8*	2.1	1.9	1.9	1.9	1.8
Child birth weight (kg)	3.4	3.4	3.4	3.5	3.4	3.4	3.4	3.4
	← % →							
Married	83.2	79.3	84.8 ^b	76.7	84.5**	75.2	85.3**	71.7
11th grade education or less	5.7	10.0	7.3	4.6	5.5*	10.6	5.7**	10.5
Completed college	42.9 ^b	34.1	43.5 ^b	34.7	44.1**	29.3	45.9**	23.2
Mother currently working	59.1	58.2	59.4	55.2	53.7	57.9	53.5	58.2
Mother's race/ethnicity								
Hispanic	9.6	10.1	9.0	11.3	9.1	11.4	10.1	8.5
Non-Hispanic African American	7.3	4.3	6.2	7.5	7.3	7.5	6.1**	10.9
Non-Hispanic white	83.2	85.6	84.8	81.2	83.6	81.1	83.7	80.6
Income								
130% or less than FPL ^c	8.8	12.7	10.0	8.6	7.8**	17.6	9.0*	14.9
185% or less than FPL ^c	21.2	27.1	21.6	25.5	20.8**	30.9	21.6**	29.7
Region of residence								
Northeast	16.4	20.8	21.6**	7.6	19.1	17.3	18.3	18.1
Midwest	25.3*	34.7	21.2**	42.1	25.9	28.3	27.5	24.8
South	35.9	33.1	36.8	30.1	32.8*	40.1	31.3**	45.3
West	22.5**	11.4	20.4	20.2	22.3**	14.3	22.9**	11.8
Urban	44.9	45.5	48.4*	36.3	49.3**	38.8	50**	37.3
Rural	18.3	18.5	17.1	20.9	16.5**	24.1	16.2**	25.5
Child is female	48.4	41.1	48.5	41.9	47.5	47	48.4	44.3
Child received WIC ^d	20.5	22.8	19.8	23.3	21.7**	33.6	22.3**	33
Child is first born	59.2	54.2	61.3**	48.7	56.8	55.3	56.9	54.2
Child ever breastfed	78.9**	62.5	76.5	72.0	80.1**	68.9	81.4**	64.4
Child is in day care	50.6	47.4	48.5	51.4	43.9	48	43.9	47.5
Child is Hispanic	12.8	11.5	11.6	14.6	12.1	14.6	12.7	12.1
Child is non-Hispanic								
African American	6.5	4.9	6.3	6.3	6.8	7.9	5.7**	10.9
Child is non-Hispanic white	80.6	83.6	82.0	79.1	81.1	77.5	81.6 ^b	77
Child has an allergy	6.3	3.5	5.4	7.4	5.1	6.7	5.3	6.3
Child has a long-term medical problem	2.5**	0.3	2.0	2.0	2.5	1.7	1.7 ^b	3.4

^aIntroduce in the diet of infants after age 6 mo; if introduced, 100% juice should be used, and juice should be limited to 6 oz/d (15).

^b<.10 Borderline significance.

^cFPL=federal poverty level. Poverty status is calculated using annual household income and family size in comparison to federal poverty thresholds for 2002. In 2002, the poverty threshold for a family of four was \$18,392.

^dWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

*Significantly different from those who did not meet guidelines at $P<.05$.

**Significantly different from those who did not meet guidelines at $P<.01$.

lege (OR 0.6; $P<.01$), ever breastfeeding the child (OR 0.6, $P<.01$), and child being first born (OR 0.6) ($P<.05$) were negatively associated with consuming sweetened

beverages. College completion (OR 0.6; $P<.05$) and urban living were negatively associated (OR 0.5; $P<.01$) with consumption of desserts or snacks.

