

**Original Research**

# Nutrient Intakes of US Infants, Toddlers, and Preschoolers Meet or Exceed Dietary Reference Intakes

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**ABSTRACT**

**Objectives** To assess the usual nutrient intakes of 3,273 US infants, toddlers, and preschoolers, aged 0 to 47 months, surveyed in the Feeding Infants and Toddlers Study (FITS) 2008; and to compare data on the usual nutrient intakes for the two waves of FITS conducted in 2002 and 2008.

**Design** The FITS 2008 is a cross-sectional survey of a national random sample of US children from birth through age 47 months. Usual nutrient intakes derived from foods, beverages, and supplements were ascertained using a telephone-administered, multiple-pass 24-hour dietary recall.

**Subjects** Infants aged birth to 5 months (n=382) and 6 to 11 months (n=505), toddlers aged 12 to 23 months (n=925), and preschoolers aged 24 to 47 months (n=1,461) were surveyed.

**Methods** All primary caregivers completed one 24-hour dietary recall and a random subsample (n=701) com-

pleted a second 24-hour dietary recall. The personal computer version of the Software for Intake Distribution Estimation was used to estimate the 10th, 25th, 50th, 75th, and 90th percentiles, as well as the proportions below and above cutoff values defined by the Dietary Reference Intakes or the 2005 Dietary Guidelines for Americans.

**Results** Usual nutrient intakes met or exceeded energy and protein requirements with minimal risk of vitamin and mineral deficiencies. The usual intakes of antioxidants, B vitamins, bone-related nutrients, and other micronutrients were adequate relative to the Adequate Intakes or Estimated Average Requirements, except for iron and zinc in a small subset of older infants, and vitamin E and potassium in toddlers and preschoolers. Intakes of synthetic folate, preformed vitamin A, zinc, and sodium exceeded Tolerable Upper Intake Level in a significant proportion of toddlers and preschoolers. Macronutrient distributions were within acceptable macronutrient distribution ranges, except for dietary fat, in some toddlers and preschoolers. Dietary fiber was low in the vast majority of toddlers and preschoolers, and saturated fat intakes exceeded recommendations for the majority of preschoolers. The prevalence of inadequate intakes, excessive intake, and intakes outside the acceptable macronutrient distribution range was similar in FITS 2002 and FITS 2008.

**Conclusions** In FITS 2008, usual nutrient intakes were adequate for the majority of US infants, toddlers, and preschoolers, except for a small but important number of infants at risk for inadequate iron and zinc intakes. Diet quality should be improved in the transition from infancy to early childhood, particularly with respect to healthier fats and fiber in the diets of toddlers and preschoolers. *J Am Diet Assoc.* 2010;110:S27-S37.

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**STATEMENT OF POTENTIAL CONFLICT OF INTEREST AND FUNDING/SUPPORT:** See page S37.

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**D**ietary assessment is used to describe contemporary dietary patterns and food sources, and to estimate the adequacy of nutrient intakes of population subgroups. Dietary Reference Intakes (DRIs) may be used to assess whether diets provide enough nutrients to meet requirements without being excessive, and for other dietary components to promote health and reduce the risk of chronic disease (1). The National Health and Nutrition Examination Surveys (NHANES) monitor the dietary intake of the US population and provide a valuable reference for dietary trends over time; however, breastfed infants are not included in reported estimates of dietary intake and sample sizes for young children are limited.

The Feeding Infants and Toddlers Study (FITS) 2002 assessed usual nutrient intakes and food consumption patterns in a national random sample of 3,022 of children aged 4 to 24 months (2). Usual nutrient intakes were evaluated against the DRIs and for the most part found to be adequate, except for vitamin E intake and dietary fiber. Mean energy intakes exceeded Estimated Energy Requirements (EER) by 10% for infants aged 4 to 6 months, 23% for infants aged 7 to 11 months, and 31% for toddlers aged 12 to 24 months. Concern was raised with respect to the validity of some of the DRIs for young children and for the potential of parental over-reporting of food items using the 24-hour dietary recall methodology (2,3).

Given cost-effectiveness and low respondent burden, the 24-hour dietary recall that was used in FITS is the preferred method for dietary assessment of young children; however, the accuracy of a 24-hour dietary recall is dependent on the primary caregivers' recollection of the types and the quantities of all food, beverages, and supplements consumed by their children. In a study designed to test the validity of the 24-hour recall in young children, the 24-hour recall was found to overestimate energy intake by 13% in infants and by 29% in toddlers compared with a 3-day weighed food record which was within 5% of EER (4). To address these apparent errors, the diet methodology was modified to decrease the likelihood that primary caregivers would overreport portion sizes of certain food items (5).

In 2008, the landmark FITS 2002 was replicated, and expanded to include a total of 3,273 infants, toddlers, and preschoolers 0 to 47 months of age (5). FITS 2008 is invaluable not only to assess nutrient adequacy and excess in a large, representative national sample of US infants, toddlers, and preschoolers, but also to monitor changes in dietary practices relative to FITS 2002. The specific objectives of this article are to assess the usual nutrient intakes of the 3,273 US infants, toddlers, and preschoolers 0 to 47 months of age surveyed in FITS 2008; and to compare data on the usual nutrient intakes for the two waves of FITS conducted in 2002 and 2008. Diets were evaluated relative to the acceptable macronutrient distribution range (AMDR), 2005 Dietary Guidelines for Americans (DGA), and DRIs.

## METHODS

### Study Design

The FITS 2008 is a cross-sectional survey of a national random sample of US children from birth through age 47 months. A targeted-list frame from a commercial vendor, the New Parent Database and the Consumer Database (Experian, Inc, Costa Mesa, CA), was used as the sample frame. The Experian databases contain records from all 50 states and the District of Columbia and, therefore, form a national sample frame. The recruitment of subjects, the sampling frame, sample characteristics, and data collection and quality assurance procedures have been described in detail by Briefel and colleagues (5). All instruments and procedures were reviewed and approved by Mathematica's independent Institutional Review Board (Public/Private Ventures, Philadelphia, PA). All participants received written information on the

study, understood that participation was voluntary, and were assured of the confidentiality of the data. Consent from each respondent was obtained before proceeding with the study interviews.

### Sample

The FITS 2008 sample included 3,273 children ages 0 to 47 months and is fully described in a companion article (see pages S16-S26) (5). A random subsample (n=701) also completed a second 24-hour dietary recall. This publication focuses on four age subgroups: 382 infants aged birth to 5.9 months, 505 older infants aged 6 to 11.9 months, 925 toddlers aged 12 to 23.9 months, and 1,461 preschoolers aged 24 to 47.9 months.

