

Nutrient Intakes and Food Choices of Infants and Toddlers Participating in WIC

MICHAEL PONZA, PhD; BARBARA DEVANEY, PhD; PAULA ZIEGLER, PhD, RD; KATHLEEN REIDY, DrPH, RD; CATHIE SQUATRITO, MS, RD

ABSTRACT

Objectives To examine the nutrient intakes, foods consumed, and feeding patterns of infants and toddlers participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

Design Cross-sectional telephone survey, including 24-hour dietary recalls of infants' and toddlers' food and nutrient intakes, as reported by parents or other primary caregivers.

Subjects National random sample of 3,022 children ages 4 to 24 months who participated in the 2002 Feeding Infants and Toddlers study. Sample sizes by age were infants 4 to 6 months: 265 WIC participants, 597 nonparticipants; infants 7 to 11 months: 351 WIC participants, 808 nonparticipants; and toddlers 12 to 24 months: 205 WIC participants, 791 nonparticipants.

Statistical Analyses Performed We used Statistical Analysis Software (version 8.2) to examine the breastfeeding status, infant feeding patterns, and foods consumed; the personal computer version of the Software for Intake Distribution Estimation to estimate mean usual intake of food energy and of key nutrients targeted by the WIC program; and methods recommended by the Institute of Medicine to assess nutrient adequacy.

Results Infants participating in WIC were less likely than nonparticipants to have ever been breastfed or to be currently breastfeeding, and they were more likely to be consuming formula. Mean usual nutrient intakes exceeded the adequate intake for WIC participants, and the percentage with inadequate nutrient intake was less than 1%. Reported mean energy intakes exceeded mean energy requirements, with the largest discrepancy observed for WIC participants. Sizeable proportions of WIC and non-WIC infants and toddlers did not consume fruits and vegetables on the recall day.

Applications WIC providers should focus nutrition education on appropriate infant and toddler feeding patterns, should continue to reinforce their message of the importance delaying the use of cow's milk until 1 year of age,

and should stress the importance of fruit and vegetable consumption.

J Am Diet Assoc. 2004;104:S71-S79.

Pregnancy, infancy, and early childhood are periods of rapid physiological growth and development. Insufficient nutrition during these critical growth and development periods places infants and children at risk of impaired emotional and cognitive development and adverse health outcomes. The largest and most visible program providing services to improve the nutritional status of pregnant women and young children is the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). WIC provides supplemental foods, nutrition education, and health care and social service referrals to low-income pregnant, breastfeeding, and postpartum women; to infants; and to children up to age 5 who have household incomes at or below 185% of the poverty level and who are at nutritional risk. The basic WIC foods include iron-fortified infant formula and infant cereal, infant and adult juices, vitamin C-rich fruit and vegetable juices, eggs, milk, cheese, peanut butter, dried beans, and peas. Almost half of all infants and one-quarter of all children 1 to 4 years of age in the United States participate in the WIC program (1).

For infants and children, WIC is expected to improve diets, lead to recommended use of health care, reduce the prevalence of iron-deficiency anemia, and improve physical, emotional, and cognitive development. Studies have found evidence of positive associations between WIC participation and the nutritional outcomes of infants and young children (2-4). WIC participation is associated with a reduction in iron-deficiency anemia (5-7) and with increases in children's growth in weight and height (8). Infants and children participating in WIC have higher intakes of iron, zinc, vitamin C, thiamin, niacin, and vitamin B-6 than low-income nonparticipants (6,9-11). Mothers of WIC infants were more likely than mothers of low-income non-WIC infants to comply with infant feeding recommendations not to feed cow's milk in the first 6 months of life (12).

Despite evidence that WIC participation by infants and children is associated with improved dietary outcomes, concern has been expressed that WIC participation leads to less breastfeeding. Although WIC promotes breastfeeding, the provision of free infant formula can serve as an incentive to feed infants formula. Some evidence confirms this. WIC participants are less likely to be breastfed than other infants (13), although other evidence suggests that innovative strategies of WIC clinics and counseling by WIC staff to promote breastfeeding leads to higher rates of breastfeeding among WIC infants (14,15).

This article uses data from the Feeding Infants and Toddlers Study (FITS) and examines the nutrient intakes, feeding patterns, and food choices of infants and

M. Ponza is senior researcher and B. Devaney is senior fellow, Mathematica Policy Research, Princeton, NJ. P. Ziegler is principal scientist, K. Reidy is director of nutrition and regulatory affairs, and C. Squatrito is director of medical marketing, Gerber Products Company, Parsippany, NJ.

Address correspondence to: Michael Ponza, PhD, Mathematica Policy Research, 600 Alexander Park, Princeton, NJ 08540.

E-mail: mponza@mathematica-mpr.com

Copyright © 2004 by the American Dietetic Association.

