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Infant Feeding and Feeding Transitions During the First Year of Life

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ABSTRACT

OBJECTIVE. Infancy is a time of rapid transition from a diet of virtually nothing but milk (either breast milk or infant formula) to a varied diet from nearly all food groups being consumed on a daily basis by most infants. Despite various recommendations about infant feeding, little is known about actual patterns of feeding among US infants. This article documents transitions in infant feeding patterns across the first year of life and determinants of key aspects of infant feeding.

METHODS. Using data from the Infant Feeding Practices Study II, we analyzed responses to a 7-day food-recall chart that was administered every month. The sample size declined from 2907 at birth to 1782 at 12 months of age.

RESULTS. Although 83% of survey respondents initiated breastfeeding, the percentage who breastfed declined rapidly to 50% at 6 months and to 24% at 12 months. Many of the women who breastfed also fed their infants formula; 52% reported that their infants received formula while in the hospital. At 4 months, 40% of the infants had consumed infant cereal, 17% had consumed fruit or vegetable products, and <1% had consumed meat. Compared with infants who were not fed solid foods at 4 months, those who were fed solid foods were more likely to have discontinued breastfeeding at 6 months (70% vs 34%) and to have been fed fatty or sugary foods at 12 months (75% vs 62%).

CONCLUSIONS. Supplementing breast milk with infant formula while infants were still in the hospital was very common. Despite recommendations that complementary foods not be introduced to infants aged 4 months or younger, almost half of the infants in this study had consumed solid foods by the age of 4 months. This early introduction of complementary foods was associated with unhealthful subsequent feeding behaviors. *Pediatrics* 2008;122:S36–S42

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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 feeding, breast milk, solid food introduction

Abbreviations

AAP—American Academy of Pediatrics
IFPS—Infant Feeding Practices Study
WIC—Special Supplemental Nutrition Program for Women, Infants, and Children

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THE AMERICAN ACADEMY of Pediatrics (AAP) recommends that infants be breastfed exclusively for the first several months of life and that breastfeeding should continue through the first year of life. The AAP Committee on Nutrition recommends that infants begin consuming foods in addition to breast milk or formula after 4 months of age, preferably at 6 months of age.^{1,2} Early foods should include a source of iron, either fortified infant cereal or meat, but foods high in fat or sugar (eg, sugar-sweetened beverages, French fries, and candy) should not be given to infants.³ Within these constraints, infants should be introduced to a variety of foods as they transition to table foods.⁴

Little is known about current patterns of feeding among US infants during their first year of life. The Feeding Infants and Toddlers Study, a cross-sectional study of US children aged 4 to 24 months conducted in 2002, documented infant and child food intake on the basis of one or two 24-hour recalls but did not collect detailed information on younger infants.⁵ In the study described here, we attempted to fill this knowledge gap by assessing milk and formula consumption among a large sample of US infants, as well as changes in their diet throughout their first year of life as they were introduced to complementary foods.

METHODS

We analyzed data from the Infant Feeding Practices Study II (IFPS II), a longitudinal mail survey of mothers of infants conducted by the US Food and Drug Administration in 2005–2007. The sample was drawn from a consumer-opinion mail panel distributed throughout the United States. Participants in the panel were asked whether any household member was currently pregnant. Panel members identified as being pregnant were then invited to participate in the study, with the time of their enrollment based on their expected due date. IFPS II participants completed mail questionnaires almost monthly from the third trimester of their pregnancy through their infant's first year of life. Additional details about the study methodology can be found elsewhere.⁶

Postpartum questionnaires were mailed to participants when their infants were ~1, 2, 3, 4, 5, 6, 7½, 9, 10½, and 12 months of age. Each questionnaire included a food-frequency table on which mothers were asked to indicate how often their infants were fed various types of food or drink in the previous 7 days (the 7 days before completing the questionnaire). Mothers could respond in times per week or times per day. With the exception of the month 1 (neonatal) questionnaire, the food-frequency table on each questionnaire consisted of 18 categories of foods and drinks. The table in the neonatal questionnaire consisted of 6 of the food/drink categories in the later questionnaires plus water and sugar water. The neonatal questionnaire also asked mothers who had ever breastfed about in-hospital feeding of infant formula, water, and sugar water.

