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## Dietary and Complementary Feeding Practices of US Infants, 6 to 12 Months: A Narrative Review of the Federal Nutrition Monitoring Data

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### STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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## Abstract

Complementary foods and beverages (CFBs) are key components of an infant’s diet in the second 6 months of life. This article summarizes nutrition and feeding practices examined by the 2020 Dietary Guidelines Advisory Committees during the CFB life stage. Breastfeeding initiation is high (84%), but exclusive breastfeeding at 6 months (26%) is below the Healthy People 2030 goal (42%). Most infants (51%) are introduced to CFBs sometime before 6 months. The primary mode of feeding (ie, human milk fed [HMF]; infant formula or mixed formula and human milk fed [FMF]) at the initiation of CFBs is associated with the timing of introduction and types of CFBs reported. FMF infants (42%) are more likely to be introduced to CFBs before 4 months compared with HMF infants (19%). Different dietary patterns, such as higher prevalence of consumption and mean amounts, were observed, including fruit, grains, dairy, proteins, and solid fats. Compared

with HMF infants of the same age, FMF infants consume more total energy (845 vs 631 kcal) and protein (22 vs 12 g) from all sources, and more energy (345 vs 204 kcal) and protein (11 vs 6 g) from CFBs alone. HMF infants have a higher prevalence of risk of inadequate intakes of iron (77% vs 7%), zinc (54% vs <3%), and protein (27% vs <3%). FMF infants are more likely to have an early introduction (<12 months) to fruit juice (45% vs 20%) and cow's milk (36% vs 24%). Registered dietitian nutritionists and nutritional professionals should consider tailoring their advice to caregivers on dietary and complementary feeding practices, taking into account the primary mode of milk feeding during this life stage to support infants' nutrient adequacy. National studies that address the limitations of this analysis, including small sample sizes and imputed breast milk volume, could refine findings from this analysis.

## Keywords

Dietary guidelines; Birth to 24 months; Pediatrics; Nutrition policy; Breastfeeding; Complementary feeding

Growth trajectories are rapid during infancy and optimal nutritional status during this life stage is critical to support immediate and long-term health and development. The timing of the transition from exclusive human milk or infant formula feeding to the introduction of complementary foods and beverages (CFBs) coincides with this time of high nutrient needs relative to body weight compared with later periods of growth. Thus, provision of nutrient-dense foods to meet nutritional requirements during this period is crucial.<sup>1</sup> As such, the American Academy of Pediatrics (AAP) has established guidance for infants during this period based on nutrient needs, developmental readiness, and other feeding practices.<sup>1</sup> The AAP recommends human milk or infant formula should be the sole source of nutrition until about 6 months of age, when the introduction of complementary foods and beverages is recommended.<sup>1</sup> Transition from a diet of exclusive consumption of human milk or infant formula to a mixed diet that includes nutrient-dense foods is recommended, depending on the infant's developmental readiness.<sup>1-4</sup> Dietary diversity and provision of appropriate forms of foods (eg, purees and finely chopped solids) are encouraged, and fruit juice, cow's milk, and use of added salts and sugars are not recommended during infancy.<sup>1</sup> A complete summary of the historical and current AAP recommendations has been published elsewhere.<sup>5</sup> More recently, federal recommendations for infant feeding were mandated for inclusion in the *Dietary Guidelines for Americans, 2020–2025* (DGA) for the first time since their inception, as part of the Agriculture Act of 2014 (ie, "The Farm Bill").<sup>3</sup> Before this iteration, the DGA were for Americans aged 2 years and older. The purpose of this article was to summarize the available federal dietary and nutrition data examined by the 2020 Dietary Guidelines Advisory Committees (the Committee), with a focus on current dietary intakes and complementary feeding practices from 6 to 12 months. Some portions of this work are also published as part of the Committee's scientific report to the US Government.<sup>6</sup>

## DATA REVIEW PROCESS

The Committee reviewed and integrated data from the following 3 US federal monitoring and surveillance systems in the development of the report: National Immunization Survey

(NIS) conducted by the National Center for Immunization and Respiratory Diseases of the Centers for Disease Control and Prevention<sup>7</sup>; National Survey of Children's Health (NSCH) conducted by the Maternal and Child Health Bureau of the Health Resources and Services Administration<sup>8</sup>; and the National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention.<sup>9</sup> The Committee only evaluated dietary intake data from federal sources so that the findings would be relevant to federal policy associated with the DGA.

Data from the NIS were used to garner information on the prevalence of breastfeeding initiation and duration by maternal characteristics among infants born in 2017 (n = 20,026).<sup>7</sup> This survey used random-digit dialing to collect data from US households via telephone to obtain a wide variety of data, including retrospective information about breastfeeding initiation, duration, and exclusivity from parents or caregivers for children 19 to 35 months of age at the time of data collection. NIS data are collected at the state level and are pooled and weighted to obtain national estimates. The sampling design and weighting system, as well as more complete details of the NIS methods, can be found elsewhere.<sup>10</sup> Exclusive breastfeeding in this survey is defined as consumption of human milk only, with no consumption of other solids or liquids.