Table 4. Maternal characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with following American Academy of Pediatrics breastfeeding and infant formula use; results of multiple regression

Characteristic	Initiated Breastfeeding			Breastfeeding at 6 Months			Breastfeeding at 12 Months			Uses Iron-Fortified Infant Formula (Among Formula Users)		
	P value	OR ^a	95% CI ^b	P value	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI
Age of mother (y)	.292			.507			.719			.291		
Income (\$)	.117			.919			.984			.015*		
No. of children in household younger than 18 y	.684			.077			.363			.010*	0.610	(0.42-0.890)
Child birth weight (kg)	.284			.004**	1.450	(1.130-1.850)	.034*	1.500	(1.030-2.180)	.326		
Married	.010*	1.680	(1.130-2.500)	.003**	2.020	(1.270-3.210)	.233			.010*	0.080	(0.24-0.080)
11th grade education or less	.002**	0.420	(0.250-0.720)	.054			.888			.177		
Completed college	.000**	2.810	(2.030-3.890)	.000**	3.150	(2.360-4.210)	.000**	3.890	(2.300-6.580)	.826		
Mother currently working	.513			.339			.708			.661		
Mother's race/ethnicity												
Hispanic	.091			.040*	1.630	(1.020-2.600)	.233			.174		
Non-Hispanic African American	.387			.011*	2.070	(1.180-3.620)	.896			.420		
Region of residence												
Midwest	.214			.299			.300			.238		
South	.241			.497			.628			.207		
West	.000**	3.450	(2.03-5.87)	.003**	1.890	(1.250-2.860)	.083			.263		
Urban	.099			.856			.131			.250		
Rural	.193			.283			.574			.784		
Child is female	.397			.201			.103			.222		
Child received WIC ^c	.871			.011*	.600	(0.400-0.890)	.934			.001**	4.340	(1.780-10.560)
Child is first born	.157			.799			.839			.252		
Child is in day care	.135			.003**	.610	(0.440-0.850)	.003**	.410	(0.230-0.730)	.603		
Child has an allergy	.199			.296			.945			.305		
Child has a long-term medical problem	.804			.336			.172			.000**	44.78	— ^d

^aOR=odds ratio.^bCI=confidence interval.^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.^dAmong those with a medical problem, all used iron-fortified formula.

* < .05 significance.

** < .01 significance.

Table 5. Maternal/child characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with following American Academy of Pediatrics infant-feeding recommendation; results of multiple regression

Characteristic	Delayed Introduction of Cow's Milk Until 12 Months			Did Not Introduce No-Fat or Reduced-Fat Milk			Met Juice Consumption Recommendation			Delayed Complementary Feeding Until 4 Months		
	P value	OR ^a	95% CI ^b	P value	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI
Age of mother (y)	.135			.325			.320			.000**	1.050	(1.030-1.080)
Income (\$)	.173			.912			.072			.512		
No. of children in household younger than 18 y	.471			.209			.629			.161		
Child birth weight (kg)	.854			.162			.027*	0.770	(0.610-0.970)	.129		
Married	.898			.063			.265			.055		
11th grade education or less	.560			.060			.130			.528		
Completed college	.929			.627			.032*	1.410	(1.030-1.940)	.000**	2.020	(1.500-2.740)
Mother currently working	.718			.070			.387			.234		
Mother's race/ethnicity												
Hispanic	.719			.273			.280			.670		
Non-Hispanic African American	.117			.698			.308			.230		
Region of residence												
Midwest	.738			.000**	0.170	(0.080-0.360)	.709			.108		
South	.237			.075			.424			.429		
West	.004**	2.790	(1.390-5.620)	.011*	0.370	(0.170-0.800)	.055			.000**	2.140	(1.400-3.260)
Urban	.374			.037*	1.640	(1.030-2.610)	.391			.357		
Rural	.666			.644			.236			.092		
Child is female	.164			.167			.917			.355		
Child received WIC ^c	.455			.557			.212			.357		
Child is first born	.378			.074			.847			.026*	1.440	(1.040-1.990)
Child ever breastfed	.004**	1.950	(1.240-3.060)	.478			.056			.000**	1.660	(1.250-2.210)
Child is in day care	.756			.208			.720			.496		
Child has an allergy	.391			.637			.328			.701		
Child has a long-term medical problem	.022*	6.870	(1.320-35.800)	.826			.435			.023*	0.440	(0.220-0.900)

^aOR=odds ratio.
^bCI=confidence interval.
^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.
* < .05 significance.
** < .01 significance.