Although most mothers completed each survey within several days of receiving it, many did not do so until several weeks or even months later. Therefore, we analyzed the feeding data according to the age of the infant when the questionnaire was actually completed. We created the following age windows 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 (~7½ months), 36 to 42 weeks (~9 months), 43 to 50 weeks (~10½ months), and 51 to 59 weeks (~1 year). For example, if a mother completed the 6-month questionnaire when her infant was 37 weeks old, we incorporated data from that questionnaire with data for infants aged 36 to 42 weeks instead of with data for infants aged 24 to 28 weeks. If a mother completed 2 questionnaires while her infant was in the same age window, we used the data from the first questionnaire she completed.

Breast Milk Consumption

We divided the infants into 5 mutually exclusive categories of breast milk consumption on the basis of their mothers' reports of the percentage of milk or formula feedings in the previous 7 days in which their infants were given breast milk: all breast milk, more than two thirds breast milk, one third to two thirds breast milk, less than one third breast milk, and no breast milk. Because in-hospital feeding data did not specify the number of feedings that infants received, we used only 3 categories for this time period: breast milk only, mixed breast milk and formula, and formula only.

Food Frequency

We determined the percentage of infants who consumed each type of food or drink at least once in the previous 7 days and also the percentage who consumed at least 1 food or drink in each of the following categories: (1) breast milk or formula; (2) water or sugar water; (3) cereal; (4) fruits and vegetables; (5) meat or meat substitute; (6) other milk products; and (7) fatty or sugary foods.

Dietary Variety

To describe the variety of foods in the infants' diet, we classified each reported feeding according to the type of

solid foods or liquids they consumed. We considered infants to have consumed solid foods in 1 of 3 groups if they were reported to have consumed foods in that group an average of at least once per day. For example, if an infant ate fish once per week and eggs 6 times per week, it would count as consuming food in the meat group once per day. The 3 solid food groups were meat or meat substitutes (meat/chicken, fish, peanuts, eggs, soy foods), fruits or vegetables (not including juice), and cereals (including infant cereal and other cereals/starches). We then created the following 8 categories of food consumption: (1) 3 groups of solids consumed at least once per day; (2) 2 groups of solids consumed at least once per day; (3) 1 group of solids consumed at least once per day; (4) some solids consumed but no group consumed at least once per day; (5) liquids other than breast milk or formula but no solids consumed; (6) only breast milk and formula consumed; (7) only formula consumed; and (8) only breast milk consumed.

Predictors of Selected Infant Feeding Practices

To identify factors associated with various infant feeding practices, we selected 5 key indicators of adherence to infant feeding recommendations: (1) breastfeeding in the hospital; (2) not consuming any solid foods at 4 months; (3) breastfeeding at 6 months; (4) consuming a varied diet with at least daily consumption of cereals, meats or meat substitutes, and fruits or vegetables at 9 months; and (5) not consuming fatty or sugary foods at 1 year. We then calculated the overall percentage of infants whose consumption met each of these criteria, as well as the percentage within various demographic categories defined by mother's age, parity, education, family income, participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), race, and region of residence. We also examined associations between the infants' feeding practices at each age interval and their feeding practices at earlier age intervals. For example, we assessed the extent to which consumption of a varied diet at 9 months was associated with consumption of solids at 4 months and with consumption of breast milk at 6 months. We used SAS 9.1 (SAS Institute, Inc, Cary, NC) to examine these associations, and we used logistic regression to predict the likelihood of various infant feeding practices on the basis of a model that accounted for all maternal socio-demographic characteristics and earlier infant feeding practices. The sample size for the logistic regressions was limited to the observations with complete data on socio-demographic characteristics and earlier feeding practices.

