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Review of the Nutritional Status of WIC Participants

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REVIEW OF THE NUTRITIONAL STATUS OF WIC PARTICIPANTS

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Center for Nutrition Policy and Promotion

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Review of the Nutritional Status of WIC Participants: Final Report

EXECUTIVE SUMMARY

Introduction: The Secretary of Agriculture committed the Department to conduct a comprehensive study of the nutritional adequacy of supplemental food packages provided in the WIC Program (The Special Supplemental Nutrition Program for Women, Infants, and Children). The Center for Nutrition Policy and Promotion is charged with the Department's nutritional review. The goal of the review is to assess how well the WIC food packages perform as supplemental food packages assisting low-income recipients to meet nutritional standards for a healthful diet. The goal has three component tasks: (1) identify current nutritional recommendations for each of the WIC participant groups; (2) assess the diets of WIC participants in light of these standards; (3) examine the contribution of the WIC food packages to meeting the standards. From this assessment, any nutrient gaps or excesses among the WIC populations can be identified, along with opportunities for improving the WIC packages.

Background: The WIC Program was established in 1972 by an amendment to the Child Nutrition Act of 1966 and provides free, nutritious, supplemental foods, nutrition education, and health care referrals to low-income, pregnant, postpartum and breast-feeding women, and to low-income infants and children under the age of 5 who are judged at nutritional risk by professionals. The WIC food packages, which are supplemental by legislative intent, contain foods rich in nutrients or food components that are limited in the diets of targeted participant groups. Legislation leaves the definition or interpretation of "supplemental" and the selection of WIC foods to the discretion of the Secretary of Agriculture. The Program has focused historically on supplying participants with protein and four important micro-nutrients: vitamins A and C, calcium, and iron. More recently, nutrition research has identified other micro-nutrients of potential concern, folic acid, zinc, vitamin B6, and magnesium. In addition, concern with other food components has surfaced; for example, Section 17(f)(12) of the Child Nutrition Act directs the Department to assure to the extent possible that the fat, sugar, and sodium content of WIC food packages is appropriate. The 1980 rule-making process restricted the amount of sugar permitted in WIC cereals to 6 grams per ounce of cereal and limited the amount of cheese in food packages, to curb sodium levels. Over the past several years, USDA has been questioned by members of Congress as well as the food industry as to the scientific basis for continuation of the Federal 6-gram sugar limit for WIC-eligible adult cereals.

Study objectives: The goal of the review is to assess how well the WIC food packages perform as supplemental food packages assisting low-income recipients to meet nutritional standards for a healthful diet. The goal has three component objectives:

(1) Identify current Federal nutritional recommendations for each of the WIC groups;

(2) Assess the diets of WIC participants in light of these standards;

(3) Examine the contribution/potential contribution of the WIC food packages to meeting the standards.

From this assessment, nutrient gaps or excesses among the WIC populations can be identified, along with opportunities for improving the WIC packages.

Objective (1): Nutrition Standards. The study identifies current recommended nutrition standards for each WIC participant group, using the National Research Council's 1989 Recommended Dietary Allowances (RDAs) for protein and the four WIC target nutrients (vitamins A and C, calcium, and iron) plus folic acid, zinc, vitamin B6, and magnesium, as well as the Recommended Energy Allowances (REAs) for total energy. The 1995 Dietary Guidelines for Americans (U.S. Department of Agriculture/ U.S. Department of Health and Human Services, 1995) and the Food Guide Pyramid (U.S. Department of Agriculture, Human Nutrition Information Service, 1992) are referenced for recommendations pertaining to total fat, saturated fat, sugars, cholesterol, and sodium.

Reference values based on nutrition standards were interpolated by nutritionists where the age/sex group receiving a package did not match the age/sex groups referenced in the RDAs or other guidelines. Children were broken into two groups to match the corresponding reference values for each group. WIC Package IV is for 1- through 4-year-old children. Four-year-old children were considered separately from 1- to 3-year-olds and compared to standards for 4- to 6-year-old children. Pregnant and breast-feeding women (who receive WIC package V) are also considered separately due to differences in reference values for nutrients and other dietary components. Additionally, breast-feeding women may receive WIC Package VII, which is an enhanced package for exclusively breast-feeding women. This package was added to the WIC Program in 1992 to encourage breast-feeding. Where reference values are specified for different ages of women, a value for all women in a participant group was also interpolated.

Objective (2): Assess the diet of WIC participants. CNPP utilizes total daily nutrient intakes of all foods reported consumed by individuals in WIC target groups and comparison groups in the nationally representative Third National Health and Nutrition Examination Survey (NHANES III) conducted from 1988 to 1994. NHANES III is a periodic survey conducted by the National Center for Health Statistics of the Department of Health Human Services (DHHS) and is used extensively in policy formulation, program planning and evaluation, regulatory analysis, education, and research. This survey includes data which represents the health and nutritional status of the civilian, non-institutionalized population of the United States and contains

information on food and nutrient intakes and socioeconomic data on households and individuals. Total daily dietary nutrient intake of individuals in the survey is the calculated sum of nutrients of all foods reported consumed in 1 day, based on a single, 24-hour dietary recall interview. NHANES III was used because it contains larger sample sizes of women and children that would be covered by the WIC Program than the other major Federal dietary intake survey considered (the 1994-96 Continuing Survey of Food Intakes by Individuals).

The median total dietary intake of six WIC participant subgroups for the WIC target nutrients,[1] four selected additional nutrients of potential public health significance, and other dietary components[2] were calculated. These subgroups include: infants 2-3 months old who receive WIC Package I; infants 4-11 months old who receive WIC Package II; children 1 through 4 years old who receive WIC Package IV; pregnant and breast-feeding (up to 12 months postpartum) mothers who receive WIC package V; and non-breast-feeding mothers up to 6 months postpartum who receive WIC Package VI. WIC Package III is a "prescription" package for individuals with special dietary needs (such as phenylketonuria). It is a heterogeneous group and is not included in the analysis. WIC Package VII is an enhanced version of WIC Package V for women who are exclusively breast-feeding. All breast-feeding women are analyzed in one group. Total dietary intakes of the nutrients and dietary components for each participant group were compared to reference values based on the current nutrition standards described above.

In order to assess how participation in the WIC Program may affect diet quality, nutrient intakes of WIC participant groups were compared to WIC-income-eligible non-participants and separately to the overall NHANES III sample using two sample t-tests with standard errors calculated by SUDAAN statistical software (Shah et al., 1997) and an alpha level of 0.05. To assess the populations with the lowest nutrient intakes, the 10th percentile of daily nutrient intakes were examined.

Objective (3): Assess the contribution of the WIC Packages to meeting nutrition standards. The nutrient content of the prototypical "maximum WIC food package" for each participant group is utilized to assess the potential contribution of the WIC food package to meeting recommendations. The nutrient content of the "maximum package," or the maximum amount of food one person could theoretically receive, was analyzed by The Pennsylvania State University in a 1991 review of the WIC Food Packages (U.S. Department of Agriculture, Food and Nutrition Service, 1991). The possible outcomes are that the target group achieves the recommendation or not. If it does not, then we look to see if this could be explained because the WIC package does not contain sufficient quantities of the nutrients. If the package

[1] Vitamin A, vitamin C, calcium, iron, and protein.

[2] FolateFolic acid, magnesium, zinc, vitamin B6, total carbohydrate, sucrose, fructose, galactose, glucose, lactose, maltose, sodium, dietary fiber, cholesterol, total fat, and saturated fatty acids.

contains the nutrients in question while the reported intake does not, then we conclude that the foods are not being consumed by the target group. Potential reasons which we are now investigating include food consumption by other household members, food preferences, or lack of effective nutrition education.

Results: WIC Infants 2-3 Months—There appears to be little concern regarding achieving recommended nutrient intakes among formula-fed WIC infants 2-3 months old (all groups) for energy and WIC-target nutrients (protein, iron, calcium, vitamin A, and vitamin C) (Table ES-1). Breastfed infants are not included in this analysis because of the difficulty of quantifying milk intake. WIC Package I (mainly formula) provides 81 percent of the RDA for kilocalories and over 100 percent of the RDA for WIC target nutrients. Intake of other nutrients of public health importance (folic acid, zinc, vitamin B6, and magnesium) are similarly over 100 percent of RDA in the diets of these infants. Infants 2-3 months old usually drink iron-fortified formula with little or no supplementary feeding of solid foods and nutrient intakes are similar for WIC and non-WIC groups at median levels.

Table ES-1. Nutrient Intake of Infants 2-3 Months Old Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	650	528	81%	665.7	19.59	102%	(97%,161%)
Protein (gm)	13	11.7	90%	14.9	0.67	114%	(105%,216%)
iron (mg)	6	9.5	158%	14.3	0.78	238%	(213%,493%)
Calcium (mg)	400	399	100%	567.4	27.50	142%	(128%,277%)
Vitamin A (IU)	1250	1591	127%	1952.6	85.84	156%	(143%,291%)
Vitamin C (mg)	30	47	157%	68.7	4.63	229%	(199%,531%)
Folic acid (mcg)	25	80	320%	91.9	4.00	368%	(336%,681%)
Zinc (mg)	5	3.9	78%	5.1	0.15	102%	(96%,161%)
Vitamin B6 (mg)	0.3	0.3	100%	0.5	0.01	410%	(143%,215%)
Magnesium (mg)	40	32	80%	61.4	3.89	154%	(134%,344%)

*C.I.=confidence interval

Results: WIC Infants 4-11 Months Old—For WIC infants 4-11 months old, median energy intake is above 100 percent of the Recommended Energy Allowance (REA) at 109 percent (Table ES-2). WIC Package II supplies 80 percent of the REA. Analysis shows that WIC infants 4-11 months old achieve well over 100 percent of the RDA for WIC target nutrients (iron, calcium, vitamin A, vitamin C, and protein); they also receive over 100 percent of the additional nutrients of concern (folic acid, zinc, vitamin B6, and magnesium).

Table ES-2. Nutrient Intake of Infants 4-11 Months Old Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	803	646	80%	872.0	15.39	109%	(105%,112%)
Protein (gm)	14	13.2	94%	21.3	0.54	152%	(145%,160%)
Iron (mg)	9	26.4	293%	16.9	0.50	187%	(177%,199%)
Calcium (mg)	554	592	107%	616.2	13.20	111%	(107%,116%)
Vitamin A (IU)	1250	1602	128%	3005.9	146.01	240%	(218%,263%)
Vitamin C (mg)	34	85	250%	103.7	4.83	305%	(277%,333%)
Folic acid (mcg)	33	86	261%	112.5	3.27	341%	(321%,360%)
Zinc (mg)	5	4.4	88%	5.7	0.15	113%	(108%,120%)
Vitamin B6 (mg)	0.5	0.4	80%	0.7	0.01	130%	(136%,144%)
Magnesium (mg)	55	80	145%	97.0	2.47	176%	(168%,185%)

*C.I.=confidence interval

Results: WIC Children 1-3 Years Old—Children 1-3 years old were examined separately from 4-year-olds because of different recommended intake levels. Most WIC children 1-3 years old consume adequate kilocalories and levels of most nutrients. WIC Package IV provides 65 percent of the REA of 1,300 kilocalories per day (Table ES-3). WIC children 1-3 consume 308 percent of the RDA for protein, slightly under 100 percent for iron and calcium, and well over 100 percent of the RDA for vitamin A and vitamin C. As Table 3 shows, the median intake for folic acid, vitamin B6, and magnesium are all over the RDA. Only zinc intake is lower than recommended levels, with the median intake only 66 percent of the RDA for this group. However, this should be interpreted with caution due to current thought which suggests that the RDA for zinc may be set too high for children. The maximum WIC package content of zinc is 41 percent of the RDA.

Table ES-3. Nutrient Intake of Children 1-3 Years Old Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	1300	849	65%	1313.2	26.52	101%	(97%,105%)
Protein (gm)	16	37.4	234%	49.3	1.29	308%	(292%,324%)
Iron (mg)	10	11.4	114%	9.6	0.33	96%	(90%,102%)
Calcium (mg)	800	986	123%	788.2	28.38	99%	(92%,105%)
Vitamin A (IU)	1400	2913	208%	2781.2	131.29	199%	(180%,217%)
Vitamin C (mg)	40	139	348%	60.2	3.79	150%	(132%,169%)
Folic acid (mcg)	50	337	674%	161.4	6.19	323%	(299%,347%)
Zinc (mg)	10	4.1	41%	6.6	0.14	66%	(63%,69%)
Vitamin B6 (mg)	1	1.1	110%	1.2	0.03	117%	(114%,126%)
Magnesium (mg)	80	158	198%	175.8	6.06	220%	(205%,235%)

*C.I.=confidence interval

Results: WIC Children 4 Years Old—WIC children 4 years old consume 88 percent of the REA of 1,800 kilocalories established for this age group (Table ES-4). CNPP has analyzed food consumption data reported for all children in this age group from the Continuing Survey of Food Intakes by Individuals (1989-91) and estimates that the average consumption of 1,530 kilocalories is nutritionally adequate in light of growing concerns about obesity among elementary school children. Because of growing concerns about an obesity "epidemic" in the United States, affecting even children of elementary school age, it is not prudent to urge parents to feed children more food than they may need.

The WIC Package for this group provides about 47 percent of the established REA. WIC children receive adequate (greater than 100 percent of the RDA) protein, iron, calcium, vitamin A, and vitamin C (the WIC target nutrients). They also receive adequate folic acid, vitamin B6, and magnesium. Like the other children 1-3 years old, however, this group has low zinc intake—reported at 76 percent of the RDA.

Table ES-4. Nutrient Intake of Children 4 Years Old Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	1800	849	47%	1584.2	65.01	88%	(81%,95%)
Protein (gm)	24	37.4	156%	59.7	4.66	249%	(211%,287%)
Iron (mg)	10	11.4	114%	11.3	0.64	113%	(100%,126%)
Calcium (mg)	800	986	123%	794.7	60.3	99%	(85%,114%)
Vitamin A (IU)	1400	2913	208%	2636.0	317.99	188%	(144%,233%)
Vitamin C (mg)	45	139	309%	54.1	9.38	120%	(79%,161%)
Folic acid (mcg)	75	337	449%	180.3	20.75	240%	(186%,295%)
Zinc (mg)	10	4.1	41%	7.6	0.53	76%	(66%,86%)
Vitamin B6 (mg)	1.1	1.1	100%	1.4	0.06	130%	(117%,138%)
Magnesium (mg)	120	158	132%	178.6	13.55	149%	(127%,171%)

*C.I.=confidence interval

Results: WIC Pregnant Women—WIC women of all categories demonstrate nutrient deficits in their diets. WIC pregnant women report consuming only 70 percent of the REA for kilocalories, 44 percent of the iron RDA, and 60 percent of the calcium RDA—all WIC target nutrients (Table ES-5). The WIC packages alone, at maximum levels, could provide 35 percent of kilocalories, 71 percent of protein, 37 percent of iron, and 99 percent of calcium. Consumption of vitamin A appeared sufficient at a median of 122 percent of RDA; the median consumption of vitamin C was 100 percent of the RDA but with a potentially large variation.

Four additional nutrients of concern appeared to be low in the diets of WIC pregnant women: folic acid (58 percent RDA), zinc (61 percent RDA), vitamin B6 (77 percent RDA), and magnesium (69 percent RDA). These nutrients are recommended for explicit inclusion in the mix of WIC foods provided to WIC population subgroups as new target nutrients. Currently, the WIC maximum package supplies 81 percent of the RDA for folic acid (as opposed to 58 percent of the RDA consumed); 31 percent of the zinc RDA (as opposed to 61 percent RDA consumed); 50 percent of the RDA for vitamin B6 (as opposed to 77 percent RDA consumed); and 60 percent of the magnesium RDA (compared to 69 percent RDA consumed). (These levels do not reflect recent folic acid fortification requirements for cereal grains, which took place after the survey dates of 1988-94.) For these women, the percentage of kilocalories from macro-nutrients fell below the 55 percent from carbohydrate minimum recommendation and exceeded the 30 percent of kilocalories from the maximum recommendation for fat and the 10 percent of kilocalories from the maximum recommendation for saturated fat.

Table ES-5. Nutrient Intake of Pregnant Women Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	2500	863	35%	1757.0	243.4	70%	(51%,89%)
Protein (gm)	60	42	71%	62.6	11.54	104%	(67%,142%)
Iron (mg)	30	1.1	37%	13.2	2.39	44%	(28%,60%)
Calcium (mg)	1200	1193	99%	716.0	119.17	60%	(40%,79%)
Vitamin A (IU)	2650	3775	142%	3221.4	421.44	122%	(90%,153%)
Vitamin C (mg)	70	141	201%	70.2	25.80	100%	(28%,173%)
Folic acid (mcg)	400	323	81%	233.6	45.93	58%	(36%,81%)
Zinc (mg)	15	4.7	31%	9.1	1.33	61%	(43%,78%)
Vitamin B6 (mg)	2.2	1.1	50%	1.7	0.31	77%	(50%,105%)
Magnesium (mg)	320	193	60%	221.3	41.47	69%	(44%,95%)

*C.I.=confidence interval

Results: WIC Breast-feeding, Postpartum Women—WIC-participating women in the 12 months after giving birth had energy intakes at 89 percent of the REA (Table ES-6). Additionally, they failed to meet 100 percent of the RDA for WIC target nutrients vitamin C and iron, as well as for other nutrients of public health concern (vitamin B6, magnesium, and zinc). Breast-feeding women had significantly higher cholesterol intake (with amounts above recommendation) than comparison groups.