Table 6. Maternal/child characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with infant-feeding practices

Characteristic	Child Consumes Fruit		Child Consumes Vegetables		Considered Child Picky Eater		Offers New Food Before Deciding Does Not Like Fewer Than Three Times	
	None (n=228)	Some (n=606)	None (n=192)	Some (n=642)	Yes (n=341)	No (n=486)	Yes (n=172)	No (n=655)
Age of mother (y)	28.2**	31.3	30.2	30.6	30.4	30.5	28.7**	30.9
Income (\$)	45,422**	58,048	52,593	54,847	55,326	53,939	46,625**	56,716
No. of children in household younger than 18 y	1.8	1.9	1.9	1.9	1.7*	2	2	1.8
Child birth weight (kg)	3.3*	3.4	3.5	3.4	3.4	3.4	3.4	3.4
	← % →							
Married	73.5**	86.1	85	81.9	81.8	82.9	68.7**	86.1
11th Grade education or less	7	6.4	9.5	5.7	6.8	6.5	15.5**	4.3
Completed college	24.8**	47.3	37.6	42	42.4	40	27.1**	44.7
Mother currently working	57.4	58.6	57.9	58.4	57.7	59.2	62.2	57.6
Mother's race/ethnicity								
Hispanic	11.2	9.1	11.2	9.2	10.8	8.8	14.6 ^a	8.4
Non-Hispanic African American	8.8	5.7	5.9	6.8	6.2	6.9	15.4**	4.2
Non-Hispanic white	80	85.2	82.9	84	83	84.3	70**	87.4
Income								
130% or less than FPL ^b	15.2*	7.4	8.7	9.9	8.7	10.1	17.7*	7.2
185% or less than FPL ^b	32.9**	18.5	20.2	23.3	18.2 ^a	25.7	38.7**	18.1
Region of residence								
Northeast	15.5	18.6	16.8	18	16.2	18.6	12*	18.9
Midwest	25.3	27.6	29.8	26.2	27.9	26.5	22.6	28.3
South	41 ^a	32.7	29.3	36.5	34.1	35.7	42.3 ^a	33.2
West	18.2	21.1	24.1	19.3	21.8	19.3	23.1	19.6
Urban	36.8*	48.3	44	45.4	46.3	44	43.2	45.6
Rural	26.4**	15	21.5	17.2	16	20	21.2	17.4
Child is female	42.8	48.2	45.9	46.9	46.6	46.9	54.9*	44.6
Child received WIC ^c	29.9**	17.3	23.2	20.1	16.3*	24.3	36.8**	16.6
Child is first born	62.5	56	56	58.3	61.8 ^a	54.5	50 ^a	59.7
Child ever breastfed	63.5**	79.8	70.6	76.6	75.3	75.4	65.7*	77.9
Child is in day care	47.7	49.9	52.2	48.5	51.1	48.5	50.9	49.2
Child is Hispanic	14.6	11.6	15.3	11.7	13.1	12.1	17.4	11.2
Child is African American	10 ^a	4.9	6.3	6.3	6.2	6.1	13.6**	4.2
Child is white	75.4*	83.5	78.5	82	80.7	81.7	68.9**	84.6
Child has an allergy	3.6 ^a	6.9	7.1	5.6	6.7	5.5	4.7	6.4
Child has a long-term medical problem	1.3	2.3	3.2	1.7	2.7	1.5	1.5	2.2

^a<.10 Borderline significance.

^bFPL=federal poverty level. Poverty status is calculated using annual household income and family size in comparison to federal poverty thresholds for 2002. In 2002, the poverty threshold for a family of four was \$18,392.

^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

*Significantly different from some or no groups at $P<.05$.

**Significantly different from some or no groups at $P<.01$.

DISCUSSION

Having a college education was associated with more positive child feeding behaviors than any other maternal characteristic. This is consistent with reports from the literature on breastfeeding practices (1,2,6,8) but has not been evaluated with respect to other current infant and toddler feeding recommendations. College-

educated women were significantly more likely to follow five out of the eight AAP recommendations assessed, including all breastfeeding recommendations and the juice and complementary feeding guidelines. In addition, infants and toddlers of these women were more likely to consume fruit, and less likely to consume sweetened beverages and desserts or candy. Also, hav-

Table 7. Maternal/child characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with consumption of foods of low nutrient density

