

Food Consumption Patterns and Micronutrient Density of Complementary Foods Consumed by Infants Fed Commercially Prepared Baby Foods

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Nutrition is critically important in the first 1000 days, and while most American babies are fed commercial baby foods, there is little or no evidence from nationally representative data to understand the implications of such consumption. We used 24-hour dietary recall data for 505 infants from The Feeding Infants and Toddlers Study to describe food consumption patterns and micronutrient density of complementary foods consumed by infants fed commercially prepared baby food fruit, vegetables, and

dinners and compared with those eaten by nonconsumers of these products. Results show that consumers were significantly more likely to report eating all vegetables (excluding white potatoes, 71% vs 51%), deep yellow vegetables (42% vs 18%), and fruits (79% vs 65%) and were less likely to report eating white potatoes (10% vs 24%), dark green vegetables (4% vs 20%), and sweets (23% vs 47%) than were nonconsumers. Nutrient density of the complementary foods of consumers was

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The Feeding Infants and Toddlers Study (FITS) 2008 data are not publicly available but may be available from the author upon reasonable request, with approval of the ownership organization (Nestlé R&D).

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greater for fiber, potassium, vitamin A, vitamin C, vitamin E, and magnesium, but lower in sodium and vitamin D. We conclude that infants fed commercially prepared baby foods were more likely to eat vegetables and fruits, and their diets were higher in several micronutrients. These findings provide important insights on complementary feeding and are useful to support the development of evidence-based infant-feeding guidelines. *Nutr Today*. 2018;53(2):68–78

Good nutrition in infancy is critical for optimal growth and development. This is also the ideal time to introduce the child to a variety of foods and flavors in order to develop healthy eating habits and dietary variety.^{1–5} Complementary feeding guidance for infants focuses on adequate nutrient intakes, as well as the introduction of nutrient-dense foods such as fruits and vegetables from an early age.^{6–8} In addition to the immediate nutrition and health benefits,^{9–11} exposure to fruits and vegetables during infancy is associated with positive long-term health outcomes,^{12,13} and shaping healthy eating habits that track into later life.^{1–5,14} Despite consensus on the criticality of this period for establishing lifelong dietary habits, because of limited dietary data, gaps still exist in our knowledge of children's nutrition issues and dietary patterns during the first 1000 days.¹⁵ The Feeding Infants and Toddlers Study (FITS) 2008 showed that consumption of commercially prepared baby food is more prevalent among 6- to 8-month-olds than 9- to 11-month-olds for vegetables (51% vs 34%) and for fruits (50% vs 42%), respectively.¹⁶ An equal percentage (25%) of infants 6 to 8 months and 9 to 11 months consume baby food dinners.¹⁶ More recent data from the National Health and Nutrition Examination Survey (NHANES) 2009–2014 show a somewhat similar prevalence of baby food fruit and vegetable consumption among 6- to 11-month-olds, with 47% consuming baby food fruit and 42% consuming baby food vegetables.¹⁷ Despite the ubiquitous use of commercial baby foods in the United States, no study to our knowledge has used nationally representative data to describe the food consumption patterns and nutrient density of the complementary foods consumed by infants fed baby foods. The aim of this study was to describe food and micronutrient consumption patterns among infants consuming commercially prepared baby food fruit and vegetables and baby and toddler dinners and to compare with those of nonconsumers of these baby food products.

Given the widespread consumption of baby foods, understanding the quality of the complementary diet among baby food consumers should be addressed in order to inform policy makers and healthcare professionals to tailor guidance to parents and caregivers on how to feed their children in this early, formative stage. This issue is particularly pressing in light of the high rates of obesity and chronic disease seen among children, as well as the

dire lack of vegetables and fruits and related nutrients in the diets of American children.^{11,18,19}

MATERIALS AND METHODS

Study Design

The FITS 2008, a cross-sectional, dietary intake study of a national sample of US children (n = 3274) living in the 50 states and District of Columbia, was designed to obtain information on the diets and feeding practices of US infants (ages birth to 11.9 months), toddlers (ages 12–23.9 months), and preschoolers (ages 24–47.9 months). The FITS 2008 consisted of 2 or 3 telephone interviews between June 2008 and January 2009: a recruitment interview that collected household and child characteristics and a dietary interview including a 24-hour dietary recall, asking about food and beverage intake from midnight to midnight, as well as questions on breastfeeding and the introduction of complementary foods. During the recruitment interview, a key step was to obtain informed consent by respondents to pursue the 24-hour dietary recall, as well as to obtain accurate contact information, so study materials could be sent.²⁰ All study instruments and protocols, including incentives and informed consent procedures, were reviewed and approved by Mathematica's independent institutional review board, Public/Private Ventures in Philadelphia, Pennsylvania. Details of the design, dietary data collection and analysis methods, and study limitations are described elsewhere.²⁰

Little is known about the impact of commercial baby foods eaten by older infants.

