

Feeding Infants and Toddlers Study: Improvements Needed in Meeting Infant Feeding Recommendations

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ABSTRACT

Objective To assess adherence to infant feeding recommendations among a sample of infants and toddlers four to 24 months of age in the United States.

Design Descriptive analysis of data collected in the 2002 Feeding Infants and Toddlers Study (FITS) based on telephone interviews and 24-hour dietary recalls collected with the Nutrition Data System for Research of the University of Minnesota.

Subjects A national random sample of 3,022 infants and toddlers age four to 24 months, including 2,024 infants age four to 11 months.

Main Outcome Measures Breastfeeding, timing of introduction of complementary foods, and adherence to infant feeding recommendations.

Statistical Analysis Means and standard errors, percentile distributions, and percentages by age group (four to six months, seven to eight months, and nine to 11 months).

Results About 76% of infants and toddlers were fully or partly breastfed at birth. This percentage declined to 30% at six months and 16% at 12 months—short of Healthy People 2010 goals of 50% and 25%, respectively. The average duration of breastfeeding was 5.5 months for all who initiated breastfeeding. About two-thirds of infants had been introduced to complementary foods between four and six months—the period recommended by the American Academy of Pediatrics (AAP); 17% consumed juice before the AAP recommended age of six months or later. Twenty-two percent of infants nine to 11 months consumed cow's milk on a daily basis before the recommended age of 12 months or later, and one in 10 consumed french fries and/or sweetened beverages on any given day.

Applications/Conclusions More parents and caregivers can benefit from guidance about the introduction of developmentally appropriate, micronutrient-rich first solid foods such as iron-rich infant cereals, iron-fortified grain products, meats, soft fruits, and cooked vegetables and the importance of breastfeeding through the first year of life.

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A smaller proportion of parents and caregivers require guidance on delaying the introduction of juices until six months of age and cow's milk other than formula until one year of age.

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Feeding patterns during infancy are important to growth and development and may affect preferences and eating habits later in childhood (1-4). Most infants consume only a liquid diet for the first two or three months of life and begin to consume complementary foods during the 4 to 6 month age period (2,5). Complementary foods such as infant cereals and pureed baby foods provide additional energy and nutrients and expose the infant to new tastes and textures during the transition from a liquid diet of breast milk or infant formula to the family diet (2). Table foods and other beverages replace breast milk or infant formula as the primary energy source as infants approach their first birthday (5).

Recommendations for infant feeding by the American Academy of Pediatrics (AAP) target breastfeeding; use of infant formula; and timing of the introduction of solid foods, cow's milk, and juices (Table 1). The American Dietetic Association and the Surgeon General also recommend breastfeeding for the first six months after birth (4,9). National public health objectives for 2010 related to infant and toddler nutrition include (a) "increase the proportion of mothers who breastfeed their babies to 75% in the early postpartum period, 50% at six months, and 25% at 12 months"; and (b) "reduce iron-deficiency among children aged one to two years to 5%" (3).

The Feeding Infants and Toddlers Study (FITS) was designed to update our knowledge of food and nutrient intake, growth and motor development, and feeding patterns of American infants and toddlers age four to 24 months. This paper describes infant feeding patterns including breastfeeding status and the use of infant formula and transitions in infant feeding from breast milk and infant formula to complementary foods, table foods, and other beverages and assesses adherence to AAP infant feeding recommendations. Another paper in this series focuses on the relationship of the transition from baby foods to table foods to the food and nutrient intakes of older infants and toddlers (10).