Table ES-6. Nutrient Intake of Breast-feeding Women Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	2700	837	31%	2411.0	194.23	89%	(75%,103%)
Protein (gm)	65	41.8	64%	97.7	4.19	150%	(138%,163%)
Iron (mg)	15	11.4	76%	13.2	2.06	88%	(61%,115%)
Calcium (mg)	1200	1172	98%	1442.6	228.49	120%	(83%,158%)
Vitamin A (IU)	4350	3723	86%	4809.0	1292.48	111%	(52%,169%)
Vitamin C (mg)	94	141	150%	67.0	30.54	71%	(8%,135%)
Folic acid (mcg)	277	344	124%	284.5	133.90	103%	(8%,197%)
Zinc (mg)	19	4.7	25%	13.6	1.36	72%	(58%,86%)
Vitamin B6 (mg)	2.1	1.1	52%	1.8	0.22	84%	(65%,106%)
Magnesium (mg)	353	183	52%	297.7	71.55	84%	(45%,124%)

*C.I.=confidence interval

Results: WIC Non-breast-feeding, Postpartum Women—This study identifies non-breast- feeding, postpartum women as having marked dietary nutrient intake inadequacies (Table ES-7). Total kilocalorie intake is 87 percent of the REA. Except for protein, they are consuming less than 100 percent of the RDA for the WIC target nutrients and nutrients of concern. A supposition may be made that they are not consuming their WIC food package, as the package supplies adequate quantities of these nutrients. Percent of kilocalories from macro-nutrients does not fall in the professionally accepted proportions of kilocalories from total carbohydrates (55 percent), protein (15 percent), total fat (30 percent), and saturated fat (10 percent). Instead, the median proportion of kilocalories from those macro-nutrients consumed was 47 percent, 16 percent, 36 percent, and 12 percent, respectively.

Table ES-7. Nutrient Intake of Non-breast-feeding Women Compared to WIC Package and RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	2200	654	30%	1913.0	152.43	87%	(73%,101%)
Protein (gm)	48	33.2	69%	77.7	9.84	162%	(122%,202%)
Iron (mg)	15	10.6	71%	12.6	1.25	84%	(68%,100%)
Calcium (mg)	1069	997	93%	636.4	60.43	60%	(48%,71%)
Vitamin A (IU)	2650	3382	128%	2999.5	534.54	113%	(74%,153%)
Vitamin C (mg)	60	101	168%	35.9	6.07	60%	(40%,80%)
Folic acid (mcg)	180	258	143%	174.5	8.82	97%	(87%,107%)
Zinc (mg)	12	3.7	31%	11.7	1.80	98%	(68%,127%)
Vitamin B6 (mg)	1.6	1	63%	1.4	0.13	89%	(72%,103%)
Magnesium (mg)	285	132	46%	196.2	20.88	69%	(54%,83%)

*C.I.=confidence interval

Impact of WIC Packages: Comparisons with WIC-Eligible Non-Participants

Among children 1-3 years old who consume at the low end of the nutrient distribution (10th percentile), comparing WIC participants (WICP) with low-income non-participants (WICNP), WICP do significantly better than WICNP for most nutrients. These WICP children 1-3 years old benefit from the WIC package for most nutrients, especially for protein, calcium, iron, folic acid, magnesium, and vitamin E. WICP zinc intakes are comparable to the other two groups. For children 1-3 years old, iron intakes are below the RDA. However, these younger WICP children have significantly higher intakes of iron as well as of vitamin C than WICNP.

For all children up to 5 years of age, intakes of calcium are below the RDA. Among children 4 years old, all three groups take in just below 100 percent of RDA for calcium (95-99 percent). WICNP and the total sample (TS) groups have greater intake of carbohydrate and dietary fiber than WICP. This may indicate the introduction of cereal earlier and in larger amounts. Also, the lower lactose and higher cholesterol in these groups could reflect greater use of whole milk. Children 4 years old also consume below 100 percent of the REA, at 88 percent.

All groups of pregnant women need to improve their diets. All three study groups report less than 100 percent RDA for vitamin A, calcium, and iron. WICP take in more vitamin C than WICNP, but not more than TS. WICP have lower intakes of calcium than the other groups. Iron intakes are similarly low (44 percent of RDA) for all three groups. All three groups consume less than 100 percent of the RDA for folic acid, magnesium, zinc, and vitamin B6, with even lower intakes of these nutrients by WICP.

WIC pregnant women, despite the supplemental foods received, report consuming less than 100 percent of the RDA for the target nutrients, calcium and iron; and for nutrients of concern, folate, zinc, and vitamin B6. Intakes of these nutrients are lower than both the WICNP and TS groups. Problems with the dietary intake of these pregnant women are low energy intakes, low nutrient-density, and higher fat intakes than recommended.

Finally, despite the supplemental foods received, WICP breast-feeding women report lower intake than WICNP and TS lactating women for the target nutrients vitamin A, vitamin C, and iron. All postpartum women, including non-breast-feeding WIC participants, consume less than the RDA for most target nutrients and nutrients of concern.

Findings Related to Sugars Intake: Because of recent interest in sugar and its effects, the study examined intake of total and component sugars—sucrose, fructose, glucose, galactose, lactose, and maltose—by study participant groups. Glucose is required by cells of the body to produce energy for cell functions. Carbohydrates in the diet, including sugars (simple carbohydrates such as monosaccharides and disaccharides) and starches (complex carbohydrates), are digested and metabolized in the gastrointestinal system primarily into glucose and, to a smaller extent, galactose and fructose. These

monosaccharides are absorbed into the portal blood, which delivers them to the liver before they enter the systemic blood. Glucose is immediately available to cells, and galactose and fructose are further metabolized in the liver into glucose, slightly delaying their entry into the blood as glucose. The rate at which glucose enters the blood after a meal depends primarily on how much total carbohydrate is consumed, how the food is prepared (cooking speeds up digestion), what else is consumed (fat slows digestion down) and minimally on the type of carbohydrate consumed. The metabolic effects of glucose derived from different sugars and carbohydrates are mainly dependent on the amount and speed at which glucose enters the blood (glycemic response curve or glycemic index[3]), rather than from what form it originated (Ludwig et al., 1998; Lee and Wolever, 1998; Daly et al., 1997; Bantle, 1989; Bantle et al., 1983). Further, there is no intrinsic difference in the way glucose, whether originating in added sugars versus naturally occurring sugars, is recognized by cells of the body (Guyton and Hall, 1996). The rate at which glucose becomes available in the blood affects hormonal secretion of insulin and glucagon, which regulate blood glucose levels and glucose entry into cells for energy production or storage. In populations with risk factors such as obesity and insulin resistence, diets including meals that produce a rapid rise in blood glucose have been associated with an increased risk of developing diabetes mellitus (Salmeron et al., 1997a,b).

Dietary data in NHANES III do not include information on the amount of sugar added to foods in the manufacturing process. However, to get a sense of the role of added sugars in the total diet, we follow the convention used in the Pyramid Food Group Servings database, and assume that added sugars include sucrose, glucose, galactose, and maltose, and that naturally occurring sugars include fructose and lactose. This method is not perfect and interpretation should be made with caution as some glucose occurs naturally (as in orange juice), and fructose can be added as a sweetener (such as high-fructose corn syrup).

Dietary guidance from the Food Guide Pyramid (U.S. Department of Agriculture, 1992) suggests teaspoon amounts of added sugar per day for selected calorie intake levels. When added sugar intakes were compared to suggested amounts in the Food Guide Pyramid, all groups of WIC children and women, with the exception of breast-feeding women, consumed more than the suggested amount (Table ES-8). Children 1-4 years old consume over twice the suggested amount. WIC pregnant women consume 1.5 times, and WIC non-breast-feeding women consume 1.3 times suggested amounts. Breast-feeding women do not exceed the suggested amount of added sugar. Although above the suggested amount, WIC children 1-3 years old consume significantly less added sugar than the total nationally representative

[3] Glycemic index is defined as the area under the glycemic response curve after consumption of 50 grams of carbohydrate from a test food divided by the area under the curve after consumption of 50 grams of carbohydrate from a control substance, either white bread or glucose.

comparison group. The contribution of the WIC package to added sugars in the overall diet is very low, coming from added sugars in peanut butter and ready-to-eat cereals. Of note is the fact that each of these groups consumes less than 55 percent of total kilocalories from carbohydrates.

Table ES-8. Consumption of Added Sugars in Teaspoons

Group	Recommendation[4]	Actual total intake	Prototype WIC package contains[5]:
Children 1-3 years old	Less than 5	11.5	1.3
Children 4 years old	Less than 8	16.8	1.3
Pregnant women	Less than 15	23	0.8-1.3
Breast-feeding women	Less than 17	17	0.8-1.3
Non-breast-feeding women	Less than 12	16	0.8

Looking at component sugars, lactose is the primary sugar consumed by infants in all three comparison groups, with WICP infants 4-11 months old receiving a significantly higher intake of lactose than the other two groups (WICNP or TS). For children 1-3 years old, sucrose is the primary sugar consumed by all three groups; however, WICP children consume significantly less sucrose and other added sugar than the TS and receive a significantly lower percent of total energy from sucrose. For pregnant, breast-feeding, and non-breast-feeding postpartum mothers, there are no significant differences in total intakes of sugar among the three comparison groups (WICP, WICNP, TS).

[4] These values are suggested by the Food Guide Pyramid for different total energy intakes, assuming that other nutritional recommendations are met.

[5] This value was estimated by adding the added sugar content (defined as sucrose + glucose + galactose + maltose) of the "maximum amount" of peanut butter and ready-to-eat cereal (Kix cereal was used in this example), the only WIC foods that contain added sugar.

Implications for WIC Food Packages:

- There were no nutrient shortfalls associated with WIC infants up to the age of 11 months.
- Among WIC children 1-4 years old, the only nutrient below 95 percent of the RDA is zinc, with reported intake at 66 percent of RDA.
- WIC children 4 years old have a slight kilocalorie deficit, with median intakes at 88 percent of the REA of 1,800 kilocalories.
- Children 1 through 4 years of age consume a median level of 11 to 17 teaspoons of added sugar per day, which is well above the recommended level of 5 to 8 teaspoons. However, CNPP estimates that the WIC packages supply only about 1 teaspoon of added sugar.
- All WIC women exhibit nutrient shortfalls in their diets. WIC pregnant women do not meet 100 percent of the RDA for four of the five target nutrients and for the four other nutrients of concern. Pregnant women report consuming only 70 percent of the REA for kilocalories, 44 percent of the iron RDA, and 60 percent of the calcium RDA—all WIC target nutrients. The WIC maximum package provides 35 percent of recommendations for kilocalories, 71 percent of RDA for protein, 37 percent for iron, and 99 percent for calcium. WIC pregnant women may not be consuming all the WIC foods furnished by their packages or may not be redeeming the maximum amount of food from the vouchers. Further study is needed to understand the reason for this low nutrient intake.
- Problems with the dietary intake of WIC pregnant women are lower energy intakes, lower nutrient density, and higher percentage fat intakes than recommended. Although the WIC package is very low in added sugar, the overall intake of added sugar by pregnant women exceeds recommendations.
- A WIC group at particular nutritional risk appears to be non-breast-feeding postpartum women who may not be consuming their WIC packages. Further food behavior research to learn more about this group is recommended. Reasons for the low nutrient intakes in this group should be further examined.
- Protein intake is well above recommendations for all WIC participant groups as well as the WIC income-eligible non-participating, and the total sample groups.
- All groups of women and children studied consume more than the suggested daily intake of added sugar (from the Food Guide Pyramid), with the exception of nursing mothers. The contribution of the WIC package to added sugars in the overall diet is very low, coming from added sugars in peanut butter and ready-to-eat cereals.

Review of the Nutritional Status of WIC Participants
Final Report

I. INTRODUCTION

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC Program) was established in 1972 by an amendment to the Child Nutrition Act of 1966 and made permanent in 1975 by Public Law 94-105. The WIC Program provides vouchers for no cost, nutritious, supplemental foods, and nutrition education and health care referrals to women and children at nutritional risk. These include low-income, pregnant, breast-feeding, and non-breast-feeding postpartum women, and low-income infants and children under the age of 5 who are determined by health professionals to be at nutritional risk.

The WIC Program is intended to provide a package of foods that is supplemental in nature, containing foods rich in nutrients and food components that are limited in the diets of targeted participant groups. As supplemental packages, the WIC foods are not intended to supply 100 percent of the Recommended Dietary Allowances (RDAs); legislation leaves the interpretation of the term "supplemental" to the discretion of the Secretary of Agriculture. The Program has focused historically on supplying participants with five targeted nutrients: Vitamins A and C, calcium, iron, and protein (referred to in this report as the WIC target nutrients). Concern with other food components has also arisen; Section 17(f)(12) of the Child Nutrition Act directs the Department to assure to the extent possible that the fat, sugar, and sodium content of WIC food packages is appropriate. The 1980 rule-making process generated several changes to the WIC food packages by limiting the amount of sugar permitted in WIC cereals (to 6 grams/ounce of cereal) and by limiting the amount of cheese in food packages, to curb sodium levels.

Over the past several years, the U.S. Department of Agriculture (USDA) has received questions from members of Congress and the food industry as to whether a scientific basis exists for continuation of the Federal 6-gram sugar limit for adult WIC cereals. To gather information and respond to these questions, USDA sought public comment in the March 18, 1996, *Federal Register* regarding whether the current WIC cereal sugar limit should be retained, modified, or eliminated. The *Notice* cited the fact that many recent studies have suggested that sugar does not appear to be a causative factor in the development of chronic diseases such as coronary heart disease, obesity, or hyperactivity. However, it is being investigated as a possible causative factor in the development of diabetes mellitus and colon cancer. It noted that although clinical evidence continues to support a correlation between sugar and dental caries, the consumption of any fermentable carbohydrate, meaning starches as well as sugars, can contribute to the incidence of dental decay.

The Department received 731 letters from a total of 878 respondents representing the full range of interested parties. The majority of 809 comments expressed support for retaining the sugar limit of *6 grams/ounce of cereal.* A few respondents suggested that USDA conduct a more comprehensive review of the WIC food packages rather than focusing on a single WIC food requirement.

In February 1997, Secretary Glickman committed the Department to undertake a WIC food package nutritional review in comments before Congress at a hearing of the Agriculture Appropriations Subcommittee on the fiscal year 1998 budget for Agriculture, Rural Development, and Related Agencies. USDA published a second *Federal Register Notice* on December 31, 1997, announcing the Department's intent to review the WIC food packages to ensure they are consistent with the recommendations of the 1995 *Dietary Guidelines for Americans.* USDA's Center for Nutrition Policy and Promotion (CNPP) was directed to conduct the analysis in consultation with the USDA Food and Nutrition Service (FNS).

A. AN OVERVIEW OF THE WIC PROGRAM

WIC is administered by the Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA). WIC gives Federal grants to States, which provide vouchers that can be redeemed for free nutritious, supplemental food packages, nutrition education, and health care referrals for low-income, pregnant, breast-feeding, and non-breast-feeding postpartum women, infants, and children under the age of 5. All recipients must be judged by professionals to be at nutritional risk. The WIC nutrition program complements needed health care during critical developmental periods with the aim of preventing health problems and improving participant health status. In fiscal year (FY) 1997, an average of 7.4 million women, infants, and children participated in the program each month for a total annual cost of about $3.8 billion. Approximately 46 percent of all infants born in the United States participate in the WIC Program. A recent USDA-funded evaluation of WIC indicated that for every dollar spent on WIC prenatal participants who are also receiving Medicaid benefits, $1.77 to $3.90 was saved in Medicaid costs for the first 60 days postpartum (Devaney et al., 1990; Devaney and Schirm, 1993).

1. The WIC Food Packages and Target Nutrients

The WIC foods are intended to supplement a participant's nutrient intake and should be consumed along with other wholesome foods to produce a balanced diet. Each of the WIC foods is selected for its richness or density in one or more of the WIC target nutrients—protein, calcium, iron, and vitamins A and C—thought to be low in the diets of the WIC target groups. The basic WIC foods include iron-fortified infant formula and infant cereal, iron-fortified adult cereal, infant and adult juices, vitamin C-rich fruit and vegetable juices, eggs, milk, cheese, peanut butter, dried beans, and peas. Tuna and carrots are added to the enhanced food package for breast-feeding women whose infants

are not receiving formula from WIC. Special therapeutic infant formulas are provided when prescribed by a physician for a specified medical condition. In addition to their nutrient profiles, WIC foods are chosen for their low cost, broad cultural and ethnic appeal, commercial availability, versatility in preparation and use, ease of apportionment into daily servings over a month's time, and administrative feasibility. Table 1 provides information on the major foods in the WIC packages.