About 56% of the sample was non-Hispanic white, 14% non-Hispanic black, 21% Hispanic, and 8% other race/ethnicity. About one third (35%) of children were first-born, 80% were ever breastfed, 48% were in child care, and 30% were receiving benefits from the Special Supplemental Nutrition Program for Women, Infants, and Children. About half (51%) of the children's mothers worked outside the home, and 46% had a college degree or higher. About 13% of the sample had annual household incomes below \$20,000 and 16% above \$100,000.

### Data Collection Methods

Study participants received up to three telephone interviews between June 2008 to January 2009: a recruitment interview to determine whether there was an age-eligible child and to collect household and child characteristics, including child feeding patterns; a dietary interview, including a 24-hour dietary recall and questions on breastfeeding, the introduction of foods, and dietary supplement use on the recall day; and for a random subsample, a second 24-hour dietary recall 3 to 10 days following the first recall. Before the dietary interview, respondents (the main caregiver of the selected child, typically the mother) were mailed a packet of materials, including a study letter, food model booklet, ruler, liquid measuring cup with instructions, and instructions for determining foods consumed while in child care (see Briefel and colleagues [5] for details on data collection methods and quality control).

Dietary interviews were administered by certified dietary interviewers at the University of Minnesota's Nutrition Coordinating Center by telephone using the FITS 2008 protocol and the Nutrition Data System for Research (NDSR) (version 2008, 2008, University of Minnesota, Minneapolis). All study materials were available in English and Spanish. Approximately 26% of the dietary recalls were collected for weekend intakes (ie, Saturday or Sunday) and 74% reflected intake on weekdays (ie, Monday through Friday).

### Nutrient Database for Foods and Supplements

The NDSR 2008 was used to compute total daily nutrient intakes from food and beverages, with and without supplements. The NDSR 2008 includes more than 18,000 foods with values for 156 nutrients, nutrient ratios, and other food components. The NDSR 2008 contains more than 7,000 brand-name products, including many baby/

toddler foods and infant formulas. The NDSR 2008 also links to the Dietary Supplement Assessment Module Database, which includes dietary supplements reported during the 2003-2004 NHANES and includes a comprehensive ingredient file that allows for the addition of supplements not found within the database. When a reported food or supplement was not available in the database, the item was entered as “missing” along with details (brand name, description, preparation details, package size, dimensions, and weight or number consumed) and resolved after data entry was completed for the recall. A total of 358 foods and 65 dietary supplements were added to the FITS 2008 database.

About 13% of the recalls among children aged 0 to 42 months included breast milk that was not quantified (breastfed the child); some recalls did include measured amounts of breast milk. Using the available literature, we assigned breast milk volumes based on the child’s age in months and the total amount or volume of other milks (infant formula, cow’s milk, or soy milk) reported over the course of the recall day (5,6-8). For exclusively breastfed infants aged birth to 5.9 months, an average intake of 780 mL/day of human milk was assumed; for partially breastfed infants, the amount of human milk was computed as 780 mL/day minus the amount of formula/other milks consumed. For infants aged 6 to 11.9 months fed human milk as the sole milk source, the amount of human milk was assumed to be 600 mL/day; for partially breastfed infants, the amount of human milk was computed as 600 mL/day minus the amount of formula/other milks consumed. For breastfed toddlers aged 12 to 17.9 months, the amount of human milk was computed as 89 mL per feeding occasion; and for breastfed preschoolers, the amount of human milk was computed as 59 mL per feeding occasion.

### Statistical Analysis

Sample weights were calculated to account for nonresponse and to weight the sample to known population demographic characteristics. All analyses use sample weights that reflect the US population aged birth to 47 months. All estimates (eg, means and proportions) were calculated using the Statistical Analysis System (version 9.1.3, 2004, SAS Institute, Cary, NC) and the appropriate sample weights and design effects. Standard errors and t-test were calculated using SUDAAN (release 9, 2005, Research Triangle Institute, Research Triangle Park, NC).

To account for day-to-day variation in food consumption, which affects usual nutrient intake, we used the personal computer version of the Software of Intake Distribution Estimation (PC-SIDE) (version 1.0.0.1, 2003, Iowa State University, Ames). This program estimates the percentiles of usual nutrient intake distributions, as well as the proportion above or below defined DRI cutoff values. Since the replicate 24-hour recalls include supplements, daily intakes of nutrients from food and supplement sources were combined before adjustments using PC-SIDE, following the recommendations of Carriquiry and colleagues (9). There was too little variation in the intakes of infants, ages birth to 5 months, for the PC-SIDE program to produce adjusted nutrient intake dis-

tributions. Therefore, for this age group, we report mean and median intakes based on a single 24-hour recall.

The DRIs were used to assess the prevalence of adequate and excessive intakes, following the methods endorsed by the Institute of Medicine (1,10). The AMDRs or the ranges of intakes from carbohydrate, protein, fat, and selected fatty acids that are associated with a decreased risk of chronic disease, yet provide adequate amounts of essential nutrients, were used to assess the macronutrient intakes for children older than 1 year of age. Since the 2005 DGA apply only to the population aged 2 years and older, usual intake of saturated fat of preschoolers only was compared to the recommendation for saturated fat (11).

For assessment of dietary vitamin and mineral adequacy, the estimated average requirement (EAR) cut-point method was used (1). The proportion of the population with usual intakes less than the EAR provides an estimate of the proportion of the group with intakes not meeting the nutrient requirement. For nutrients with only an adequate intake (AI), methods for assessing dietary adequacy are limited. The AI cannot be used to determine the proportion of individuals in a group with inadequate nutrient intakes. Population subgroups with mean intakes at or above the AI can be assumed to have nutritionally adequate diets. For nutrients with established Tolerable Upper Intake Levels (ULs) and for which the NDSR output is in the form of the nutrient on which the UL is based, the proportions of toddlers and preschoolers with usual intakes from food and beverages with or without supplements exceeding the UL were computed. Usual energy intakes could not be evaluated against EERs, because precise body weights and heights of the FITS 2008 participants on the days diets were assessed were not available.

A comparison between usual mean nutrient intakes from food, beverages, and supplements in FITS 2002 and FITS 2008 was performed for infants aged 6 to 11 months and toddlers aged 12 to 23 months, the age groups that were represented in both waves of FITS. The comparison was based on standard errors of Day 1 intakes using a two-sample mean comparison test (*t* test). The prevalence of inadequate intakes, excessive intakes and intakes outside of the AMDR also were compared between the two surveys using a mean comparison *t* test. Differences were considered statistically significant at  $P < 0.05$ .

## RESULTS

### Vitamin/Mineral Supplement Use

As reported by the child’s primary caregiver, the percentage of infants aged 0 to 5 months and 6 to 11 months, toddlers, and preschoolers receiving vitamin/mineral supplements on the day of their 24-hour dietary recall was  $8.8 \pm 2.3$ ,  $12.6 \pm 2.7$ ,  $24.8 \pm 2.2$ , and  $40.4 \pm 2.1\%$ , respectively.