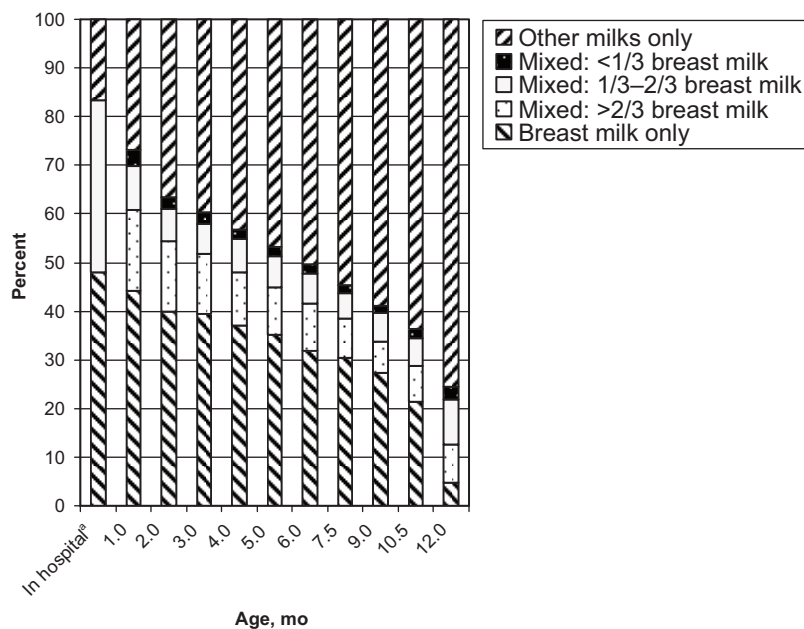
RESULTS

Infants' Consumption of Liquids and Solids

Breast Milk or Formula

Although 83% of infants in this study were breastfed in the hospital, the diets of 42% of these infants were supplemented with formula (Fig 1). By 3 months, the percentage of infants who received formula (61%) roughly equaled the percentage who received breast

FIGURE 1
Percentage of milk or formula feedings in which infants received breast milk.^a The middle category is any mixture of breast milk and formula, because the number of feedings was not assessed in the hospital.



milk. The percentage of infants who received both breast milk and other milk or formula declined continuously from 35% in the hospital to only 14% at 9 months but then rose again as infants began to consume cow's milk. The percentage of breastfed infants whose diets were supplemented with infant formula declined from 42% in the hospital to 34% at 3 months of age and remained at this level until 9 months of age. More than half of the infants classified as "mixed-milk feeders" received more than two thirds of their feedings from breast milk. Infant formula accounted for most of the "other-milk" feedings of infants up to the age of 10½ months, but by the age of 1 year, 81% of the infants had begun consuming cow's milk (Table 1).

Water

Infants' consumption of water and sugar water was only assessed in the neonatal questionnaire. Responses to this questionnaire showed that 13% of the infants were given sugar water while in the hospital and 10% of the infants were receiving water without sugar at the age of 1 month despite findings that infants who do not consume solid foods have no need for solute-free water.^{7,8}

Cereal

By 3 months of age 18% of the infants were consuming infant cereal, and by 4 months of age 40% were consuming infant cereal. Infants were introduced to infant cereal at a median age of slightly older than 4 months and to other cereals at a median age of ~8 months. By the end of infancy, consumption of infant cereal had dropped off markedly, with only 46% of the infants still consuming infant cereal at 1 year (Table 1).

Fruits and Vegetables

Fruits and vegetables were introduced into the infants' diet at a median age of between 5 and 6 months, and

by 7½ months, >90% of the infants were consuming fruits and vegetables. The percentage of infants who consumed 100% fruit juice rose continuously throughout infancy, from <20% at 5 months to 77% at 1 year (Table 1).

Meat and Meat Substitutes

The median age of infants when introduced to meat or combination foods containing meat was ~8 months, and by the age of 1 year, nearly 97% of all the infants were consuming meat or meat substitutes, including 60% who were consuming eggs, 25% who were consuming peanuts or peanut butter, 18% who were consuming fish or shellfish, and 6% who were consuming soy products (Table 1).