0002-8223/04/10401-1001\$30.00/0

doi: 10.1016/j.jada.2003.10.018

toddlers participating in the WIC program. The analysis addresses the following specific research questions:

- What are the characteristics of infants and toddlers participating in the WIC program?
- What are the feeding patterns and transitions of infants and toddlers participating in WIC?
- What are the usual nutrient intakes of WIC participants, and do they have nutritionally adequate diets?
- What foods do infants and toddlers participating in the WIC program consume?

DATA AND METHODS

The FITS is a rich data set that provides detailed information on food and nutrient intakes of a large sample of US infants and toddlers. The FITS consisted of up to three separate interviews, all conducted by telephone from March to July 2002: (a) household interview, (b) 24-hour dietary recall, and (c) second-day 24-hour dietary recall for a random subsample of respondents. The FITS sample was drawn from the New Parent Database maintained by Experian (16) and included 3,022 infants and toddlers 4 to 24 months of age. The sampling plan was designed to have adequate sample sizes for six key infant and toddler age subgroups: 4 to 6 months, 7 to 8 months, 9 to 11 months, 12 to 14 months, 15 to 18 months, and 19 to 24 months of age, with oversampling of two age groups (infants 4 to 6 months and 9 to 11 months) for analytic purposes. A detailed discussion of the sample design, as well as the data collection methodology and procedures, is presented in an article by Devaney and colleagues (17).

We used the Nutrition Data System for Research from the University of Minnesota Nutrition Coordinating Center to collect the 24-hour dietary recalls (18). For exclusively breastfed infants under 7 months of age, we assumed an intake of 780 mL of breast milk per day, and for infants who had both breast milk and formula, we subtracted the volume of formula from 780 mL to obtain an estimate of the quantity of breast milk consumed (19,20). For infants 7 months and older, the comparable quantity was 600 mL per day as the quantity of breast milk for those being fed only breast milk as their milk intake. For infants 7 months and older who consumed both breast milk and formula, we subtracted the volume of formula from 600 mL to estimate the quantity of breast milk consumed.

To have adequate sample sizes for analyses of WIC subgroups by age, we examined three age groups, 4 to 6 months, 7 to 11 months, and 12 to 24 months, by WIC participation status. Final sample sizes for the WIC analyses were infants 4 to 6 months: 265 WIC participants, 597 nonparticipants; infants 7 to 11 months: 351 WIC participants, 808 nonparticipants; and toddlers 12 to 24 months: 205 WIC participants, 791 nonparticipants.

We also examined the characteristics of WIC nonparticipants for each age subgroup according to whether they were income-eligible nonparticipants (incomes less than or equal to 185% of the poverty level) and income-ineligible nonparticipants (incomes greater than 185% of the poverty level). Despite similar total family incomes, the characteristics of families of WIC infants and toddlers were more disadvantaged than families of income-eligible nonparticipants. For example, they were more likely to be teenage mothers and less likely to have a high school diploma or to be married. The sample sizes for the income-eligible nonparticipant groups were small, only 45

infants 4 to 6 months, 52 infants 7 to 11 months, and 87 toddlers 12 to 24 months old. We therefore focused the nutrient and food choice analyses on all WIC nonparticipants for each age subgroup, rather than separating nonparticipants into income-eligible and ineligible nonparticipants.

We analyzed infant and toddler feeding patterns using data collected from parents and caregivers about the child's history of breastfeeding and timing of introduction of specific food items. Following the methodology used by Briefel and colleagues (21), for each of the WIC subgroups we tabulated the proportion of infants ever breastfed, currently breastfeeding, currently exclusively breastfeeding, ever fed formula, and ever fed cow's milk; and for toddlers (12 to 24 months), the mean age at which specific foods—infant formula, baby cereals, pureed baby foods, and cow's milk—were introduced.

The nutrient analyses consisted of tabulating mean usual nutrient intake of food energy and key nutrients that are the target of the WIC program: calcium, iron, protein, vitamin A, and vitamin C. To account for the day-to-day variation in nutrient intake, we used the personal computer version of the Software of Intake Distribution Estimation from Iowa State University (version 1.02, 1999, Iowa State University, Ames, IA). Using methods developed by Nusser and colleagues (22), this program provides estimates of the percentiles of usual nutrient intake distributions as well as estimates of those below or above defined cutoff values. Nutrient intakes included intakes from foods, beverages, and supplements. As described in detail by Devaney and colleagues (23), we used methods recommended by the Institute of Medicine to assess the adequacy of the diets of WIC participants and nonparticipants in regard to the WIC target nutrients and food energy (24).

Because of the difficulty in estimating the quantity of breast milk for those infants 4 to 6 months of age who consume breast milk and other nonmilk food and beverages (25), nutrient intakes for the ages 4 to 6 months were not included in these analyses. This same issue of estimating the quantity of breast milk may also apply to older breastfed infants, although the assumed quantity of breast milk consumed for these older infants (600 mL for breastfed infants older than 6 months) accounts for the fact that energy from solid foods replaces energy from breast milk as solids are introduced. In addition, the proportion breastfeeding was substantially lower among infants 7 to 11 months of age, suggesting that the issue related to estimating the quantity of breast milk was less important for older infants.