Table 1. Content of Maximum WIC Food Packages*

FOODS	Package I Infants 0-3 months old	Package II Infants 4-11 months old	Package IV Children 1-5 years old	Package V Pregnant and breast-feeding Women	Package VI Non-breast-feeding women
Infant formula (concentrated liquid)	403 fl. oz.	403 fl. oz.			
Juice (reconstituted frozen)		96 fl. oz.[6]	288 fl. oz.	288 fl. oz.	192 fl. oz.
Infant cereal		24 fl. oz.			
Cereal (hot or cold)			36 oz.	36 oz.	36 oz.
Milk[7]			24 qt.	28 qt.	24 qt.
Eggs[8]			2-2 $^1/_2$ dozen	2-2 $^1/_2$ dozen	2-2 $^1/_2$ dozen
Dried beans/peas and/or peanut butter			1 lb. beans/peas or 18 oz. peanut butter	1 lb. beans/peas or 18 oz. peanut butter	

* Package VII adds tuna and carrots to Package V for breast-feeding women whose infants are not receiving formula from WIC.

There are seven WIC food packages designed for different target groups. Package I is for infants 0 to 3 months old, Package II for infants 4 up to 12 months old, Package III for women and children with special dietary needs, Package IV for children 1-4 years old, Package V for pregnant and breast-feeding women, Package VI for postpartum women who are not breast-

[6] Infant juice may be substituted for adult juice at the rate of 63 fl. oz. per 92 fluid oz. single strength adult juice

[7] A choice of various forms of milks and cheeses may be available. Cheese may be substituted for fluid whole milk at the rate of 1 lb. per 3 qts., with a 4-lb. maximum. Additional cheese may be issued in cases of lactose intolerance.

[8] Dried egg mix may be substituted at the rate of 1.5 lbs. per 2 dozen fresh eggs; or 2 lbs. per 2 dozen fresh eggs.

feeding, and Package VII, an enhanced package for breast-feeding women whose babies do not receive formula. This study will assess the dietary nutrient intake of recipients of each package and compare them with the nutrient content of typical maximum packages for these groups as analyzed by The Pennsylvania State University for USDA in 1991 (U.S. Department of Agriculture, Food and Nutrition Service, 1991). At the time the food packages were analyzed, WIC Package VII had not yet been implemented and is therefore not included in the 1991 analysis. Breast-feeding women may receive either Package V or VII, depending on whether their child receives formula or not. Dietary intake of this group is included in this report but cannot be compared to Package VII.

The FNS establishes nutritional guidelines for each of the seven food packages, including nutritional criteria for WIC-approved foods and provisions for substituting certain foods for others. For example, 1 pound of cheese may be substituted for 3 quarts of milk. Individuals may choose how they use their WIC vouchers in authorized stores and are permitted to substitute certain foods within categories. States may also substitute among foods in different categories. The resulting nutritional variations cannot be exactly quantified, because no one entity collects specific data on individual WIC foods consumed by WIC participants or aggregates WIC foods consumed on a national basis.

2. WIC Eligibility Criteria

WIC Program eligibility criteria for individuals include household income, State residency, and individual's nutritional risk status. To meet WIC Program income requirements, applicants' income must be 185 percent or less of the U.S. Poverty Income Guidelines (185 percent equaled $28,860 for a family of four in 1997). Most States use the maximum income guidelines permitted, although they may set lower income limits. Eligibility for income-based assistance programs such as the Food Stamp Program or Medicaid automatically confers income eligibility for the WIC Program. In addition to the income criterion, WIC participants must meet "nutritional risk" standards. Two major types of nutritional risk are recognized for WIC eligibility. Medically based risks such as anemia, underweight, maternal age, history of pregnancy complications, or poor pregnancy outcomes are designated as "high priority" risks; and diet-based risks such as inadequate dietary pattern are rated as lower priority risks. Nutritional risk is evaluated by a health professional (physician, nutritionist, or a nurse) based on Federal guidelines. There are no uniform national records of participants' nutritional risk status. Therefore, only income and Medicaid eligibility were used to identify WIC-eligible survey respondents in NHANES III.

3. Package Reviews

The USDA FNS developed and has periodically reviewed the WIC food packages, in consultation with experts on food, nutrition, and health and with input from Program participants and the public at large. The last

comprehensive package review was completed in 1991 through a cooperative agreement between the FNS and The Pennsylvania State University. The final report prepared by the University concluded that the WIC food packages offer rich, bio-available sources of protein and the four target micronutrients (vitamins A and C, calcium, and iron) that continue to be of importance to the health of program participants (U.S. Department of Agriculture, Food and Nutrition Service, 1991). Other nutrients of public health concern for WIC target populations based on dietary survey analysis or literature citations were identified but not further addressed during The Pennsylvania State University review of the WIC packages. In decreasing order of nutritional importance were folic acid, zinc, dietary fiber, vitamin B-6, magnesium, kilocalories, copper, thiamin, and heme iron. CNPP designates a set of "Nutrients of Concern" in the current study (in addition to the original WIC target nutrients) based partially on the 1991 review along with other nutrition literature, which include folic acid, zinc, vitamin B-6, and magnesium, along with kilocalories, sugars, and fat.

4. WIC Program Impacts: Selected Literature

Since its inception, the WIC Program has been evaluated for various purposes using a variety of methods. WIC Program evaluations have demonstrated WIC effectiveness in increasing birth weight, decreasing incidence of low birth weight and prematurity, improving hematological status, and/or improving nutrient intake (Kennedy, 1997; Rose et al., 1998; Rossi, 1996). Two recent studies examine effects of WIC participation of mothers on infant death rates and on birth outcomes, including gestational age and weight at birth. Two recent studies published in the *American Journal of Public Health* (Moss and Carver, 1998; Ahluwalia et al., 1998) concluded that both WIC and Medicaid Programs had beneficial effects for poor women and their infants. In the first study, Moss and Carver, analyzing data from the 1988 National Maternal and Infant Health Survey, concluded that participation in WIC and Medicaid decreased the risk of both pre- and post-natal infant death in the United States. The study also found that women who participated in the Medicaid program while pregnant were as likely to give birth to live infants as women who are privately insured. The authors note that until recently no population-based surveys included program participation or detailed maternal and infant health variables, and that the findings are critical since health care coverage for vulnerable groups is threatened due to legislative reforms (Moss and Carver, 1998). The second study also found that WIC enrollment of mothers was associated with lower prevalence of small-for-gestational-age deliveries in Michigan in 1992. Researchers linked 41,234 WIC records with birth certificates for 1992 full-term births and concluded that the duration of WIC participation prior to pregnancy improved the odds of having a normal-for-gestational-age baby. Researchers concluded, "Early and continuous enrollment in programs such as WIC can improve the health of pregnant women and children ... and can help avert adverse birth outcomes such as small-for-gestational-age delivery and the related long- and short-term consequences" (Ahluwalia et al., 1998).

Relatively fewer studies have examined WIC impacts on nutrition. A recent study by Rose et al. (1998) examined the relationship among preschool children between WIC participation and nutrient intake adequacy for 15 nutrients, finding that WIC participation positively influenced the intake of 10 of the 15 nutrients. Iron and zinc contributed by WIC represented 16.6 percent and 10.6 percent, respectively, of the preschooler recommended RDA for these nutrients. Participation in the WIC program (with the receipt of WIC benefits) demonstrated a more positive effect on the intake of iron and zinc than transfer of cash alone. Neither WIC nor Medicaid participation affected intakes of fat, saturated fat, or cholesterol.

In a fourth recent study, Basiotis et al. (1998) examined the effects of WIC Program participation on household diet quality. Using the USDA Healthy Eating Index (Bowman et al., 1998), which measures diet quality based on recommendations from the USDA's Food Guide Pyramid (USDA, Human Nutrition Information Service, 1992), the authors found that WIC participation exerted significant and sizeable positive impacts on the diet quality of the household. The study was unique in examining not only overall diet quality, but also the Healthy Eating Index components, including recommended consumption of food groups and dietary components. WIC participation not only contributed to improved consumption of WIC-authorized foods but also enhanced fruit and vegetable intake in the household.

B. NUTRITIONAL CONTRIBUTION OF THE WIC FOOD PACKAGES

The major goal of this review is to assess how well the WIC food packages perform as supplemental food packages in assisting recipients to meet nutritional standards for a healthful diet. Attaining this goal implies three analytical tasks: (1) identification of current recommended nutrition standards for each of the WIC groups; (2) assessment of diets of WIC participants in light of these standards; and (3) examination of the contribution of the WIC food packages to meeting the standards. From this assessment, any nutrient gaps or excesses among the WIC participant groups can be identified, along with opportunities for improving the WIC packages.

1. Nutritional Standards

The study identifies current recommended nutrition standards using the 1989 Recommended Dietary Allowances (RDA) for the five WIC target nutrients (protein, vitamins A and C, calcium, and iron) plus folic acid, zinc, vitamin B6, and magnesium and associated Recommended Energy Allowances (REAs) for total energy in kilocalories. The 1995 *Dietary Guidelines for Americans* are referenced for recommendations for fat and saturated fat intake. Quantitative recommendations for cholesterol, sodium, and carbohydrate presented in *Diet and Health* by the National Research Council (NRC) are used as reference standards. Standards for added sugar intake are based on the Food Guide Pyramid. The Recommended Dietary Allowances (RDA) and Recommended Energy Allowances (REA) were issued by the Food and Nutrition Board of the National Research Council (1989). The *Dietary Guidelines for Americans* are jointly issued every 5 years by the Department of Health and Human Services and the Department of Agriculture, with guidance from a Federal advisory committee (USDA and DHHS, 1995). The Food Guide Pyramid, based on the *Dietary Guidelines,* is developed by the USDA.

The RDAs and REA represent levels of intake of food energy and 19 essential nutrients judged adequate by the Food and Nutrition Board to meet the known nutrient needs of practically all healthy Americans, and they include a margin of safety. RDAs are expressed as average daily intake over a period of time and have long provided standards to assess nutrient adequacy among population groups. The REA for food energy for individuals of different age and gender represents an estimate of the <u>average</u> energy needs of that population group, rather than a greater amount sufficient to meet the needs of most individuals. Using the average as a standard decreases the risk of overconsumption by individuals with lower energy needs. However, it may increase the risk of underconsumption by those with higher energy needs.

Although RDAs are most appropriately applied to groups, a comparison of individual intakes, averaged over a sufficient length of time, permits an assessment to be made about the probable risk of deficiency for individuals. The recommended allowances for nutrients are amounts intended to be consumed as part of a normal diet. They are neither minimal requirements nor necessarily optimal levels of intake.

Dietary Reference Intakes

The Dietary Reference Intakes (DRIs) for calcium and related nutrients, B vitamins, and choline were released by the Institute of Medicine's (IOM), Food and Nutrition Board in 1997/98 to replace the RDAs (Yates, 1998). The DRI activity is a comprehensive effort undertaken by IOM to include current concepts about the role of nutrients and food components in long-term health, going beyond deficiency diseases. They represent the new approach adopted by the Food and Nutrition Board to providing quantitative estimates of nutrient intakes for use in a variety of settings, replacing and expanding on the past 50 years of periodic updates and revisions of the Recommended Dietary Allowances (RDAs). The DRIs are reference values that are quantitative estimates of nutrient intakes to be used for planning and assessing diets for healthy people. They include RDAs as goals for intake by individuals but also present new types of reference values: Adequate Intake (AI), the Tolerable Upper Intake Level (UL) , and the Estimated Average Requirement (EAR) (Yates, 1998).

Dietary Reference Intakes: Recommended Levels for WIC Target Groups for Study Nutrients

Life-stage group	Calcium (mg/d) AI	Magnesium (mg/d) RDA	Vitamin B6 (mg/d) RDA	Folic acid (mcg/d) RDA
Infants 0-3 mos	210	30 (AI)	0.1 (AI)	65 (AI)
Infants 4-12 mos	256	65 (AI)	0.3 (AI)	77 (AI)
Children 1-3 yrs	500	80	0.5	150
Children 4 to 5 yrs	800	130	0.6	200
Pregnant women ≤ 18 yrs	1300	400	1.1	600
Pregnant women 19-30 yrs	1000	350	1.3	600
Pregnant women 31-50 yrs	1000	360	1.3	600
Breast-feeding women ≤ 18 yrs	1300	360	2.0	500
Breast-feeding women 19-30 yrs	1000	310	2.0	500
Breast-feeding women 31-50 yrs	1000	320	2.0	500
Non-breast-feeding 9-13yrs	1300	240	1.0	300
Non-breast-feeding 14-18 yrs	1300	360	1.2	400
Non-breast-feeding 19-30 yrs	1000	310	1.3	400
Non-breast-feeding 31-50 yrs	1000	320	1.3	400

For infants the DRIs are lower than the RDAs for calcium, vitamin B6 and higher for folic acid and magnesium. For children 1-3 years of age the DRIs are lower than the RDAs for calcium and vitamin B6, the same for magnesium and higher for folic acid; for children 4 to 5 years of age the DRIs are the same for calcium, lower for vitamin B6 and higher for magnesium and folic acid. For both pregnant and breastfeeding women œ 18 years of age, DRIs are higher than RDAs for calcium, folic acid, and magnesium and lower for vitamin B6. With the exception of the DRI for calcium which is lower that the RDA, this comparison between DRIs and RDAs is similar for older pregnant women, but differs for older breastfeeding women in that magnesium DRIs are lower than RDAs.

In all cases, folic acid DRIs are higher than folic acid RDAs. This has implications for the WIC package, especially, for those packages provided to target groups with low or marginal folic acid intakes. With the exception of children 1-3 years of age, magnesium DRIs are higher than magnesium RDA. This also has implications for the WIC package, where target groups have low intakes of this nutrient.

DRIs are not analyzed in this report due to small sample sizes for each of the DRI life-stage groups as shown below.

Sample sizes of WIC recipient groups:

Groups of mothers based on DRI recommendations	Pregnant/breast-feeding (receives WIC Package V)	Non-breast-feeding (receives Package VI)
9-13 years old	0	0
14-18 years old	21	20
19-30 years old	64	52
31-50 years old	17	8
51-70 years old	0	0

2. Recommendations for Infants and Children, From 1 to 5 Years Old

Nutrient recommendations for infants and children from 1 to 5 years of age relate directly to their growth and developmental needs.

Infants: During the first months of life, infants' proportionately large energy requirements (three to four times those of adults on a body weight basis) can be met with only breast milk or iron-fortified infant formula. Such a diet provides about 40-50 percent of kilocalories from fat, and all the energy, vitamins, and minerals needed to support rapid infant metabolism, growth, and development (Heird, 1996). Because young infants have immature digestive and excretory systems and are not equipped to handle a wide variety of foods, they need energy-dense food, readily digestible and metabolizable, with appropriate micronutrients to maintain normal physiologic functions and growth (Glinsmann, 1996; RDA, 1989; American

Dietetic Association, 1996a). In particular, infants require adequate amounts of iron, calcium, and zinc. Iron-deficiency anemia is a risk factor for abnormal cognitive and social development, as well as for consistent delays in body-balance coordination and motor skills (Glinsmann, 1996). Low intake of zinc may compromise the immune function and hamper growth, while inadequate intake of dietary calcium may impair rapid, continuous bone development needed for normal growth during the first years of life.

Diets restricted in fat and cholesterol and high in fiber and complex carbohydrate are inappropriate for infants as such diets provide inadequate kilocalories for growth and development and the bulking effect of fiber results in a feeling of satiety, reducing caloric intake. However, introduction of fruits, vegetables, and grains into the infant diet gradually is important and infants who eat a variety of these foods will get all the fiber they need along with important vitamins and minerals (Glinsmann, 1996; Williams, 1995).

Infants need sugars in their diets because, like fat, sugars represent a readily metabolizable, efficient energy source for active, rapidly growing infants (Glinsmann, 1996; Rickard, 1998). Sodium in moderation supports several physiologic functions. The intake of adequate amounts of breast milk or iron-fortified formula in the early months of life along with the selection of foods, prepared without salt, in the later months of the first year of life satisfy infants' sodium needs.

Children: Rate of growth slows considerably after the first year of life. Average gains in weight and height for the first year are usually more than three times those in either the second or third year. Young children have a unique need for energy and fat to support growth and development, and care should be taken not to restrict dietary fat unduly, which can result in growth failure (American Academy of Pediatrics, 1997). The transition to a lower fat diet, beginning at 2 years of age, requires special consideration. As solids are introduced during the first and second year of age, the percentage of kilocalories in the diet from fat decreases from that in a breast milk or iron-fortified formula-based diet. Early childhood is a transition period during which the fat and cholesterol content of the diet should gradually decrease to amounts recommended for older individuals. Children older than 2 years of age should consume a minimal amount of dietary fiber equivalent to age plus 5 grams per day (Williams, 1995). The concern about increasing the fiber intake in children's diets is that the combination of low calorie density of high-fiber foods along with the small gastric capacity of young children may result in inadequate intake of kilocalories; additionally, high intakes of fiber will reduce the bio-availability of essential nutrients (Williams, 1995).

As children approach the second year of life, fruits, vegetables, and grains become increasingly important in the diet. As with infants, children 1 to 2 years of age have high iron and calcium requirements. An adequate intake of iron helps children resist infections, reduce the risk of anemia, and improve the ability to concentrate and learn. Pound for pound, children require two to

four times more calcium per kilogram of body weight than adults to support bone growth and developmental needs.

In general, children grow slowly and steadily during the preschool years, but growth rates may vary in individual children. Energy needs remain high. Because children are growing and developing bones, teeth, muscles, and blood, their requirements for protein, vitamins, and minerals gradually increase during this period (Mahon and Escott-Stump, 1996; American Dietetic Association, 1996).