The NSCH protocol includes annual collection of data from parents and caregivers on various aspects of infant feeding practices and health, including practices such as the timing of introduction of CFBs for infants. The NSCH is also designed to produce nationally representative estimates, and complete details of the methods are available publicly.<sup>8</sup> In the 2016–2018 NSCH, the sample size was adequate to stratify infants into the following 3 feeding groups based on status at age 4 months: human milk only (n = 9,085), infant formula only (n = 9,567), or mixed-fed human milk and infant formula (n = 4,863), and the Committee examined data on early introduction to CFBs from this study.<sup>11</sup>

The vast majority of data provided to the Committee were data or research briefs from the existing literature or original analyses from the Federal Data Analysis Team (a trans-agency team of scientists) of dietary data from the What We Eat in America component of NHANES. Complete details of the NHANES methodology are available publicly.<sup>9</sup> Dietary data are collected from two, 24-hour dietary recalls (24HRs), the first collected in person at a mobile examination center, and the second via telephone. Both of the recalls were collected from a parent or proxy caregiver using the Automated Multiple-Pass Method methodology, in collaboration with the US Department of Agriculture.<sup>12,13</sup> Age of the infant was based on age at the time of examination in the mobile examination center. Data from NHANES 2007–2016 were combined to achieve a sample size sufficient to examine the data for older infants (6 to 12 months; n = 988) and stratified by feeding status based on both 24HRs: infants receiving human milk (HMF; n = 141; mean age 8.1 months) or infants receiving infant formula, including those who were mixed-fed (FMF; n = 847; mean age 8.6 months). Mixed-fed infants (n = 92; mean age 8.4 months) were included with formula-fed infants (n = 755; mean age 8.6 months) due to small sample sizes in NHANES data.

NHANES collects more detail on dietary intakes and feeding behaviors than the NIS and NSCH, although there are still limitations, as summarized elsewhere.<sup>14</sup> For example, the

volume of breast milk that was provided to an infant by direct breastfeeding was not quantified during the dietary recall. However, if the proxy reported that an infant was fed expressed human milk, then the amount was quantified and coded as such. Otherwise, the volume of human milk consumed was estimated according to coding rules based on pre-existing data from several studies,<sup>15–18</sup> a strategy that has been further supported in systematic review and model estimates from stable isotope studies from 12 countries in 5 continents<sup>19</sup> and used previously with NHANES data.<sup>20</sup> Briefly, infants whose only milk source at 6 to 12 months was human milk were assigned breast milk intakes of 600 mL/d, and mixed-fed infants were assigned human milk intakes by subtracting the amount of formula or other milks consumed from 600 mL/d.

For CFBs, the proportion of infants with reported intake of a food group or subgroup on a given day and the mean intakes of energy, nutrients, and other food components were estimated. Mean dietary intakes from all sources and from CFBs are presented separately; CFBs include all foods and beverages except human milk and infant formula. Usual intake distributions were derived using the National Cancer Institute method<sup>21</sup> to estimate the potential risk of dietary inadequacy for protein, iron, and zinc (the only nutrients for which an Estimated Average Requirement value is available during this age range)<sup>22</sup>; usual intake estimates were not compared statistically. All statistical differences in feeding practices and dietary intakes between HMF and FMF infants were determined by *t* tests, with statistical significance set at  $P < .01$  to account for multiple comparisons.

## SUMMARY OF FEDERAL DATA

The national prevalence of breastfeeding initiation was 84.1% among infants born in 2017, according to the NIS.<sup>7</sup> However, low rates of exclusive breastfeeding were observed at 3 months (49.6%) and 6 months of age (25.6%).<sup>7</sup> The Healthy People 2030 target goal for exclusive breastfeeding through 6 months is 42.2%.<sup>23</sup> Differences in duration of any and exclusive breastfeeding were evaluated by race and ethnicity, maternal education, maternal age, marital status, and poverty-to-income ratio.<sup>24</sup> Figure 1 illustrates that exclusive breastfeeding rates differ by race and ethnicity; notable increases have been observed over time among non-Hispanic Black infants. Exclusive breastfeeding rates also tend to be positively associated with maternal age, education, and income. NHANES data indicate that for infants who are fed infant formula, the predominant form is cow's milk-based (69%), with lower percentages of infants receiving soy (12%), specialty (6%), or "gentle/sensitive" or lactose-free or lactose-reduced formulas (5%).<sup>25</sup>

The majority of US infants are introduced to CFBs before 6 months of age (51%). Approximately one-third (32%) of infants receive CFBs before 4 months of age, and this proportion is higher among formula-fed infants (42%) compared with those who are mixed-fed (32%) or fed human milk as the only source of milk (19%) (Figure 2).<sup>11</sup> Non-Hispanic Black infants (40.5%) were more likely than Hispanic (29.9%), non-Hispanic White infants (31.5%), and Asian infants (23.8%) to be introduced to CFBs before 4 months. Differences in early introduction to CFBs were also observed by geographic location and other sociodemographic factors, such as maternal age and education and household income.<sup>11</sup>