### Nutrient Intakes of Infants

The intake distributions of macronutrients, antioxidants, B vitamins, bone-related nutrients, and other micronutrients for infants aged 0 to 5 months and 6 to 11 months are presented in Table 1 and Table 2, respectively. The

**Table 1.** One-day nutrient intake distributions from food, beverages, and supplements for infants from birth to age 5 mo (n=382)

Nutrient	Dietary Reference Intakes-Adequate Intake <sup>a</sup>	Mean/Median Intake Percentiles					
		10th	25th	Median	Mean±standard error	75th	90th
<b>Macronutrients</b>							
Energy (kcal/d)		495	562	568	611±6.9	644	779
Fat (g/d)	31	26	30	36	34±0.3	36	39
Saturated fat (g/d)		10	13	15	14±0.2	16	17
Carbohydrate (g/d)	60	53	56	57	66±1.0	72	87
Protein (g/d)	9.1	8.4	8.4	10.4	11.5±0.20	13.6	16.9
Dietary fiber (g/d)		0	0	0	0.5±0.06	0	1.4
<b>As percentage of total energy</b>							
Fat (%)		44	47	50	50±0.3	56	56
Saturated fat (%)		16	19	22	22±0.2	26	26
Carbohydrate (%)		39	39	42	43±0.2	44	48
Protein (%)		6	6	8	8±0.1	9	9
<b>Antioxidants</b>							
Vitamin C (mg/d)	40	41	41	48	60±1.8	70	86
Vitamin E (mg/d)	4	1	1	3	4±0.2	6	8
<b>B vitamins</b>							
Thiamin (mg/d)	0.2	0.1	0.1	0.4	0.5±0.02	0.6	0.8
Riboflavin (mg/d)	0.3	0.3	0.3	0.6	0.7±0.03	0.9	1.2
Niacin (mg/d)	2	1	1	5	6±0.3	7	10
Vitamin B-6 (mg/d)	0.1	0.1	0.1	0.3	0.3±0.02	0.5	0.6
Folate (μg dietary folate equivalents/d)	65	41	41	94	113±3.9	159	203
Vitamin B-12 (μg/d)	0.4	0.4	0.4	1.3	1.5±0.08	2.0	2.5
<b>Bone-related nutrients</b>							
Calcium (mg/d)	210	260	260	354	424±10.2	528	709
Phosphorus (mg/d)	100	114	114	190	236±7.1	329	444
Magnesium (mg/d)	30	24	24	38	44±1.2	54	71
Vitamin D (μg/d)	5	0.8	0.8	6.7	6.5±0.43	9.5	10.8
<b>Other micronutrients</b>							
Vitamin A (μg retinol activity equivalent/d)	400	407	490	491	582±18.2	593	815
Vitamin K (μg/d)	2	2	2	29	29±1.4	51	63
Iron (mg/d)	0.27	0.24	0.24	6.74	7.87±0.43	11.71	16.31
Zinc (mg/d)	2	1.4	1.4	3.4	3.8±0.13	5.7	7.0
Sodium (mg/d)	120	138	138	150	175±3.0	192	240
Potassium (mg/d)	400	414	414	513	574±10.7	681	849

<sup>a</sup>Adequate Intake values were used. For infants birth to age 5 mo, there was too little variation in the intakes for the personal computer version of the Software of Intake Distribution Estimation (PC-SIDE; version 1.0.0.1, 2003, Iowa State University, Ames) to produce adjusted nutrient intake distributions. Therefore, mean, median, and percentiles are based on a single 24-hour recall, and the percent of nutrient intakes above the Tolerable Upper Intake Level could not be calculated using PC-SIDE.

macronutrient intakes in absolute terms and as a percentage of total energy intakes reflect the predominantly milk-based diets during infancy. The mean and median intakes of the macronutrients, antioxidants, B vitamins, and bone-related nutrients and micronutrients exceeded the AIs, indicating that the prevalence of nutrient inadequacy is probably low. For older infants, EARs are available only for iron and zinc. The mean iron intake was 15.8 mg/day for infants aged 6 to 11 months. When usual iron intakes were compared to the EAR (6.9 mg/day), there was a vulnerable subset of infants (12%) whose intakes were inadequate. Mean usual zinc intake was 6.4 mg/day in later infancy. A subset of infants (6%) had inadequate dietary zinc relative to the EAR (2.5 mg/day). Supplement use lowered the prevalence of inadequate intakes for iron from 14% to 12%, but not for zinc in older infants. The usual intakes of synthetic preformed vitamin A and zinc

from food, beverages, and supplements exceeded the ULs in 26% and 68% of infant (aged 6 to 11 months) diets, respectively. The usual intakes of synthetic preformed vitamin A and zinc from only food and beverages exceeded the ULs in 16% and 68% of infant (age 6 to 11 months) diets, respectively (data not shown).

#### Nutrient Intakes of Toddlers

The usual nutrient intake distributions of toddlers aged 12 to 23 months are displayed in Table 3. The composition of the transitional diet from infancy to toddlerhood is characterized as lower in fat and higher in protein, as percentages of energy intake. The majority of toddlers' diets fell within the AMDR for protein, carbohydrate, and fat, except for 23% and 5% of diets that were below the AMDR for fat and carbohydrate, respectively. The usual

**Table 2.** Usual nutrient intake distributions from food, beverages, and supplements for infants aged 6 to 11 mo (n=505)