3. Recommendations for Pregnant and Postpartum Women

Pregnant Women: Previous studies show that pregnant women of various ethnic backgrounds and income levels consistently consume less than the 1989 RDAs for vitamins B6, D, E, folic acid, iron, calcium, zinc, and magnesium (Picone et al., 1982; Rush et al., 1988; Suitor et al., 1989; Endres et al., 1985 and 1987; Loris et al., 1985; Taper et al., 1985; Brennan et al., 1983; Hunt et al., 1983; Butte et al., 1981).

Increased iron is required during pregnancy to increase maternal red blood cell mass to supply nutrients to the growing fetus and placenta (Hallberg, 1988). Iron deficiency is common among pregnant women, especially poor women with limited education and high parity (number of pregnancies). Several studies have shown that iron deficiency anemia is associated with low birth weight, pre-term birth, and perinatal mortality (Murphy et al., 1986; Garn et al., 1981; Lieberman et al., 1987).

For women of childbearing age, folic acid has become an important nutrient for a positive pregnancy outcome due to its presumed capability to reduce the risk of neural tube defects in their babies (U.S. Department of Health and Human Services, 1992). Because folic acid is necessary in cell-division, it is an important nutrient needed by rapidly growing infants and children, as well as by pregnant women who are nurturing a developing fetus, and by breast-feeding women who are replacing the folic acid secreted daily in breast milk.

Zinc plays an important role in cell differentiation and replication (Hambidge et al., 1986). Animal studies have shown associations of zinc deficiency with fetal growth retardation, behavioral abnormalities in offspring, immune system abnormalities, prolonged labor, and prematurity. Human studies have been less conclusive, but several studies have shown that low plasma levels of zinc are associated with pregnancy-induced hypertension, prolonged labor, intrapartum hemorrhage, impaired fetal development, and prematurity (Institute of Medicine, 1990).

Protein is required to support the expansion of maternal blood volume and growth of both maternal and fetal tissue. Pregnant women in the United States (including low-income women) consume amounts of protein higher than the RDA (Rush et al., 1988). However, inadequate overall energy intake can induce compensatory catabolism of protein and amino acids and may

contribute to protein deficiency (Institute of Medicine, 1990). Maternal protein and/or energy restriction results in decreased fetal growth (Fattet et al., 1984; Hill, 1984; Lederman and Rosso, 1980; Pond et al., 1988; Rosso, 1977, 1980; Rosso and Streeter, 1979). The Institute of Medicine has recommended that a moderate increase in food sources of protein, as part of a balanced diet, should be encouraged in pregnant women.

The physiologically active form of vitamin B6, pyridoxal phosphate, is involved in over 100 known reactions, primarily in amino acid metabolism. It is also an important coenzyme in the synthesis of heme compounds. Because of its role in amino acid metabolism, higher intakes of vitamin B6 are required with increased intakes of protein. Fetal uptake of vitamin B6 increases in late pregnancy, causing a biochemical deficiency of vitamin B6, which also increases maternal requirements.

Calcium is transported actively by placental calcium-binding proteins to the placenta. Efficiency of absorption increases throughout pregnancy. The amount of calcium retained by the mother has been reported to be insufficient to supply fetal needs, suggesting that some calcium is withdrawn from the mother's bones.

Vitamin A is important in maintaining visual function. However, there is no conclusive evidence that requirements are increased during pregnancy. Vitamin A deficiency is rare in the United States and fetal vitamin A requirements remain low until the third trimester, when needs increase by only 9 percent (Institute of Medicine, 1990). Furthermore, increasing bodies of evidence suggest that an excess of vitamin A may have adverse effects on birth outcome, including the possibility of teratogenicity.

An increased intake of vitamin C is required during pregnancy to meet fetal needs and to offset losses from the mother's body stores. Vitamin C levels in fetal blood are about 50 percent higher than in maternal blood due to a placental concentration gradient.

Breast-feeding Women: A mother's choice to breastfeed has an effect on the nutritional status of both herself and her infant. Breast-feeding increases substantially the mother's requirements of most nutrients. The primary impact of nutrient deficiencies on milk production in breast-feeding mothers is a reduction in the quantity of milk produced. The Subcommittee on Nutrition during Lactation of the Institute of Medicine has indicated that calcium, zinc, magnesium, vitamin B6 and folic acid are consumed in amounts lower than the RDAs for breast-feeding women (Institute of Medicine, 1991). The vitamin content of breast milk is dependent on the mother's current vitamin intake and her body's vitamin stores. The RDA for vitamin C is 35 milligrams higher than during pregnancy for the replenishment of losses in the milk. Higher intakes of vitamin A are recommended to maintain maternal liver reserves and provide a margin of safety (National Research Council, 1989).

The concentration of some nutrients (vitamin B6, calcium, magnesium, zinc) in breast milk can be maintained at the expense of maternal stores (National Research Council, 1989). The vitamin B6 content in milk reflects maternal stores. An increase in the recommended intake of vitamin B6 is recommended due to its major role in amino acid metabolism and the increased protein intakes. Increases in the recommended intake of calcium are due to evidence of higher calcium absorption during pregnancy and lactation. Increases in dietary intakes of magnesium and zinc are recommended to replenish nutrients lost in milk. Poor nutritional status of the mother has also been shown to be associated with low host resistance factors in breast-fed infants.

Non-breast-feeding postpartum women: Non-breast-feeding postpartum women have nutritional needs similar to those of healthy premenopausal women, not pregnant or lactating. Any special dietary needs, such as a weight-loss diet or an identified nutrient deficiency associated with pregnancy, need to be addressed on an individual basis. For non-breast-feeding postpartum women aged 19 to 50 years old, the average REA is 2,200 kilocalories per day for light to moderate activity. Nutrients of concern for these women are the bone-related nutrients, calcium, magnesium, phosphorus; vitamin D (as relates to calcium absorption); folate; iron; and zinc.

In particular, women 19 to 24 years of age have high calcium and phosphorus needs to attain peak bone mass. Calcium intake seems to exert its greatest effect on bone mineral density during the bone-building years of childhood and early adulthood (up to 24 years of age). However, it is also necessary to achieve an adequate calcium intake during the adult years to avoid skeletal depletion. Calcium is concentrated in a limited number of foods, with the most bioavailable sources being milk and dairy products. Other sources of calcium are canned fish with soft bones, dark-green leafy vegetables, and tofu (processed with calcium sulfate).

Adequate intake of folate by all U.S. women who are capable of becoming pregnant can reduce the risk of neural tube defects, such as spina bifida. Women who follow current dietary recommendations for fruits, vegetables, and grains are likely to consume at least 0.4 mg of folate daily because most folate in the diets of women comes from these foods. Increased folate intake can also be achieved with supplementation or consumption of fortified cereals.

Also, during the reproductive years, women are at high risk for iron deficiency due to menstrual iron losses. The RDA for iron is set at 15 milligrams per day, the highest for any age/gender category, except pregnant women. Some good sources of iron include red meats, poultry, fish, leafy greens, legumes, iron-enriched white bread, pasta, rice, and cereals.

Historically, dietary surveys show women's average intake of zinc at less than 80 percent of the RDA. Major dietary sources of zinc are animal products

such as shellfish, meats, liver, poultry, eggs, and dairy products. The lower energy intake of women (as compared to men) can make it difficult to meet the zinc needs, especially if animal products are limited in the diet.

The dietary intake of non-breast-feeding postpartum women are influenced by many sociodemographic factors, including the demands of child care, level of income, employment outside the home, increased eating away from home, use of convenience foods, and tobacco use.

4. Federal Guidance in Relation to Sugar Consumption

One of the items of interest in this review is sugar consumption in relation to nutrition guidance. The 1995 Dietary Guidelines for Americans includes the following sugar guideline:"Choose a Diet Moderate in Sugars."The text states that "Sugars should be used in moderation by most healthy people and sparingly by people with low energy needs." Recommendations for ranges of added sugar are provided by the Food Guide Pyramid, which is based on the Dietary Guidelines.

What Is Sugar? Sugars are common food ingredients that originate from many sources. ***Sugar*** is defined by the FDA as any mono- or disaccharide with up to four saccharide units present in food or food ingredients, such as glucose, fructose, sucrose, maltose, or lactose. ***Sweeteners*** include "high-intensity sweeteners including saccharine, aspartame, or cyclamate" along with ***carbohydrate or nutritive sweeteners,*** food ingredients comprised of carbohydrates containing sugars and used for sweetening. ***Nutritive (carbohydrate) sweeteners*** include sucrose, invert sugar, and a variety of products derived from starch hydrolysis, molasses, honey and other edible syrups, malt syrup, and also fruit juice sweeteners (Glinsmann and Park, 1995). Major categories of purified sweeteners are glucose, liquid glucose, high-fructose syrups, liquid fructose, and crystalline fructose. ***Added sugars*** or ***extrinsic sugars*** are all sugars added to a food for any purpose through the use of a carbohydrate sweetener as defined above or through the use of a food ingredient in purified form defined as sugar (such as lactose)[9]. ***Naturally occurring sugars, or intrinsic sugars,*** refer to all sugars present in a food that are not added, primarily fructose and lactose. ***Total sugars*** are the sum of naturally occurring and added sugars.

According to the *Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 1995:*

> Sugars are carbohydrates. Dietary carbohydrates also include the complex carbohydrates starch and fiber. During digestion all carbohydrates except fiber break down into sugars. Sugars and starches

[9] The USDA Continuing Survey of Food Intakes by Individuals defines "added sugars" as "All sugars used as ingredients in processed and prepared foods such as breads, cakes, candies, soft drinks, jams and ice cream, as well as sugars eaten separately or added to foods at the table."

> occur naturally in many foods—including milk, fruits, some vegetables, breads, cereals, and grains—that also supply other nutrients. Americans eat sugars in many forms, and most people like their taste. Some sugars are used as natural preservatives, thickeners, and baking aids in foods; they are often added to foods during processing and preparation or when they are eaten. The body cannot tell the difference between naturally occurring and added sugars because they are identical chemically (USDA/DHHS, 1995, p. 16).

Scientific Evaluation of Safety and Health Effects of Added Sugar: The *Dietary Guidelines Report* elaborates:"In the committee's judgment the vast majority of scientific studies fail to show either significant detriment from consumption of sugars in the amounts generally consumed by Americans or significant benefit from reducing sugar consumption per se. This conclusion is consistent with the 1986 Food and Drug Administration (FDA) report "Evaluation of the Health Aspects of Sugars Contained in Carbohydrate Sweeteners" (DHHS, 1995; Glinsmann et al., 1986).

The FDA evaluated the safety of added sugars in 1986 as part of a required reevaluation of all substances classified as Generally Recognized As Safe (GRAS) under the Federal Food, Drug, and Cosmetic Act, as amended. Sugars may be either naturally occurring or added to foods, usually in highly purified forms. Glinsmann and Park state:

> This distinction is important because the evaluation of health effects of sugars relates to nutrient dilution, nutrient interactions, and changes in metabolic pathways influenced by the mix of sugars absorbed and their rate of absorption. Increased consumption of any purified energy source without accompanying food components containing vitamins, minerals, dietary fiber, trace elements, and other dietary ingredients can lead to imbalanced diets, altered intestinal physiology, and changes in glucose, lipid, and amino acid metabolism, which can have both acute and chronic health consequences. Sugars are not toxic substances except in a very few individuals who have genetic abnormalities of carbohydrate metabolism such as galactosemia and hereditary fructose intolerance. They are common food components that may have adverse health effects when consumed in excessive amounts. Many sugars are readily fermentable by bacteria in the mouth and they can significantly contribute to dental caries, particularly in persons with poor dental hygiene and inadequate exposure to fluoride (Glinsmann and Park, 1995, p. 161S).

Currently, the Dietary Guidelines Advisory Committee, selected to advise the Federal Government during formulation of the Dietary Guidelines for Americans 2000, is examining new research to determine whether the Dietary Guideline pertaining to sugar should be revised. For the purposes of this CNPP review, the 1995 *Dietary Guidelines for Americans* recommendations for added sugars intake and percentages of energy from carbohydrate are compared with reported consumption.

Metabolic Effects of Sugar: Glucose is required by cells of the body to produce energy for cell functions. Carbohydrates in the diet, including sugars (simple carbohydrates such as monosaccharides and disaccharides) and starches (complex carbohydrates), are digested and metabolized in the gastrointestinal system primarily into glucose and to a smaller extent, galactose and fructose. These monosaccharides are absorbed into the portal blood, which delivers them to the liver before they enter the systemic blood. Glucose is immediately available to cells, and galactose and fructose are further metabolized in the liver into glucose, slightly delaying their entry into the blood as glucose. The rate at which glucose enters the blood after a meal depends primarily on how much total carbohydrate is consumed, how the food is prepared (cooking speeds up digestion), what else is consumed (fat slows digestion down) and minimally on the type of carbohydrate consumed. The metabolic effects of glucose derived from different sugars and carbohydrates are dependent on the amount and speed at which glucose enters the blood (glycemic response curve or glycemic index[10]), rather than from what form it originated (Ludwig et al., 1998; Lee and Wolever, 1998; Daly et al., 1997; Bantle, 1989; Bantle et al., 1983). Further, there is no intrinsic difference in the way glucose, whether originating in added sugars versus naturally occurring sugars, is recognized by cells of the body (Guyton and Hall, 1996). The rate at which glucose becomes available in the blood affects hormonal secretion of insulin and glucagon, which regulate blood glucose levels and glucose entry into cells for energy production or storage. In populations with risk factors such as obesity and insulin resistence, diets including meals that produce a rapid rise in blood glucose have been associated with an increased risk of developing diabetes mellitus (Salmeron et al., 1995).

C. ORGANIZATION OF REST OF REPORT

The rest of the report is organized into Part II, Data and Methods and Parts III-V Results. Conclusions are presented in VI, followed by References and supporting Appendices.

[10] Glycemic index is defined as the area under the glycemic response curve after consumption of 50 grams of carbohydrate from a test food divided by the area under the curve after consumption of 50 grams of carbohydrate from a control substance, either white bread or glucose.

II. DATA AND METHODS

The major goal of this review is to assess how well the WIC Food Packages perform as supplemental food packages in assisting recipients to meet nutritional standards for a healthful diet. Attaining this goal implies three component tasks: (1) identify current recommended dietary standards for each of the WIC groups; (2) assess diets of WIC participants in light of these standards; (3) examine the contribution of the WIC food packages to meeting the standards. From this assessment, any nutrient gaps or excesses among the WIC populations can be identified, along with opportunities for improving the WIC packages.

A. DATA SOURCE SELECTION

CNPP needed food intake data from sufficient numbers of WIC participants to permit valid inferences to be drawn to represent all WIC participants in each study group and to contrast WIC participants with non-participants. Two Federal surveys of food intake, the Third National Health and Nutrition Examination Survey 1988-94 (NHANES III) and the Continuing Survey of Food Intakes by Individuals 1994-96 (CSFII), were considered as potential data sources to assess the nutritional adequacy of the WIC food packages and the dietary status of WIC participants. Whereas both surveys provide recent information on the food and nutrient intake of Americans and the socioeconomic characteristics of households and individuals, CNPP criteria for choosing NHANES III as the primary data set for our analysis included population coverage, sample size, and the survey variables available.

The small sample sizes in the CSFII of WIC-participating younger infants and pregnant, breast-feeding, or postpartum women increase the likelihood of invalid interpretation of observations for these WIC subgroups (Table 2). Aggregating 3 years of CSFII survey data (1994-96) increased total WIC participants to 681; however, cell counts of infants (46), and pregnant/breast-feeding women (28) and total postpartum, non-breast-feeding women (28) were inadequate. NHANES III compares favorably, as shown. Also, the NHANES III nutrient and individual food files, described in more detail below, contain expanded nutrient information on sugars, one of the research issues of interest in the WIC package review.

Table 2. Sample Size of WIC Participants by Category using the 1994-96 Continuing Survey of Food Intakes by Individuals and the NHANES III, 1988-94.

WIC program categories	CSFII sample size (n)	NHANES III (n)
Total infants (0 to 11 months old):	155	710 (2-11 months old)
Infants (0 to 3 months old)	46	155 (2-3 months old)
Infants (4 to 11 months old)	109	555
Total children (1 to 5 years old)	470	933
Total pregnant/or breast-feeding women	28	102
Total postpartum, non-breast-feeding women	28	80
Total WIC participants	681	1825

B. DESCRIPTION OF NHANES III AND COLLATERAL DATA SETS

1. NHANES III Survey Design

The NHANES is a periodic survey conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. NHANES III was conducted from October 1988 through October 1994 using a complex, multi-stage, clustered sampling design to provide a nationally representative sample of the civilian, non-institutionalized population of the United States, ages 2 months and older. This 6-year survey, including about 36,000 persons interviewed in their homes or in a mobile examination center, consisted of two 3-year phases, both separately and together constituting a national probability sample.

One of the goals of NHANES was to precisely describe the health status of certain population groups of interest who may have unique characteristics. Mexican-Americans, African-Americans, older persons, and young children were oversampled to more accurately describe their health status. Estimates for the overall population may differ from the sample population estimates due to sampling variability, undercoverage among certain demographic groups, and response errors due to differential response rates or misclassification errors. Sampling weights, which reflect the probability that a category of persons would be selected from the general population, are used with the survey samples to most accurately estimate the health and nutritional status of the U.S. population. A sample weight is an estimated measure of the number of persons the particular sample observation represents. Weighting takes into account the specific probabilities of selection for groups that are oversampled (including young children, elderly persons, African-Americans, and Mexican-Americans) as well as reduces bias due to non-response and sampling inadequacies (e.g., omissions of some housing units and omissions of persons with no fixed address).