Sample

The sample included infants between 6 and 11.9 months of age participating in the FITS study. Baby food consumers (hereto in referred to as “consumers”) were defined by reported use of any commercial baby food fruit, baby food vegetable, or baby or toddler dinner on the 24-hour dietary recall. Participants who reported no use of these specific baby foods were identified as “nonconsumers.” Infant cereal was not included in the definition of consumers for this analysis because doing so would have classified almost all children as baby food consumers, leaving us with no comparison group. Given that infant cereal has a different nutritional profile from baby food fruits, vegetables, and dinners, we elected to study it separately.²¹ All FITS children in this age group consumed some complementary foods, that is, anything in addition to breast

TABLE 1 Maternal and Infant Characteristics

Characteristic	Consumers of Baby Food Fruits, Vegetables, and Dinners			Nonconsumers of Baby Food Fruits, Vegetables, and Dinners			χ^2 P
	n = 365			n = 128			
	n	%	SE	n	%	SE	
Age of child, mo							
6–6.9	55	14.4	(2.4)	15	10.9	(3.3)	.004 ^a
7–7.9	54	17.6	(3.9)	13	11.0	(3.8)	
8–8.9	82	23.0	(3.9)	20	9.3	(2.6)	
9–9.9	55	16.9	(3.1)	22	15.7	(4.2)	
10–10.9	71	15.5	(2.4)	16	19.8	(6.3)	
11–11.9	48	12.7	(2.8)	42	33.4	(6.3)	
Gender of child							
Male	198	52.0	(4.5)	71	55.5	(6.6)	.659
Female	167	48.0	(4.5)	57	44.5	(6.6)	
Race of child [†]							
White	332	85.8	(2.6)	105	68.1	(6.4)	.009 ^a
Black or African American	34	16.1	(2.9)	18	28.9	(6.1)	.063
American Indian or Alaska Native	4	2.6	(1.3)	6	4.1	(2.2)	.546
Asian, Hawaiian, or Pacific Islander	10	2.9	(1.0)	5	5.1	(2.7)	.406
Other	4	1.4	(1.0)	0	0.0	.	N/A
Currently breastfed							
Yes	97	39.7	(5.4)	56	58.0	(7.4)	.021 ^a
No	188	60.3	(5.4)	49	42.0	(7.4)	
Mother's education [‡]							
High school or less	89	33.1	(4.8)	34	34.47	(7.2)	.352
Some postsecondary	95	22.4	(3.3)	36	31.48	(7.1)	
College or graduate work	139	44.5	(4.9)	45	34.06	(6.5)	
Child receives WIC							
Yes	119	40.7	(4.3)	40	55.28	(6.2)	.139
No	246	59.35	(4.3)	88	44.72	(6.2)	

(continues)

TABLE 1 Maternal and Infant Characteristics, Continued

Characteristic	Consumers of Baby Food Fruits, Vegetables, and Dinners			Nonconsumers of Baby Food Fruits, Vegetables, and Dinners			χ^2 P
	n = 365			n = 128			
	n	%	SE	n	%	SE	
Household income, \$							
<10 000	11	4.7	(1.8)	6	10.6	(5.7)	.145
10 000–19 999	19	8.8	(2.5)	15	18.2	(6.3)	
20 000–34 999	38	10.9	(2.3)	14	17.3	(5.4)	
35 000–49 999	51	15.4	(3.4)	17	12.7	(4.0)	
50 000–74 999	86	27.4	(4.8)	38	24.6	(5.0)	
75 000–99 999	58	16.3	(2.8)	15	9.1	(4.1)	
100 000–149 999	40	11.7	(2.4)	9	4.7	(2.3)	
≥150 000	21	4.8	(1.4)	4	2.9	(1.8)	

^aSignificant effect of characteristic on likelihood of consuming baby food fruits, vegetables, and dinners at 95% confidence.
[†]More than 1 race can be reported, so total adds to more than 100%.
[‡]Includes biological and adoptive mothers who are main caretaker/respondent.
Abbreviation: WIC, Special Supplemental Food Program for Women Infants and Children.

milk or formula.⁸ However, children who consumed only beverages and/or supplements, but no food, on the day of the survey were excluded from the analysis (n = 12). Of the 505 children in the FITS 2008 sample who were aged 6 to 11 months, the final sample included 493 children, 365 baby food consumers and 128 nonconsumers (Table 1).