Cow's Milk and Milk products

At 10½ months, only 17% of the infants were consuming cow's milk, but by 12 months 81% of them were. Other dairy foods, such as cheese and yogurt, were introduced to infants at a median age of ~10 months.

Fatty or Sugary Foods

By 1 year of age, approximately half of the infants were consuming French fries and candy, cookies, or cake, although only 15% were consuming sweetened drinks such as soda or juice drinks.

Type of Feeding According to Age

From birth through 3 months of age, at least 80% of the infants were fed nothing but breast milk or formula; between 4 and 5 months, most of the infants were introduced to solid foods; and from 6 months onward, >80% of the infants consumed solid foods on a daily basis (Fig 2). At 6 months, the majority of infants consumed at least 1 serving per day of solid foods only from 2 food groups, but by 9 months, most

TABLE 1 Percentage of Infants Fed Each of 7 Categories of Liquid or Solid Food in the Previous 7 Days, According to Infant Age

	In Hospital (n = 2907)	Age, wk									
		3-6	7-10	11-14	15-18	19-23	24-28	29-35	36-42	43-50	51-59
		(1 mo) (n = 1961)	(2 mo) (n = 2240)	(3 mo) (n = 2302)	(4 mo) (n = 2101)	(5 mo) (n = 2139)	(6 mo) (n = 2046)	(7½ mo) (n = 1990)	(9 mo) (n = 1920)	(10½ mo) (n = 1779)	(1 y) (n = 1782)
Breast milk or formula	100.0	100.0	99.9	99.9	99.7	99.7	99.7	99.5	99.2	96.6	58.3
Breast milk	83.3	74.0	65.4	61.0	57.2	54.6	50.1	45.9	41.7	36.8	25.9
Infant formula	52.0	57.2	61.1	60.5	62.9	64.7	67.3	68.9	70.8	70.9	36.4
Water product	15.5	11.8	—	—	—	—	—	—	—	—	—
Water	3.3	10.4	—	—	—	—	—	—	—	—	—
Sugar water	12.9	2.3	—	—	—	—	—	—	—	—	—
Any cereal	—	5.4	11.7	18.3	40.2	71.2	86.1	91.8	96.3	96.1	97.0
Baby cereal	—	5.4	11.6	18.2	39.9	70.8	83.7	86.2	83.4	71.4	46.6
Other cereal/starches	—	0.0	0.4	1.0	2.2	6.1	17.4	39.3	71.7	85.7	93.3
Any fruit or vegetable	—	1.7	3.7	6.7	16.8	47.0	80.7	96.0	98.9	99.0	99.2
100% juice	—	1.7	3.1	5.0	7.9	19.3	33.4	50.3	62.8	68.5	76.9
Fruit	—	0.0	1.0	2.8	10.4	37.4	71.3	91.3	97.0	98.3	98.4
Vegetables	—	0.0	0.5	1.4	7.6	35.8	73.1	92.7	97.2	97.9	98.7
Any meat or meat substitute	—	0.0	0.3	0.7	1.0	6.4	22.0	48.6	78.4	90.2	96.6
Meat, chicken, combination	—	0.0	0.3	0.5	0.7	5.8	21.0	47.2	76.3	87.7	93.8
Fish/shellfish	—	0.0	0.0	0.0	0.1	0.1	0.2	1.0	3.9	7.8	17.7
Peanut/peanut butter	—	0.0	0.1	0.2	0.1	0.1	0.3	0.6	1.7	6.5	25.1
Eggs	—	0.0	0.0	0.2	0.3	0.5	1.7	4.5	14.2	28.6	59.2
Soy foods	—	0.0	0.0	0.1	0.2	0.3	0.7	1.2	2.7	3.7	5.8
Other milk products	—	0.5	0.9	1.1	1.8	2.7	7.3	15.9	37.1	62.7	93.9
Cow's milk	—	0.5	0.5	0.3	0.4	0.7	1.2	1.5	5.3	17.3	81.2
Other milk	—	0.0	0.2	0.3	0.4	0.4	0.4	1.0	1.7	2.6	7.1
Other dairy foods	—	0.0	0.3	0.7	1.1	1.9	6.0	14.5	34.0	57.0	80.1
Any fatty/sugared foods	—	0.4	0.7	1.3	1.7	2.7	4.8	9.8	23.6	40.9	66.2
Sweet drinks	—	0.4	0.7	1.1	1.5	2.3	3.1	4.2	6.2	9.4	14.6
French fries	—	0.0	0.0	0.1	0.2	0.4	1.5	3.8	14.3	25.7	42.9
Candy/cookies/cake	—	0.0	0.1	0.2	0.2	0.5	1.5	3.9	12.3	25.6	52.2