For the analyses of foods consumed, we tabulated the percentage of infants and toddlers who consumed specific foods/food groups on one day. All reported foods and beverages were included in these tabulations, regardless of the amount consumed. We used 1- and 2-digit food group codes and food descriptions to assign individual foods and beverages reported in the 24-hour recalls to major and minor food groups. The food group classifications are identical to those used by Fox and colleagues (26), except some adjustments were made to permit a more detailed assessment of specific types of foods and beverages contained in the WIC food package, such as iron-fortified formula.

All analyses used weighted data. Sample weights adjusted for the oversampling, nonresponse, and undercoverage of some subgroups of children not included in the sample frame.

Table 1. Characteristics of WIC^a participants and nonparticipants^b (percentages)

	Infants 4 to 6 months		Infants 7 to 11 months		Toddlers 12 to 24 months	
	WIC participants	Nonparticipants	WIC participants	Nonparticipants	WIC participants	Nonparticipants
Gender						
Male	55	54	55	51	57	52
Female	45	46	45	49	43	48
Child's ethnicity		**		**		**
Hispanic or Latino	20	11	24	8	22	10
Non-Hispanic or Latino	80	89	76	92	78	89
Child's race		**		**		**
White	63	84	63	86	67	84
Black	15	4	17	5	13	5
Other	22	11	20	9	20	11
Child in day care				**		*
Yes	39	38	34	46	43	53
No	61	62	66	54	57	47
Age of mother		**		**		**
14 to 19	18	1	13	1	9	1
20 to 24	33	13	38	11	33	14
25 to 29	29	29	23	30	29	26
30 to 34	9	33	15	36	18	34
35 or older	9	23	11	21	11	26
Missing	2	2	1	1	0	1
Mother's education		**		**		**
11th grade or less	23	2	15	2	17	3
Completed high school	35	19	42	20	42	19
Some postsecondary	33	26	32	27	31	28
Completed college	7	53	9	51	9	48
Missing	2	1	2	0	1	2
Parent's marital status		**		**		**
Married	49	93	57	93	58	88
Not married	50	7	42	7	41	11
Missing	1	1	1	0	1	1
Mother or female guardian works				**		*
Yes	46	51	45	60	55	61
No	53	48	54	40	45	38
Missing	1	1	1	0	0	1
Urbanicity		**		**		**
Urban	34	55	37	50	35	48
Suburban	36	31	31	34	35	35
Rural	28	13	30	15	28	16
Missing	2	1	2	1	2	2
Sample size (unweighted)	265	597	351	808	205	791

Data from 2002 Feeding Infants and Toddler Study, weighted data.

^aWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

^b χ^2 tests were conducted to test for statistical significance in the differences between WIC participants and nonparticipants within each age group for each variable. The results of the χ^2 test are listed next to the variable under the column labeled nonparticipants for each of the three age groups.

* $P < .05$; ** $P < .01$; nonparticipants significantly different from WIC participants on the variable.

RESULTS

Table 1 shows the WIC participation rates and sample characteristics of WIC participants and nonparticipants. About one-third of the FITS infants and one-fifth of toddlers were WIC participants. Mothers of infants and toddlers participating in WIC were more likely to be teenagers and to be either Hispanic or black than were nonparticipants. They were less likely to have completed high school, to be married, and to be employed than were nonparticipants. WIC participants also were more likely to live in rural areas than urban ones.

Feeding Patterns

Although most WIC infants were not currently breast-feeding, more than two-thirds had ever been breastfed (Table 2). The vast majority of WIC infants consumed infant formula: 95% of WIC infants 4 to 6 months and 96% of WIC infants 7 to 11 months old had been fed infant formula. Early introduction of cow's milk was rare for young WIC infants, although by 7 to 11 months of age, almost one-fifth of WIC infants consumed cow's milk. More than three-quarters of WIC infants 4 to 6 months of age consumed cereals and more than 70% consumed pu-

Table 2. Infant feeding patterns of WIC^a participants and nonparticipants (percentages)

	Infants 4 to 6 months		Infants 7 to 11 months	
	WIC participants	Nonparticipants	WIC participants	Nonparticipants
Ever breastfed	69	84**	68	83**
Currently breastfeeding	21	48**	16	26**
Exclusively breastfeeding	4	17**	0	0
Ever fed formula	95	77**	96	90**
Ever fed cow's milk	4	1*	25	21
Ever fed cereal	82	83	97	97
Ever fed pureed food	71	63	98	98

Data from 2002 Feeding Infants and Toddler Study, weighted data.

^aWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

* $P<.05$; ** $P<.01$; nonparticipants significantly different from WIC participants.

reed foods; for infants 7 to 11 months, over 95% consumed cereal and pureed food.

Feeding patterns generally differed between WIC infants and non-WIC infants. WIC infants 4 to 11 months old were less likely than nonparticipating infants to have ever been breastfed or to be currently breastfeeding, and were more likely to have consumed formula (Table 2).