Outcomes and Variable Measures

The main outcomes were consumption of major food groups and specific types of vegetables, as well as micronutrient density of the complementary foods consumed. The percent of children in each group consuming major food groups and specific types of vegetables was estimated. Grams and calories per capita from different types of vegetables were calculated by adding all grams or calories from each type of vegetable consumed by children in each group (consumers and nonconsumers) and dividing by the number of children in the group. To calculate amounts and calories consumed from vegetables, all mixed foods were disaggregated into their food components, and each component food was assigned to its appropriate food group using the US Department of Agriculture's My Pyramid Equivalence Database version 2.0.²² Recipes for infant products not in the database were added. For instance, baby food dinners were disaggregated into vegetable, meat, and grain, and each portion of the product assigned to the appropriate food group.²² Nutrient densities were deter-

mined for each child, by summing contribution of each nutrient from all complementary foods consumed, dividing by the total number of calories consumed from complementary foods by the child, and multiplying by 1000. Group means were then calculated for each nutrient. Breast milk, formula, and supplements were excluded from the assessment of the nutrient density of the complementary food, as complementary foods are defined as "any foods other than breast milk or formula (liquids, semisolids, or solids) introduced to an infant to provide nutrition."⁸

Statistical Analysis

All foods and beverages reported in the 24-hour dietary recalls were assigned to food groups using the FITS 2002 food classification scheme adapted from that used for national dietary surveys.²³ The FITS 2002 food groups were updated to account for new foods and beverages reported in FITS 2008.²⁰

All analyses used sample weights so that results and survey design are nationally representative of the US age and racial/ethnic distribution of children from birth to 4 years, based on population counts in the National Vital Statistics Reports for 2007, accounting for nonresponse at different stages and population coverage.²⁰ Means and proportions were calculated using SAS (version 9.1.3; SAS Institute, Cary, North Carolina; 2004); *t* tests were used to compare consumers and nonconsumers; statistical significance was set at $\alpha = .05$.

RESULTS

Sample

Baby food consumers were younger and more likely to be white, and nonconsumers were more likely to be breastfed (Table 1). Income and education did not differ between the groups. Energy intake from complementary foods was not significantly different among consumer and nonconsumers (330 vs 521 kcal, $P = .07$), but

consumers reported less complementary food, when measured by weight, than did nonconsumers (481 vs 619 g, $P = .008$). Among consumers, the average consumption of total baby foods was 217 g, and 57% of total vegetable intake and 45% of total fruit intake were from baby food.

Food Group Consumption

Baby food consumers were overall more likely to report consumption of total vegetables (other than white potatoes)

TABLE 2 Percent of Children Consuming the Major Food Groups

Food	Description	Consumers of Baby Food Fruits, Vegetables, and Dinners		Non-Consumers of Baby Food Fruits, Vegetables, and Dinners		χ^2 P
		n = 365		n = 128		
		Mean	(SE)	Mean	(SE)	
Vegetables	Any	74.5	(4.2)	60.8	(6.7)	.076
	All except white potatoes	71.0	(4.4)	51.2	(6.7)	.013 ^a
	Dark green	3.5	(1.6)	19.75	(4.6)	.001 ^b
	Deep yellow	41.8	(4.2)	18.3	(4.2)	.001 ^b
	Other	30.6	(4.3)	22.6	(4.9)	.228
	Starchy	20.8	(3.3)	29.1	(5.6)	.189
	Potatoes	9.5	(2.3)	23.5	(5.3)	.007 ^b
Fruit	Any fruit or 100% juice	88.4	(1.9)	80.6	(4.1)	.063
	Fruit	79.34	(3.7)	65.46	(5.9)	.041 ^a
	100% Juice	34.0	(4.5)	40.1	(6.0)	.423
Mixed dishes		46.7	(4.4)	26.1	(4.9)	.021 ^a
Sweets		23.3	(4.1)	46.6	(6.2)	.028 ^a
Meat and other protein sources		13.0	(2.3)	62.2	(5.3)	.000 ^b
Milk and milk products	Any	100.0	0.0	100.0	0.0	1.000
	Breast milk	27.42	(4.3)	42.58	(7.0)	.054
	Cow's milk	8.46	(3.0)	17.25	(4.9)	.111
	Infant formula	79.65	(4.2)	48.33	(6.4)	.0001 ^b
Grains and grain-based products	Any	93.1	(1.9)	88.0	(3.5)	.1730
	Infant cereal	79.7	(3.1)	37.7	(5.6)	.000 ^b
	Noninfant cereal	16.2	(2.6)	46.9	(6.6)	.000 ^b
	Breads, biscuits, and tortilla	5.3	(1.3)	19.4	(4.9)	.000 ^b

^aSignificant difference between consumers and nonconsumers at 95% confidence.