— indicates that questions regarding the item were not included in the questionnaire.

of them consumed at least 1 serving per day from all 3 food groups. Except in the hospital, only a small percentage of the infants consumed liquids other than breast milk or formula without also consuming solid foods.

Predictors of Infant Feeding Behavior

Predictors of In-Hospital Breastfeeding

Initiation of breastfeeding in the hospital was positively associated with living in the western region of the country,

Hispanic ethnicity, and mothers having had at least some college education but negatively associated with WIC enrollment (Table 2). Although mothers >30 years old had a higher unadjusted rate of breastfeeding initiation than those who were ≤30 years old, older maternal age was actually negatively associated with breastfeeding initiation after we controlled for other characteristics.

Predictors of not Eating Solid Foods at 4 Months

Overall, 41% of the infants were consuming solid foods at 4 months of age (Table 2). Adherence to the recom-

FIGURE 2

Type of infant feeding according to age. The number of groups of solid foods consumed by the infants indicates the number of food groups (cereal, meat and meat substitutes, and fruits and vegetables) from which infants consumed at least 1 serving per day. All other categories were based on consumption at least once during the previous week among the infants who did not consume foods from any food group on a daily basis.

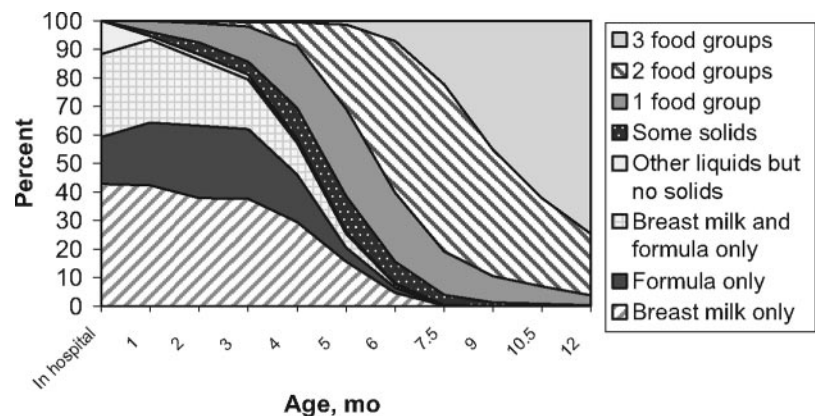


TABLE 2 Percentage of Infants Who Engaged in Selected Feeding Practices at Various Ages, According to Maternal Demographic Characteristics and Previous Feeding Practices, With Adjusted Odds Ratios for Categories Within Each Variable