Nutrient	Dietary Reference Intakes <sup>a</sup>		Usual Intake Percentiles						Inadequate/ Excessive Usual Intake	
	AI/EAR	UL	10th	25th	Median	Mean±standard error	75th	90th	% <EAR	% >UL
<b>Macronutrients</b>										
Energy (kcal/d)			583	675	807	854±11.3	981	1,183	—	—
Fat (g/d)	30		27	30	34	35±0.4	39	46	—	—
Saturated fat (g/d)			10	12	14	14±0.2	16	19	—	—
Carbohydrate (g/d)	95		74	89	110	114±1.6	134	161	—	—
Protein (g/d)	11.0		11.2	14.2	19.0	22.4±0.59	26.5	37.2	—	—
Dietary fiber (g/d)			2	4	5	6±0.1	8	10	—	—
<b>As percentage of total energy</b>										
Fat (%)			31	34	38	38±0.2	42	45	—	—
Saturated fat (%)			12	13	15	16±0.1	17	19	—	—
Carbohydrate (%)			46	50	53	54±0.2	57	61	—	—
Protein (%)			7	8	9	10±0.1	11	13	—	—
<b>Antioxidants</b>										
Vitamin C (mg/d)	50		52	65	83	90±1.7	106	137	—	—
Vitamin E (mg/d)	5		2	4	6	6±0.2	7	11	—	—
<b>B vitamins</b>										
Thiamin (mg/d)	0.3		0.4	0.6	0.7	0.9±0.03	1.0	1.4	—	—
Riboflavin (mg/d)	0.4		0.6	0.9	1.1	1.2±0.04	1.3	1.9	—	—
Vitamin B-6 (mg/d)	0.3		0.5	0.6	0.8	0.8±0.02	1.0	1.3	—	—
Niacin (mg/d)	4		6	8	10	11±0.2	13	16	—	—
Folate (μg dietary folate equivalents/d)	80		109	152	204	219±4.3	268	346	—	—
Vitamin B-12 (μg/d)	0.5		ND <sup>b</sup>	ND	ND	2.4±0.19	ND	ND	—	—
<b>Bone-related nutrients</b>										
Calcium (mg/d)	270		318	419	561	603±11.5	741	942	—	—
Phosphorus (mg/d)	275		212	306	420	471±11.0	574	796	—	—
Magnesium (mg/d)	75		56	73	95	101±1.8	122	153	—	—
Vitamin D (μg/d)	5	25	1.8	4.4	7.4	7.1±0.2	9.1	11.6	—	<1 <sup>c</sup>
<b>Other micronutrients</b>										
Vitamin A (μg retinol activity equivalents/d)	500	600	531	612	720	744±8.2	849	987	—	26 <sup>d</sup>
Vitamin K (μg/d)	2.5		17	31	52	61±2.19	78	111	—	—
Iron (mg/d)	6.9 <sup>e</sup>	40.0	6.3	10.3	14.6	15.8±0.4	19.9	26.6	12	2 <sup>e</sup>
Zinc (mg/d)	2.5 <sup>e</sup>	5.0	3.1	4.5	6.1	6.4±0.13	7.8	9.8	6	68
Sodium (mg/d)	370		165	225	365	528±21.2	650	1,104	—	—
Potassium (mg/d)	700		650	835	1,079	1,129±18.9	1,348	1,644	—	—

<sup>a</sup>Either an Estimated Average Requirement (EAR) or Adequate Intake (AI) have been defined for most nutrients. However, not all nutrients have a defined Tolerable Upper Intake Level (UL). A blank space in the UL column indicates that no UL has been defined.

<sup>b</sup>ND=not determined.

<sup>c</sup>Point estimate is considered imprecise because of small sample size and uncommon or very common event.

<sup>d</sup>Percentage above UL for vitamin A based on preformed vitamin A only.

<sup>e</sup>Values shown for zinc and iron are EARs, not AIs.

mean intakes of the antioxidants, B vitamins, bone-related nutrients, and other micronutrients were adequate, with the exception of vitamin E. An estimated 63% of toddlers had usual vitamin E intakes that were less than the EAR. The usual intakes of synthetic folate, preformed vitamin A, zinc, and sodium from food, beverages, and supplements exceeded the UL in 6%, 31%, 47%, and 45% of toddlers' diets, respectively. The usual intakes of folate, preformed vitamin A, zinc, and sodium from only food and beverages exceeded the UL in 1%, 4%, 4%, and 45% of toddlers' diets, respectively (data not shown). Mean

usual potassium intake (1,736 mg), as well as the 90th percentile (2,355 mg), was below the AI of 3,000 mg. Mean usual fiber intake (8.7 g/day), as well as the 90th percentile, was below the AI of 19 g/day.

#### Nutrient Intakes of Preschoolers

The usual intake distributions of macronutrients, antioxidants, B vitamins, bone-related nutrients, and other micronutrients for preschoolers 24 to 47 months are displayed in Table 4. The preschoolers' diets fell within the

**Table 3.** Usual nutrient intake distributions from food, beverages, and supplements of toddlers aged 12 to 23 mo (n=925)

Nutrient	Dietary Reference Intakes <sup>a</sup>			Usual Intake Percentiles					Inadequate/Excessive Usual Intake		
	EAR or AMDR	AI	UL	10th	25th	Median	Mean±standard error	75th	90th	% <EAR or <AMDR	% >AMDR or >UL
<b>Macronutrients</b>											
Energy (kcal/d)				837	958	1,113	1,141±8.5	1,294	1,481	—	—
Fat (g/d)				29	34	41	42±0.4	49	56	—	—
Saturated fat (g/d)				12	14	17	17±0.2	20	23	—	—
Carbohydrate (g/d)		100		109	126	147	151±1.2	173	199	—	—
Protein (g/d)		13		29	35	43	44±0.4	51	60	—	—
Dietary fiber (g/d)		19		5	7	8	9±0.1	11	13	—	—
<b>As percentage of total energy</b>											
Fat (%)	30-40			28	30	33	33±0.1	36	38	23	3
Saturated fat (%)				11	12	14	14±0.1	15	17	—	—
Carbohydrate (%)	45-65			47	50	53	53±0.2	57	60	5	<1 <sup>b</sup>
Protein (%)	5-20			12	14	15	15±0.1	17	19	<1 <sup>b</sup>	5
<b>Antioxidants</b>											
Vitamin C (mg/d)	13		400	25	40	64	73±1.5	96	134	2 <sup>b</sup>	<1 <sup>b</sup>
Vitamin E (mg/d)	5		200	2	3	4	5±0.1	6	8	63	— <sup>c</sup>
<b>B vitamins</b>											
Thiamin (mg/d)	0.4			0.7	0.9	1.1	1.1±0.01	1.3	1.6	<1 <sup>b</sup>	—
Riboflavin (mg/d)	0.4			1.2	1.4	1.8	1.8±0.02	2.1	2.6	<1 <sup>b</sup>	—
Niacin (mg/d)	5		10	8	9	12	13±0.2	15	19	<1 <sup>b</sup>	ND <sup>d</sup>
Vitamin B-6 (mg/d)	0.4		30.0	0.8	0.9	1.2	1.3±0.02	1.5	1.9	<1 <sup>b</sup>	<1 <sup>b</sup>
Folate (μg dietary folate equivalents/d)	120		300	198	249	324	352±4.8	423	539	<1 <sup>b</sup>	6 <sup>e</sup>
Vitamin B-12 (μg/d)	0.7			2.5	3.2	4.1	4.4±0.06	5.3	6.6	<1 <sup>b</sup>	—
<b>Bone-related nutrients</b>											
Calcium (mg/d)		500	2,500	580	712	872	892±8.5	1,050	1,227	—	<1 <sup>b</sup>
Phosphorus (mg/d)	380		3,000	590	715	871	891±8.2	1,045	1,220	<1 <sup>b</sup>	<1 <sup>b</sup>
Magnesium (mg/d)	65		65 <sup>f</sup>	113	132	156	160±1.3	183	212	<1 <sup>b</sup>	— <sup>cf</sup>
Vitamin D (μg/d)		5	50	4	5	7	8±0.1	10	13	—	<1 <sup>b</sup>
<b>Other micronutrients</b>											
Vitamin A (μg retinol activity equivalents/d)	210		600	346	457	621	684±10.6	840	1,099	<1 <sup>b</sup>	31 <sup>g</sup>
Vitamin K (μg/d)		30		17	22	32	38±0.8	47	66	—	—
Iron (mg/d)	3.0		40.0	6.1	7.5	9.6	10.3±0.13	12.3	15.4	<1 <sup>b</sup>	<1 <sup>b</sup>
Zinc (mg/d)	2.5		7.0	4.8	5.7	6.9	7.2±0.07	8.3	10.0	<1 <sup>b</sup>	47
Sodium (mg/d)		1,000	1,500	914	1,143	1,438	1,489±16.0	1,780	2,130	—	45
Potassium (mg/d)		3,000		1,175	1,402	1,691	1,736±15.5	2,020	2,355	—	—