METHODS

The study population of 3,022 included 2,024 infants four to 11 months of age and 998 toddlers 12 to 24 months of age selected for participation in the FITS. The sample sizes by age group were four to six months (n=862), seven to eight months (n=483), nine to 11 months (n=679), and 12 to 24 months (n=998). To assess adherence to recommendations with cutoff levels of six months of age, some

Table 1. American Academy of Pediatrics' infant feeding recommendations

Breastfeed exclusively for approximately the first 6 months, continue until 12 months (1).
Supplement breastfed infants with iron after four to six months (1,6).
Iron-fortified infant formula is an appropriate substitute for breastfeeding in the first year (6).
Introduce solid foods when the infant is developmentally ready, typically in the four to six month age range (5).
Juices may be introduced in the diet of infants after six months of age; if introduced, 100% juices should be used, and juice should be limited to four to six ounces daily (7).
Delay the introduction of cow's milk until one year of age; cow's milk should be whole milk during the second year of life (8).

data in this paper are presented for infants age four to 5.9 months rather than the study's usual age group (four to six months). Although the sample was designed to recruit four- to six-month-old infants, 18% (n=157) had not reached four months of age when they were surveyed. Complete details of the study's sample design and data collection were described by Devaney and colleagues (11).

About 79% of the sample was non-Hispanic white, 7% non-Hispanic black, 9% Hispanic, and 5% multiracial or of "other" or unknown race (unweighted estimates). About 48% of the sample were first-born children, about 55% of their mothers worked outside the home, and 10% lived in a low-income household (unweighted estimates). (Note: Low-income was defined as a household income at or below 130% of the poverty line (12), the federal cutoff for income eligibility for the Food Stamp Program.)

The parent or primary caregiver was interviewed by trained telephone interviewers about the selected child's feeding history, developmental stage, and family sociodemographic characteristics. The introduction of specific food items (infant formula, infant cereals, pureed baby foods, and cow's milk) was defined by the parent's or caregiver's response to feeding the item "on a daily basis." For this study, exclusive breastfeeding was defined as consuming only breast milk and no supplemental infant formula, cow's milk, or other foods (except water), as reported by the parent or caretaker, and verified with the 24-hour dietary recall. Exclusively breastfeeding infants may have consumed water. There were 111 infants (out of 862) infants six months and younger, and four infants age seven months, who were exclusively breastfeeding at the time of the study.

Following the initial telephone interview, but prior to the follow-up telephone interview, a food measurement aid was mailed to parents and caretakers to collect a 24-hour dietary recall. Trained telephone interviewers fluent in English and Spanish used the University of Minnesota's Nutrition Data System for Research (NDS-R) to collect dietary intakes (13). This paper uses information collected during the recruitment and follow-up interviews and the one-day dietary intake data. The percentage of infants consuming specific food items are reported within broad categories of food groups: milk and milk products, commercially prepared baby foods, juices and other beverages, vegetables, meat and other protein sources, grains and grain products, and dessert items.

Sample weights were calculated to account for nonresponse and to weight the sample to known population demographic characteristics. Estimates were calculated using the Statistical Analysis System, version 8.2 (SAS Institute, Inc., February 2001, Cary, NC) and the appropriate sample weights.

RESULTS

Tables 2 and 3 present descriptive information on the initiation and duration of breastfeeding, use of infant formula, and timing and introduction of complementary foods and cow's milk in the FITS population. Table 4 and Figure 1 present information on the consumption of types of milk (breast, infant formula, and cow's), pureed baby foods, and selected foods and beverages based on the 24-hour dietary recall data.

Breastfeeding

Table 2 presents the prevalence of breastfeeding and use of infant formula and cow's milk among infants and toddlers. About three-fourths of children age four to 24 months had been breastfed, and 7% of toddlers age 12 to 24 months were currently breastfeeding based on information collected during the interview. There was a high level of agreement in breastfeeding rates between the interview and the 24-hour dietary recall. Among all infants and toddlers in the study, the rate of current breastfeeding was 17% based on the interview and 16% based on 24-hour dietary recall.

Among toddlers who had stopped breastfeeding, their average breastfeeding duration was 5.5 months (median, 4.5 months). About 30% of infants were still breastfeeding at six months of age, 16% at 12 months of age, and 4% at 24 months (data not shown). Almost all of the exclusively breastfed infants were under six months of age, representing 17% of infants age four to 5.9 months and 1% of infants age six to eight months (Table 3).