For purposes of this study, WIC eligibility is defined as income eligibility based on income/poverty level and Medicaid participation. Because of difficulties in identifying nutritional risk status that varies across the country and has numerous identifying factors, CNPP uses only income less than or equal to 185 percent of the poverty threshold (in dollars) produced annually by the Census Bureau (U.S. Bureau of the Census, Series P-60) and eligibility of any family member for Medicaid to represent the WIC-eligible population. A more detailed description of variable definitions can be found in the Analytical Methods section of this report ("Variable Definitions," page 20). Large enough sample sizes were needed to examine not only WIC participants but also those meeting eligibility criteria but choosing not to participate. Sample size in low-income categories, therefore, was the major criterion that persuaded the Center to employ the NHANES III data.

2. Food Consumption and Nutrient Information

Nutritional status was addressed by analyzing NHANES III individual dietary intake data based on one 24-hour dietary recall interview. Total nutrient intake of individual respondents is the calculated sum of nutrients in all foods reported by the respondent in a 24-hour recall. Nutrient intake data is based on the University of Minnesota Nutrition Coordinating Center (NCC) nutrient composition database (Buzzard, 1987 and University of Minnesota Nutrition Coordinating Center, 1996).

The NHANES III food intake files include NCC nutrient database values for foods and beverages that were reported during the survey. The NCC version of the foods files contains information on more than 80 nutrients and food components, including individual fatty acids, artificial sweeteners, caffeine, selenium, starch and sugars, amino acids and vitamin D (NHANES III). The NHANES III Individual Foods File contains complete and reliable 24-hour food intake recall data for 29,105 survey participants. The intake of all foods and beverages except plain drinking water was recorded for each respondent for the previous 24-hour period (midnight to midnight).

Foods were coded using the USDA Food Coding Database, which contains 7,352 food codes, each bearing a complete description of the food, and if relevant, the preparation method. These food codes link to the USDA Recipe Database, which contains recipe entries for each unique food code. These entries include ingredients and their amounts, as well as information for determining changes in nutrients that occur during cooking. Foods that are not mixtures, for example, whole milk, are represented as single-ingredient recipes. Recipes are considered "representative," meaning they are not exact for every sample person nor were they developed to determine the intake of specific food ingredients. They are reflective of current culinary practices and market ingredient formulations.

The Survey Nutrient Database, maintained by the U.S. Department of Agriculture and based on the Primary Data Set[11] of nutrient values maintained in the Agricultural Research Service Nutrient Data laboratory, is the source of nutrient composition in NHANES III (USDA, 1993, 1995), which provided food composition values that were appropriate for the period when NHANES III was conducted. The data entry system for the foods database was designed specifically to handle time-related changes in food descriptions, food amounts, and recipes, such as product reformulation, recipe and food components changes (e.g., fat substitutes and artificial sweeteners), and new products. The database includes values for food energy and the following nutrients and food components: protein, total fat, saturated fatty acids, mono-unsaturated fatty acids, polyunsaturated fatty acids, cholesterol, total carbohydrate, dietary fiber, vitamin A, carotenes, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B-6, folic acid, vitamin B-12, calcium, phosphorus, magnesium, iron, zinc, copper, sodium, potassium, alcohol, and moisture (water).

3. Sugar and Starch Data

The NHANES III uses version 22 of the NCC Nutrient Database for sucrose, starch, fiber and other carbohydrates. Fiber values are for crude fiber[12] only, and "other carbohydrates" are calculated as: Total carbohydrates - (sucrose + starch + fiber). This version of the NCC database defines sucrose to include both naturally occurring and added sucrose. Nutrient values for lactose, glucose, fructose, galactose and maltose[13] are added, and starch values are updated based on recent literature or calculated from updated ingredient formulas based on manufacturers' data; calculations from recipes; and calculations from ingredient lists or similar food products. Also, the NCC Research Database, which contains values for carbohydrate fractions of some ingredients used in the food industry (e.g., various types of corn syrups, whey, caseinate) is used to calculate starch and sugar values of these components (NHANES III).

One limitation of the NCC sugars and starch database is that the sum of available carbohydrates (starch and sugars) and dietary fiber does not always equal the total carbohydrate value of the food. This is because: (1) data are obtained from a variety of sources and, therefore, a variety of food samples; (2) total carbohydrate is calculated as the difference between 100 g and the

[11] The 1994-96 CSFII Primary Data Set of nutrient values was based on Standard Reference Release No 11. (USDA/ARS 1996). It includes unpublished data for new products, low in sodium and fat as well as for new foods reported by sample persons for the period of the 1994-96 CSFII.

[12] "Crude fiber" is the amount of plant material remaining after treatment with acid and alkalai. "Dietary fiber," the amount of plant material remaining after treatment with digestive enzymes and reduction with acid and alkali. The action of digestive enzymes is less rigorous, so the amount of fiber remaining after digestion in the human digestive tract is greater than that estimated by the crude fiber process. Dietary fiber values are often 2 to 5 times higher than for crude fiber.

[13] Maltose values were added to all but 12 elemental foods in the nutrient database. However, these foods were either not commonly eaten or not eaten in large quantities.

amount of fat, protein, ash, and water in the food; thus, it may include compounds other than sugars, dietary fiber, and starch; and (3) the database currently contains fields for only six sugars; some foods contain other sugars not available in the database.

C. ANALYTICAL METHODS

1. Nutritional Standards and Guidelines

Food and nutrient intake of WIC participant groups was evaluated by comparing individual 24-hour intake with the 1989 Recommended Dietary Allowances (RDA, 1989) and the 1995 *Dietary Guidelines for Americans* (USDA/DHHS, 1995). Analysis was focused on five WIC target nutrients (protein, iron, calcium, vitamin A, and vitamin C), and four other nutrients of concern (folic acid, zinc, vitamin B6, and magnesium). Values for nine other nutrients for which intake data and/or RDAs are available (thiamin, riboflavin, niacin, vitamin B12, vitamin D, vitamin E, phosphorus, copper, and sodium) were calculated and reported in the appendices. Total and saturated fat intake of WIC participant groups were assessed based on recommendations and general guidance in the 1995 *Dietary Guidelines for Americans.* Added sugar intake was compared to guidance from the Food Guide Pyramid.

In some cases the dietary recommendations were targeted to groups categorized differently than the WIC participant groups. For example, specific RDAs are given for infants ages 0-5 months and ages 6-11 months. WIC Package Number II (WIC-II) is given to infants ages 4-11 months which does not match the RDA group exactly. For this reason the RDA value for infants 4-11 months old was interpolated mathematically based on the RDA age groups 0-5 months and 6-11 months. In the case of WIC Package Number 5 (WIC-V), given to both pregnant and breast-feeding women, two groups were created consisting of pregnant women and breast-feeding women. This was done in order to compare their nutrient intake to their respective RDAs, which are grouped and reported in this manner. The basic intent of the analysis is to first examine the reported food intake of WIC participants, WIC income-eligible non-participants, and others of similar age and gender and to compare them to nutritional standards (the RDA, the REA, and food constituent recommendations) for appropriate groups. Cases in which WIC participants do not meet nutrient recommendations are noted.

2. Variable Definitions

The demographic groups of interest for this study were designated by the previously defined groups used in the administration of WIC food packages and in national nutritional guidelines for Recommended Dietary Allowances (RDA). Assessments of the nutritional status of the groups defined for WIC will be made as closely as possible to the recommendations made in the RDAs due to the differences in group definitions. For example, there are separate recommendations for children ages 1 to 3 years and ages 4 to 6 years. WIC Package IV is given to children ages 1-4 years old. A reference value for nutrients based on the weighting of the sample and RDAs for each age was

imputed by two registered dieticians. Also, there are separate recommendations for breast-feeding women in their first 6 months postpartum and their second 6 months postpartum, whereas the WIC Packages do not make this distinction. In this study, WIC eligibility and participation are assessed using the following definitions: (Table 3)

Table 3. WIC Participation and Eligibility, Variable Definitions

Variable	Definition
WIC participating	Answers yes to the question, "Are you receiving WIC benefits now?" (Answered by parents or caregivers if too young to answer.)
WIC eligible	Either the Poverty Income Ratio (PIR) is less than or equal to 1.85 or a household member is receiving Medicaid benefits. (Nutritional risk cannot be assessed using the information in NHANES III.)
WIC eligible, not participating	Respondent is eligible for WIC benefits based on the above definition, but responds no to the question, "Are you receiving WIC benefits now?"

Sometimes, "WIC participating" and "WIC eligible but not participating" are not mutually exclusive and do not add up to 100 percent due to variable definitions (Table 4). For example, of the 184 infants aged 2-3 months who were eligible for WIC benefits, 52 were not participating and 132 were participating in the WIC Program. Of the 155 infants who were reported to be receiving WIC benefits, 23 were not eligible for WIC according to the definition used in this study. Persons who are income-eligible for the WIC Program must also be determined to be at "nutritional risk" by a health care practitioner. Nutritional risk includes medically based factors (such as anemia, underweight, history of poor pregnancy outcome), dietary-based factors (inadequate dietary pattern), or other predisposing factors. Identification of nutritional risk is not possible with this or any other known data set.

Table 4. Infants 2-3 Months Old, WIC Participating and WIC Eligible

Infants 2-3 Months Old		WIC eligible (Poverty or Medicaid criteria)		
		No	Yes	Total
WIC participating (Receiving WIC benefits)	No	108	52	160
	Yes	23	132	155
	Total	131	184	315

The Poverty Income Ratio (PIR), or poverty index, is an indicator reported for each respondent in the survey. It was calculated based on the midpoint of the observed family income category from the Family Questionnaire (numerator) and the poverty threshold value produced annually by the Census Bureau, the age of the respondent, and the calender year of the interview (denominator). Poverty threshold values are based on the calendar years and are adjusted for changes between years caused by inflation. Persons reporting no income had a value of zero. The PIR is "relatively" standardized for inflation and can be used to compare income data across the 6 years of the survey.

WIC eligibility is also based on Medicaid coverage. Medicaid is a State-administered program that uses income guidelines of 185 percent or less of the Federal poverty level and requires documentation of income. Recipients of Medicaid are automatically eligible for WIC. Individuals from a family receiving Medicaid benefits are also eligible for the WIC program. Medicaid coverage of any persons in the surveyed person's family was assessed and used in the definition of WIC eligibility for this study.

3. Statistical Analysis

Statistical analysis is used to identify any significant differences among the groups in terms of weighted median nutrient intake. Medians were used as opposed to means due to the skewed nature of 24-hour dietary intake data. An alpha level of 0.05 was used as the level of significance. P-values were calculated using the Student's t-distribution. Variables and study groups were defined and coded using the SAS Statistical Analysis System (SAS Institute, 1990). Weighted median nutrient intake levels and corresponding weighted standard errors were generated by the SUDAAN statistical program (Shah et. al., 1997).

4. Nutrient Content of the WIC Prototype Packages

CNPP used specifications of prepared, typical maximum packages that were specified by the Food and Nutrition Service, originally for the review conducted by The Pennsylvania State University (The Pennsylvania State University, 1991). These package specifications are listed in Table 5. CNPP consulted with FNS regarding any changes in the specifications.

Table 5. Foods included in "Maximum WIC Packages" as analyzed in 1991 review.

Package I: Infants 2-3 mo

Similac concentrate with iron 403 fl oz

Package II: Infants 4-11 mo

Similac concentrate with iron 403 fl oz
Rice cereal, dry, instant 24 oz
Infant apple juice 63 fl oz

Package IV: Children 1-5 yr

Kix cereal 36 oz
fresh Eggs 2 doz
orange Juice Concentrate 72 fl oz
choice 1: whole milk 24 qts
peanut butter 18 oz
choice 2: whole milk 20 qts
processed American cheese 1 lb
peanut butter 18 oz
choice 3: whole milk 24 qts
red kidney beans 1 lb
choice 4: whole milk 20 qts
processed American cheese 1 lb
red kidney beans 1 lb

Package V: Breast-feeding women 1st 12 mo

Kix cereal 36 oz
fresh eggs 2 doz
orange juice 72 oz
choice 1: low-fat (2%) milk 28 qts
peanut butter 18 oz
choice 2: low-fat (2%) milk 28 qts
red kidney beans 1 lb
choice 3: low-fat (2%) milk 24 qts
cheddar cheese 1 lb
peanut butter 18 oz
choice 4: low-fat (2%) milk 24 qts
cheddar cheese 1 lb
red kidney beans 1 lb

Package VI: Non-breastfeeding women 1st 6 mo

Kix cereal 36 oz
fresh eggs 2 doz
orange juice 48 oz
choice 1: low-fat (2%) milk 20 qts
cheddar cheese 1 lb
choice 2: low-fat (2%) milk 24 qts

5. Sugar Intake

Information on the sugar content of foods in the NHANES III database is broken down into sucrose, fructose, galactose, glucose, lactose, and maltose. Total sugars were calculated as the sum of all sugars. Added sugars were defined as the sum of sucrose + galactose + glucose + maltose. Natural sugars were defined as the sum of fructose + lactose (Cleveland et al., 1997). The percentage of total kilocalories and the percentage of total carbohydrates were calculated for sucrose, total sugars, added sugars, and natural sugars. Added sugar intake was compared with recommendations in the Food Guide Pyramid.

In the context of the overall WIC food package review, CNPP examined Federal nutrition guidance with respect to sugars, total sugar consumption by WIC target groups and others, and the contribution of the WIC packages to total sugar consumption. CNPP's analysis of the sugar issue is solely consumption-based. Consumption levels are compared to dietary standards. It is beyond the scope of this study to conduct a health risk assessment of sugar consumption or to model the marginal effects of single grams of additional dietary sugar consumed on short-term or longer term health outcomes.

III. RESULTS

A. DEMOGRAPHIC CHARACTERISTICS

This section presents information about the NHANES III sample used to analyze nutrient intake of the target groups of concern. NHANES III contains 29,105 subjects with complete dietary recall data. Table 6 presents the groups selected for the WIC analysis along with sample frequencies. The age group for which the most observations existed are children 1-4 years old (n=4,309). To assess how well the WIC food packages function as supplemental packages to remedy nutrient deficiencies of the target population groups, WIC participants and those who are eligible but do not participate are identified, and differences in diet between the two groups are examined. Among the possible explanatory factors is participation in the WIC Program. Three groups were identified: WIC participants (WICP), WIC income-eligible non-participants (WICNP), and a total sample (TS), which is nationally representative and includes all income groups.

The first WIC food package (WIC-I) is designed for infants aged 0-3 months who receive formula. The NHANES III data begins with infants 2-3 months old, and infants who are breast-fed are not included in the 24-hour dietary recall interview. The total sample (TS) of infants 2-3 months old includes 315 observations (Table 6). Of that number about half, or 155, participate in WIC (WICP), while 52 are WIC-eligible, but not participating (WICNP).[14] The second WIC food package (WIC-II) is designed for infants aged 4-11 months. The total sample (TS) of infants 4-11 months old was 1,305, about four times the sample size of the younger infants. WIC Package IV is designed for children age 1 up to 5 years. Children 1-4 years old comprise the largest total NHANES III sample in this study (TS=4,309). WIC Package V is designed for pregnant and breast-feeding women. The TS includes 426 women (Table 6). WIC Package VI is designed for non-breast-feeding women, 6 months postpartum. There are 249 women in the TS.

Table 6. Sample Size for WIC Package Recipient Groups

Package	Recipients	WIC Participating	WIC Eligible Non-participating	Total Sample
I	Infants 2-3 months old	155	52	315
II	Infants 4-11 months old	555	277	1305
IV	Children 1-5 years old	933	2000	4309
V	Pregnant/breast-feeding	102	194	426
VI	Non-breast-feeding	80	110	249

[14] Note: WIC participating and WIC eligible non-participating are not mutually exclusive and do not add up to 100 percent. See variable definitions, page 20.

In Table 7, demographic characteristics of WIC participants and non-participants as well as the total, nationally representative sample are shown. The mean poverty-income ratio (percentage of the Federal poverty level) of WIC participant women is significantly lower than pregnant and postpartum women in the national sample. Also, the mean age of all WIC participant women is significantly lower than in the national sample. The percentage of non-Hispanic, white pregnant women is significantly higher in the WIC eligible, non-participating and total sample groups than for those participating in WIC. The sample sizes of breast-feeding women in the WIC participant and WIC eligible, non-participant groups are too small to detect significant differences in demographics. The ethnicity of WIC participant women in this NHANES III sample is comparable to actual program participants reported in the Study of WIC Participant and Program Characteristics 1992 (USDA/FNS, 1994).