The analysis of feeding patterns among toddlers 12 to 24 months of age shows that similar proportions of WIC participants and nonparticipants reported ever consuming infant formula, infant cereal, pureed baby food, and cow's milk (Table 3). For the most part, the timing of the introduction of these foods was similar for WIC participants and nonparticipants. The one exception was the timing of the introduction of infant formula; the mean age of introducing infant formula was lower for WIC participants than for nonparticipants.

Usual Nutrient Intake

Mean intakes of food energy exceeded the estimated energy requirements (EERs) for both WIC participants and nonparticipants (Table 4). The discrepancy between mean energy intake and the mean EER was greater for WIC participants than for nonparticipants. For infant WIC participants 7 to 11 months, mean energy intake exceeded the mean EER by 32%, compared with 19% for nonparticipants. For toddlers, mean energy intakes exceeded mean EERs by 40% for WIC participants and 29% for nonparticipants.

Table 5 presents estimates of the mean usual intake of the nutrients targeted by the WIC food package—calcium, vitamin A, vitamin C, iron, and protein. Mean usual intake for both age groups, and for both WIC participants and nonparticipants, exceeded the adequate intake (AI). For iron, the estimated prevalence of inadequacy (percentage of infants with usual intakes less than the estimated average requirements [EAR]) was 1% or less for three of the four subgroups in Table 5. For infants 7 to 11 months old who did not participate in WIC, the estimated prevalence of inadequate iron intake was 10%. For nutrients with tolerable upper limits (ULs), the percentage with usual intakes exceeding the UL was less than 1% (not shown in table) for four of the five nutrients in Table 5. For vitamin A, the prevalence of usual intakes exceeding the UL for toddlers 12 to 24 months old was

Table 3. Transitions in infant and toddler feeding among toddlers 12 to 24 months of age

Food item	WIC ^a participants	Nonparticipants
Infant formula		
Ever fed infant formula (%)	94	92
Mean age infant formula was introduced	1.7	2.6**
Standard deviation	2.6	3.0
Infant cereal		
Ever fed infant cereal (%)	100	98
Mean age infant cereal was introduced	4.4	4.6
Standard deviation	2.1	2.0
Pureed baby food		
Ever fed pureed baby food (%)	99	99
Mean age pureed baby food was introduced	5.2	5.5
Standard deviation	1.8	1.9
Cow's milk		
Ever fed cow's milk (%)	94	94
Mean age cow's milk was introduced	11.6	11.8
Standard deviation	2.0	1.6

Data from 2002 Feeding Infants and Toddler Study, weighted data.

^aWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

* $P<.05$; ** $P<.01$; nonparticipants significantly different from WIC participants.

about 40% for WIC participants and 34% for nonparticipants.

Food Choices of WIC Participants and Nonparticipants

Table 6 shows the percentages of infants and toddlers by WIC participation status that consumed different food groups on the day of the dietary recall. Similar percentages of WIC participants and nonparticipants consumed milk products, although infant WIC participants were less likely to have consumed breast milk and more likely to have consumed formula than nonparticipants.

Infant cereals were consumed frequently by both WIC

	Infants 7 to 11 months		Toddlers 12 to 24 months	
	WIC participants	Nonparticipants	WIC participants	Nonparticipants
EER (kcal/day)	751	733	948	950
Mean energy intake (kcal/day)	988	874	1,327	1,227
Standard deviation	249	177	341	281

Data from 2002 Feeding Infants and Toddler Study, weighted data.
^aEER=estimated energy requirement.
^bWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

Nutrient	DRI ^b		WIC participants			Nonparticipants		
	A1 ^c	EAR ^d	Mean intake	Standard deviation	%<EAR	Mean intake	Standard deviation	%<EAR
Infants 7 to 11 months								
Calcium (mg)	270		662	195	NA ^e	618	219	NA
Vitamin A (μg, RAE ^f)	500		805	248	NA	763	225	NA
Vitamin C (mg)	50		127	41	NA	94	31	NA
Iron (mg)		6.9	18.5	6.1	1.0	14.8	6.8	10.0
Protein (g)		1.1 g/kg	24.8	8.6	<1	22.2	8.5	<1
Toddlers 12 to 24 months								
Calcium (mg)	500		991	409	NA	924	299	NA
Vitamin A (μg, RAE)		210	688	312	2.0	690	295	1.0
Vitamin C (mg)		13	103	42	<1	88	54	<1
Iron (mg)		3.0	10.4	3.5	<1	9.7	4.5	1.0
Protein (g)		0.88 g/kg	50.0	16.7	<1	46.7	12.4	<1

Data from 2002 Feeding Infants and Toddler Study, weighted data.
^aWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.
^bDRI=dietary reference intakes.
^cA1=adequate intake.
^dEAR=estimated average requirement.
^eNA=not applicable.
^fRAE=retinol activity equivalents.

infants and non-WIC infants, although WIC infants and toddlers were slightly more likely to have consumed infant cereals than nonparticipants. Noninfant cereals were also popular by 7 months of age and became more popular for toddlers, regardless of WIC status. Most of the noninfant cereals were not presweetened, but almost a quarter of nonparticipating toddlers consumed presweetened noninfant cereals, compared with only 18% of WIC toddlers.