<sup>a</sup>Either an Estimated Average Requirement (EAR) or Adequate Intake (AI) have been defined for all nutrients. However, not all nutrients have a defined Tolerable Upper Intake Level (UL). No value in the UL column indicates that no UL has been defined.

<sup>b</sup>Point estimate is considered imprecise because of small sample size and uncommon or very common event.

<sup>c</sup>This percentage could not be calculated using the personal computer version of the Software of Intake Distribution Estimation (PC-SIDE; version 1.0.0.1, 2003, Iowa State University, Ames).

<sup>d</sup>ND=not determined. The UL for niacin applies only to the synthetic form obtained from supplements and/or fortified foods. The nutrient database does not include values for synthetic niacin, so the percentage above the UL could not be determined.

<sup>e</sup>Percentage above UL for folate based on synthetic forms from fortified foods and supplements.

<sup>f</sup>The UL for magnesium is based on supplements only.

<sup>g</sup>Percentage above UL for vitamin A based on preformed vitamin A only.

AMDR for the percentage of energy from protein and carbohydrate, but not fat. An estimated 47% of diets fell below the AMDR for fat (30% to 40% of energy). At the same time, usual intakes of 76% of preschoolers provided more saturated fat, as a percentage of energy, than recommended by the DGA. The usual mean intakes of the antioxidants, B vitamins, bone-related nutrients, and other micronutrients were adequate, except for vitamin E, in which 37% of preschoolers' intakes were inadequate relative to the EAR. The usual intakes of synthetic folate, preformed vitamin A, zinc, and sodium from food, beverages, and supplements exceeded the UL in 30%, 59%, 72%, and 78% of preschoolers' diets, respectively. The usual intakes of folate, preformed vitamin A, zinc, and sodium from only food and beverages exceeded the UL in 1%, 17%, 52%, and 78% of preschoolers' diets, respec-

tively (data not shown). Mean usual potassium intake (1,853 mg), as well as the 90th (2,508 mg) percentile, was below the AI of 3,000 mg.

### Comparison of FITS 2002 and FITS 2008

Mean usual intakes from food, beverages, and supplements as reported in FITS 2002 and FITS 2008 were compared for infants aged 6 to 11 months and toddlers aged 12 to 23 months. Mean usual intakes of energy and carbohydrate were significantly lower in FITS 2008 than FITS 2002 ( $P=0.01$  to  $0.05$ ). Energy intakes were 3.3% and 8.2% lower for infants aged 6 to 11 months and toddlers aged 12 to 23 months, respectively, in FITS 2008 than FITS 2002. In addition, mean usual intakes of several vitamins (A, E, C, and D) and minerals (calcium, phosphorus, magnesium,

**Table 4.** Usual nutrient intake distributions from food, beverages, and supplements of preschoolers aged 24 to 47 mo (n=1,461)

Nutrient	Dietary Reference Intakes <sup>a</sup>			Usual Intake Percentiles					Inadequate/Excessive Usual Intake		
	EAR/AMDR <sup>b</sup>	AI	UL	10th	25th	Median	Mean ± standard error	75th	90th	% <EAR or <AMDR	% >AMDR or >UL/DG
<b>Macronutrients</b>											
Energy (kcal/d)				969	1,113	1,289	1,308±7.3	1,483	1,673	—	—
Fat (g/d)				30	36	44	45±0.3	53	62	—	—
Saturated fat (g/d)				11	13	17	17±0.2	21	25	—	—
Carbohydrate (g/d)		130		133	153	178	181±1.0	205	232	—	—
Protein (g/d)	13			35	41	49	50±0.4	58	68	—	—
Dietary fiber (g/d)		19		6	8	10	10±0.1	12	15	—	—
<b>As percentage of total energy</b>											
Fat (%)	30-40			25	27	30	30±0.1	33	36	47	2
Saturated fat (%)	<10 <sup>c</sup>			9	10	12	12±0.1	13	15	—	76 <sup>c</sup>
Carbohydrate (%)	45-65			49	52	56	56±0.1	59	63	3	4
Protein (%)	5-20			13	14	15	16±0.1	17	19	<1 <sup>d</sup>	4
<b>Antioxidants</b>											
Vitamin C (mg/d)	13		400	36	54	82	98±1.8	123	176	<1 <sup>d</sup>	<1 <sup>d</sup>
Vitamin E (mg/d)	5		200	3	4	6	8±0.1	10	14	37	— <sup>ef</sup>
<b>B vitamins</b>											
Thiamin (mg/d)	0.4			0.9	1.1	1.4	1.5±0.02	1.8	2.3	<1 <sup>d</sup>	—
Riboflavin (mg/d)	0.4			1.2	1.5	2.0	2.2±0.04	2.5	3.4	<1 <sup>d</sup>	—
Niacin (mg/d)	5		10	9	12	16	18±0.2	22	30	<1 <sup>d</sup>	ND <sup>g</sup>
Vitamin B-6 (mg/d)	0.4		30.0	1.0	1.2	1.5	2.0±0.05	2.2	3.2	<1 <sup>d</sup>	<1 <sup>d</sup>
Folate (μg dietary folate equivalents/d)	120		300	254	346	488	543±7.2	682	908	<1 <sup>d</sup>	30 <sup>df</sup>
Vitamin B-12 (μg/d)	0.7			2.6	3.6	5.2	6.0±0.10	7.4	10.3	<1 <sup>d</sup>	—
<b>Bone-related nutrients</b>											
Calcium (mg/d)		500	2,500	499	666	881	910±8.9	1,119	1,354	—	<1 <sup>d</sup>
Phosphorus (mg/d)	380		3,000	637	777	954	981±7.5	1,155	1,358	<1 <sup>d</sup>	<1 <sup>d</sup>
Magnesium (mg/d)	65		65 <sup>h</sup>	127	151	180	184±1.3	214	247	<1 <sup>d</sup>	— <sup>eh</sup>
Vitamin D (μg/d)		5	50	3	5	8	9±0.2	12	17	—	<1 <sup>d</sup>
<b>Other micronutrients</b>											
Vitamin A (μg retinol activity equivalents/d)	210		600	383	560	856	995±15.9	1,283	1,787	<1 <sup>d</sup>	59 <sup>i</sup>
Vitamin K (μg/d)		30		19	25	35	42±0.7	51	72	—	—
Iron (mg/d)	3.0		40.0	6.6	8.5	11.3	12.9±0.17	15.5	21.0	<1 <sup>d</sup>	<1 <sup>d</sup>
Zinc (mg/d)	2.5		7.0	5.3	6.7	8.7	9.7±0.12	11.3	15.1	<1 <sup>d</sup>	72
Sodium (mg/d)		1,000	1,500	1,307	1,536	1,819	1,863±12.3	2,140	2,473	—	78
Potassium (mg/d)		3,000		1,250	1,501	1,812	1,853±13.1	2,161	2,508	—	—