^bSignificant difference between consumers and nonconsumers at 99% confidence.

TABLE 3 Specific Vegetables Reported Within Each Type of Vegetable	
Vegetable Types	Specific Vegetables Reported
Dark green	Broccoli, spinach, other greens, Romaine lettuce
Deep yellow/orange	Carrots, sweet potatoes, winter squash, pumpkin
White potatoes	French fries and other fried potatoes, mashed, baked, boiled
Other starchy	Corn, green peas, lima beans, black-eyed peas
Other	Artichoke, asparagus, beets, Brussels sprouts, cabbage, cauliflower, celery, cucumber, eggplant, green beans, lettuce, mushrooms, okra, onions, pea pods, peppers, tomatoes/tomato sauce, wax/yellow beans, zucchini, summer squash

compared with nonconsumers (71% vs 51%, $P = .013$) (Table 2). Specific vegetables reported within each vegetable type are listed in Table 3. When compared with nonconsumers, consumers were more likely to report deep yellow vegetables (42% vs 18%, $P = .001$) and were less likely to report white potatoes (10% vs 24%, $P = .007$) and dark green vegetables (4% vs 20%, $P = .001$). Both the per-capita amount of vegetables consumed (in grams) and calories from vegetables showed a similar pattern (Figure). Overall baby food consumers had a much higher intake of all vegetables when measured in grams. The smaller differences in calories from vegetables show that the vegetables eaten by baby food consumers were lower

in calories. Top vegetables consumed by more than 5% of children in each group are listed in Table 4, which shows that sweet potatoes (20%) were the most frequently reported vegetable among baby food consumers, whereas white potatoes were the top vegetable reported by nonconsumers (24%). Baby food consumers were also more likely to report fruit (excluding juice), but did not differ with regard to 100% fruit juice consumption when compared with nonconsumers (Table 2). Baby food consumers were less likely to report sweets (eg, cookies, ice cream, sweetened beverages) when compared with nonconsumers (23% vs 47%, $P = .028$) (Table 2). Consumers were more likely to report intake of infant cereal, and nonconsumers were more likely to report noninfant cereals (Table 2).

Nutrient Density of Complementary Food

Nutrient densities of the complementary foods of consumers were higher in several nutrients typically found in fruits and vegetables (Table 5). Consumers' diets had significantly higher total fiber (20.4 vs 14.4 g per 1000 kcal, $P = .000$), both insoluble and soluble fiber, vitamin E (5.5 vs 4.6 mg per 1000 kcal, $P = .012$), vitamin C (131 vs 96 mg per 1000 kcal, $P = .046$), and vitamin A (1172 vs 696 retinol activity equivalent per 1000 kcal, $P = .002$) compared with nonconsumers. Consumers' diets were also higher in potassium (2025 vs 1607 mg per 1000 kcal, $P = .000$), magnesium (202 vs 177 mg per 1000 kcal, $P = .015$), and total carotenoids (18635 vs 9447 μg per 1000 kcal, $P = .000$). Diets of consumers were lower in sodium (572 vs 1192 mg per 1000 kcal, $P = .000$) and vitamin D (1.0 vs 1.75 μg per 1000 kcal, $P = .009$) compared with those of nonconsumers. No differences in micronutrient densities were observed by baby food consumption for any of the B vitamins, calcium, phosphorus, iron, or zinc.