Breastfeeding rates at birth were higher for white (77%) than for black (66%) newborns. Breastfeeding rates also were higher for first-born infants and infants of mothers who were married, had a higher education level, and a higher household income level. Among four- to six-month-old infants, current breastfeeding rates were higher for infants of nonworking mothers (50%) than for mothers who worked outside the home (33%) (data not shown).

Use of Infant Formula and Cow's Milk Among Breastfed Infants

Among all children who were currently breastfeeding, 59% had been fed infant formula and 25% had been fed cow's milk at some point in time "on a daily basis" (Table 2). Among currently breastfeeding infants age four to 5.9 months, 52% had also been fed formula on a daily basis. This percentage increased to 65% to 70% of breastfeeding infants at six to 11 months of age. Among toddlers who were still breastfeeding, 54% had been fed formula, indicating slightly lower formula use among children breastfed longer than one year. However, nine out of 10 infants who were ever breastfed had also been fed infant formula.

Use of Infant Formula

Infant formula is used as both a primary source of nutrition for young infants and to supplement breastfeeding. About 80% of infants age four to 5.9 months and over 90%

Table 2. Breastfeeding status and use of formula and cow's milk^a

	Age 4-5.9 mo		Age 6-8 mo		Age 9-11 mo		Age 12-24 mo		Total age 4-24 mo		
	%	SE	%	SE	%	SE	%	SE	N	%	SE
Ever breastfed	81	1.6	79	1.5	77	1.6	74	1.4	2,336	76	0.8
Currently breastfeeding	43	2.0	27	1.7	21	1.6	7	0.8	686	17	0.7
Currently exclusively breastfeeding ^b	17	1.5	0.7	0.3	0		0		115	2	0.3
Ever fed infant formula	79	1.6	92	0.1	92	1.1	92	0.9	2,684	90	0.5
Ever fed cow's milk	1	0.5	7	0.9	33	1.8	94	0.8	1,188	60	0.9
Sample size	636		709		679		998		3,022		

Data from 2002 Feeding Infants and Toddlers Study.
^aBased on information collected in the parent/caregiver interview.
^bDefined as consuming no other foods or beverages except water.

Table 3. Introduction of specific foods among all toddlers 12 months and older

Food item	When food item was introduced ^a										
	Ever fed the food item		Never introduced, or not on a daily basis				Introduced at some age between birth and current age		Age that food item was introduced (mo)		Age range that food item was first introduced
	%	SE	Since birth	SE	%	SE	%	SE	Mean	SE	
Infant formula	95	0.7	36	1.6	5	0.7	54	1.6	2.4 ^b	0.10	0-14
Infant cereal	98	0.4	N/A		2	0.4	97	0.5	4.6	0.06	0.2-15
Pureed baby food	99	0.4	N/A		1	0.4	97	0.5	5.5	0.06	0.9-18
Cow's milk	97	0.6	N/A		3	0.5	90	1.0	11.8	0.06	1-18

Data from 2002 Feeding Infants and Toddlers Study.
^aDefined as "fed on a daily basis" based on responses during the parent/caregiver interview.
^bThe mean age of introduction of infant formula for those not introduced to formula at birth is 3.9 months (SE, 0.13).

of older infants and toddlers had been fed infant formula on a daily basis (Table 2). About 36% of toddlers were fed infant formula from birth, and 54% of all infants were fed infant formula beginning later in infancy, at a mean age of 3.9 months (SD, 3.0) (Table 3).

Over 90% of all infant formula consumed by infants and toddlers was iron-fortified (Table 4). About 10% of all infant formula consumed was soy based (90% of soy formula was also iron fortified, data not shown). The most common form of infant formula used was powdered. Only about 1% to 2% of infants consumed formulas high in n-3 fatty acids.

Timing of the Introduction of Cow's Milk

The introduction of cow's milk was uncommon for young infants. One percent of those age four to 5.9 months and 6% of those age six to eight months had been fed cow's milk (Table 2). However, 33% of nine- to 11-month-old infants had been fed cow's milk (Table 2), and about 20% of toddlers were introduced to cow's milk "on a daily basis" before one year of age (Table 3).