Similar proportions of WIC participants and nonparticipants consumed vegetables. The percentage consuming vegetables ranged from about 40% of young infants to about 80% of toddlers. For infants, baby food vegetables were popular, although for toddlers, fewer than 5% consumed baby food vegetables and almost three-quarters consumed cooked vegetables. The most popular vegetable for both WIC and non-WIC toddlers was potatoes.

The percentage of infants and toddlers consuming fruit was higher for WIC infants 4 to 6 months old than for nonparticipants of this age, although the opposite was true for older age groups. For infants 7 to 11 months and toddlers 12 to 24 months old, lower percentages of WIC

participants than nonparticipants consumed baby food fruit, non-baby food fruit, fresh fruit, and canned fruit.

Non-baby food meat was consumed by high proportions of both WIC and non-WIC toddlers. For other food sources of protein, some significant differences between WIC participants and nonparticipants were found. For infants 7 to 11 months old, a higher percentage of WIC infants consumed eggs and lower percentages consumed cheese and yogurt. For toddlers, a lower percentage of WIC participants consumed yogurt.

Sweets and desserts became more popular with age, and 80% to 90% of toddlers consumed sweets and desserts on a given day. WIC infants were more likely than nonparticipants to consume sweets and desserts, and older WIC infants and WIC toddlers were more likely to consume sweetened beverages than other infants and toddlers.

WIC infants and toddlers had higher percentages consuming 100% juice than nonparticipating infants and toddlers. In addition, higher percentages of WIC infants 7 to 11 months old and toddlers consumed fruit-flavored drinks than nonparticipants.

Table 6. Food choices for infants and toddlers by WIC^a participation status

	Infants 4 to 6 months		Infants 7 to 11 months		Toddlers 12 to 24 months	
	WIC participants	Nonparticipants	WIC participants	Nonparticipants	WIC participants	Nonparticipants
Milk						
Any type of milk	100.0	100.0	100.0	100.0	99.1	97.0
Breastmilk	20.7	48.4**	15.8	26.5**	6.6	6.5
Formula, total	89.7	66.8**	89.2	73.5**	9.0	7.0
Iron-fortified	86.5	60.4**	84.7	63.5**	8.2	5.9
Other	6.8	9.4	7.3	12.0*	0.9	1.4
Cow's milk	1.0	0.6	11.4	13.2	92.3	85.8*
Grains						
Infant cereals	69.7	62.5	74.7	69.7	13.5	9.2
Noninfant cereals, total	0.9	0.5	21.7	38.5**	58.1	56.0
Not presweetened	0.5	0.5	18.7	32.9**	43.7	36.3
Presweetened	0.0	0.0	4.0	6.9	17.7	24.1
Grains in combination foods	0.9	0.1	18.8	14.7	50.3	52.9
Vegetables						
Any vegetable	40.2	39.8	68.2	70.7	77.5	80.2
Baby food vegetables	32.9	37.0	38.2	45.0	4.8	4.7
Cooked vegetables	8.0	3.9*	33.8	33.8	73.1	72.3
Raw vegetables	1.4	0.1**	3.6	4.1	11.8	15.4
Dark green vegetables	0.4	0.0	2.9	4.0	6.3	8.4
Deep yellow vegetables	23.2	28.1	30.1	34.8	12.5	16.9
Other starchy vegetables	6.5	6.4	12.9	15.2	21.1	21.5
Potatoes	6.0	2.4*	20.7	18.2	43.1	38.3
Fruits						
Any fruit	47.8	39.2*	64.7	81.0**	58.5	74.6**
Baby food fruits	43.8	36.9	48.4	57.4*	3.8	6.5
Non-baby food fruit	8.1	4.0*	22.9	35.9**	56.4	70.9**
Fresh fruit	5.4	3.8	14.3	24.3**	43.6	57.0**
Canned fruit	3.4	0.5**	10.3	17.3**	22.3	25.3
Meat or other protein sources						
Baby food meat	0.9	2.0	3.3	3.6	0.0	0.3
Non-baby food meat	3.7	0.5**	25.0	22.0	77.7	75.1
Eggs	0.9	0.6	8.5	4.2**	24.1	23.0
Peanut butter, nuts, seeds	0.0	0.0	1.4	1.3	12.9	9.8
Cheese	0.0	0.6	9.0	12.5	38.5	38.8
Yogurt	0.8	1.4	5.5	13.3**	9.3	18.9**
Sweets, desserts, and snacks						
Desserts and sweets	18.2	6.7**	64.3	48.8**	88.6	84.3
Sweetened beverages	0.6	0.6	15.1	6.7**	47.4	35.3**
Beverages						
Juices and drinks, total	36.1	15.6**	79.6	47.6**	88.6	77.7**
100% juice	35.6	14.9**	71.6	42.9**	74.0	55.5**
Fruit-flavored drinks	0.7	0.6	12.2	5.9**	38.9	29.3*
Sample Size (unweighted)	265	597	351	808	205	791

Data from 2002 Feeding Infants and Toddler Study, weighted data.

^aWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.* $P < .05$; ** $P < .01$; nonparticipants significantly different from WIC participants.

DISCUSSION

This study provides useful descriptive data on the feeding practices, nutrient intakes, and food choices of WIC infants and toddlers. Although extensive literature has examined the feeding practices and nutrient intakes of WIC participants and nonparticipants, many of these studies are older and few have examined the detailed food choices of WIC infants and toddlers in conjunction with feeding practices and nutrient intakes. In addition, the analysis of nutrient intakes presented in this article is one of the

first studies of WIC participants and nonparticipants to use the methods suggested by the Institute of Medicine for assessing nutrient intakes using the new Dietary Reference Intakes (24).

Although the FITS data provide important and new data on food and nutrient intakes of infants and toddlers receiving WIC benefits, two caveats to the analysis should be noted. First, the WIC participation rates observed in the data were lower than national WIC participation rates. For example, about one-third of FITS in-

infants were WIC participants, compared with almost one-half of all US infants, and about one-fifth of the FITS toddlers were WIC participants, compared with one-quarter of all US children (1). Although the lower WIC participation rates for infants may reflect that the FITS sample was only of infants 4 months and older, part of this discrepancy is likely caused by the difficulty in obtaining a true national sample frame from which to draw the sample for FITS. As a result, the FITS sample was of higher socioeconomic status compared with all infants and toddlers 4 to 24 months of age (17).

A second important point is that the differences between WIC participants and nonparticipants found in this analysis should not be considered as effects of the WIC program. WIC participants were a self-selected group of individuals who chose to participate in the WIC program, although nonparticipants included those who either were not eligible for WIC or chose not to receive WIC if eligible. This analysis did not attempt to model and estimate the effects of WIC, controlling for other differences between participants and nonparticipants. Rather, the analysis focused on the food and nutrient intakes of WIC participants, and the WIC/non-WIC comparisons in this article were descriptive analyses only. As a result, differences in food and nutrient intakes between the two groups may reflect differences in both observed and unobserved characteristics, as well as differences in WIC participation status.

Despite these caveats, several interesting findings emerged from the analysis presented in this article. First, as shown in other analyses of WIC infant feeding (13), infants participating in WIC were much less likely than nonparticipants to have ever been breastfed or to be currently breastfeeding, and they were much more likely to be consuming iron-fortified formula. The vast majority of infants 4 to 6 months (more than 80%), regardless of WIC status, were fed infant cereal, suggesting that most parents or caregivers are introducing solid foods before 6 months of age.

Despite significant differences in breastfeeding, other feeding transitions were similar for WIC participants and nonparticipants. Parents of toddlers receiving WIC and those of other toddlers reported similar proportions ever consuming infant formula, infant cereal, pureed baby food, and cow's milk. In addition, except for infant formula, the mean age for introducing these foods was similar for toddler WIC participants and nonparticipants.

As recommended (27), most children do not consume cow's milk on a daily basis until almost 1 year of age. In particular, the mean age for introducing cow's milk on a daily basis was 11.6 months of age (± 2.0 months) for WIC toddlers and 11.8 months (± 1.6 months) for non-WIC toddlers. Nonetheless, a significant proportion of WIC and non-WIC infants consumed cow's milk before 1 year of age, as shown by both data from the dietary recalls and retrospective questions on the timing of the introduction of cow's milk. Specifically, 11% of WIC infants 7 to 11 months and 13% of non-WIC infants consumed cow's milk on the day of the recall. Moreover, cow's milk consumption increased with the age of infants; as described by Briefel and colleagues, one-third of infants 9 to 11 months consumed cow's milk (20).

Overall, the FITS data show that the diets of infants and toddlers participating in WIC are nutritionally adequate. Mean usual intake of calcium, vitamin A, vitamin C, iron, and protein (the nutrients targeted by the WIC

food package) exceeded the AI for WIC participants ages 7 to 11 months and 12 to 24 months; and the estimated prevalence of inadequate intakes among toddlers (percentage with usual intakes less than the EAR) was less than 1% for both age groups of WIC participants. For nutrients with ULs, the percentage with usual intakes exceeding the UL was less than 1% for all of the WIC-targeted nutrients except vitamin A. Consistent with previous research (6,9-11), WIC participants' mean intakes of the WIC-targeted nutrients and food energy exceeded those of nonparticipants. Although nonparticipants had lower intakes than WIC participants, they also had nutritionally adequate diets—their intake of the WIC-targeted nutrients exceeded the AI and the percentage with inadequate intakes was low.