<sup>a</sup>Either an Estimated Average Requirement (EAR) or Adequate Intake (AI) have been defined for all nutrients. However, not all nutrients have a defined Tolerable Upper Intake Level (UL). No value in the UL column indicates that no UL has been defined.

<sup>b</sup>AMDR=acceptable macronutrient distribution range.

<sup>c</sup>US Dietary Guideline for saturated fat.

<sup>d</sup>Point estimate is considered imprecise because of small sample size and uncommon or very common event.

<sup>e</sup>This percentage could not be calculated using the personal computer version of the Software of Intake Distribution Estimation (PC-SIDE; version 1.0.0.1, 2003, Iowa State University, Ames).

<sup>f</sup>Percentage above UL for vitamin E and folate based on synthetic forms from fortified foods and supplements.

<sup>g</sup>ND=not determined. The UL for niacin applies only to the synthetic form obtained from supplements and/or fortified foods. The nutrient database does not include values for synthetic niacin, so the percentage above the UL could not be determined.

<sup>h</sup>The UL for magnesium is based on supplements only.

<sup>i</sup>Percentage above UL for vitamin A based on preformed vitamin A only.

sodium, and potassium) were lower in FITS 2008 than FITS 2002 ( $P=0.01$  to  $0.05$ ). In contrast, mean usual intakes of folate, vitamin B-12, and zinc were significantly higher in FITS 2008 than FITS 2002 ( $P=0.01$  to  $0.05$ ). The prevalence of inadequate intakes, excessive intake, and intakes outside the AMDR was similar in FITS 2002 and FITS 2008 (Table 5). Excessive zinc intakes tended to be more prevalent in 2008 (68%) than 2002 (59%) in infants aged 6 to 11 months ( $P<0.01$ ). Excessive sodium intakes tended to be less prevalent in 2008 (45%) than 2002 (56%) in toddlers ( $P<0.01$ ).

## DISCUSSION

FITS 2008 dietary assessment of US infants, toddlers, and preschoolers revealed nutrient-adequate diets that complied with the AMDRs, with few exceptions that will

be discussed below. The macronutrient composition in some toddlers' and preschoolers' diets fell below the AMDR for dietary fat (30% to 40% of energy). As seen in toddlers in FITS 2002 (2), the percentage of energy derived from fat was lower than the AMDR in 23% and 47% of toddlers' and preschoolers' diets, respectively. Although the macronutrient composition may reflect true dietary practices, in particular, the recommended use of low-fat dairy products, reporting errors such as underreporting of hidden fat or cooking fat or overreporting of nonfat energy may contribute to the apparently low dietary fat content. The interpretation of these findings may be tempered by discrepant guidelines for the macronutrient composition of young children's diets published by expert committees (10,12). The American Academy of

**Table 5.** Comparison of data from 2008 and 2002 Feeding Infants and Toddlers Study surveys: Prevalence of inadequate intakes (% < Estimated Average Requirement [EAR]), excessive intakes (% > Tolerable Upper Intake Level [UL]), and intakes outside acceptable macronutrient distribution ranges (AMDR) among infants aged 6 to 11 mo and toddlers aged 12 to 23 mo<sup>a</sup>

Nutrient	Infants 6 to 11 mo			
	% < EAR		% > UL	
	2008 (n= 505)	2002 (n=1,395)	2008 (n=505)	2002 (n=1,395)
<b>Micronutrients</b>				
Vitamin A ( $\mu\text{g}$ retinol activity equivalents/d)	NA	NA	26 <sup>b</sup>	28 <sup>b</sup>
Vitamin D ( $\mu\text{g}/\text{d}$ )	NA	NA	<1 <sup>c</sup>	<1 <sup>c</sup>
Iron (mg/d)	12	7	2 <sup>c</sup>	<1 <sup>c</sup>
Zinc (mg/d)	6	5	68	59
<b>Toddlers 12 to 23 mo</b>				
	2008 (n=925)	2002 (n=1,003)	2008 (n=925)	2002 (n=1,003)
<b>As percentage of total energy</b>				
	% < AMDR		% > AMDR	
Fat (%)	23	28	3	8
Carbohydrate (%)	5	8	1 <sup>c</sup>	2
Protein (%)	<1 <sup>c</sup>	<1 <sup>c</sup>	5	3
<b>Antioxidants</b>				
	% < EAR		% > UL	
Vitamin C (mg/d)	2 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>
Vitamin E (mg/d)	63	61	— <sup>de</sup>	<1 <sup>e</sup>
<b>B vitamins</b>				
Thiamin (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	—	—
Riboflavin (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	—	—
Niacin (mg/d)	<1 <sup>c</sup>	3	ND <sup>f</sup>	ND <sup>f</sup>
Vitamin B-6 (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>
Folate ( $\mu\text{g}$ dietary folate equivalents/d)	<1 <sup>c</sup>	2	6 <sup>e</sup>	2 <sup>ce</sup>
Vitamin B-12 ( $\mu\text{g}/\text{d}$ )	<1 <sup>c</sup>	<1 <sup>c</sup>	—	—
<b>Bone-related nutrients</b>				
Calcium (mg/d)	—	—	<1 <sup>c</sup>	<1 <sup>c</sup>
Phosphorus (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>
Magnesium (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	— <sup>d</sup>	<1 <sup>cg</sup>
Vitamin D ( $\mu\text{g}/\text{d}$ )	—	—	<1 <sup>c</sup>	<1 <sup>c</sup>
<b>Other micronutrients</b>				
Vitamin A ( $\mu\text{g}$ retinol activity equivalents/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	31 <sup>b</sup>	34 <sup>b</sup>
Iron (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>	<1 <sup>c</sup>
Zinc (mg/d)	<1 <sup>c</sup>	<1 <sup>c</sup>	47	42
Sodium (mg/d)	—	—	45	56

<sup>a</sup>Either an EAR or AI has been defined for all nutrients, but not all nutrients have a defined UL. Not applicable (NA) in the EAR column indicates that the nutrient has an AI. No value in the UL column indicates that no UL has been defined.