Table 7. Demographics of WIC Participating and WIC Eligible Non-participating Groups

Pregnant Women

	WIC participating (n=71)		WIC eligible non-participating (n=171)		Total sample (n=346)	
	value	s.e.	value	s.e.	value	s.e.
Mean age	**21.55**	0.68	**24.32***	0.80	**26.05***	0.63
Mean poverty-income ratio	**0.95**	0.12	**1.22**	0.07	**2.67***	0.21
Mean years of education	**10.76**	0.33	**11.34**	0.30	**12.50***	0.24
Mean family size	**3.58**	0.26	**3.78**	0.23	**3.34**	0.14
Percent urban	**36.61**	8.71	**39.06**	7.17	**50.38**	7.51
Percent non-hispanic white	**40.58**	10.23	**63.96***	4.79	**71.43***	3.30
Percent non-Hispanic black	**28.02**	7.25	**18.70**	3.71	**14.97**	2.49
Percent Mexican-American	**17.11**	4.20	**13.71**	1.92	**10.35**	1.32
Percent other	**14.28**	6.74	**3.64**	2.59	**3.25**	1.39

Breast-feeding Women

	WIC participating (n=33)		WIC eligible non-participating (n=23)		Total sample (n=83)	
	value	s.e.	value	s.e.	value	s.e.
Mean age	**25.66**	1.40	**26.95**	2.38	**29.05***	0.92
Mean poverty-income ratio	**1.09**	0.19	**1.13**	0.22	**2.52***	0.39
Mean years of education	**11.74**	0.82	**12.60**	1.03	**13.19**	0.40
Mean family size	**4.76**	0.60	**6.26**	0.57	**4.62**	0.36
Percent urban	**54.55**	14.63	**68.30**	19.40	**60.48**	10.76
Percent non-Hispanic white	**26.18**	15.15	**23.80**	20.35	**57.92**	9.97
Percent non-Hispanic black	**8.57**	5.30	**5.86**	5.08	**4.27**	1.73
Percent Mexican-American	**38.75**	11.90	**24.24**	11.31	**16.92**	4.13
Percent other	**26.50**	15.00	**46.10**	20.18	**20.89**	8.76

Non-breast-feeding Women

	WIC participating (n=80)		WIC eligible non-participating (n=110)		Total sample (n=249)	
	value	s.e.	value	s.e.	value	s.e.
Mean age	**22.75**	0.94	**22.97**	0.92	**26.67***	0.87
Mean poverty-income ratio	**1.11**	0.22	**1.28**	0.24	**2.63***	0.29
Mean years of education	**11.28**	0.34	**10.06**	0.59	**11.84**	0.34
Mean family size	**4.59**	0.36	**4.16**	0.26	**3.96**	0.15
Percent urban	**50.31**	11.14	**67.70**	7.91	**61.91**	7.67
Percent non-Hispanic white	**40.59**	11.69	**32.84**	9.62	**58.09**	6.55
Percent non-Hispanic black	**35.22**	7.03	**33.50**	6.36	**23.07**	4.34
Percent Mexican-American	**19.07**	5.58	**13.94**	3.74	**10.00**	1.93
Percent other	**5.12**	4.88	**19.72**	8.61	**8.84**	3.64

* Value is significantly different than value for WIC participants ($p<.05$)

B. NUTRIENT INTAKE OF WIC PACKAGE RECIPIENT GROUPS

Analysis of median intake of WIC target nutrients and other nutrients and dietary components of public health importance for WICP, WICNP, and TS individuals was undertaken. In all, this analysis included nine nutrients with RDAs, as well as an analysis of the macronutrients, including sugars as a component of total carbohydrate, dietary fiber, and cholesterol. The WIC target nutrients include vitamins A and C, calcium, iron, and protein. Additional nutrients of public concern are folic acid, magnesium, zinc, and vitamin B6. Significance was evaluated at the p œ 0.05 level.

The original five WIC target nutrients were selected because they are deemed nutrients likely to be limited in the diets of the eligible WIC populations and are also linked to adverse health conditions and/or nutritional consequences. The analysis of additional nutrients and dietary components indicate that four nutrients—folic acid, vitamin B6, magnesium, and zinc— have potential for dietary inadequacy by one or more of the WIC target groups. Three of these nutrients—folic acid, vitamin B6, and zinc—were previously recommended for targeting in the 1991 Pennsylvania State University (USDA/FNS, 1991) report on the WIC package review.

1. Package I: Infants 2-3 Months Old

Intake of target nutrients by WIC infants, as well as all other infants studied, exceeded 100 percent of the RDA (Table 8). The Recommended Energy Allowance (REA) for infants 2-3 months old is 650 total kilocalories per day. WIC infants slightly exceeded total calorie requirements with median scores at 102 percent of the REA (95 percent confidence interval 97-161 percent). WIC Package I (mainly formula) provides 81 percent of the RDA for kilocalories and above 100 percent of the RDA for WIC target nutrients. Intake of other nutrients of public health importance (folic acid, zinc, vitamin B6, and magnesium) are similarly above 100 percent of the RDA in the diets of these infants. Infants 2-3 months old receiving this package are most likely drinking iron-fortified formula with little or no supplementary feeding of solid foods and nutrient intake is similar for the three study groups. Breast-fed infants are not included in this analysis because of the difficulty of quantifying milk intake.

Table 8. Total Nutrient Intake of Infants 2-3 Months Old and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	650	528	81%	665.7	19.59	102%	(97%,161%)
Protein (gm)	13	11.7	90%	14.9	0.67	114%	(105%,216%)
Iron (mg)	6	9.5	158%	14.3	0.78	238%	(213%,493%)
Calcium (mg)	400	399	100%	567.4	27.50	142%	(128%,277%)
Vitamin A (IU)	1250	1591	127%	1952.6	85.84	156%	(143%,291%)
Vitamin C (mg)	30	47	157%	68.7	4.63	229%	(199%,531%)
Folic acid (mcg)	25	80	320%	91.9	4.00	368%	(336%,681%)
Zinc (mg)	5	3.9	78%	5.1	0.15	102%	(96%,161%)
Vitamin B6 (mg)	0.3	0.3	100%	0.5	0.01	410%	(143%,215%)
Magnesium (mg)	40	32	80%	61.4	3.89	154%	(134%,344%)

* Confidence Interval

2. Package II: Infants 4-11 Months Old

WIC participating infants consume at least 100 percent of the RDA for all target nutrients and nutrients of concern. Total energy intake was also adequate at 109 percent of the REA, which is 803 total kilocalories per day (Table 9).

Table 9. Total Nutrient Intake of Infants 4-11 Months Old and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	803	646	80%	872.0	15.39	109%	(105%,112%)
Protein (gm)	14	13.2	94%	21.3	0.54	152%	(145%,160%)
Iron (mg)	9	26.4	293%	16.9	0.50	187%	(177%,199%)
Calcium (mg)	554	592	107%	616.2	13.20	111%	(107%,116%)
Vitamin A (IU)	1250	1602	128%	3005.9	146.01	240%	(218%,263%)
Vitamin C (mg)	34	85	250%	103.7	4.83	305%	(277%,333%)
Folic acid (mcg)	33	86	261%	112.5	3.27	341%	(321%,360%)
Zinc (mg)	5	4.4	88%	5.7	0.15	113%	(108%,120%)
Vitamin B6 (mg)	0.5	0.4	80%	0.7	0.01	130%	(136%,144%)
Magnesium (mg)	55	80	145%	97.0	2.47	176%	(168%,185%)

* Confidence Interval

3. Package IV: Children 1-5 Years Old

Most WIC children 1-3 years old consume adequate kilocalories and intake of most nutrients based on RDAs for this group. WIC Package IV provides 65 percent of the REA of 1300 kilocalories per day (Table 10). WIC children 1-3 years old consume 308 percent of the RDA for protein, slightly under 100 percent for iron and calcium, and well over 100 percent of the RDA for vitamins A and vitamin C. As Table 10 shows, WICP median intake for folic acid, vitamin B6, and magnesium are all over the RDA. Only zinc intake falls below recommended levels, with the median intake only 66 percent of the RDA for this group. The maximum WIC package contains 41 percent of the RDA for zinc.

Table 10. Total Nutrient Intake of Children 1-3 Years Old and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	1300	849	65%	1313.2	26.52	101%	(97%,105%)
Protein (gm)	16	37.4	234%	49.3	1.29	308%	(292%,324%)
Iron (mg)	10	11.4	114%	9.6	0.33	96%	(90%,102%)
Calcium (mg)	800	986	123%	788.2	28.38	99%	(92%,105%)
Vitamin A (IU)	1400	2913	208%	2781.2	131.29	199%	(180%,217%)
Vitamin C (mg)	40	139	348%	60.2	3.79	150%	(132%,169%)
Folic acid (mcg)	50	337	674%	161.4	6.19	323%	(299%,347%)
Zinc (mg)	10	4.1	41%	6.6	0.14	66%	(63%,69%)
Vitamin B6 (mg)	1	1.1	110%	1.2	0.03	117%	(114%,126%)
Magnesium (mg)	80	158	198%	175.8	6.06	220%	(205%,235%)

* Confidence Interval

WIC children 4 years old consume 88 percent of the RDA of 1800 established for children 4-6 years old (Table 11). (Children, 5 and 6 years old, are not eligible for the WIC Program.) CNPP, working with technical researchers on the adaptation of the Food Guide Pyramid for children, suggests that an REA of 1,600 may be more appropriate for 4- to 6-year-old children (USDA,CNPP, 1999). Food consumption data reported for this age group in the CSFII 1989-91 averaged 1,530 Kilocalories and is thought to be nutritionally adequate. Because of growing concerns about an obesity "epidemic" in the United States, affecting even children of elementary school age, it is not prudent to urge parents to feed children more food than they need. The WIC package for this group provides about 47 percent of the established REA. WIC children receive greater than 100 percent RDA of the WIC target nutrients and adequate amounts of folic acid, vitamin B6, and magnesium. Like the other children 1-3 years old, however, this group has low zinc intake—reported at 76 percent of the RDA.

Table 11. Total Nutrient Intake of Children 4 Years Old and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	1800	849	47%	1584.2	65.01	88%	(81%,95%)
Protein (gm)	24	37.4	156%	59.7	4.66	249%	(211%,287%)
Iron (mg)	10	11.4	114%	11.3	0.64	113%	(100%,126%)
Calcium (mg)	800	986	123%	794.7	60.3	99%	(85%,114%)
Vitamin A (IU)	1400	2913	208%	2636.0	317.99	188%	(144%,233%)
Vitamin C (mg)	45	139	309%	54.1	9.38	120%	(79%,161%)
Folic acid (mcg)	75	337	449%	180.3	20.75	240%	(186%,295%)
Zinc (mg)	10	4.1	41%	7.6	0.53	76%	(66%,86%)
Vitamin B6 (mg)	1.1	1.1	100%	1.4	0.06	130%	(117%,138%)
Magnesium (mg)	120	158	132%	178.6	13.55	149%	(127%,171%)

* Confidence Interval

4. Package V: Pregnant and Breast-feeding Women

WIC participating pregnant women consumed significantly less than the RDA of iron, calcium, folic acid, zinc, and magnesium ($p<.05$, 95 percent confidence interval does not contain 100 percent). They consumed less than 100 percent of the RDA (77 percent) of vitamin B6, but this was not statistically significant (95 percent confidence interval includes 100 percent, Table 12).

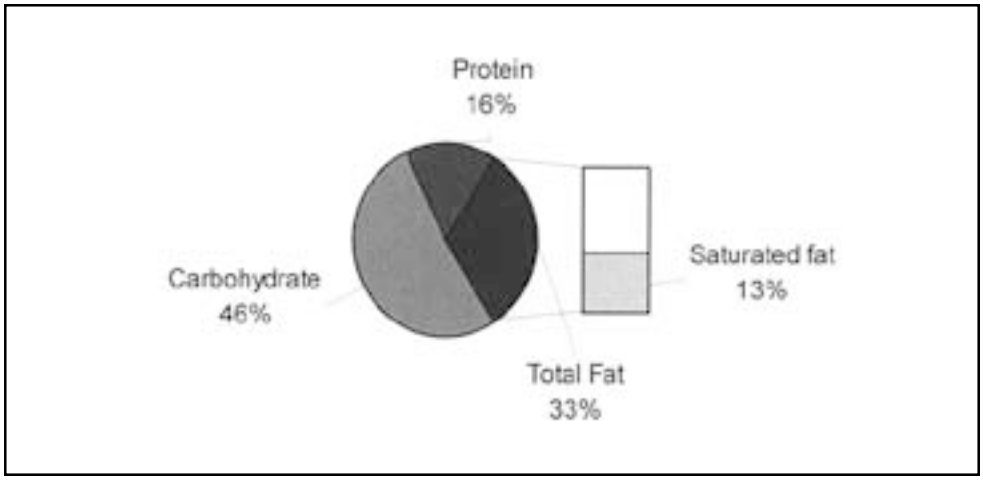
Table 12. Total Nutrient Intake of WIC Pregnant Women and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	2500	863	35%	1757.0	243.4	70%	(51%,89%)
Protein (gm)	60	42	71%	62.6	11.54	104%	(67%,142%)
Iron (mg)	30	1.1	37%	13.2	2.39	44%	(28%,60%)
Calcium (mg)	1200	1193	99%	716.0	119.17	60%	(40%,79%)
Vitamin A (IU)	2650	3775	142%	3221.4	421.44	121.6%	(90%,153%)
Vitamin C (mg)	70	141	201%	70.2	25.80	100%	(28%,173%)
Folic acid (mcg)	400	323	81%	233.6	45.93	58%	(36%,81%)
Zinc (mg)	15	4.7	31%	9.1	1.33	61%	(43%,78%)
Vitamin B6 (mg)	2.2	1.1	50%	1.7	0.31	77%	(50%,105%)
Magnesium (mg)	320	193	60%	221.3	41.47	69%	(44%,95%)

* Confidence Interval

WIC pregnant women also consumed only 70 percent of the REA for kilocalories (95 percent C.I. 51 percent to 89 percent) (Table 12). Thirty-three percent of these kilocalories consist of total fat and 13 percent saturated fat (fig. 1).

Figure 1. Percentage of Kilocalories from Macronutrients: Pregnant Women



Similar to the WIC pregnant women, WIC breast-feeding women failed to meet the RDA for vitamin C, iron, and zinc (Table 13); however, only zinc was significantly lower (95 percent confidence interval 58-86 percent).

Figure 2. Percentage of Kilocalories from Macronutrients: Breast-feeding Women

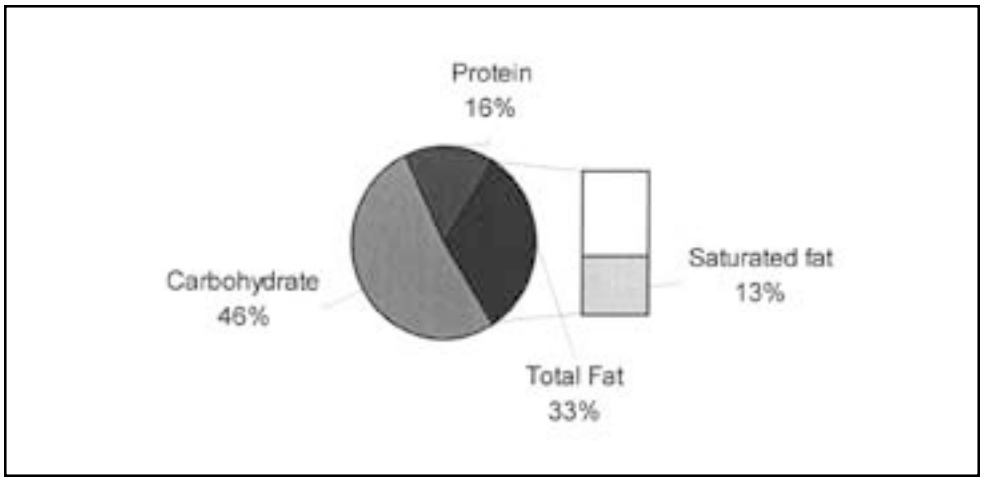


Table 13. Total Nutrient Intake of Breast-feeding Women and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	2700	837	31%	2411.0	194.23	89%	(75%,103%)
Protein (gm)	65	41.8	64%	97.7	4.19	150%	(138%,163%)
Iron (mg)	15	11.4	76%	13.2	2.06	88%	(61%,115%)
Calcium (mg)	1200	1172	98%	1442.6	228.49	120%	(83%,158%)
Vitamin A (IU)	4350	3723	86%	4809.0	1292.48	111%	(52%,169%)
Vitamin C (mg)	94	141	150%	67.0	30.54	71%	(8%,135%)
Folic acid (mcg)	277	344	124%	284.5	133.90	103%	(8%,197%)
Zinc (mg)	19	4.7	25%	13.6	1.36	72%	(58%,86%)
Vitamin B6 (mg)	2.1	1.1	52%	1.8	0.22	84%	(65%,106%)
Magnesium (mg)	353	183	52%	297.7	71.55	84%	(45%,124%)

* Confidence Interval

5. Package VI: Non-breast-feeding Women

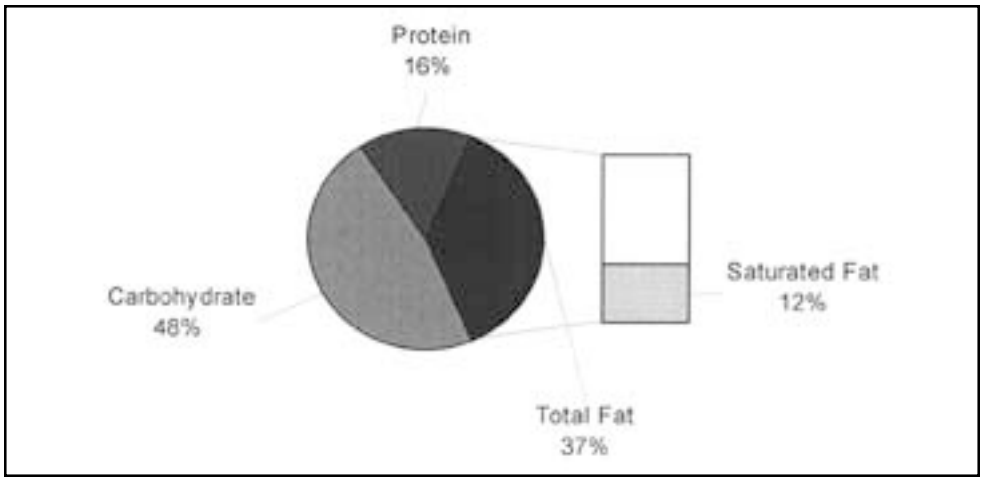
WIC mothers who chose not to breast-feed consumed significantly less than the RDA of calcium, vitamin C, and magnesium ($p<.05$) and slightly less than the RDA (95 percent confidence interval includes 100 percent) of iron, folic acid, zinc, and vitamin B6 (Table 14). These women consumed adequate amounts (greater than the RDA) of protein and vitamin A.