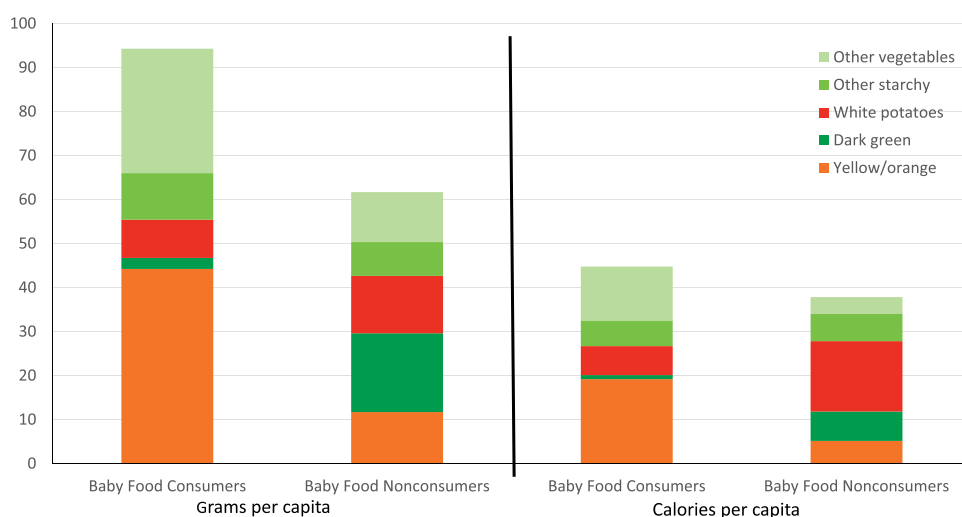


FIGURE. Consumption of vegetables by baby food consumers and nonconsumers, by vegetable type. Children 6 to 11.9 months old from the Feeding Infants and Toddlers Study, United States.

Several nutrients found in fruits and vegetables were higher in the diets of commercial baby food consumers.

DISCUSSION

This is the first nationally representative study to describe diets of US infants consuming commercially prepared baby foods and compare them with nonconsumers, in order to characterize and understand what is being consumed and implications for the diet. It has been shown previously, in a statewide sample of infants participating in the Special Supplemental Nutrition Program for Women Infants and Children, that consumption of commercial baby foods is associated with a greater variety of fruits and vegetables in the diet.²⁴ Other studies have indicated that commercial baby food products may be too high in sugar and sodium,²⁵⁻²⁷ but

TABLE 4 Top Vegetables Consumed (Percent of Children Consuming)

Consumers of Baby Food Fruits, Vegetables, and Dinners n = 365	Nonconsumers of Baby Food Fruits, Vegetables, and Dinners n = 128
Sweet potatoes (20.1)	White potatoes (23.5)
Carrots (15.1)	Carrots (13.1)
Mixed garden vegetables (14.1)	Broccoli (12.9)
Squash (11.9)	Green beans (11.3)
Green peas (11.6)	Green peas (9.6)
Green beans (11.6)	Corn (5.8)
White potatoes (9.5)	Other mixtures (5.4)

TABLE 5 Nutrient Density of Complementary Foods by Baby Food Consumption

Nutrients per 1000 kcal		Consumers of Baby Food Fruit, Vegetables, Dinners n = 635		Nonconsumers of Baby Food Fruit, Vegetables, Dinners n = 128		P
		Weighted Mean Intake	(Weighted SE Mean)	Weighted Mean Intake	(Weighted SE Mean)	
		Antioxidants	Vitamin E, mg	5.5	(0.2)	
	Vitamin C, mg	131.0	(9.6)	95.8	(15.0)	.046 ^a
	Retinol equivalent, μg	1172.3	(109.9)	696.1	(109.1)	.002 ^b
Carotenoids	Total carotenoids, μg	18 635.1	(1604.4)	9447.1	(1812.3)	.000 ^b
	α-Carotene, μg	2923.8	(440.0)	1439.6	(465.0)	.021 ^a
	β-Carotene equiv, μg	12 828.2	(1323.1)	5499.9	(1333.9)	.000 ^b
	β-Cryptoxanthin, μg	284.6	(108.7)	229.3	(71.3)	.671
	Lutein + zeaxanthin, μg	3139.2	(395.8)	1498.7	(464.7)	.007 ^b
	Lycopene, μg	1067.0	(372.4)	1614.8	(916.5)	.582
B vitamins	Riboflavin, mg	1.4	(0.0)	1.4	(0.1)	.866
	Thiamin, mg	1.1	(0.0)	1.2	(0.1)	.157
	Niacin, mg	15.9	(0.6)	16.7	(1.0)	.445
	Vitamin B ₆ , mg	1.5	(0.0)	1.5	(0.1)	.596
	Dietary folate equivalent, μg	327.7	(16.9)	417.6	(47.4)	.070
	Vitamin B ₁₂ , μg	2.5	(0.1)	3.0	(0.3)	.106

(continues)

TABLE 5 Nutrient Density of Complementary Foods by Baby Food Consumption, Continued