Dietary data from NHANES suggest that FMF infants are more likely to receive cow's milk (36% vs 24%) and fruit juice (45% vs 20%) between 6 and 12 months of age than are HMF infants (Table 1). FMF infants are also more likely to consume fruits (86% vs 75%), grains (91% vs 81%), protein foods (51% vs 35%), and solid fats (a proxy for saturated fat in the diet; 62% vs 49%) on a given day than are HMF infants (Table 2). For total fruit, this difference is driven by higher intake of fruit juice and fruits other than citrus, melons, and berries among FMF infants compared with their HMF counterparts (Table 3; available online at [www.jandonline.org](http://www.jandonline.org)). In addition, compared with HMF infants, FMF infants have a higher intake of refined grains relative to whole grains. These patterns of dietary intake are associated with differences in intakes of energy, macronutrients, total sugars, and fiber (Table 1), as well as micronutrients (Table 4) between groups of infants categorized by primary feeding mode. HMF infants have a high prevalence of inadequate intakes of protein (27% HMF vs <3% FMF), iron (77% HMF vs 7% FMF), and zinc (54% HMF vs <3% FMF) compared with FMF infants. Although <3% of all infants (regardless of primary mode of feeding) were at risk of potentially excessive iron intakes from the diet, more than three-quarters (77%) of FMF infants had zinc intakes that exceeded the Tolerable Upper Intake Level; this was much less common among HMF infants (3%) (data not shown).

## DISCUSSION

For the first time, the 2020 Dietary Guidelines Advisory Committee extensively reviewed data on breastfeeding, the introduction of CFBs, and the diets of infants in order to inform the development of the DGA for infants and toddlers. Although rates of breastfeeding initiation are high, exclusive breastfeeding at 6 months (26%) was markedly lower than the Healthy People 2030 target goal (42.2%),<sup>23</sup> with notably lower rates of initiation and duration observed among non-Hispanic Black and lower-resource caregivers, consistent with previous reports.<sup>26,27</sup> This is concerning because breastfeeding has positive health benefits for both the mother and her offspring.<sup>28–36</sup> Nutritional exposures and feeding practices in infancy have been related to risk of overweight and obesity and associated cardiometabolic conditions in childhood and subsequently later in life.<sup>37</sup> Through the systematic review process, the Committee concluded that “moderate evidence suggested that ever, compared with never, consuming human milk is associated with a lower risk of overweight and obesity at ages 2 y and older, particularly if the duration of human milk consumption is >6 mo.”<sup>38</sup> However, the Committee noted a need for stronger research designs to better address the complex relationship between infant feeding practices and risk of overweight and obesity. Nevertheless, policies and strategies can support breastfeeding across multiple sectors, including immediate support and education after childbirth, community-level programs, as well as workplace-related practices, including length of maternity leave,<sup>39</sup> as well other as known barriers.<sup>40</sup>

The AAP Committee on Nutrition recommends against introduction of CFBs before 4 months, with appropriate introduction at about 6 months.<sup>1</sup> Approximately one-third of US infants are fed CFBs before 4 months<sup>11</sup>; these estimates are higher than those reported in other studies, such as Project Viva (19%)<sup>41</sup> and the Feeding Infants and Toddlers Study (FITS; 17%).<sup>42</sup> Although the Committee did not have information on early introduction of CFBs and demographic characteristics from NHANES, data from FITS 2016<sup>42</sup> and the



NSCH<sup>11</sup> suggest that non-Hispanic Black infants are more likely than other reported racial and ethnic groups to receive early CFBs.<sup>42</sup> Data are not reported in these studies on Native Hawaiians, Pacific Islanders, American Indian, or Alaska Native groups. Infants receiving infant formula are also more likely to have early introduction of CFBs.<sup>11</sup> Regardless of primary milk feeding mode, some studies suggest that early introduction of CFBs before 4 months of age has been associated with markers of childhood adiposity.<sup>41</sup>

The timing of introduction and the types and amounts of CFBs provided to infants and toddlers potentially influence nutritional status, growth and body composition, neuro-cognitive development, healthy feeding behaviors, and both short-term and long-term health outcomes, including bone health and risk of food allergies and other atopic diseases.<sup>43–48</sup> Introduction of fruit juice<sup>49–51</sup> or cow's milk<sup>52</sup> is not recommended before 12 months of age. National data suggest that approximately 1 in 10 US infants consume cow's milk before 12 months of age,<sup>25</sup> signaling a need for caregiver education surrounding early introduction of cow's milk, given that it does not optimally support nutrient requirements at this age, has been associated with gastrointestinal blood loss in infants,<sup>53,54</sup> and has low iron and high protein content. Overall, 40% of older infants consume fruit juice before 12 months of age. This is of potential concern because the energy provided by fruit juice may displace energy from more nutrient-rich CFBs, which may compromise the infant's ability to meet requirements for essential nutrients or may lead to excess energy intake.