Characteristic	Child Consumed Any Salty Snacks		Child Consumed Any Sweetened Beverage		Child Consumed Any Desserts or Candy	
	Some (n=171)	None (n=663)	Some (n=288)	None (n=546)	Some (n=561)	None (n=273)
Age of mother (y)	29.4**	30.8	29.2**	31.2	30.3	30.8
Income (\$)	47,695**	56,361	50,091**	57,019	56,173*	50,400
No. of children in household younger than 18 y	1.8	1.9	2.0*	1.8	1.8	2
Child birth weight (kg)	3.4	3.4	3.4	3.4	3.4	3.4
	← % →					
Married	78.4	83.8	75.5**	86.8	82.8	82
11th Grade education or less	11.3 ^a	5.2	10.3*	4.3	5.5	8.9
Completed college	32.8*	43.4	26.7**	49.5	39.5	44.6
Mother currently working	59.9	57.8	59.2	57.7	58.1	58.6
Mother's race/ethnicity						
Hispanic	10.1	9.5	13.2 ^a	7.5	7.7	14.1
Non-Hispanic African American	7.1	6.4	7.3	6.1	5.9	8
Non-Hispanic white	82.8	84.1	79.5 ^a	86.3	86.4*	77.9
Income						
130% or less than FPL ^b	13.4	8.5	12	8.2	6.4**	16.8
185% or less than FPL ^b	30.3 ^a	20.4	27.7**	19.6	20.2 ^a	28.1
Region of residence						
Northeast	15.1	18.5	14.7	19.5	18.1	16.9
Midwest	34.2 ^a	24.8	21**	30.5	27.9 ^a	24.8
South	35.1	35	41.5*	31.1	35.6	33.6
West	15.6	21.7	22.8	18.9	18.3 ^a	24.8
Urban	40.1	46.5	41.1	47.4	40.7**	54.6
Rural	17.9	18.2	21.4	16.2	19.5	15.2
Child is female	49.9	45.7	42.9	48.9	46	48.1
Child received WIC ^c	29.1*	18.3	26.2*	17.6	18.4 ^a	25.9
Child is first born	59.9	57.2	48.9**	63.1	57.7	58.2
Child ever breastfed	70.2	76.7	65.5**	81	73.9	78.3
Child is in day care	54.9	47.7	52.4	47.5	49.3	49.4
Child is Hispanic	12.5	12.4	18.2**	9.1	11	15.6
Child is non-Hispanic						
African American	6.7	6.2	6.6	6.2	5.5	8
Child is non-Hispanic white	80.9	81.3	75.2**	84.8	83.5 ^a	76.3
Child has an allergy	3.7	6.6	6.9	5.4	6.9	4
Child has a long-term medical problem	2.1	2	2.2	1.9	2	2.1

^a<.10 Borderline significance.

^bFPL=federal poverty level. Poverty status is calculated using annual household income and family size in comparison to federal poverty thresholds for 2002. In 2002, the poverty threshold for a family of four was \$18,392.

^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

*Significantly different from those who consumed none at $P<.05$.

**Significantly different from those who consumed none at $P<.01$.

ing less than a high school education was associated with offering foods fewer than three times before deciding a child did not like it. The Avon Longitudinal Study of Pregnancy and Childhood, conducted in the United Kingdom, has previously reported increased sugared beverage consumption by toddlers whose mothers had lower levels of education (22). Higher maternal education has been consistently associated

with improved child health practices, including across cultures and in deprived environments (23). Based on these findings, nutrition education messages targeting US mothers with a high school diploma, some college, or less education is important for improving infant and toddler feeding practices.

Mothers living in the western region of the United States were more likely to follow four of the AAP infant

Table 8. Maternal/child characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with infant-feeding practices; results of multiple regression