Some exceptions to the overall findings of nutritionally adequate diets for both WIC participants and nonparticipants were that (a) their reported energy intakes exceeded estimated requirements, and (b) significant proportions of toddlers had excessive intakes of vitamin A. Mean intakes of food energy for both WIC participants and nonparticipants were substantially greater than requirements as calculated using the Institute of Medicine equations for the EERs, with the difference between intakes and the EERs larger for WIC participants than nonparticipants and increasing with the age of child. The factors contributing to the discrepancy between mean energy intake and mean EERs are discussed in detail by Devaney and colleagues. (23). Some of the difference between mean energy intakes and the mean EER may reflect the consumption of more energy than required; overconsumption, however, cannot account for the entire discrepancy between reported intakes and the EERs. Other important factors are the likely overreporting of food intake and underreporting of the child's weight, which leads to underestimates of calculated EERs. Overreporting by adults of food intakes of the children may occur either unintentionally because of the difficulty of distinguishing between foods offered and what was actually consumed, or intentionally to portray their child as eating well.

The intake of vitamin A may also warrant attention. Significant proportions of toddlers participating and not participating in WIC had usual intakes greater than the UL for vitamin A, findings that are consistent with results from National Health and Nutrition Examination Survey III. However, there is no clinical evidence of excess consumption of vitamin A. The method used to set the UL for vitamin A resulted in a narrow margin between the RDA and the UL in young children (28). The finding that a high proportion of toddlers had reported vitamin A intakes that exceeded the UL reinforces the need to avoid unwarranted supplementation, but it also points to the need for better data with which to set appropriate ULs for infants and children (23).

WIC participants were more likely than nonparticipants to consume many of the foods that are provided in the WIC food package. Infants 4 to 6 months old participating in WIC were more likely than nonparticipants to consume iron-fortified formula and 100% juice; and WIC participants 7 to 11 months were more likely than nonparticipants to consume iron-fortified formula, eggs, and 100% juice. WIC toddlers 12 to 24 months old were more likely than nonparticipants to consume 100% juice, cow's milk, and peanut butter.

One possible concern is the low prevalence of fruit and

vegetable consumption, especially among toddlers. Among both WIC participants and nonparticipants, sizeable proportions of older infants and toddlers did not consume any fruit or vegetable in a given day. This was especially true of WIC participants for fruit consumption: 35% of older infants and 41% of toddlers did not consume any fruit as distinct food items in a day. Moreover, the vegetables consumed tended to be those lower in micronutrients and higher in energy. These fruit and vegetable consumption patterns are of particular concern because the consumption of a wide variety of fruits and vegetables is viewed as the foundation of a healthy diet (29-31).

APPLICATIONS

Because of its broad coverage of infants and young children, the WIC program is an important vehicle for delivering food assistance and nutrition education to US families. Overall, the WIC program seems to be meeting its objectives. Infants and toddlers get enough and not too much of most nutrients, most formula-fed infants use iron-fortified formula, and most infants delay the use of cow's milk until 1 year of age.

The FITS data on WIC infants and toddlers suggest the following points for WIC providers:

- All infants and toddlers, but especially WIC infants and toddlers, seem to be consuming more energy than required. A large part of the difference between energy intakes and energy requirements is most likely the overreporting of food consumption. However, the increasing prevalence of overweight and obesity among children suggests that nutrition education through WIC should focus on appropriate infant and toddler feeding patterns, especially consumption of low-calorie, high-nutrient food. WIC professionals should also monitor the weight gain of infants and toddlers.
- Among both WIC participants and nonparticipants, sizeable proportions of older infants and toddlers did not consume any fruit or vegetable in a given day, and the vegetables consumed tended to be those lower in micronutrients and higher in energy. WIC professionals should continue to emphasize fruit and vegetable consumption because these foods are the bases of a healthy diet. Moreover, they should encourage parents to continue to provide these foods to their children in developmentally appropriate forms, such as purees and very soft dices.
- WIC professionals should advise parents to limit the frequency with which they offer sweets, desserts, and salty snacks.
- Although most WIC infants use iron-fortified formula, a sizeable proportion still consume cow's milk before 1 year of age. WIC providers should continue to reinforce their message of the importance of delaying the use of cow's milk.
- Given the lack of clinical evidence suggesting overconsumption of vitamin A, additional research is needed to substantiate the UL for vitamin A.