Variable	Breastfed in Hospital			No Solids at 15–18 wk (4 mo)			Breastfed at 24–28 wk (6 mo)			3 Foods Groups Fed Daily at 36–42 wk (9 mo)			No Fatty/Sugary Foods at 51–59 wk (1 y)		
	n ^a	%	aOR ^b	n ^a	%	aOR ^b	n ^a	%	aOR ^b	n ^a	%	aOR ^b	n ^a	%	aOR ^b
Total	2907	83.3	—	2086	58.5	—	2046	50.2	—	1916	45.3	—	1782	33.8	—
Maternal characteristics															
Age, y															
18–24	672	79.0	—	417	40.3	—	385	31.2	—	340	47.7	—	291	28.9	—
25–29	972	86.7	1.07	700	61.0	1.46 ^c	686	53.8	1.33	634	43.4	0.83	607	31.6	0.91
30–34	808	82.2	0.65 ^c	609	63.9	1.47 ^c	613	55.1	1.10	587	44.1	0.94	539	36.6	1.38
≥35	450	84.7	0.73	357	65.8	1.59 ^c	360	55.3	1.11	353	48.2	1.12	344	37.5	1.53
Parity															
Primiparous	815	87.1	—	584	54.8	—	566	41.5	—	534	45.1	—	507	39.5	—
Multiparous	2019	82.0	0.67 ^c	1459	60.5	1.23	1441	54.3	1.45 ^c	1350	45.3	1.05	1245	31.5	0.68 ^c
Education															
HS graduate or less	562	72.4	—	382	42.2	—	375	36.0	—	331	45.9	—	295	26.4	—
Some college	1067	85.7	2.08 ^c	747	55.7	1.49 ^c	713	45.7	1.04	668	43.7	0.88	606	32.0	1.02
College graduate	1042	89.6	2.82 ^c	836	71.5	2.42 ^c	846	64.0	1.96 ^c	819	45.9	1.18	786	37.5	0.97
Income, % of federal poverty level															
<185	1221	79.4	—	839	51.9	—	799	44.6	—	729	44.0	—	648	28.2	—
185–350	1041	84.7	1.09	735	60.1	0.76 ^c	740	55.1	0.79	694	47.3	1.00	667	33.6	1.00
≥350	645	88.5	0.99	512	67.2	0.79	507	51.7	0.41 ^c	493	44.2	0.97	467	42.0	1.09
WIC participant															
No	1803	87.9	—	1325	66.2	—	1311	59.3	—	1263	45.7	—	1192	35.7	—
Yes	1104	75.8	0.59 ^c	761	45.2	0.60 ^c	735	33.9	0.46 ^c	653	44.4	0.87	590	30.2	0.92
Race															
White	2388	82.6	—	1749	59.5	—	1730	51.5	—	1621	45.7	—	1508	33.4	—
Black	135	80.7	1.19	80	37.5	0.61	67	35.8	0.84	66	36.4	1.03	59	30.5	1.27
Hispanic	171	90.1	1.79 ^c	112	55.4	0.89	107	42.1	0.54 ^c	104	51.0	1.69	97	38.1	2.18 ^c
Region															
Northeast	502	78.1	—	373	57.9	—	390	48.5	—	358	45.3	—	346	36.4	—
Midwest	877	80.8	1.27	637	57.3	1.00	624	47.0	0.87	585	49.9	1.19	560	34.8	1.01
South	942	82.7	1.50 ^c	663	53.4	1.02	623	45.3	0.98	586	42.8	0.89	532	29.1	0.80
West	586	92.5	3.57	413	69.3	1.51 ^c	409	64.1	2.12 ^c	387	41.9	0.89	344	36.9	1.33
Previous feeding															
Breastfed in hospital															
No	—	—	—	327	35.8	—	—	—	—	—	—	—	—	—	—
Yes	—	—	—	1668	63.1	2.75 ^c	—	—	—	—	—	—	—	—	—
Fed solids at 15–18 wk															
No	—	—	—	—	—	—	1017	65.8	—	985	39.4	—	917	38.0	—
Yes	—	—	—	—	—	—	658	30.2	0.29 ^c	614	53.9	1.95 ^c	572	25.2	0.53 ^c
Breastfed at 24–28 wk															
No	—	—	—	—	—	—	—	—	—	820	46.8	—	733	31.4	—
Yes	—	—	—	—	—	—	—	—	—	882	43.1	1.04	820	34.6	0.88
Fed 3 foods groups daily at 36–42 wk															
No	—	—	—	—	—	—	—	—	—	—	—	—	858	37.4	—
Yes	—	—	—	—	—	—	—	—	—	—	—	—	707	29.6	0.78
–2 log likelihood	2017.861			2150.496			1756.855			1757.931			1359.183		

— indicates variable or category not included in model.