Characteristic	Child Consumed No Fruit			Child Considered Picky Eater			Offers New Food Before Deciding Does Not Like Fewer than Three Times		
	P value	OR ^a	95% CI ^b	P value	OR	95% CI	P value	OR	95% CI
Age of mother (y)	.045*	0.950	(0.900-1.000)	1.000			.079		
Income (\$)	.263			.816			.904		
No. of children in household younger than 18 y	.945			.137			.901		
Child birth weight (kg)	.127			.796			.343		
Married	.580			.528			.480		
11th Grade education or less	.038*	0.460	(0.220-0.960)	.995			.015*	2.510	(1.200-5.260)
Completed college	.022*	0.590	(0.380-0.930)	.970			.819		
Mother currently working	.521			.283			.219		
Mother's race/ethnicity									
Hispanic	.612			.309			.388		
Non-Hispanic African American	.776			.772			.006**	3.180	(1.400-7.240)
Region of residence									
Midwest	.730			.260			.637		
South	.630			.396			.153		
West	.695			.158			.191		
Urban	.742			.895			.588		
Rural	.097			.442			.459		
Child is female	.442			.981			.049*	1.500	(1.000-2.250)
Child received WIC ^c	.677			.017*	0.550	(0.330-0.900)	.059		
Child is first born	.437			.968			.223		
Child ever breastfed	.013*	0.560	(0.350-0.880)	.663			.108		
Child is in day care	.510			.521			.536		
Child has an allergy	.120			.376			.461		
Child has a long-term medical problem	.814			.314			.758		

^aOR=odds ratio.
^bCI=confidence interval.
^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.
* < .05 significance.
** < .01 significance.

feeding guidelines (breastfeeding initiation, breastfeeding to 6 months, delaying cow's milk until age 12 months, and complementary feeding initiation). This is consistent with previous reports for improved breastfeeding practices in this region (1). Although we did find lower rates of breastfeeding initiation in the South, when other maternal/child characteristics were controlled for, this was not significant. Other differences found in food consumption patterns by region of the country included early introduction of low-fat milk by mothers living in the Midwest or West. Urban mothers were more likely to delay introduction of low-fat milk and their children were less likely to consume desserts or candy.

Other maternal/child characteristics associated with three or more specific infant feeding recommendations or practices were being married, child being in day care, child's birth weight, and child participating in WIC. As with previous reports of maternal characteristics, we

found being married was positively associated with most recommended infant feeding practices (1,6,7); mothers who were married were more likely to initiate breastfeeding and continue to 6 months. However, married mothers who used formula were less likely to use iron-fortified infant formula (the total percentage of use of non-iron-fortified formula was low at <10%). Child being in day care was associated with a mother less likely to breastfeed to 6 or 12 months and with consumption of salty snacks. Day care may be an appropriate target for nutrition education messages and guidelines for both mothers and other caregivers. It may also be feasible for day-care providers to assist with identifying and removing barriers for mothers for continuing breastfeeding to age 6 and 12 months. The American Dietetic Association has published a position statement on this important topic (24). Whereas the child's birth weight was associated with breastfeeding to age 6 and 12 months, it was negatively

Table 9. Maternal/child characteristics of participants in the 2002 Feeding Infants and Toddlers Study (n=2,515) associated with consumption of foods of low nutrient density; results of multiple regression

Characteristic	Child Consumed Any Salty Snacks			Child Consumed Any Sweetened Beverage			Child Consumed Any Desserts or Candy		
	P value	OR ^a	95% CI ^b	P value	OR	95% CI	P value	OR	95% CI
Age of mother (y)	.562			.014*	0.960	(0.920-0.990)	.052		
Income (\$)	.088			.912			.002**	1.000	(1.000-1.000)
No. of children in household younger than 18 y	.777			.406			.105		
Child birth weight (kg)	.417			.629			.231		
Married	.436			.405			.565		
11th Grade education or less	.112			.612			.121		
Completed college	.622			.005**	0.550	(0.370-0.830)	.035*	0.640	(0.430-0.970)
Mother currently working	.459			.840			.872		
Mother's race/ethnicity									
Hispanic	.871			.290			.105		
Non-Hispanic African American	.626			.478			.510		
Region of residence									
Midwest	.170			.394			.773		
South	.888			.160			.486		
West	.378			.367			.287		
Urban	.459			.854			.002**	0.530	(0.360-0.790)
Rural	.257			.799			.952		
Child is female	.388			.156			.749		
Child received WIC ^c	.089			.595			.077		
Child is first born	.975			.033*	0.570	(0.340-0.960)	.117		
Child ever breastfed	.735			.006**	0.550	(0.360-0.850)	.491		
Child is in day care	.0327*	1.720	(1.050-2.830)	.190			.566		
Child has an allergy	.188			.704			.239		
Child has a long-term medical problem	.823			.676			.697		

^aOR=odds ratio.
^bCI=confidence interval.
^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.
* <.05 significance.
** <.01 significance.

associated with following the juice recommendation. A child participating in WIC was associated with a mother being less likely to breastfeed to age 6 months and less likely to consider her child a picky eater. Mothers of WIC infants and toddlers were more likely to use iron-fortified infant formula, which would be expected based on the WIC food package at the time FITS was conducted (25,26).