Cow's milk was introduced "on a daily basis" at a mean age of 11.8 months (Table 3). The median age of introduction of cow's milk was 12 months, and there was no

significant difference in the timing of introduction by ethnicity or poverty level. Based on the 24-hour dietary recalls, 22% of infants age nine to 11 months consumed cow's milk at least once in a day (Table 4). Three-fourths of the milk was whole milk, and almost one-fourth was reduced fat or low-fat milk.

Timing of the Introduction of Solid Foods

About 29% of all infants were introduced to infant cereals or pureed foods before four months of age, and 6% were introduced to them after six months of age. Table 3 presents information on the timing of the introduction of complementary foods. This analysis was limited to toddlers 12 months and older to ensure that nearly all (95% to 99%) were past the age when these food items are typically introduced. Infant cereal was introduced, on average, at 4.6 months of age, but as early as one week and as late as 15 months (with a median age of four months). There were no significant differences in the mean age of introducing cereal, pureed foods, or cow's milk by income level or ethnicity. However, in concert with lower rates of breastfeeding, infant formula was introduced at an earlier age among infants at or below the poverty level compared with those above the poverty

Table 4. Percentage of infants consuming food item at least once in a day

Food item	4-6 mo	7-8 mo	9-11 mo
Milk and milk products (% consuming)			
Breast milk	40	26	21
Infant formula-total	74	82	75
Iron-fortified formula	69	75	66
Lipil or similac advanced	<1	<1	2
Cow's milk-total ^a	<1	3	20 ^a
Reduced-fat cow's milk	<1	<1	5
Cheese, yogurt	1	6	29
Commercially prepared baby foods (% consuming)			
Jarred baby foods, total ^b	73	95	87
Organic baby foods ^c	5	12	11
Fruits ^b	39	68	45
Vegetables ^b	36	55	34
Meats ^b	2	4	3
Jarred dinners	10	40	34
Jarred desserts	4	18	17
Juices and other beverages (% consuming)			
100% juice-vegetable or fruit	22	46	56
Sweetened beverages ^d	<1	8	11
Water, total ^e	34	56	67
Grains, grain products, and desserts (% consuming)			
Infant cereal, dry and jarred	65	81	64
Ready-to-eat cereal (adult)	<1	18	39
Hot cereal (adult)	<1	1	8
Baby baked snacks ^f	3	17	18
Crackers, pretzels, rice cakes	3	16	33
Sample size	862	483	679
Data from 2002 Feeding Infants and Toddlers Study. Based on 24-hour dietary recall data.			
^a Includes goat's milk.			
^b Commercial baby foods only; estimates do not include table foods (fruits, vegetables, or meats). Includes jarred toddler food.			
^c Baby foods marketed or labeled as organic.			
^d Includes fruit-flavored drinks, carbonated beverages, and other sweetened beverages such as iced tea.			
^e Includes tap, bottled, mineral and carbonated water.			
^f Includes animal crackers, teething biscuits, zwieback, and arrowroot baby cookies.			

level (mean=1.4 months vs 2.4 months, $P<.05$) (data not shown).

The median age and the distribution of age when infant cereals, pureed baby foods, and cow's milk were introduced for toddlers who were ever breastfed were also investigated. In general, the median age of introduction of these food items was not significantly different for children who were ever breastfed compared with those who were never breastfed.

Transitions in Food Patterns During Infancy

The 24-hour dietary recall data that provided a direct measure of the infants' food consumption by age were used in combination with the retrospective reporting by parents and caretakers to study transitions in infant feeding patterns. Table 4 and Figure 1 provide information on the percentages of infants who consumed broad

categories of foods with a special focus on milk sources (breast milk, infant formula, and cow's milk), commercially prepared baby foods, juices and other beverages, and infant cereals and other grain products. (Other papers in this series provide greater detail on infants' consumption of foods and beverages [14,15].)