Nutrients per 1000 kcal		Consumers of Baby Food Fruit, Vegetables, Dinners		Nonconsumers of Baby Food Fruit, Vegetables, Dinners		P
		n = 635		n = 128		
		Weighted Mean Intake	(Weighted SE Mean)	Weighted Mean Intake	(Weighted SE Mean)	
Bone related	Calcium, mg	672.3	(22.9)	637.1	(51.5)	.547
	Phosphorus, mg	654.1	(15.8)	686.6	(31.7)	.353
	Vitamin D, μ g	1.0	(0.1)	1.7	(0.3)	.009 ^b
	Magnesium, mg	201.6	(5.3)	176.9	(8.2)	.015 ^a
Other micronutrients	Iron, mg	33.2	(1.9)	27.7	(3.2)	.181
	Potassium, mg	2025.1	(57.1)	1607.2	(83.3)	.000 ^b
	Zinc, mg	7.9	(0.3)	8.3	(0.6)	.458
	Sodium, mg	572.4	(54.9)	1191.8	(104.0)	.000 ^b
	Chlorine, mg	145.8	(7.1)	141.0	(8.4)	.672
Dietary fiber	Total dietary fiber, g	20.4	(0.6)	14.4	(0.9)	.000 ^b
	Insoluble dietary fiber, g	13.3	(0.4)	9.7	(0.7)	.000 ^b
	Soluble dietary fiber, g	7.0	(0.2)	4.6	(0.4)	.000 ^b

^aSignificant difference between consumers and nonconsumers at 95% confidence.

^bSignificant difference between consumers and nonconsumers at 99% confidence.

these studies have only compared with theoretical cut points, rather than the nutritional quality of the actual diets of baby food consumers versus nonconsumers. Because we used a comparison group, our findings provide key insights about the quality of the diets of US infants that include commercial baby foods versus diets of those infants who do not include these foods. Because the majority of infants 6 to 11 months in the United States consume commercial baby foods of some type, this analysis was limited to children consuming baby food fruits, vegetables, and dinners, in order to have a comparison group of nonconsumers. Infant cereal is a widely consumed infant food, and we assessed its impact in the diet separately.²¹ Including infant cereal in our definition of baby food consumer would have resulted in a comparison group that was too small to be meaningful. In addition, because the nutritional attributes of infant cereals and fruits and vegetables are quite different, they lend themselves to different assessments of dietary impact. Approximately 80% of the infants classified here as consumers also consumed infant cereal, as well as did approximately 38% of the nonconsumers. Nonconsumers were far more likely to consume noninfant cereals (47% vs 16%).

The noninfant cereals fed to children 6 to 11 months are not presweetened much more often than presweetened.¹⁶ These cereals are generally lower in iron than are infant cereals. A separate comparison of consumers and nonconsumers showed that infant cereal consumers have higher iron intakes.²¹

This research suggests that the diet quality of infants consuming commercially prepared baby fruits, vegetables, and dinners was higher than that of nonconsumers for nutrients of public health concern and food groups specified in the Dietary Guidelines for Americans.¹¹ Specifically, children with diets including these baby foods are more likely to consume vegetables (excluding white potatoes) and fruits and less likely to consume sweets and have diets higher in fiber, potassium, vitamin A, vitamin C, and magnesium and lower in sodium and energy density. While nonconsumers ate more food than consumers (619 vs 481 g), these results show that the foods eaten by nonconsumers were less nutrient dense than the foods eaten by baby food consumers. This lower nutrient density and higher energy density of the diets of nonconsumers are likely driven by both the lower intake of fruits and vegetables and higher intake of sweets.

It is well established that vegetables are a food group of public health concern, with more than 90% of both the US population overall and also specifically of 2- and 3-year-olds not meeting vegetable intake recommendations.^{11,22} It has also been shown that diets of infants at 6 to 11 months, and specifically vegetable consumption, are associated with diets later in childhood,⁴ underscoring the importance of feeding in late infancy. Previous assessment of the FITS data has shown that approximately 30% to 40% of infants 6 to 11 months old were not consuming even 1 serving of vegetable on the day of the survey.¹⁶ The NHANES data showed that, when white potatoes were excluded from the definition of vegetable, more than 40% of older infants were not consuming vegetables on the day of the survey.¹⁷ There were shortfalls in intakes of all subgroups of vegetables. Greater intakes of all of them are desirable, especially for the vegetables, whose intakes are very low, such as the dark green and orange vegetables. These are excellent sources of vitamin C, folate, magnesium, and potassium.¹¹ An interesting finding of our study was that, whereas consumption of dark green vegetables was limited generally,^{16,18} nonconsumers were more likely to report dark green vegetable intake. Investigation into potential reasons for lack of green vegetables in baby food revealed that there are few commercial offerings of products made predominantly of dark green vegetables for infants because of both regulatory and quality control limits on nitrates in baby foods. These are barriers to using many dark green vegetables as a major ingredient in recipes, and research into approaches for controlling nitrates is underway Jupiter Yeung, PhD, Nestlé R&D, personal phone communication via phone call in 2017.