Maternal age was positively associated with two important infant feeding practices: appropriate timing of complementary feeding and fruit consumption. Our findings are consistent with previous studies that show maternal age is not consistently related to breastfeeding initiation or duration (with the exception of the very youngest mothers decreasing breastfeeding initiation and duration) (9). Maternal characteristic of race/ethnicity subgroup, which has been previously reported to be significantly associated with breastfeeding practices (1), was not the most important maternal characteristic identified

in this research. While maternal non-Hispanic African American race/ethnicity was associated with a significantly lower rate of breastfeeding initiation, after controlling for other maternal characteristics, we did not find an association with maternal race or ethnicity and breastfeeding initiation. We did find that non-Hispanic African-American and Hispanic mothers were more likely to continue breastfeeding the child to age 6 months. Recent data from the National Health and Nutrition Examination Survey, 1999-2000, found Hispanic women who were more highly acculturated were less likely to breastfeed their children than less acculturated women, even after education, age, and income were taken into account (27). Acculturation was not assessed in FITS.

Group differences between mothers whose children met the AAP guidelines and those who did not found higher income associated with adherence to all of the AAP recommendations, except feeding of low-fat dairy. Higher income was also associated with fruit consumption, offer-

ing food more than three times, consuming no salty snacks or sweetened beverages, but negatively associated with dessert and candy consumption. Conversely, household income below 130% or 180% of the federal poverty level was associated with not following the breastfeeding recommendations, the juice or complementary feeding recommendations, and several of the dietary patterns assessed. However, household income was not significantly associated with infant feeding practices in multiple regression. Income and education are positively correlated, and our maternal education variable was more precise than income. The importance of maternal education has previously been discussed and many of the same aspects may relate to household income. The main focus of FITS was on the infants and toddlers in the cohort, and we oversampled for age groups of interest for infant feeding, not maternal characteristics. Had we oversampled for factors like income, we would have had more cases to study income effects.

We found that the child being ever breastfed was associated with consistently positive feeding practices of appropriate timing of complementary foods, delaying cow's milk until age 12 months, and with the child consuming any fruit and not consuming sweetened beverages. Previous research has found that planning to breastfeed was associated with other positive maternal health-related behaviors, such as increased folic acid intake and not smoking during pregnancy (28). These findings underscore the importance of breastfeeding initiation and increased duration; education surrounding other infant feeding practices should be part of the focus in support of breastfeeding practices.

Whereas breastfeeding initiation rates have increased, these need to be maintained while increasing duration to 6 and 12 months; additional positive infant and toddler feeding practices have been found to be associated with increased duration of breastfeeding. Baker and colleagues (4) found that women who breastfed longer introduced complementary foods later. In a cohort of breastfed infants, maternal prepregnancy weight was strongly associated with infant feeding practices; mothers with overweight and obesity breastfed for shorter periods and introduced complementary foods earlier. Taveras and colleagues (29) found mothers who breastfed longer were less likely to restrain their children's food intake at 1 year. These mothers were significantly more likely to be older, have a healthful prepregnancy body mass index, and higher income and education. Ertem and colleagues (3) studied WIC mothers who were primarily minority and unmarried and found maternal knowledge and lactation problems were not associated with termination of breastfeeding, although lack of confidence and the belief that their infant preferred formula were. These investigators and others suggest a shift in focus from simply increasing knowledge to enhancing maternal attitudes through positive social support and anticipatory guidance to increase breastfeeding duration (3,9). Some research indicates this would be most effective if begun during pregnancy or before.