^a Sample size within each demographic category may not add to the total because of missing data.

^b Adjusted odds ratios (aORs) were adjusted for all demographic and previous feeding variables shown.

^c $P < .05$.

mendation to not introduce solid foods before their infants were 4 months was more common among college-educated mothers, mothers >25 years old, and those living in the western region of the country and less common among WIC participants. Although the mothers with higher income seemed to be more likely to follow this recommendation, the association between income and adherence to this recommendation was actually negative after we adjusted for other characteris-

tics. The infants who were initially breastfed were far more likely to have solids introduced after 4 months than those who were fed only infant formula in the hospital.

Predictors of Continued Breastfeeding at 6 Months

Although primiparous mothers were more likely than multiparous mothers to initiate breastfeeding, they were less likely to still be breastfeeding when their infants

were 6 months of age (Table 2). Also, although the rates of breastfeeding at 6 months were higher among college-educated mothers and those who were not WIC participants, family income was actually negatively associated with breastfeeding rates at 6 months after we controlled for these 2 factors. We also found that Hispanic mothers were more likely to initiate breastfeeding but were less likely to continue it for 6 months than white mothers, that mothers living in the western region of the country had the highest rate of breastfeeding initiation and the highest rate of breastfeeding at 6 months, and that mothers who began feeding their infants solids by 4 months were far less likely than those who did not to be breastfeeding when their infants were aged 6 months.

Predictors of a Varied Diet at 9 Months

By the age of 9 months, 45% of the infants consumed at least 1 serving per day of food from each of 3 food groups (cereals, fruits and vegetables, and meats or meat substitutes) (Table 2). The introduction of solids by 4 months was the only factor we found to be significantly associated with the infants' consumption of a varied diet at 9 months.

Predictors of not Consuming Fatty or Sugary Foods at 1 Year of Age

At the age of 1 year, only one third of the infants were reported to have refrained from sweetened drinks, French fries, cookies, cakes, or candies in the previous week (Table 2). Refraining from fatty or sugary foods was less common among infants with at least 1 older sibling, more common among Hispanic infants than among white or black infants, and less common among those introduced to solid food by 4 months of age than among those who were not.

DISCUSSION

In this study, we documented the dramatic transitions in dietary consumption that occurred among infants during their first year. The transition from a diet of virtually nothing but breast milk, infant formula, or both to a varied diet of foods from all food groups began for most infants at ~4 to 5 months of age and continued throughout their first 12 months. Infant cereal was usually the first food other than milk or formula given to infants and remained the most common supplementary food until infants were ~8 months of age. Fruits and vegetables were introduced at a median age of 5 to 6 months, and meats were introduced at a median age of ~8 months. By 1 year of age, more than half of the infants were consuming a diet that included not only cereals, fruits, vegetables, meats, and milk products but also foods high in sugar or fat but low in nutrient density.

Several of the infant feeding patterns that we found are cause for concern. For example, we found that the diets of almost half of the breastfed infants were supplemented with infant formula while the infants were still in the hospital. Although one might expect breastfeeding women to turn to infant formula as a supplement to breast milk when they return to work or other activities, there is no medical reason for most infants to be given

formula while they are in the hospital.⁹ The AAP recommends that breastfed infants be given formula in the hospital only when medically necessary, because early supplementation can lead to later problems with breastfeeding.²

The AAP Section on Breastfeeding and the Committee on Nutrition agree that introduction of solid foods should not occur any earlier than 4 months of age. In this study, we found that 41% of the infants were already consuming solid foods at 4 months of age, the beginning of the window recommended by the AAP Committee on Nutrition¹ and well before the age for introducing solid food recommended by the AAP Section on Breastfeeding.² Not only do infants not need solid foods before 4 months,¹ but the consumption of solid foods exposes infants to additional pathogens and solid foods do not provide the immunologic benefits of the breast milk they replace.² We demonstrated here that early introduction to solid foods is also a risk factor for both earlier cessation of breastfeeding and increased consumption of fatty or sugary foods at 1 year of age. Our finding that so many infants were consuming solid foods at such a young age indicates that physicians may need to provide clearer guidance to parents about when to introduce their infants to solid food and the risks of starting too early.