References

1. Oliveira V, Racine E, Olmsted J, Ghelfi LM. The WIC Program: Background, Trends, and Issues. Food and Rural Economic Division, Economic Research Service. Washington, DC: United States Department of Agriculture; 2002. Food Assistance and Nutrition Report No. 27.
2. Rossi P. Feeding the Poor. Washington, DC: American Institute Press; 1998.
3. Devaney BL, Ellwood MR, Love JM. Programs that mitigate the effects of poverty on children. *The Future of Children: Children and Poverty*. 1997;7:88-112.
4. Owen AL, Owen GM. Twenty years of WIC: A review of some effects of the program. *J Am Diet Assoc*. 1997;97:777-782.
5. Yip R, Parvana I, Scanlon K, Borland E, Russell C, Trowbridge F. Pediatric surveillance system—United States 1980-1991. *MMWR Surveill Summ*. 1992;41:1-23.
6. Rush D, Leighton J, Sloan NL, Alvir JM, Horvitz DG, Seaver WB, Garbowski GC, Johnson SS, Kulka RA, Devore JW. The national WIC evaluation: Evaluation of the Special Supplemental Food Program for Women, Infants and Children, VI: Study of infants and children. *Am J Clin Nutr*. 1988;48:484-511.
7. Yip R, Binkin NJ, Fleshood L, Trowbridge F. Declining prevalence of anemia among low-income children in the United States. *JAMA*. 1987;258:1619-1623.
8. Edozien J, Switzer B, Bryan R. Medical evaluation of the Special Supplemental Food Program for Women, Infants and Children. *Am J Clin Nutr*. 1979;32:677-692.
9. Brown JE, Tieman P. Effect of income and WIC on the dietary intake of preschoolers: results of a preliminary study. *J Am Diet Assoc*. 1986;86:1189-1191.
10. Batton S, Hirschman J, Thomas D. Impact of the Special Supplemental Food Program on infants. *J Pediatr*. 1990;117:S101-S109.
11. Rose D, Habicht JP, Devaney B. Household participation in the food Stamp and WIC programs increases the nutrient intakes of preschool children. *J Nutr*. 1998;128:548-555.
12. Gordon A, Nelson L. Characteristics and Outcomes of WIC Participants and Nonparticipants: Analysis of the 1988 National Maternal and Infant Health Survey. Washington, DC: United States Department of Agriculture, Food and Consumer Service, Office of Analysis and Evaluation; 1995.
13. Chatterji P, Bonuck K, Dhawan S, Deb N. WIC participation and the initiation and duration of breastfeeding. Madison, WI: Institute for Research on Poverty Discussion Paper no. 1246-02; February 2002.
14. Ahluwalia IB, Tessaro I, Grummer-Strawn LM, MacGowan C, Benton-Davis S. Georgia's breastfeeding promotion program for low-income women. *Pediatrics*. 2000;105:1-6.
15. Schwartz BJ, Guilky DK, Akin JS, Popkin BM. The WIC Breastfeeding Report. The Relationship of WIC Program Participation to the Initiation and Duration of Breastfeeding. Research Triangle Park, NC: Research Triangle Institute; 1992.
16. Experian. New Parent Data File. Available at: www.experian.com/. Accessed June 10, 2003.
17. Devaney B, Kalb L, Briefel R, Zavitsky-Novak T, Clusen N, Ziegler P. Feeding Infants and Toddlers Study: Overview of the study design. *J Am Diet Assoc*. 2004;104(suppl 1):S8-S13.
18. University of Minnesota Nutrition Coordinating Center. Nutrition Data System for Research. Minneapolis, MN: University of Minnesota; 2001.
19. Institute of Medicine. Food and Nutrition Board. Di-

- etary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride. Washington, DC: National Academy Press; 1997.
20. Heinig MJ, Nommsen LA, Peerson JM, Lonnderal B, Dewey KG. Energy and protein intakes of breast-fed and formula-fed infants during the first year of life and their association with growth velocity: The DARING study. *Am J Clin Nutr.* 1993;58:152-161.
 21. Briefel RR, Reidy K, Karwe V, Devaney B. Feeding Infants and Toddlers Study: Improvements needed in meeting infant feeding recommendations. *J Am Diet Assoc.* 2004;104(suppl 1):S31-S37.
 22. Nusser SM, Carriquiry AL, Dodd KW, Fuller WA. A semiparametric transformation approach to estimating usual daily intake distributions. *J Am Stat Assoc.* 1996;91:1440-1449.
 23. Devaney B, Ziegler P, Pac S, Karwe V, Barr SI. Nutrient intakes of infants and toddlers. *J Am Diet Assoc.* 2004;104(suppl 1):S14-S21.
 24. Institute of Medicine. Dietary Reference Intakes. Applications in Dietary Assessment. Washington, DC: National Academy Press; 2000.
 25. Stuff JE, Nichols BL. Nutrient intake and growth performance of older infants fed human milk. *J Pediatr.* 1989;115:959-968.
 26. Fox MK, Pac S, Devaney B, Jankowski L. Feeding Infants and Toddlers Study: What foods are infants and toddlers eating? *J Am Diet Assoc.* 2004;104(suppl 1):S22-S30.
 27. American Academy of Pediatrics, Committee on Nutrition. The use of whole cow's milk in infancy [policy statement]. *AAP News.* 1992;8:8-22.
 28. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Washington, DC: National Academy Press; 2001.
 29. The Food Guide Pyramid. Washington, DC: US Department of Agriculture, Center for Nutrition Policy and Promotion; 1996. Home and Garden Bulletin No. 252.
 30. US Department of Agriculture, Center for Nutrition Policy and Promotion. Tips for Using the Food Guide Pyramid for Young Children 2 to 6 Years Old. Washington, DC: US Department of Agriculture; 1999. Program Aid 1647.
 31. US Department of Agriculture and US Department of Health and Human Services. Nutrition and Your Health: Dietary Guidelines for Americans. 4th ed. Washington, DC: US Government Printing Office; 2000.