Two different analyses of the NHANES data have shown that all baby food, including cereal and a wider variety of baby foods, considered as 1 food group, is the major source of a large number of nutrients among infants 6 to 11 months old.^{28,29} Our findings, while including a more limited number of baby food items (fruits, vegetables, and dinners), complement those of Grimes et al,²⁸ showing that the diets of consumers were actually also higher in many of these nutrients including fiber, potassium, vitamin A, vitamin C, and magnesium, compared with those of nonconsumers. However, our findings differ somewhat from those of Maalouf et al,²⁹ who found that baby food considered together as 1 food group is the top food source of sodium. Contrary to the findings of Maalouf et al,²⁹ when comparing diets as consumed, we found that diets of baby food consumers were actually lower in sodium than diets of nonconsumers. This is likely due to the fact that Maalouf et al²⁹ did not have a comparison group, as we did in our analysis.

Potatoes are the most commonly consumed vegetable and make up 25% of all vegetable consumption by Americans¹¹ and are already the no. 1 vegetable among

9- to 11-month-olds.¹⁶ We observed that nonconsumers of baby foods were significantly more likely to consume white potatoes than were consumers. While white potatoes are a good source of potassium and fiber, they are not as rich in some of the other nutrients as more colorful vegetables, and all children, including infants, need to consume more vegetables in the other vegetable subgroups beyond white potatoes.¹¹

All caregivers should include plenty of deep green and yellow vegetables and other vegetables and fruits to replace sweets and other high-energy and low-nutrient foods in infant and toddler diets.

Mixed dishes contribute approximately a third of vegetables consumed by Americans.¹¹ We found that children consuming baby foods were about twice as likely to consume mixed dishes as nonconsumers. When the composition of specific mixed dishes consumed by most baby food consumers (chicken and vegetables or turkey and vegetables infant dinners) was examined, we found that the first food ingredient in both products was vegetable, followed by meat. We also found that baby food consumers were far less likely to consume meat and protein foods. This lower likelihood of consuming meat is probably due to the fact that mixed dishes usually have meat or another protein as a key ingredient, and meat is therefore not consumed as often as a separate food item by children consuming mixed dishes. In addition, nonconsumers were older than consumers (28% of the consumers and 53% of the nonconsumers were 10-11 months old), and this may have impacted some of the foods consumed, because of developmental stage. Perhaps nonconsumers were more likely to eat meat, as they were older and may have had more advanced feeding skills to better handle meats. This may have also been the case for green vegetables, as broccoli was the most often consumed green vegetable. Yellow vegetables, however, generally have a softer texture and are a common baby food offering, likely contributing to the higher intake seen in baby food consumers.

Diets of consumers were lower in vitamin D, and although this finding was statistically significant, it may not be important, as the majority of vitamin D in infant diets comes from formula and breast milk,²⁸ not from the complementary food, which was assessed here. However, because cow's milk is included in the definition of complementary foods, nonconsumers of baby foods may have been more

likely to consume cow's milk (not significant), and this may account for the higher levels of vitamin D seen in diets of nonconsumers.

There are some limitations in these analyses. Given the very widespread use of baby food in the United States, it was not possible to define the sample among consumers and nonconsumers of all baby foods. While the objective of the study was to compare the diets of children consuming baby food fruits, vegetables, and baby and toddler dinners, children in both groups were consuming other baby foods such as infant cereal and baby snacks. Also, as indicated above, the percentage of children consuming vegetables was assessed based on distinct servings (in any amount) of vegetable dishes, and vegetables in mixed dishes were not included. Consumers of baby food were more likely to consume mixed dishes, and most contained vegetables, which likely led to an underestimate of the number of baby food consumers eating vegetables. The data were collected in 2008 and therefore may not reflect exact consumption patterns of baby food at present. However, more recent data from NHANES 2009–2014 show a similar level of baby food consumption, as indicated above. The current analyses provide important insights and baseline data with which to compare baby food consumption from future surveys.