Similar to other studies, we observed many differences in the patterns of dietary intake and, importantly, in the amounts of CFBs that were related to an infant's primary mode of milk feeding, that is, between HMF and FMF infants. For example, FMF infants are more likely to consume fruit juice and saturated fats by 1 year of age; they also consume more total energy and larger amounts of most other food components compared with HMF infants, who had a higher prevalence of risk for dietary inadequacy for iron. These observations suggest the need to introduce foods that are good sources of bioavailable iron during the transition from milk-based to table food feedings, particularly if human milk is the primary milk source, given its low iron content.<sup>55</sup> Data across the years from FITS studies (2002, 2008, and 2016) suggest that dietary iron inadequacy has increased over time.<sup>56,57</sup> Although the Committee did not specifically examine trends in the use of iron-fortified cereals, FITS data suggest that consumption has decreased over time. Thus, the specific guidance to provide foods that are intrinsically rich in iron (eg, meats) or fortified with iron (eg, iron-fortified infant cereal), particularly during the period of 6 to 12 months of age among infants receiving human milk, is warranted. The identification of iron as a nutrient of public health concern among HMF infants was based largely on dietary intake data<sup>58</sup>; more information is needed to interpret these dietary estimates, including maternal iron status, timing of umbilical cord clamping at birth, and biomarkers of iron status in infants in this age group.<sup>59</sup> Recent data from Abrams and colleagues<sup>60</sup> also suggest that less net iron is absorbed by HMF infants compared with formula-fed infants, but that overall the estimated iron from typical CFBs is below that needed and recommended for optimal growth and erythropoiesis in a large proportion of infants in the CFB life stage. Although updated Dietary Reference Intake values for infants and toddlers are needed to better characterize potential risk of dietary inadequacy and excess,<sup>61</sup> the iron data examined by the Committee



and those of FITS<sup>60</sup> together signal a concern for iron adequacy during this life stage; more extensive biomarker data of the nutritional status of infants in this life stage are also needed.

### Research Gaps and Limitations

Many gaps exist and more research is needed to better characterize the dietary landscape of older infants. The findings presented in this article should be considered with several considerations in mind. First, although the mean ages of the 2 feeding groups in NHANES were similar (8.1 months in HMF; 8.6 months in FMF), energy intakes are largely influenced by the age of the infant, and our findings should be interpreted with the caveat that each month represents a dynamic period of growth and development. The NHANES data are weighted to be reflective of the US population. The limited sample size from which national data are derived has precluded additional analysis of food and nutrient intake related to primary milk feeding mode and other important characteristics, such as race and ethnicity, family income, food security, and participation in federal food assistance programs. Mixed-fed infants were combined with formula-fed infants into a single group in the NHANES, although they may have different food consumption patterns. We also know that chrononutrition is an emerging area of importance,<sup>62</sup> and very little is known about the timing of feeding both milk sources and CFBs throughout the day and how that may relate to growth and weight status.<sup>63</sup> Although the AAP recommends offering fruits and vegetables to young children at each feeding occasion,<sup>64</sup> the Committee did not have these data to compare contemporary dietary patterns with this guideline.

Energy and nutrient values from breastmilk are based on very limited data that may not be representative of a diverse range of factors that influence human milk nutrients and other bioactive components; there are ongoing federal efforts to update the human milk composition database. Our analysis and the published literature from 24HR data suggest that reported energy intakes at this age exceed estimated needs.<sup>20,65</sup> If assumptions of over-reporting energy intakes in infants are true,<sup>66</sup> the current reported estimates of inadequacy may be biased; however, to our knowledge the magnitude of this potential bias is largely unknown, and it is unknown whether this bias is different based on primary mode of milk feeding. What may be considered “usual” intakes is difficult to define in such a dynamic segment of the population. For example, the Committee categorized infants participating in NHANES into 2 feeding groups based on a reporting of 24HRs, which may or may not be representative of usual milk feeding. Proxy and retrospective recall bias of other child feeding behaviors may also exist, the extent to which is largely unknown.<sup>67,68</sup> Another limitation of the data is a lack of information about those infants who receive cereal that is used to thicken milk feedings before 4 months of age, as this is a common recommendation for infants with symptoms of gastroesophageal reflux.

### CONTEXT AND CONCLUSIONS

We found significant differences in dietary exposures by primary mode of milk feeding (human milk vs infant formula). CFBs are needed to provide more than one-half of the infant’s requirements for vitamins B-6, D, E, thiamin, and niacin as well as iron, zinc, magnesium, phosphorus, manganese, and fluoride at 6 to 8 months of age,<sup>4</sup> but this varies

by the amounts and combinations of human milk and infant formula. Given the estimated calorie requirements during this life stage, it can be quite challenging to meet these nutrient requirements without careful consideration of choices for CFBs. Through extensive food pattern modeling exercises, described elsewhere, the Committee developed a number of potential dietary patterns to meet dietary recommendations in this age group.<sup>69</sup> This led to one of the hallmark recommendations of the DGA to “make every bite count.”<sup>3</sup>

This work of the Committee identified opportunities to improve current infant feeding practices and demonstrates that a “one-size fits all approach” to CFBs may not be ideal, given the differences observed between subgroups of infants categorized by primary milk feeding mode. Registered dietitian nutritionists and nutritional professionals across all sectors should educate caregivers on the recommended timing of introduction of CFBs and tailor their advice to caregivers to support needs for growth and development during this life stage. Because food preferences and patterns are beginning to form during this developmental stage, it is important that caregivers encourage consumption of nutrient-rich foods and avoidance of energy-dense but nutrient-poor CFBs.