Table 14. Total Nutrient Intake of Non-Breast-feeding Women and Percentage of RDA

TOTAL ENERGY AND NUTRIENTS	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I*.)
Total energy (kcal)	2200	654	30%	1913.0	152.43	87%	(73%,101%)
Protein (gm)	48	33.2	69%	77.7	9.84	162%	(122%,202%)
Iron (mg)	15	10.6	71%	12.6	1.25	84%	(68%,100%)
Calcium (mg)	1069	997	93%	636.4	60.43	60%	(48%,71%)
Vitamin A (IU)	2650	3382	128%	2999.5	534.54	113%	(74%,153%)
Vitamin C (mg)	60	101	168%	35.9	6.07	60%	(40%,80%)
Folic acid (mcg)	180	258	143%	174.5	8.82	97%	(87%,107%)
Zinc (mg)	12	3.7	31%	11.7	1.80	98%	(68%,127%)
Vitamin B6 (mg)	1.6	1	63%	1.4	0.13	89%	(72%,103%)
Magnesium (mg)	285	132	46%	196.2	20.88	69%	(54%,83%)

* Confidence Interval

Figure 3. Percentage of Kilocalories from Macronutrients: Non-breast-feeding Women



C. IMPACT OF WIC PACKAGES: COMPARISONS WITH WIC ELIGIBLE NON- PARTICIPANTS

1. Package I: Infants 2-3 Months Old

Table 15. Amounts of Carbohydrate, Sugars, Fiber, and Cholesterol Consumed by Infants 2-3 Months Old by WIC Participation Category

Infants 2-3 months old	WIC participating	WIC Eligible Non-participating	Total Sample
Total Carbohydrate (gm)	78.8	78.6	76.8
Total Sugars (gm)	65.3	58.6	64.9
sucrose	2	0.8	1.7
fructose	0.8	1.2	0.9
glucose	1.6	2.7	1.7
lactose	56	44	55
maltose			
Total Added Sugar (gm)	5	7	5
Total Natural Sugar (gm)	60	45	59
Total Dietary Fiber (gm)	0.9	0.11	0.09
Cholesterol (mg)	5.12	3.96	4.97

WIC infants 2-3 months old had similar intake of carbohydrate, sugars, protein, and fats in absolute amounts and as percentages of total kilocalories (see also Appendix B-1) ($p > .05$).

The distribution of intakes of the target nutrients by infants 2-3 months old at the 10th percentile (Table 16) or lowest end of intake, shows that WICP infants meet a higher percentage of the RDA for vitamin A and protein than WICNP infants. Percentage of the RDA by the TS are equal to or higher than intake by WICP infants for all nutrients except iron.

Table 16. Nutrient Intake of Target Nutrients at the 10th Percentile: Infants 2-3 Months Old

Infants 2-3 Months Old	WIC	Non-WIC	Total
Vitamin A (IU)	97%	80%	102%
Vitamin C (mg)	138%	139%	144%
Calcium (mg)	74%	83%	84%
Iron (mg)	109%	110%	103%
Protein (gm)	72%	63%	74%

2. Package II: Infants 4-11 Months Old

WICP infants 4-11 months old had significantly more kilocalories from total fat than comparison groups (Appendix B-2) but significantly lower intake of cholesterol and dietary fiber than the other two groups (Table 17). The higher consumption of dietary fiber as well as carbohydrate by WICNP and TS than by WICP may indicate the introduction of cereal earlier and in larger amounts. Lactose was the primary sugar consumed by infants in all three groups, with WICP infants 4-11 months old having a significantly higher intake of lactose than the other two groups (Table 17).

The nutrient intake of the WICP infants 4-ll months old differed significantly from WICNP and TS groups for calcium and iron, where calcium intakes are lower and iron intake higher in the diets of WICP infants. Also, WICP infants consumed a significantly higher amount of vitamin C and a significantly lower amount of protein to WICNP infants. WICNP and TS 4- through 11- month-old infants may be receiving whole milk, or a greater proportion of whole milk, than iron-fortified formula when compared to WICP infants, as indicated by significantly less intake of magnesium, vitamin B12, phosphorus, and sodium by WICP than the other two groups. Whole milk has a higher protein, calcium, magnesium, phosphorus, and vitamin A content, whereas iron-fortified formula has a higher iron, zinc, and copper content.

Table 17. Amounts of Carbohydrate, Sugars, Fiber, and Cholesterol Consumed by Infants 4-11 Months Old by WIC Participation Category

Infants 4-11months old	WIC participating	WIC Eligible Non-participating	Total Sample
Total Carbohydrate (gm)	115.3	122.6*	117.6
Total Sugars (gm)	80	79.8	79.5
Sucrose	10	11	12
Fructose	8	9	9
Glucose	7	8	8
Lactose	49	42*	43**
Maltose			
Total Added Sugar (gm)	20.3	22.4	23.3
Total Natural Sugar (gm)	57.2	532	54.7
Total Dietary Fiber (gm)	3.9	4.6*	4.6**
Cholesterol (mg)	15.07	50.9*	22.05

*WIC Participating is significantly higher or lower than WIC Eligible Non-participating
**WIC Participating is significantly higher or lower than Total Sample

For infants 4-11 months old at the 10th percentile (Table 18), WICP infants meet a higher percentage of the RDA for vitamins A and C, and iron, but lower percentage of the RDA for calcium and protein than WICNP infants of the same age. The percentage of the RDA by the TS is higher than that of the WICP infants for vitamin A, calcium, and protein. These values indicate the greater use of whole milk by the WICNP and TS infants than by WICP infants.

Table 18. Nutrient Intake of Target Nutrients at the 10th Percentile: Infants 4-11 Months Old

Infants 4-11 Months Old	WIC	Non-WIC	Total
Vitamin A (IU)	113%	110%	119%
Vitamin C (mg)	139%	71%	113%
Calcium (mg)	68%	76%	72%
Iron (mg)	78%	47%	64%
Protein (gm)	85%	96%	90%

3. Package IV: Children 1-5 Years Old

WIC children 1 - 5 years of age consumed adequate amounts (at least at the level of the RDA) for all target nutrients and nutrients of concern except for zinc. WIC children consumed significantly higher amounts of iron and vitamin C than non-WIC children ($p < .05$) (Appendix A-3 and A-4).

Zinc intakes were well below the RDA for WICP children 1-3 years old at 66 percent (95 percent confidence interval 63-69 percent, fig. 4) and children 4 years old at 76 percent (95 percent confidence interval 66-86 percent, fig. 5). Recent dietary surveys indicate that American children 1-5 years of age consume 87 percent of the RDA for zinc (CSFII, 1996). These are higher levels than consumed by the WIC participants. The significance of low dietary intake of zinc requires further study (FASEB/LSRO, 1995), but human zinc deficiency may be a health concern for WIC participants, particularly during periods of growth and development, and metabolic stress such as in childhood.

Figure 4. Comparison of Zinc Intake of All Groups 1- to 3-year-old Children

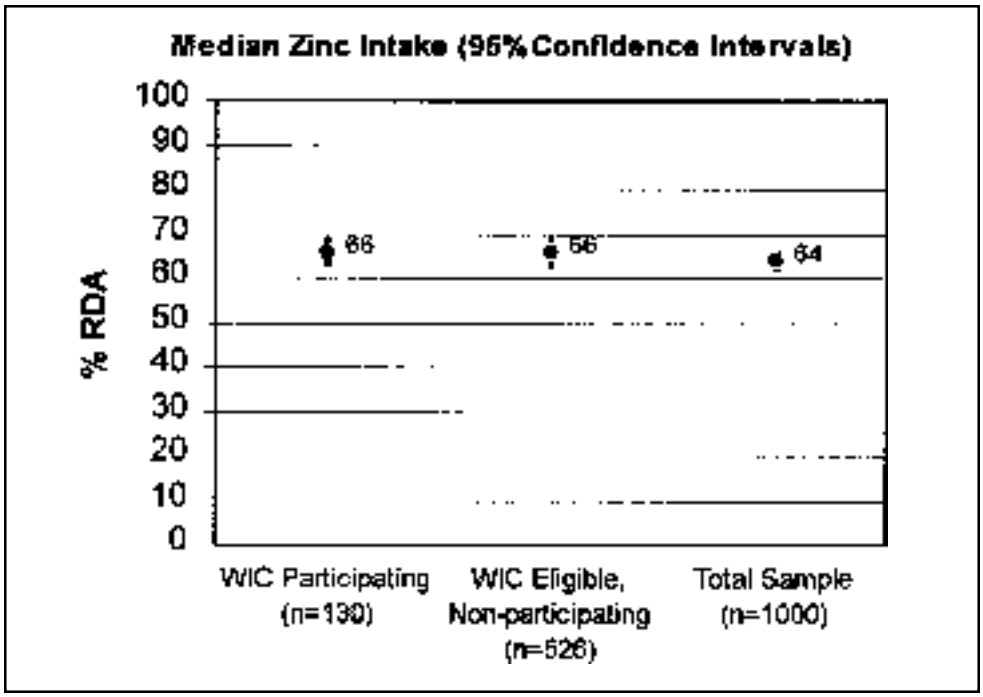
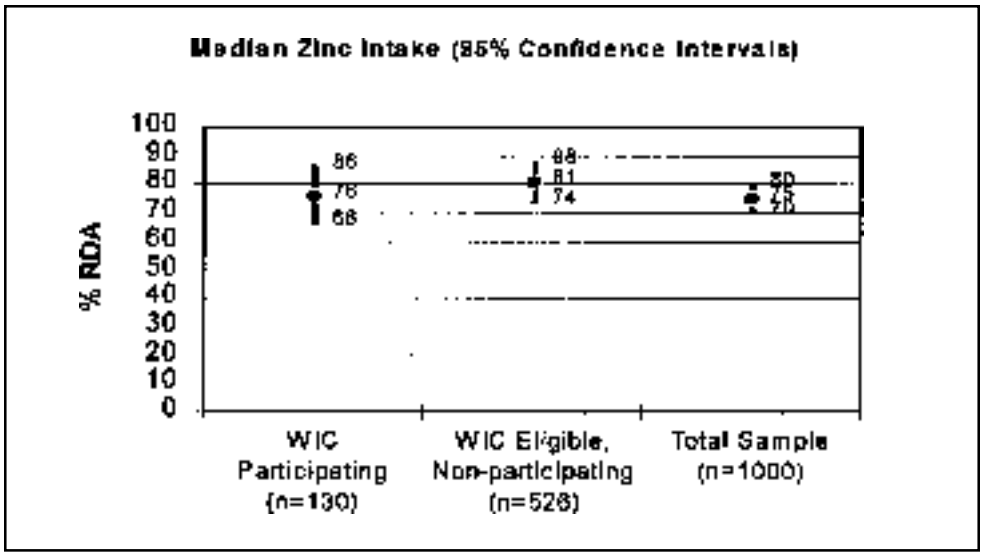
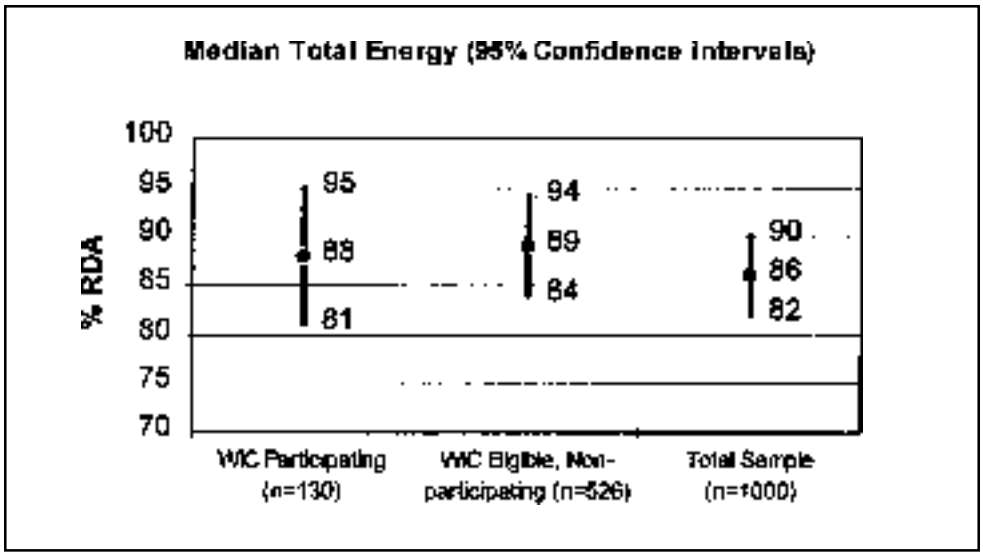


Figure 5. Comparison of Total Zinc Intake of All Groups of 4--year-old Children



All children 1 to 3 years old had kilocalorie intake greater than the REA, with percent kilocalories from carbohydrate at 52 percent, total fat around 34 percent, and saturated fatty acids around 13 percent. All children 4 years of age had kilocalorie intakes less than the REA (fig. 6) with a similar proportion of kilocalories from carbohydrate, protein, total fat, and saturated fat (Appendix B-4). With the exception of kilocalorie and zinc intake by children 4 years of age, children from each of the three groups are meeting dietary guidance recommendations (USDA/DHHS, 1995). In particular, percent of kilocalories from fat and saturated fatty acids meet the recommendations of the Dietary Guidelines for Americans, that is, a gradual reduction of fat in the diet from 2 to 5 years of age, with a goal of 30 percent or less for total fat and 10 percent or less for saturated fat at age 5. All three groups in each age group (1-3 and 4 years old) had similar intakes of dietary fiber.

Figure 6. Comparison of Total Energy Intake of All Groups of 4-Year-Old Children



For children 1 to 3 years old sucrose was the primary sugar consumed by all three groups. WICP children ate significantly less sucrose and added sugar than TS (Table 19). In addition, these WICP children obtain a significantly lower percent of total caloric intake from sucrose and a lower percent of carbohydrate from sucrose and have significantly lower maltose intake than WICNP and TS. WICP children 4 years of age ate significantly more fructose and glucose than WICNP children. It is probable that the higher percentage of kilocalories from sucrose and fructose intake among WICP reflects a higher consumption of fruit-based drinks and lower intakes of foods with sucrose, such as pastries and sweets, by WICP than other groups. Intake of added sugar by all three groups was higher than the recommended amount of 5 teaspoons for 1- to 3-year-olds and 8 teaspoons for 4-year-olds by the Food Guide Pyramid. Children 1-3 years old consumed 11.5-12.4 teaspoons and 4-year-olds consumed 15.0-16.8. WIC children 1-3 years old consumed significantly less added sugar than the total sample.

Table 19. Amounts of Carbohydrate, Sugars, Fiber, and Cholesterol Consumed by Children by WIC Participation Category

Children 1-3 years old	WIC participating	WIC Eligible Non-participating	Total Sample
Total Carbohydrate (gm)	168.5	172.4	173.1
Total Sugars (gm)	90.5	89.9	93.4
Sucrose	24	27	27**
Fructose	19	17	19
Glucose	17	18	18
Lactose	19	18	20
Maltose	1	1	1
Total Added Sugar (gm)	45.9	48.8	49.7**
Total Natural Sugar (gm)	42.8	39.7	41.9
Total Dietary Fiber (gm)	7.9	8.3	8.3
Cholesterol (mg)	164	151	137**

Children 4 years old	WIC participating	Non-participating	WIC Eligible Total Sample
Total Carbohydrate (gm)	213.7	205.2	208
Total Sugars (gm)	110.5	104	108.4
Sucrose	38	37	40
Fructose	25	20*	21**
Glucose	25	20*	21
Lactose	14	17	18
Maltose	1	1	2
Total Added Sugar (gm)	67.4	60.3	65.5
Total Natural Sugar (gm)	40.3	40.9	42.3
Total Dietary Fiber (gm)	9.7	10.6	10.2
Cholesterol (mg)	168	176	150

*WIC Participating is significantly higher or lower than WIC Eligible Non-participating
**WIC Participating is significantly higher or lower than Total Sample

The distribution of intake of the target nutrients by children 1-3 years old at the 10th percentile (Table 20) or lowest end of intake shows that WICP children meet a higher percentage of the RDA for vitamins C and protein than WICNP and TS children. For children 4 years old at the 10th percentile (Table 21), WICP children meet a higher percentage of the RDA for vitamin A, calcium, iron, and protein, but a lower percentage of the RDA for vitamin C than the other two groups of the same age.