The complementary feeding period is critically important for the introduction of flavors and flavor preference development¹ and the development of habits that have been shown to track into later childhood.^{3,4,30} The Infant Feeding Practices Study showed that children who are consuming fruits and vegetables at age 6 to 11 months are more likely to consume them at age 6 years⁴ and that infants consuming sweetened beverages at this time are also more likely to consume them at age 6 years.³⁰ In this current descriptive analysis, we found that baby food consumers were more likely to consume vegetables and fruits and less likely to consume sweets during these critical months. The developmental appropriateness and convenience aspects of commercial baby foods, as well as the positive nutritional benefits that foods with these qualities may bring to the infant diet, may be overlooked by health professionals and parents who might have a desire for homemade and less processed foods. We have shown here that when children are fed commercial baby foods, they are more likely to be fed vegetables and fruits and less likely to be fed sweets, and their diets are more micronutrient dense. These data further show that when nonconsumers of baby food are fed vegetables, the no. 1 vegetable is potatoes, often in the form of mashed potatoes. Although we do not have data on reasons for feeding choices, it is true that it requires more planning and preparation to make a variety of healthy homemade foods in appropriate forms for an infant.

Our findings provide important insights about children's nutrition and dietary issues in the first 1000 days that can be used in the development of public health policy as

well as healthcare provider advice to parents. These findings indicate that a diet that includes commercial baby foods can be an appropriate and healthful way to feed during the complementary feeding period. We have found that diets including commercial baby foods are higher in fruits and vegetables and lower in sweets and are more micronutrient dense and less energy dense than diets of children who do not consume these baby foods. All caregivers, whether they choose to feed commercial baby food or not, should include more vegetables and fruits in their child's diet, including plenty of deep yellow and green vegetables, and these should replace high-energy and low-nutrient foods, such as sweets.

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THE AMERICAN COLLEGE OF SPORTS MEDICINE ANNOUNCES NEW RECOMMENDATIONS AND WARNINGS REGARDING SAFETY OF ENERGY DRINKS

The American College of Sports Medicine has released a new official statement regarding energy drinks that provides guidance and warnings regarding these beverages because of the dangers they present to at-risk populations, primarily children who are the most vulnerable and the target of marketing efforts.

Energy drinks are highly caffeinated beverages that often contain a myriad of vitamins, minerals, amino acids, and herbal mixtures. The recommendations help consumers to understand the risks associated with rapid and excessive consumption of energy drinks. American College of Sports Medicine's primary recommendations in the article focus on 4 key areas:

- Protecting children at risk: Children and adolescents appear to be at a particularly high risk of complications from energy drinks due to their small body size, being relatively caffeine naive, and potentially heavy and frequent consumption patterns, as well as the amounts of caffeine. The message that these beverages are not intended for children needs to be reinforced and widely disseminated, according to the article.
- Marketing to at-risk groups, especially children: Marketing should not appeal to vulnerable populations. Currently, manufacturers of energy drinks advertise on Web sites, social media, and television channels that are appealing to both children and adolescents. Target marketing to sporting and other events involving children and adolescents should not be permitted.
- Do not use energy drinks before/during/after strenuous exercise: Regardless of health and fitness level and until such time that proper safety and efficacy data are available, energy drinks should be avoided before, during, or after strenuous activities. Some of the deaths allegedly due to energy drinks have occurred when a person consumed energy drinks before and/or after performing strenuous activities.
- More education and data needed: Investment in awareness and educational resources highlighting the potential adverse effects and safe use of energy drinks is required. Significant efforts should be made to educate consumers regarding the clear and present differences between soda, coffee, sports drinks, and energy drinks. Energy drink education also should be a priority in school-based curricula related to nutrition, health, and wellness.

The American College of Sports Medicine article called for the development of a research agenda to prioritize key questions about the acute and chronic effects of energy drink use. The organization encouraged healthcare providers to talk to their patients about energy drink use and report adverse events to watchdog agencies, such as the Poison Control Centers, the Consumer Product Safety Commission, and the US Food and Drug Administration. According to the article, a national registry should be set up to specifically track energy-drink adverse effects with mandated reporting requirements.

The article also recommended that children, adolescents, or other vulnerable populations, including pregnant or breastfeeding women, should not consume energy drinks. Individuals with cardiovascular or medical conditions should not drink them as well. They should not be used for sports hydration or mixed with alcohol and should carry labels such as "High Source of Caffeine" or "Do Not Mix with Alcohol."

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