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## RESEARCH SNAPSHOT

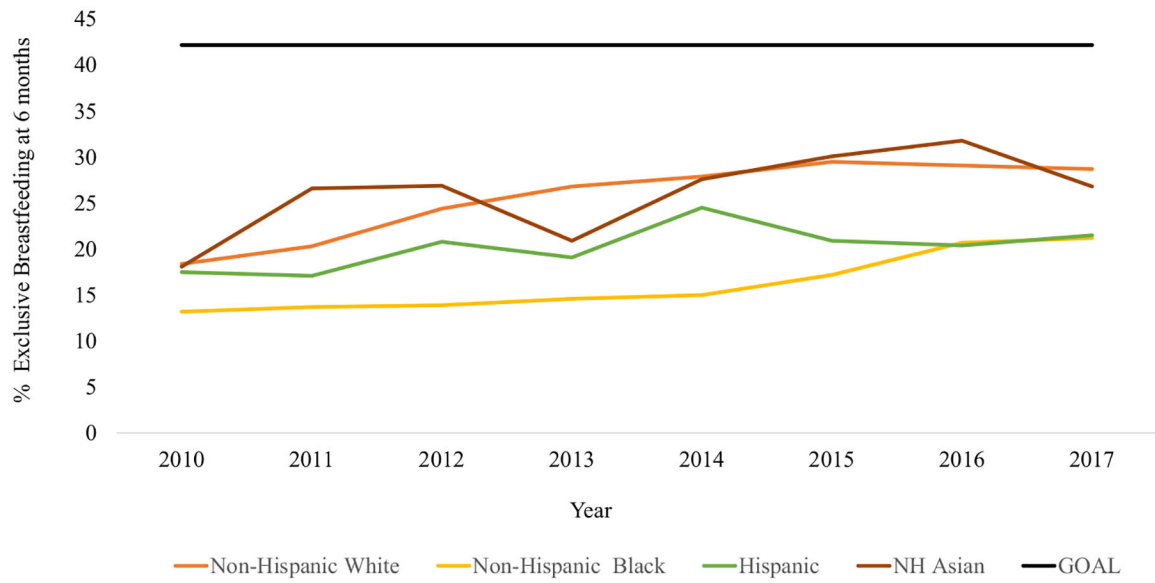
**Research Question:**

What was the existing evidence base to inform the 2020 Dietary Guidelines Advisory Committee with regard to the dietary intakes and feeding practices during the complementary feeding period among US infants, 6 to 12 months of age?

**Key Findings:**

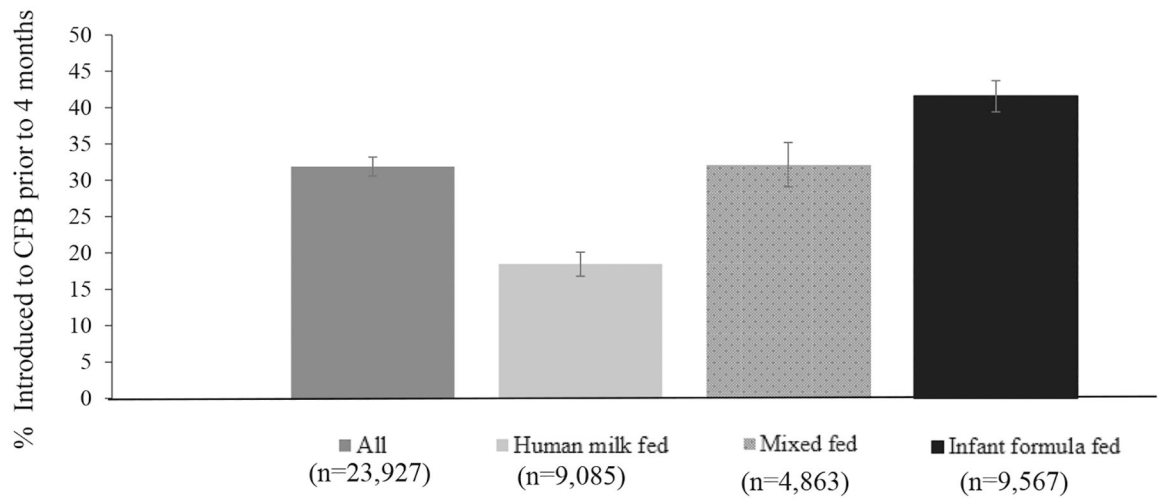
Intake of complementary foods and beverages differs by primary mode of infant milk feeding; health care professionals must help caregivers make appropriate nutrient-dense complementary food choices.





**Figure 1.**

The prevalence (%) of exclusive breastfeeding at 6 months of age among US infants born in 2010–2017, by race and Hispanic origin (non-Hispanic [NH] and Hispanic), National Immunization Survey compared with the Healthy People 2030 goal. The Healthy People 2030 target goal for exclusive breastfeeding through 6 months is 42.2%.



**Figure 2.**

The prevalence (%) of introduction before 4 months of age of complementary foods and beverages (CFBs) among US infants, overall and stratified by mode of milk feeding, National Survey of Children's Health, 2016–2018. The error bars represent the 95% CIs.