<sup>b</sup>Percentage above UL for vitamin A based on preformed vitamin A only.

<sup>c</sup>Point estimate is considered imprecise because of small sample size and uncommon or very common event.

<sup>d</sup>This percentage could not be calculated using the personal computer version of the Software of Intake Distribution Estimation (PC-SIDE; version 1.0.0.1, 2003, Iowa State University, Ames).

<sup>e</sup>Percentage above UL for vitamin E and folate based on synthetic forms from fortified foods and supplements.

<sup>f</sup>ND—not determined. The UL for niacin applies only to the synthetic form obtained from supplements and/or fortified foods. The nutrient database does not include values for synthetic niacin, so the percentage above the UL could not be determined.

<sup>g</sup>Percentage above UL for magnesium based on supplements only.

Pediatrics recommends a gradual lowering of the percentage of fat intake during toddler years to ~30% with a lower limit of 20% of energy, and states that there is no evidence that the macronutrient composition of the diet affects child growth if protein and energy requirements are met, which seems to be the case here (12). The percentage of energy derived from protein increased with age

from 7.6% and 9.9% to 15.5%, well within the AMDR for protein (5% to 20% of energy). Unfortunately, energy intakes of the children surveyed in FITS 2008 cannot be evaluated directly against EERs, because body weights and heights on the day of diet assessment were not available. However, if we assume the Centers for Disease Control and Prevention median weights and heights of

US children (13) for the median weights and heights of the FITS 2008 sample and calculate their EERs, the reported mean usual energy intakes would exceed the EER by a substantial margin in infants (8% for infants 0 to 5 months, 22% for infants 6 to 11 months) and toddlers (28%), but less so in preschoolers (8% assuming a low active physical activity level or 1% assuming an active physical activity level). The discrepancies between the reported energy intake and estimated EER may reflect a true overconsumption of energy, but more likely overreporting of children's energy intakes was due to caregivers' inaccurate estimate of portion sizes, underestimation of weights of the children in FITS 2008 by using Centers for Disease Control and Prevention median values, or a combination of errors. The DGA recommend diets with <10% of energy from saturated fatty acids for individuals 2 years of age and older (11). In FITS 2008, the vast majority of preschoolers (76%) had diets that exceeded 10% of energy as saturated fat. With fat intakes below the AMDR and saturated fat intakes in excess of the levels recommended by the DGA, preschoolers may not meet their requirements for the essential fatty acids. The source of fats in the diets of preschoolers requires special attention to ensure adequate intakes of healthier fats.

Both the mean and upper level (90th percentile) intakes of fiber were far less than the AI of 19 g/day. The AI was based on studies that found an association between high intakes of dietary fiber and significant reductions in cardiovascular disease risk in adults (10). An average dietary fiber:energy ratio of 14 g/1,000 kcal was applied to the reported energy intakes of young children. The rationale and the feasibility of attaining the AI for young children have been questioned; nevertheless, nutritional and health benefits may be gained from some increase in fiber intake from fruits, vegetables, legumes, and whole grains (14). For instance, the Special Turku Coronary Risk Factor Intervention Project demonstrated an inverse correlation between fiber intake and serum cholesterol in children aged 8 months to 9 years (15).

#### **Assessment of the Prevalence of Inadequate Micronutrient Intakes**

In FITS 2008, usual nutrient intakes met or exceeded vitamin and mineral requirements, except for iron and zinc in a small subset of older infants, and for vitamin E and potassium in a sizeable proportion of young children for whom the DRIs are controversial. Mean usual iron intakes were well above the AI for young infants, except for a small but important subset of 6- to 11-month-old infants whose usual intakes were below the EAR. Although the use of iron supplements, iron-fortified cereals, and infant formula has reduced iron deficiency in the United States, the prevalence of iron deficiency anemia in children younger than age 5 years was 14.9% in the 2008 Pediatric Nutrition Surveillance Survey (16). Continued parental education with specific actionable advice, medical professional training, and government surveillance are needed to control this nutrient deficiency. Given the critical role of zinc in normal growth and development, and immune function, the subset of older infants (6%) whose dietary zinc fell below the EAR should not be disregarded.

Usual mean vitamin E intakes met or exceeded the AI in infancy, but thereafter a high proportion of toddlers'

and preschoolers' usual intakes were less than the EAR. NHANES and Continuing Survey of Food Intakes by Individuals (CSFII) surveys have repeatedly shown a high prevalence of inadequacy of dietary vitamin E across all age and sex subgroups, despite the lack of evidence of vitamin E deficiency in the US population (17-19). The EAR in young children was extrapolated from the adult EAR, which was based on one study in vitamin E-depleted adult men who were fed large amounts of polyunsaturated fatty acids to increase their vitamin E requirements (20). Reassessment of the EAR across all age groups seems warranted given the lack of evidence of vitamin E deficiency in the US population (3).

Usual mean potassium intakes, as well as the 90th percentile values, were below the AI, consistent with findings in FITS 2002 (21), NHANES (22), and CSFII (23). Since the AI for potassium in children was extrapolated from data in adults relating inadequate potassium intake to chronic diseases, there is a need to define the physiologic requirements of potassium for toddlers and preschoolers.

#### **Assessment of the Prevalence of Excessive Micronutrient Intakes**

A significant proportion of diets exceeded the ULs for synthetic folate, preformed vitamin A, zinc, and sodium derived from food, beverages, and supplements. Of interest, diets exceeding the UL for zinc and sodium were attributable to food sources, and diets exceeding the UL for folate and preformed vitamin A were due mainly to supplement use, which was similar in FITS 2002 and NHANES 1999-2000 and 2001-2002 (24).

The UL for synthetic folate was based on the potential adverse effect of masking B-12 deficiency (25). The pediatric UL of 300  $\mu\text{g}/\text{day}$  from fortified foods or supplements was derived from adult data with an adjustment for weight and an uncertainty factor of 5. Since the initiation of the US folic acid fortification policy, there has been a dramatic increase in serum and red blood cell folate concentrations in the US population, with no evidence of increased masking of B-12 deficiency (26). The highest serum folate concentrations in NHANES 1988-2004 were seen in children between the ages of 4 and 11 years and in elderly people (27). While the benefits of folic acid fortification for target groups (ie, women of childbearing age) are well-recognized, fortification programs and supplement formulation should guard against excessive intakes for others, and potentially adverse effects on neurodevelopment, cognition, and risk for certain chronic diseases (27,28).