From Four to Six Months. Formula and breast milk were the major milk sources and the major contributors to energy in the diets of infants four to six months of age. Among infants age four to six months, 74% were consuming infant formula and 40% were consuming breast milk (Table 4). During the four- to six-month stage, infants were introduced to infant cereals and pureed baby foods (mostly fruits and vegetables). About 73% of infants age four to six months consumed commercial baby foods with a mean of 187 grams in a day for consumers (or approximately 1.5 jars sized four oz per jar). About 65% of infants in this age group consumed infant cereals, an important source of energy, iron, and zinc; dry infant cereals provided about 7% of the energy intake of infants age four to six months. Typically, the instant form of cereal reconstituted with water, formula, or breast milk was used. About 22% of infants age four to six months consumed juice, with a mean amount for consumers of 126 grams (about four fluid oz) of 100% fruit juice in a day. In comparison, the figure most relevant to the AAP recommendation on delaying juice consumption until six months of age (7) was 17% for infants age four to 5.9 months.

From Seven to Eight Months. About 82% of infants age seven to eight months consumed formula, and 26% consumed breast milk (Table 4). Within this age group, the percentage of infants consuming infant cereals peaked, with a prevalence of 81%. Infant cereals, of which 94% was in the dry form, provided an average of 9% of energy across all infants age seven to eight months. Commercial baby foods were consumed by 95% of infants age seven to eight months and provided about 20% of total food energy, on average, across all infants age seven to eight months. About 12% of this age group consumed baby foods marketed or labeled as "organic." Consumption of 100% juices increased to 46% of infants in this age group, and jarred meats were consumed by only 4%. Finger foods, snacks, and sweets appeared in the diets of infants by age seven to eight months. About 16% consumed snacks such as crackers, pretzels, and rice cakes. About one-fifth of this age group consumed finger foods such as ready-to-eat cereals and baked baby snacks (including zwieback and teething biscuits).

From Nine to 11 Months. Three-fourths of infants age nine to 11 months consumed formula; one-fifth consumed breast milk, and one-fifth consumed cow's milk, typically whole milk (Table 4). For this age group, the percentage consuming commercial baby foods remained high (87% of all infants). About one in 10 in this age group consumed organic baby foods. Infant cereal consumption remained high (64%), providing 7% of daily energy across all infants in the age group. Consumption of ready-to-eat cereals increased to 39% of all infants age nine to 11 months.

Commercial baby foods and juices provided 16% of daily food energy as infants approached their first birthday, and table foods were introduced and contributed 25% of energy (data not shown). Consumption of juices increased to slightly more than half of infants in this age group (56%), and jarred dinners were consumed by 34%.