Lack of vegetable consumption was found to be pervasive across maternal/child characteristics, indicating all pregnant women, mothers, and caregivers need education on the importance of increasing vegetable consumption

for young children and guidance on how to achieve this. Although not assessed in FITS, previous research has found significant associations between maternal diet and child feeding patterns (30-32). Vereecken and colleagues (30) found mother's food consumption patterns were an independent predictor for fruit and vegetable consumption. Research on limited-income families (n=113 mother-child pairs) found poor maternal dietary quality an effective screen for the diet of their child (31). Mothers who skipped breakfast or omitted fruits, vegetables, or dairy were at greater risk for not following feeding guidelines for their infants. Similarly, Johnson and colleagues (32) found that low-income children (n=515) aged 2 to 17 years, who participated in the Continuing Survey of Food Intakes by Individuals, 1989 and 1990, whose parents smoked were significantly more likely to have mothers employed in blue collar occupations and had poorer dietary quality (ie, lower vitamin A, higher total energy, higher sodium, and higher saturated fat) (32). Studies have documented the need for nutrition guidance during the dietary transition of early childhood (33); results of a few interventions have been published. A nutrition education project aimed at toddlers of rural, low-income families found knowledge alone insufficient to change eating habits (34). Interestingly, Wardle and colleagues (35) studied 156 parents of 2- to 6-year-old children randomized to a parent-based exposure involving a daily tasting strategy (35). The exposure group showed greater liking and consumption of the target vegetable postintervention. Thus, action-based interventions may hold promise.

We found non-Hispanic African-American mothers and mothers with less than a high school education were more likely to offer foods to their children a very limited number of times. A previous report assessing parenting styles found African-American mothers to be "uninvolved" whereas Hispanic mothers were more likely to be "indulgent" in their feeding styles (36). Additional analysis of these minority mothers reported "authoritative" feeding style was positively associated with attempts to get the child to eat dairy, fruit, and vegetables, as well as with their consumption (37). Other investigators have demonstrated that the best predictor of a child's ability to regulate energy intake was a feeding situation in which parents provided healthful food choices but allowed the child to assume control of how much he or she ate (38). These findings reinforce the need for parents to provide healthful food choices in a structured environment while allowing the child to control how much they consume. Future research should explore more closely the influence of other variables, such as maternal weight, feeding style, and diet, on child feeding practices.

Women with children who have a long-term medical problem may represent a unique group. These mothers were more likely to use iron-fortified infant formula and delay introduction of cow's milk to age 12 months, but also more likely to offer complementary foods early. The number of mothers/children was small (n=62) but may indicate different feeding issues or more frequent exposure to medical care. Additional research focusing on the nutritional needs of this vulnerable group, and barriers to achieving optimal nutrient intake, is warranted.

LIMITATIONS

The FITS sample had slightly higher middle- and high-income subjects and a slightly lower percentage of Hispanic race/ethnicity than actual national distributions of household incomes (19). Dietary intake was assessed by a single 24-hour recall, the limitations of which have been discussed previously (19,39). Certain maternal characteristics were not studied (smoking, acculturation, and maternal weight). FITS was also cross-sectional, thus it did not follow mothers or their offspring over time.

CONCLUSIONS

Our findings provide important insights into maternal/child characteristics, which should help target interventions to improve infant and toddler feeding practices; dietetics professionals can play a primary role in each of these.

- Initiatives to improve infant and toddler feeding practices should focus on assisting mothers who have less than a college education, who are unmarried, whose children are in day care, or whose children are enrolled in WIC.
- Ever breastfeeding the child was associated with other positive infant feeding practices, underscoring it as an infant feeding goal of primary importance. Education surrounding other infant feeding practices could also begin with breastfeeding support.
- Agencies such as WIC and day care, which have contact with many US infants and toddlers, may be able to assist in identification of barriers and mechanisms to overcome them to improve duration of breastfeeding and other primary child feeding outcomes.
- Proposed criteria for selecting the WIC food package indicate interest in increasing fruit and vegetable consumption, which, if economically feasible, will contribute positively to this important goal (26).
- A number of infant and toddler feeding practices, such as increasing vegetable consumption and delaying low-fat dairy until age 24 months, should be global messages for caregivers through consistent family-based methods that are culturally appropriate.
- Regional and cultural influences on maternal differences in infant and toddler feeding practices exist. Thus, individual agencies and programs should tailor efforts to their population of mothers and their children.

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