In agreement with FITS 2002 (2,29,30), CSFII (23), and NHANES 2001-2002 (22), we found a significant proportion of children in all age subgroups with diets exceeding the UL for vitamin A, but particularly in preschoolers receiving supplements. The pediatric UL for vitamin A was based on adverse effects of intracranial pressure (bulging fontanels) and skeletal abnormalities in infants receiving high doses of vitamin A, and a conservative uncertainty factor of 10 since infants are more susceptible to vitamin A toxicity than older children and chronic hypervitaminosis (eg, anorexia, increased intracranial pressure, abnormal bone development, dermatitis, and hepatotoxicity) can go undetected (31,32). Dietary supplements and some foods commonly consumed

by young children are formulated with preformed vitamin A. Several children's vitamin supplements contain preformed vitamin A in amounts exceeding the UL, exposing young children unnecessarily to risk of vitamin A toxicity. All sources of preformed vitamin A in the diets of young children should be considered in the regulatory guidance for food manufacturers.

In FITS 2008, zinc intakes from food, beverages, and supplements were above the UL in 47% of toddlers and 72% of preschoolers, consistent with FITS 2002 (30), CSFII (2,23,33), and NHANES 2001-2002 (22). Zinc-fortified infant formula, infant cereals, and ready-to-eat cereals are leading sources of dietary zinc for infants and young children, and largely account for the high prevalence of zinc intakes above the UL, although supplements contributed to the excess seen in toddlers in FITS 2008. The UL for zinc was based on findings from a zinc-fortified infant formula study and an uncertainty factor of 1.0 since no adverse zinc-copper interactions were observed (34). The validity of the UL for zinc in infants and children aged 1 to 3 years has been questioned based on the paucity of data used to establish the UL, and the absence of zinc toxicity with usual zinc intakes in the US pediatric population (2,23,33,35). Although there are no recent reports of overt zinc toxicity in US children and zinc homeostatic mechanisms largely protect against excessive zinc intakes (36), food fortification and dietary supplements should be used to correct zinc deficiency and/or to support a demonstrated positive function without adverse consequences. Safety monitoring of zinc intake from all sources should include measures of copper status, immune function, and neurodevelopment in young children. Research is needed on micronutrient absorption, nutrient interactions, and biomarkers of zinc adequacy and toxicity to better define the UL for zinc in young children.

The US Food and Drug Administration provides regulatory information on vitamin/mineral supplements marketed for infants and children younger than 4 years of age (<http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/DietarySupplements/DietarySupplementlabelingguide/ucm070620.htm>). Current regulations are based on Reference Daily Intakes, not the more recent DRIs, and need to be updated. Presently, the ULs for zinc, folate, and vitamin A are at levels below the Daily Values for these same nutrients for children younger than age 4 years. Clearly, these discrepancies need to be reconciled with further research, as suggested above. In revising the Food and Drug Administration regulations, usual nutrient intakes of infants and young children via all sources of nonfortified and fortified food and beverages and supplements—like the data presented here—should be considered.

### Comparison of FITS 2002 and FITS 2008

Overall, nutrient adequacy and excess findings were remarkably similar in FITS 2002 and FITS 2008. Although statistically significant, differences in usual mean nutrient intakes were small in magnitude and of limited clinical significance. Mean energy intakes were lower in infants and toddlers in FITS 2008 than FITS 2002. Consistent with an overall decrease in energy from food and beverages, several vitamins and minerals were also lower in FITS 2008 than FITS 2002. The percent of toddlers aged 12 to 23 months

who had sodium intakes that exceeded the UL for sodium decreased in FITS 2008. In contrast, folate, zinc, and vitamin B-12 intakes were higher in FITS 2008 than FITS 2002, possibly due to changes in food fortification, vitamin/mineral supplement formulations, and/or differences in food choices. The percentage of infants and toddlers receiving supplements was similar in FITS 2002 and FITS 2008. Although the dietary analysis and assessment were standardized between the two surveys, changes were made in the dietary collection methodology to improve the intake data by reducing the likelihood of overreporting. A bridging study was performed to test for the effect of these changes (5). The sample size of infants and toddlers in the bridging study was designed to detect a difference of 100 kcal/day in mean energy intake for infants and for toddlers. The mean difference observed was not statistically significant (42 kcal/d for infants and 28 kcal/d for toddlers); it therefore seems unlikely that methodology accounts for the differences between surveys, but the bridging study was underpowered to detect these small differences. Another potential explanation for the observed differences could be that the caregivers in FITS 2008 differed from those in FITS 2002 in ways that made them less likely to overreport intakes, more likely to feed smaller portion sizes, and less likely to feed empty energy foods to their children. The consumption of many desserts and sweets actually were reduced in several age groups in FITS 2008 (37,38). Observed changes are most likely a combination of actual changes in the population's food intake (eg, less sweets), sample characteristics (eg, higher education level of caregivers), population characteristics (eg, more Hispanics), and methodological improvements related to reporting amounts of foods and beverages (5,38).

### Implications of Findings

The diet quality of toddlers and preschoolers in the United States may be improved by alternative sources of dietary fat, decreased sodium, and increased fiber content. Dietetics practitioners and health care providers should provide practical and actionable guidance to parents. For older infants, the critical role of iron and zinc in the diet should be emphasized, and menus with adequate iron and zinc provided. For toddlers and preschoolers, guidance should be given on the importance of adequate fruits, vegetables, and whole grains, not only for providing good nutrition, but also for building healthy eating habits during a critical developmental window. Menus for toddlers and preschoolers should moderate the intake of sodium and saturated fat, and provide foods with adequate essential fatty acids.

Continued vigilance with regard to the iron and zinc content of infant diets is warranted. Further research is needed on vitamin E and potassium requirements of young children, the ULs for synthetic folate, preformed vitamin A and zinc, and the role of fiber in diets of young children. Regulatory guidance on food labeling and dietary supplements for infants and young children should be revised based on the most recent DRIs.

### CONCLUSIONS

Usual nutrient intakes met or exceeded energy and protein requirements with minimal risk of vitamin and mineral deficiencies, except for iron and zinc in a small subset of

older infants. Intakes of synthetic folate, preformed vitamin A, zinc, and sodium exceeded ULs in a significant proportion of toddlers and preschoolers. Macronutrient distributions were within AMDR, except for dietary fat. Dietary fiber was low in the vast majority of toddlers and preschoolers, and saturated fat intakes exceeded recommendations for the majority of preschoolers. Although the diets for the majority of infants, toddlers, and preschoolers in FITS 2008 were nutritionally adequate, diet quality could be improved in the transition from infancy to early childhood.

#### STATEMENT OF POTENTIAL CONFLICT OF INTEREST:

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