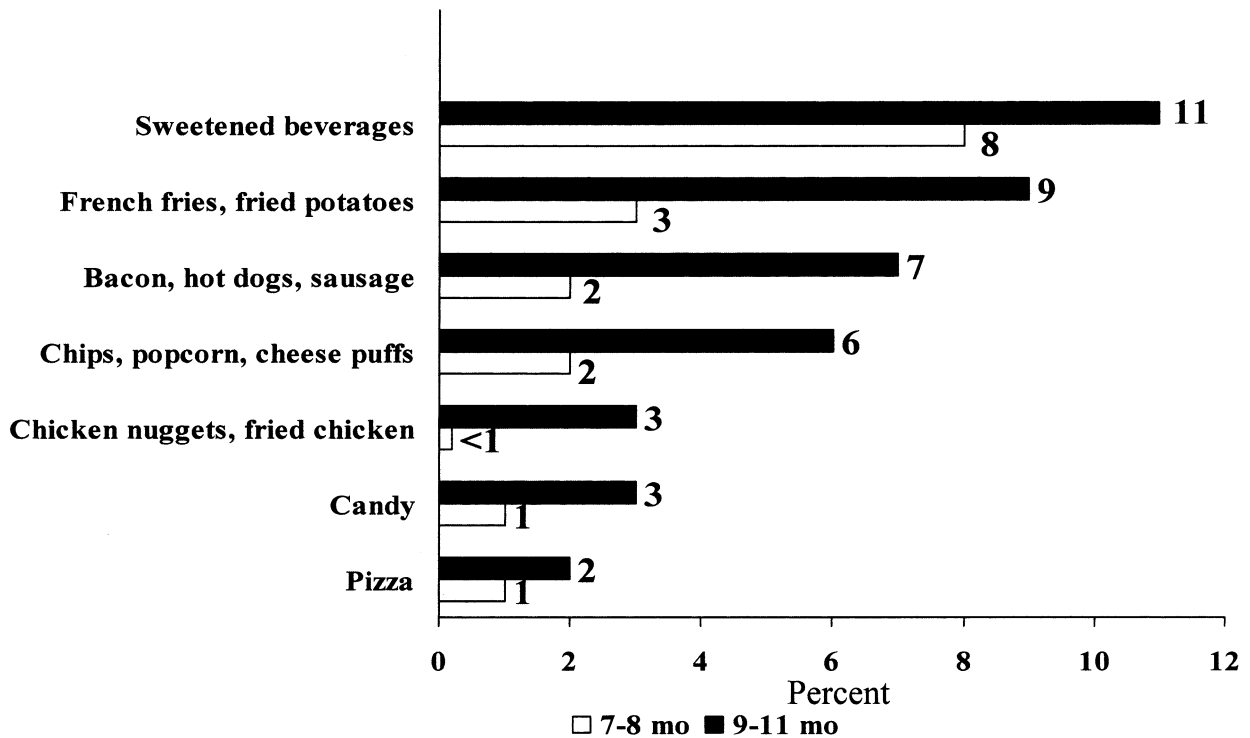


Figure 1. Percentage consuming selected foods at least once in a day. (Data from 2002 Feeding Infants and Toddlers Study. From the 24-hour dietary recall data.)

For the nine- to 11-month age group, snacks and sweets were consumed by a larger percentage of infants than by those in the younger age groups.

One-third of infants age nine to 11 months consumed snack items such as crackers, pretzels, and rice cakes, and about 40% consumed baked goods such as cakes, cookies, pastries, pies, and baby baked items (data not shown). Popular table food and beverage items that are high in fat, sugar, or salt were each consumed by 2% to 11% of infants nine to 11 months of age on any given day (Figure 1). For example, on average, 11% consumed carbonated drinks or other sweetened beverages; 9% consumed french fries or fried potatoes; and 7% consumed bacon, sausage, or hot dogs. These same items were consumed by about 2% to 8% of infants age seven to eight months, indicating an increase in the percentage of infants consuming these particular food items with increasing age.

DISCUSSION

The FITS provides new and important information on the percentages of infants and toddlers who met infant feeding recommendations. Breastfeeding rates for this study are similar to estimates from a large study of mothers conducted in 2001, and provide evidence of a sustained increase in the initiation of breastfeeding since the 1980s and early 1990s (3,16). Ryan and colleagues reported 2001 breastfeeding rates of 70% at birth and 32% at 6 months, compared with 76% and 30%, respectively, in the FITS (16). A study conducted by Ross Laboratories in 1998 found that 64% were breastfeeding in the postpartum period, 29% at 6 months, and 16% at 12 months (3).

Previous population-based national surveys found

lower overall rates of initiating breastfeeding than the FITS, but they also show increases in rates over time. For example, the 1988 to 1994 National Health and Nutrition Examination Survey found that 55% of children 4 months to 6 years of age had been breastfed (17), compared with 65% of children ages 19 to 35 months in the 2001 National Immunization Survey (18). In 2001 National Immunization Survey, 27% and 12% were still breastfeeding at six and 12 months, respectively, compared with 30% and 16% in the FITS (18). Given different populations and methods, an overview across studies suggests that breastfeeding rates have likely increased since the 1990s. However, additional progress is needed to reach public health goals for continued breastfeeding (50% at six months and 25% at 12 months) (3).