A summary of feeding practices and intakes of macronutrient and dietary components among US older infants (6 to 12 months) by primary milk feeding mode, National Health and Nutrition Examination Survey, 2007–2016<sup>a</sup>

**Table 1.**

Variable	HMF <sup>b</sup> infants (n = 141)	FMF <sup>c</sup> infants (n = 847)	P value
<i>mean ± standard error</i>			
<b>AAP<sup>d</sup> guidelines</b>			
Early-introduction fruit juice <12 mo, %	20 ± 4.4	45 ± 2.2	<.0001
Early-introduction cow's milk <12 mo, %	24 ± 3.2	36 ± 1.4	.0028
<b>Intake of macronutrients and dietary components</b>			
Energy (all sources <sup>e</sup> ), kcal	631 ± 12.1	845 ± 12.5	<.0001
Energy (CFBs <sup>f</sup> only), kcal	204 ± 12.0	345 ± 11.9	<.0001
Protein (all sources <sup>e</sup> ), g	12.2 ± 0.4	21.7 ± 0.5	<.0001
Protein (CFBs only), g	5.9 ± 0.4	10.8 ± 0.5	<.0001
Proportion at risk of protein inadequacy, <sup>g</sup> %	27 ± 2.8	<3	—
Carbohydrate (all sources <sup>e</sup> ), g	78 ± 2.2	112 ± 1.9	<.0001
Carbohydrate (CFBs only), g	36 ± 2.2	58 ± 1.8	<.0001
Total sugars (All sources <sup>e</sup> ), g	57 ± 1.0	78 ± 1.1	<.0001
Total sugars (CFBs only), g	15 ± 1.0	26 ± 0.9	<.0001
Dietary fiber (All sources <sup>e</sup> ), g	3.8 ± 0.3	4.8 ± 0.2	.0195
Dietary fiber (CFBs only), g	3.8 ± 0.3	4.7 ± 0.2	.0229
Total fat (all sources <sup>e</sup> ), g	31.6 ± 0.5	35.3 ± 0.5	<.0001
Total fat (CFBs only), g	4.8 ± 0.5	8.3 ± 0.5	<.0001

<sup>a</sup>Milk reporting status determined by the report of human milk on either day 1 or day 2 of the 24-h dietary recall. Complementary foods include all foods and beverages except human milk and infant formula.

<sup>b</sup>HMF = human milk fed.

<sup>c</sup>FMF = formula or mixed fed.

<sup>d</sup>AAP = American Academy of Pediatrics.

<sup>e</sup>Includes energy and nutrients obtained from human milk or infant formula.

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CFBs = complementary foods and beverages.

$\hat{U}_g$  Usual intake distributions were used to estimate the proportion of infants at risk for dietary inadequacy.

Proportion (%) and mean (standard error) daily intake of older infants (6 to 12 months) reporting food group consumption by primary milk feeding mode, NHANES,<sup>a</sup> 2007–2016<sup>b</sup>

**Table 2.**

Food group consumption	HMF <sup>c</sup> Infants (n = 141)		FMF <sup>d</sup> Infants (n = 847)	
	Proportion of consumers, %	Intake	Proportion of consumers, %	Intake
	<i>mean ± standard error</i>			
Fruits (cup equivalent)	75 ± 3.7	0.38 ± 0.02	86 ± 1.1 <sup>e</sup>	0.67 ± 0.03 <sup>f</sup>
Grains (ounce equivalent)	81 ± 3.1	0.71 ± 0.07	91 ± 1.1 <sup>e</sup>	1.14 ± 0.05 <sup>f</sup>
Vegetables (cup equivalent)	76 ± 3.8	0.35 ± 0.04	80 ± 1.7	0.41 ± 0.02
Protein foods (ounce equivalent)	35 ± 3.4	0.32 ± 0.04	51 ± 2.4 <sup>e</sup>	0.58 ± 0.05 <sup>f</sup>
Dairy (cup equivalent)	40 ± 4.2	0.08 ± 0.01	46 ± 1.7	0.30 ± 0.03 <sup>f</sup>
Oils (g)	46 ± 4.5	1.7 ± 0.40	59 ± 2.4	1.7 ± 0.18
Solid fats (g)	49 ± 3.9	1.3 ± 0.23	62 ± 1.7 <sup>e</sup>	3.7 ± 0.25 <sup>f</sup>
Added sugars (teaspoon equivalent)	55 ± 4.3	0.7 ± 0.10	64 ± 2.0	1.1 ± 0.08

<sup>a</sup>NHANES = National Health and Nutrition Examination Survey.

<sup>b</sup>Data are from NHANES, What We Eat In America 2007–2016 Day 1 and Food Patterns Equivalents Databases. Milk reporting status determined by the report of human milk on either day 1 or day 2. The mean amount represents the feeding group-level average for consumers and nonconsumers. Legumes are included in the Protein Foods food group.

<sup>c</sup>HMF = human milk fed.

<sup>d</sup>FMF = formula or mixed fed.

<sup>e</sup>Statistically significant at  $P < .01$  compared with the proportion of HMF infants who are consumers.

<sup>f</sup>Statistically significant differences when the mean intake of HMF infants is compared with the mean intake of FMF infants at  $P < .01$ .

Proportion (%) and mean (standard error) daily intake of older infants (6 to 12 months) reporting food subgroup consumption by primary milk feeding mode, NHANES, <sup>a</sup> 2007–2016<sup>b</sup>

Table 3.