Although we found that cereal was typically introduced into the infants' diet quite early, most infants were not introduced to meat until they were ~8 months of age. Because fetal iron and zinc stores are typically depleted by ~6 months of age,¹⁰ good sources of bioavailable iron and zinc need to be among the first solid foods given to breastfed infants. Unfortunately, the bioavailability of the iron compounds commonly used in infant cereal is relatively low,¹¹ and although some infant cereals are now fortified with zinc in addition to iron, the bioavailability of the zinc in these cereals has not been reported. Early introduction of meat has the advantage of providing a good source of iron and zinc in a highly bioavailable form,^{1,12,13} and pureed meats have been shown to be well tolerated by infants as a first complementary food.¹⁴

Approximately two thirds of the infants in our study were consuming high-fat/high-sugar foods at 1 year of age. These foods provide high amounts of calories but are poor in nutrient content. The nutritional requirements of older infants leave little room in their diet for such foods.³ Given the increasing prevalence of obesity among children and infants,¹⁵ it is important that infants establish healthy eating behaviors as early as possible. Although children's eating patterns can change over time, researchers have shown that healthy eating patterns begun early in life form a foundation that may continue for many years¹⁶; unfortunately, the same has been shown to be true of unhealthy eating patterns.³ Counseling parents of infants about the importance of good nutrition could help increase the number of infants who establish healthful eating habits and, thus, reduce their risk for obesity and other chronic diseases that have been linked to diet.

This study suffers from some key limitations. Al-

though the sample was drawn from across the country, minority groups were underrepresented, the educational level of participants was higher than the national average,⁶ and study participants had to be English-speaking and have a literacy level high enough to complete the questionnaires. In addition, only mothers who were willing to complete a series of monthly questionnaires were included, creating an unknown bias in the sample. The sample at the end of the study was further biased in favor of women with higher socioeconomic status, because those who dropped out of the study between the neonatal questionnaire and the 12-month questionnaire were more likely to be younger, to be less educated, to have lower income, to be participating in WIC, to be nonwhite, and to live in the southern region. In addition, we were unable to estimate the nutrient intake of the infants (because the IFPS II data on infant feeding did not include information on serving size) or to precisely characterize the infants' diets (because of the broad food categories asked about in the IFPS II questionnaires).

However, the study also has some key strengths. To our knowledge, the IFPS II was the largest study of infant feeding conducted in the United States, with >3000 infants sampled in the neonatal period and nearly 1800 followed through 12 months of age. Although an earlier study conducted beginning in 1992 collected detailed longitudinal information about the diets of infants beginning at 2 months of age, only 98 infants were followed.¹⁷ The National Health and Nutrition Examination Survey, which is used to monitor the diets of all Americans, includes only a cross-sectional sample of ~500 infants every 2 years. Because the IFPS II followed infants longitudinally from birth through 1 year of age with questionnaires sent to their mothers nearly every month, we were able to characterize changes in infants' diets on a nearly monthly basis and to assess associations between feeding behaviors at 1 time during infancy with feeding behaviors at later times. In addition, because the IFPS II asked mothers about feeding over the previous 7 days, it minimized the risk for recall error that is typically a problem with retrospective reporting of infant feeding other than breastfeeding.¹⁸

CONCLUSIONS

In this study, we identified several infant feeding practices of concern, including substantial formula supplementation in the hospital, early introduction of solid foods, late introduction of meats, and feeding of high-fat/high-sugar foods to infants. Because of their frequent contact with infants and their parents, clinicians have a unique opportunity to advise new parents about recommended infant feeding practices. By being aware of these infant feeding recommendations and communicating them to parents, clinicians can help start children on the road to a healthy lifestyle.

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