Beginning at about 6 months of age for full-term infants, dietary iron is needed to prevent iron deficiency and iron deficiency anemia and to support cognitive and motor development (3,4,6,19). The timely introduction of iron-rich complementary foods is especially important for breastfeeding infants (20,21). Formula-fed infants receive adequate iron if they are fed iron-fortified formula. The risk of iron deficiency is increased among infants consuming cow's milk (about one-fifth of the nine- to 11-month-old infants) or, to a lesser extent, infant formula that is not fortified with iron (6). Although the FITS data indicate that infants have adequate iron intakes overall (22), increased attention to iron intake would be warranted if breastfeeding rates were higher and breastfeeding continued longer than the average 5.5 months. Iron-fortified infant cereals, iron-fortified grain products, and meats are important sources of iron for all infants and especially for those who breastfeed past six months (6,19).

Infants must be developmentally ready to accept solids before infant cereals are introduced (that is, the baby can lift the head, sit with support, and turn the head to indicate that he or she has had enough food) (2,5). The introduction of solid foods before the infant is developmentally ready may delay the timely appearance of other feeding developmental milestones (5). The FITS data indicate that two-thirds of infants were introduced to complementary foods during the period when most infants exhibit developmental readiness (four to six months) (2,5). About three out of 10 infants began solids before four months, and a small fraction (one out of 20) began after six months.

In general, patterns of the timing of introduction of infant cereals and pureed foods have changed little since the 1990s. National data collected during the 1988 to 1994 National Health and Nutrition Examination Survey found that solid foods were introduced to about 25% of children before four months of age, compared with 29% in the FITS study (17). The FITS findings on the introduction of complementary foods are similar to findings of the study conducted by Gerber Products Company in 1994 (23,24). Although the dietary methods differ between these two studies sponsored by the same company (the 1994 study used four-day food records [23]), broad conclusions about the timing and contributions of complementary foods to daily energy intake can be made.

Although most parents and caregivers followed the AAP recommendation to delay cow's milk until 12 months of age (8), about 5% of all infants age nine to 11 months were fed low-fat or reduced-fat milk. Fat should not be restricted in the diets of infants and toddlers because fat restriction has been associated with failure to meet recommended intakes of many nutrients (25,26). Practitioners should encourage parents and caregivers to delay whole cow's milk until the infant is 12 months of age and to avoid reduced-fat milk through two years of age (8).

About 83% of parents and caregivers followed the AAP's recommendation to delay the introduction of juices until six months of age. National dietary data show that the intake of 100% fruit juices declines in the preschool years, whereas that of fruit drinks and carbonated soft drinks increases as children age (27). Parents and caregivers should be cautioned about overfeeding juices and juice drinks, which can lead to excessive calorie intake, and to offer more nutritive beverages at meal and snack time (7,15,26,27) and water to quench thirst between times.

When table foods are introduced to infants' diets, areas of potential concern for the development of healthy eating habits include the offering of sweetened beverages and popular food items that are high in calories, especially fat or sugar. Some appropriate finger foods include soft fruits, well-cooked vegetables, jarred diced fruits and vegetables, and easily dissolvable, fortified grain products such as some ready-to-eat cereals and grain-based baby snacks (28,29). Items that are high in calories and low in nutrient density are inappropriate for infants in this age group, a time of life when micronutrient needs are high. These areas of concern are explored elsewhere in more detail (10,14,15).

APPLICATIONS

The first year after birth is the time when habits and preferences are beginning to be formed, and it is important to begin to foster healthy eating habits early. Most

parents and caregivers can benefit from guidance about the following: (a) introducing appropriate first solid foods such as iron-fortified infant cereals and meats when the infant is developmentally ready, (b) offering a healthy variety of foods such as soft fruits, cooked vegetables, soft cheeses, and fortified grain products in place of energy-dense, but micronutrient-poor items, and (c) breastfeeding as long as possible throughout the first year. About two out of 10 parents and caregivers of infants need guidance about delaying whole cow's milk until 12 months of age and juices until six months of age and avoiding high-calorie sweetened beverages and reduced-fat cow's milk.

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