Food subgroup consumption	HMF <sup>c</sup> Infants (n = 141)		FMF <sup>d</sup> Infants (n = 847)	
	Proportion of consumers, %	Intake, g	Proportion of consumers, %	Intake, g
	<i>mean ± standard error</i>			
<b>Fruits (cup equivalent)</b>				
Citrus, melon, berry	18 ± 2.4	0.03 ± 0.01	17 ± 1.7	0.03 ± 0.01
Other fruit	70 ± 3.6	0.31 ± 0.02	75 ± 1.9	0.41 ± 0.02 <sup>e</sup>
Juice	20 ± 4.4	0.04 ± 0.01	45 ± 2.2 <sup>f</sup>	0.22 ± 0.01 <sup>e</sup>
<b>Grains (ounce equivalent)</b>				
Whole	51 ± 4.1	0.24 ± 0.05	61 ± 2.7	0.34 ± 0.02
Refined	68 ± 4.5	0.46 ± 0.04	83 ± 1.7 <sup>f</sup>	0.81 ± 0.04 <sup>e</sup>
<b>Vegetables (cup equivalent)</b>				
Total starchy	37 ± 4.6	0.07 ± 0.01	43 ± 2.1	0.11 ± 0.01
Potatoes	18 ± 3.7	0.03 ± 0.01	29 ± 1.5	0.06 ± 0.00
Other starchy	28 ± 4.3	0.04 ± 0.01	31 ± 2.0	0.05 ± 0.01
Total red/orange	59 ± 4.6	0.17 ± 0.02	66 ± 2.1	0.21 ± 0.01
Tomatoes	12 ± 2.7	0.01 <sup>g</sup> ± 0.00	19 ± 1.9	0.03 ± 0.00 <sup>e</sup>
Other red/orange	55 ± 5.3	0.16 ± 0.02	57 ± 2.2	0.18 ± 0.02
Dark green	6 <sup>g</sup> ± 1.9	0.01 <sup>g</sup> ± 0.01	6 ± 1.5	0.01 <sup>g</sup> ± 0.00
Other	36 ± 5.3	0.08 ± 0.02	28 ± 2.4	0.06 ± 0.01
Legumes	6 <sup>g</sup> ± 1.6	0.01 <sup>g</sup> ± 0.00	6 ± 0.9	0.01 ± 0.00
<b>Protein foods (ounce equivalent)</b>				
Total meat, poultry, seafood	25 ± 3.7	0.21 ± 0.03	44 ± 2.1 <sup>f</sup>	0.43 ± 0.04 <sup>e</sup>
Meat (eg, beef, veal, or pork)	7 <sup>g</sup> ± 2.4	0.06 <sup>g</sup> ± 0.02	16 ± 1.3 <sup>f</sup>	0.13 ± 0.02 <sup>e</sup>
Poultry	18 ± 3.6	0.13 <sup>g</sup> ± 0.02	30 ± 2.0	0.22 ± 0.03
Cured meat	3 <sup>g</sup> ± 0.9	0.01 <sup>g</sup> ± 0.01	8 ± 1.3 <sup>f</sup>	0.07 ± 0.02
Total fish and seafood	— <sup>h</sup>	— <sup>h</sup>	1 <sup>g</sup> ± 0.4	0.01 <sup>g</sup> ± 0.00

Food subgroup consumption	HMF <sup>c</sup> Infants (n = 141)		FMF <sup>d</sup> Infants (n = 847)	
	Proportion of consumers, %	Intake, g	Proportion of consumers, %	Intake, g
Eggs	17 ± 3.1	0.04 <sup>g</sup> ± 0.01	19 ± 1.7	0.08 ± 0.01
Peanuts, nuts, seeds	3 <sup>g</sup> ± 1.3	0.02 <sup>g</sup> ± 0.01	2 ± 0.7	0.01 <sup>g</sup> ± 0.01
Soy products	2 <sup>g</sup> ± 1.2	0.01 <sup>g</sup> ± 0.01	3 ± 0.8	<sub>h</sub>
<b>Dairy (cup equivalent)</b>				
Fluid milk	24 ± 3.2	0.02 <sup>g</sup> ± 0.01	36 ± 1.4 <sup>f</sup>	0.20 ± 0.02 <sup>e</sup>
Cheese	10 ± 2.5	0.01 <sup>g</sup> ± 0.01	21 ± 1.4 <sup>f</sup>	0.06 ± 0.01 <sup>e</sup>
Yogurt	17 ± 3.1	0.04 ± 0.01	10 ± 1.4	0.04 ± 0.01

<sup>a</sup>NHANES = National Health and Nutrition Examination Survey.

<sup>b</sup>Data are from NHANES What We Eat In America 2007–2016 Day 1 and Food Patterns Equivalents Databases. Milk reporting status determined by the report of human milk on either day 1 or day 2. The mean amount represents the feeding group-level average for consumers and nonconsumers.

<sup>c</sup>HMF = human milk fed.

<sup>d</sup>FMF = formula or mixed fed.

<sup>e</sup>Statistically significant difference when the mean intake of HMF infants is compared with the mean intake of FMF infants,  $P < .01$ .

<sup>f</sup>Statistically significant at  $P < .01$  when compared with the proportion of HMF infants who are consumers.

<sup>g</sup>Less stable estimate due to small sample size or a large relative standard error.

<sup>h</sup>Nonzero value that is too small to present.



Micronutrient intakes among older US infants (6 to 12 months) by primary milk feeding mode, NHANES,<sup>a</sup> 2007–2016<sup>b</sup>

**Table 4.**

Micronutrient intake data	HMF <sup>c</sup> infants (n = 141)	FMF <sup>d</sup> infants (n = 847)	P value
	mean ± standard error		
Vitamin A, RAE <sup>e</sup> (all sources <sup>f</sup> ), µg	588 ± 28.0	690 ± 16	.0027
Vitamin A, RAE (CFBs <sup>g</sup> only), µg	215 ± 28.1	242 ± 13.2	.3911
Retinol (all sources <sup>f</sup> ), µg	393 ± 5.5	506 ± 6.8	<.0001
Retinol (CFBs only), µg	26 ± 5.4	58 ± 4.3	<.0001
Thiamin (all sources <sup>f</sup> ), mg	0.39 ± 0.04	0.91 ± 0.02	<.0001
Thiamin (CFBs only), mg	0.31 ± 0.04	0.48 ± 0.02	.0010
Riboflavin (all sources <sup>f</sup> ), mg	0.59 ± 0.04	1.29 ± 0.02	<.0001
Riboflavin (CFBs only), mg	0.37 ± 0.04	0.62 ± 0.02	<.0001
Niacin (all sources <sup>f</sup> ), mg	5.2 ± 0.4	11.4 ± 0.3	<.0001
Niacin (CFBs only), mg	4.1 ± 0.4	6.4 ± 0.2	.0002
Vitamin B-6 (all sources <sup>f</sup> ), µg	0.36 ± 0.02	0.74 ± 0.02	<.0001
Vitamin B-6 (CFBs only), µg	0.29 ± 0.02	0.44 ± 0.02	<.0001
Folate, DFE <sup>h</sup> (all sources <sup>f</sup> ), µg	93 ± 5.6	214 ± 4.4	<.0001
Folate, DFE (CFBs only), µg	62 ± 5.6	91 ± 4.6	.0016
Choline (all sources <sup>f</sup> ), mg	127 ± 2.6	135 ± 3.4	.0943
Choline (CFBs only), mg	29 ± 2.6	52 ± 2.8	<.0001
Vitamin B-12 (all sources <sup>f</sup> ), mg	0.67 ± 0.04	2.14 ± 0.05	<.0001
Vitamin B-12 (CFBs only), mg	0.36 ± 0.04	0.77 ± 0.06	<.0001
Vitamin C (all sources <sup>f</sup> ), mg	52.6 ± 1.9	98.7 ± 2.4	<.0001
Vitamin C (CFBs only), mg	21.9 ± 1.9	47.7 ± 2.1	<.0001
Vitamin D (all sources <sup>f</sup> ), µg	1.08 ± 0.07	8.36 ± 0.13	<.0001
Vitamin D (CFBs only), µg	0.41 ± 0.07	1.18 ± 0.09	<.0001
Alpha-tocopherol (all sources <sup>f</sup> ), mg	2.00 ± 0.13	7.72 ± 0.14	<.0001
Alpha-tocopherol (CFBs only), mg	1.50 ± 0.13	2.06 ± 0.08	.0045
Calcium (all sources <sup>f</sup> ), mg	329 ± 12.9	684 ± 10.8	<.0001

Micronutrient intake data	HMF <sup>c</sup> infants (n = 141)	FMF <sup>d</sup> infants (n = 847)	P value
Calcium (CFBs only), mg	133 ± 12.9	258 ± 10.0	<.0001
Magnesium (all sources <sup>f</sup> ), mg	59 ± 3.2	105 ± 2.1	<.0001
Magnesium (CFBs only), mg	41 ± 3.2	63 ± 1.9	<.0001
Iron (all sources <sup>f</sup> ), mg	5.8 ± 0.7	17.0 ± 0.4	<.00001
Iron (CFBs only), mg	5.5 ± 0.7	8.5 ± 0.3	.0013
Proportion at risk of iron inadequacy, <sup>g</sup> %	77 ± 4.7	7 ± 1.3	—
Zinc (all sources <sup>f</sup> ), mg	2.6 ± 0.2	6.7 ± 0.1	<.0001
Zinc (CFBs only), mg	1.6 ± 0.2	2.4 ± 0.1	.0010
Proportion at risk of zinc inadequacy, <sup>g</sup> %	54 ± 4.8	<3	—
Potassium (all sources <sup>f</sup> ), mg	700 ± 24	1141 ± 20	<.0001
Potassium (CFBs only), mg	388 ± 23.8	613 ± 20.0	<.0001
Sodium (all sources <sup>f</sup> ), mg	305 ± 21	508 ± 23	<.0001
Sodium (CFBs only), mg	201 ± 20.4	344 ± 24.1	<.0001

<sup>a</sup>NHANES = National Health and Nutrition Examination Survey.

<sup>b</sup>Data are from NHANES What We Eat In America 2007–2016 Day 1 and Food Patterns Equivalents Databases. Milk reporting status determined by the report of human milk on either day 1 or day 2.

<sup>c</sup>HMF = human milk fed.

<sup>d</sup>FMF = formula or mixed fed.

<sup>e</sup>RAE = retinol activity equivalents.

<sup>f</sup>Includes energy and nutrients obtained from human milk or infant formula.

<sup>g</sup>CFBs = complementary foods and beverages.

<sup>h</sup>DFE = dietary folate equivalent.

<sup>i</sup>Usual intake distributions were used to estimate the proportion of infants at risk for dietary inadequacy using the Estimated Average Requirement and were not compared statistically.