Table 20. Nutrient Intake of Target Nutrients [percent of RDA] at the 10th percentile: Children 1- 3 Years of Age

Children 1-3 Years Old	WIC	Non-WIC	Total
Vitamin A (IU)	76%	73%	81%
Vitamin C (mg)	41%	33%	36%
Calcium (mg)	40%	39%	43%
Iron (mg)	43%	45%	47%
Protein (gm)	177%	171%	170%

Table 21. Nutrient Intake of Target Nutrients [percent of RDA] at the 10th percentile: Children 4 Years of Age

Children 4 Years Old	WIC	Non-WIC	Total
Vitamin A (IU)	89%	76%	85%
Vitamin C (mg)	22%	44%	37%
Calcium (mg)	58%	41%	43%
Iron (mg)	69%	59%	58%
Protein (gm)	144%	120%	125%

4. Package V: Pregnant and Breast-feeding Women

All pregnant women failed to meet the RDA for iron and calcium from food intakes (figs. 7 and 8). Iron intakes are similarly low (44 percent RDA) for the three groups. Thus, despite the supplemental foods received, WICP pregnant women did not meet the RDA for three of the five target nutrients from their diets.

Figure 7. Comparison of Iron Intake of All Groups of Pregnant Women

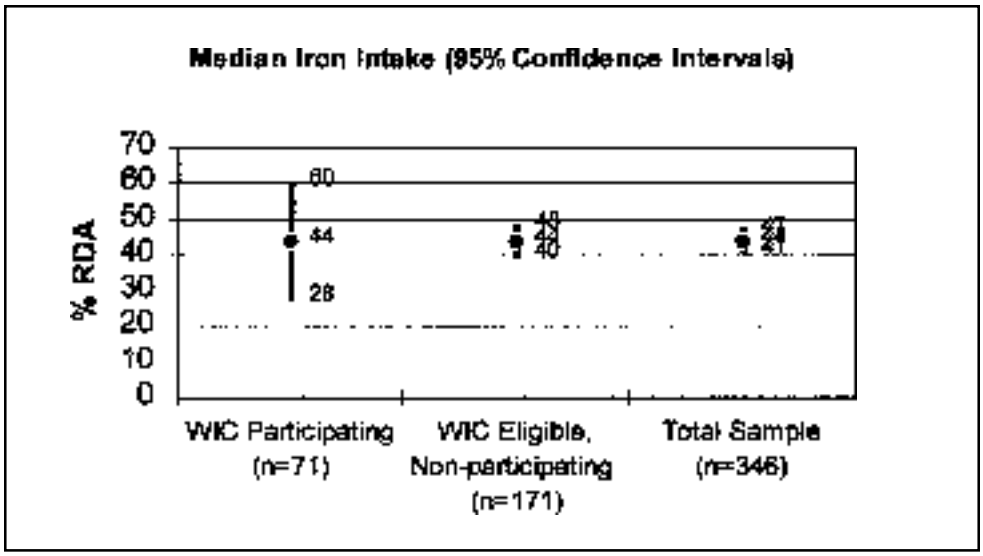
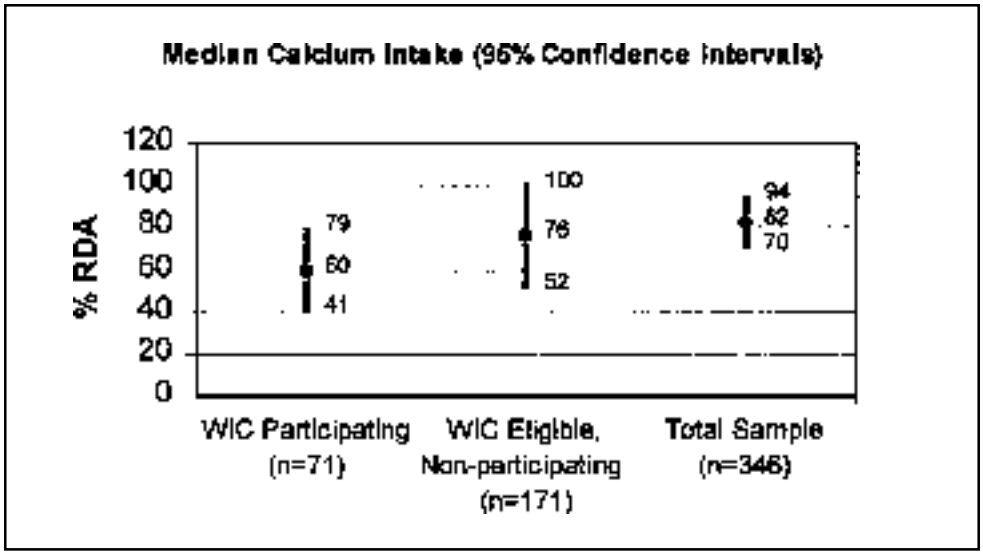
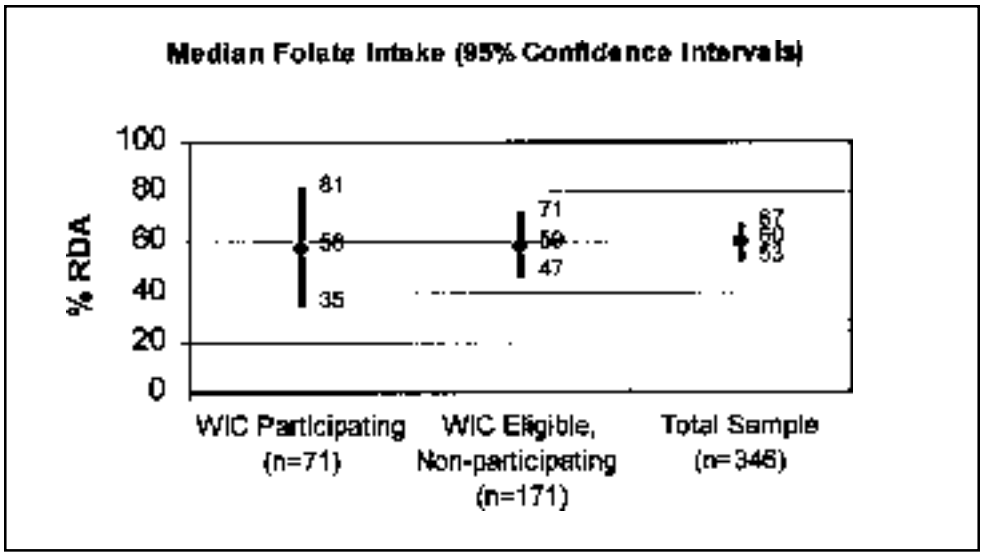


Figure 8. Comparison of Calcium Intake of All Groups of Pregnant Women



Folic acid dietary intakes were analyzed using the RDA, rather than the new Dietary Reference Intakes (DRI), because NHANES III includes nutrient information for the years 1988-94 and does not reflect folic acid fortification of cereal products, beginning January 1, 1998. Folic acid intakes were extremely low for pregnant women in each of the three groups (fig. 9), with intakes by WICP pregnant women at 58 percent of the RDA. Folic acid intakes were higher for WICP breast-feeding women, at 103 percent of the RDA (fig.10).

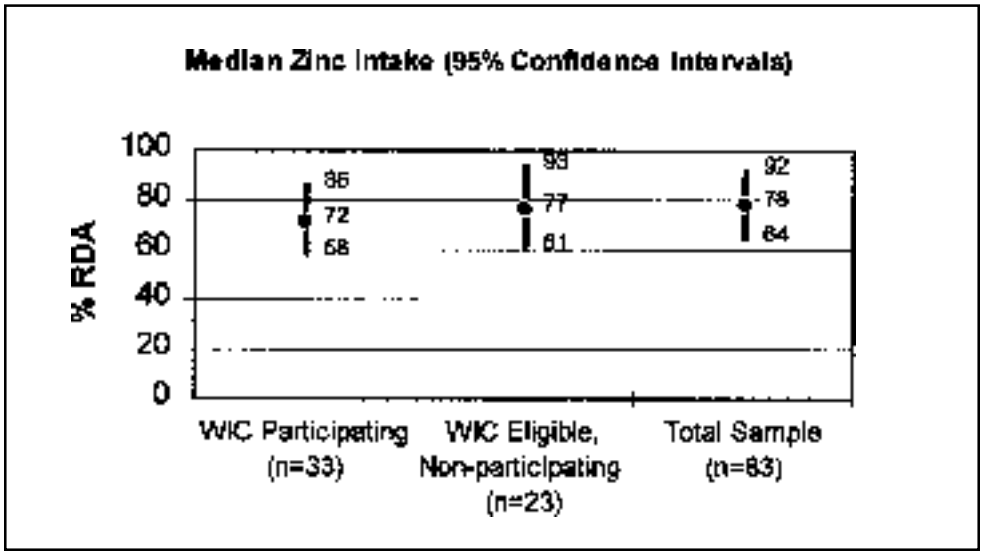
Figure 9. Comparison of Folate Intake of All Pregnant Women



Vitamin B6 intakes fall below the RDA for WICP pregnant women and breast-feeding women at 77 percent and 84 percent of the RDA, respectively. However, these levels were not significantly below 100 percent of the RDA for these groups. Recommendations for vitamin B6 are linked to protein intakes, that is, higher protein intakes require higher vitamin B6 intakes. This relationship reflects the role vitamin B6 plays in amino acid metabolism. Vitamin B6 concentration in breast milk varies depending on the mother's vitamin B6 intake and it is, therefore, important for a breast-feeding mother to sustain intake of vitamin B6. Vitamin B6 is not stored in the body, indicating a need for continual replacement. WICP pregnant and breast-feeding women are exceeding their recommended protein intakes; therefore, getting suitable amounts of vitamin B6 becomes a very important issue. The 1989 RDA handbook supports the proposition that the extra allowance for protein for pregnant women should be accompanied by additional vitamin B6 (RDA 1989).

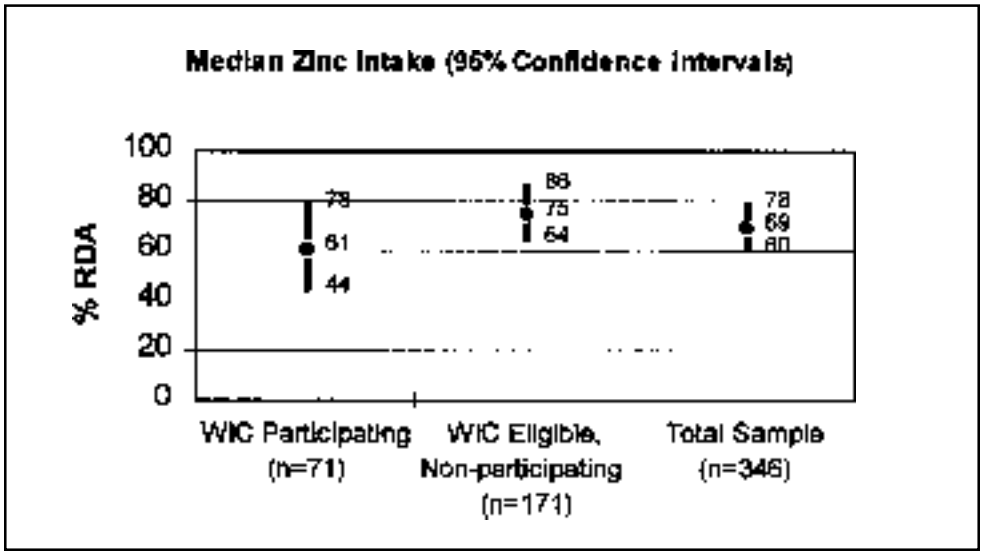
Magnesium dietary intake was found to be low in the diets of pregnant and breast-feeding WICP women at 69 percent and 84 percent of the RDA, respectively. Magnesium is important for maintaining an adequate supply of materials needed for RNA and DNA synthesis that occurs during cell proliferation, such as that found during fetal growth and the rapid growth periods that characterize infancy and young children under age 4. Magnesium also plays a major role in bone and mineral homeostasis. Green leafy vegetables are rich in magnesium. Foods such as unpolished grains and nuts also have high magnesium content. Meats, starches, and milk are intermediary sources. About 25 percent of magnesium in the food supply comes from grain products; 30 percent from milk, meat, and eggs; 20 percent from fruits and vegetables; and 13 percent from legumes, nuts, and soy foods (Gerrior, 1997).

Figure 10. Comparison of Zinc Intake of All Groups of Breast-feeding Women



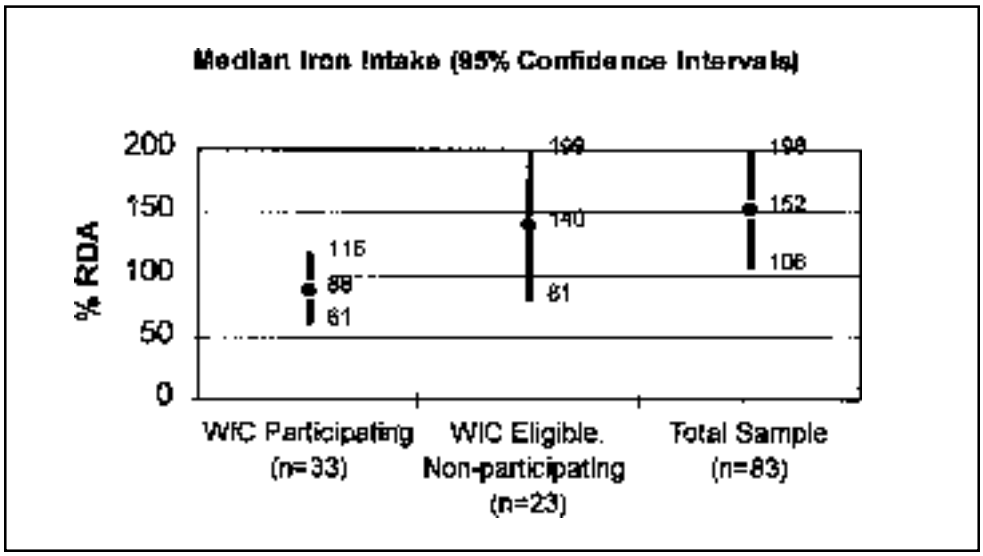
Zinc intakes were below the RDA for pregnant women at 61 percent, and breast-feeding women at 72 percent (figs. 10 and 11). In all cases, women in the WICNP and TS groups failed to meet the RDA for zinc as well.

Figure 11. Comparison of Zinc Intake of All Groups of Pregnant Women



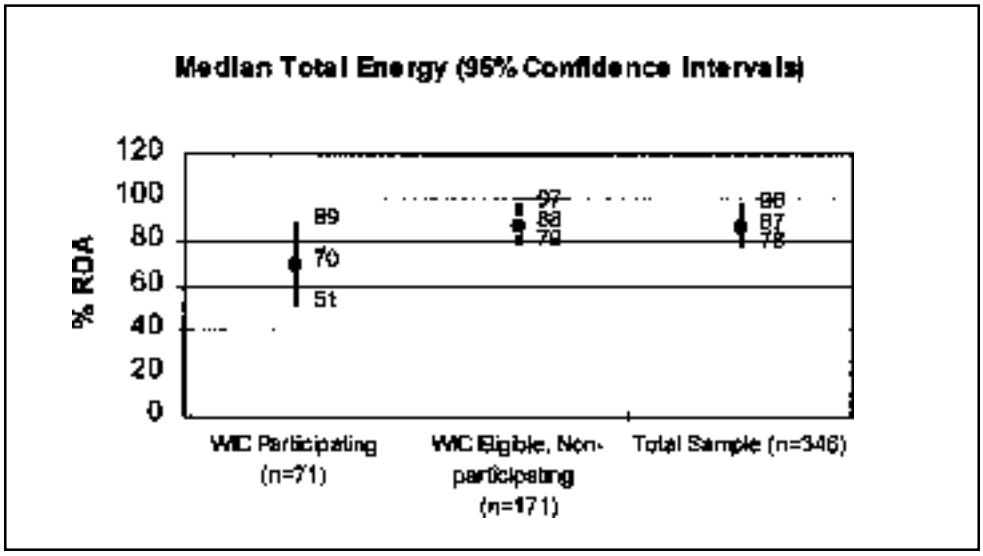
Similar to the WICP pregnant women, WICP breast-feeding women failed to meet the RDA for vitamin A, vitamin C, and iron (iron shown in fig.12). Their comparison groups met the RDA for these nutrients, with the TS having significantly higher intakes of iron than the WICP. Thus, despite the supplemental foods received, WICP breast-feeding women fared less well than WICNP and TS breast-feeding women for the target nutrients—vitamin A, vitamin C, and iron. These findings must be interpreted in light of the fact that pregnant and breast-feeding women should be receiving prenatal supplements, and that these are covered by public health programs. Nutrients from supplements are not included in the 24-hour dietary intake and total nutrient intake data in NHANES III.

Figure 12. Comparison of Iron Intake of All Breast-feeding Women



Pregnant women reported kilocalorie intake less than the 100 percent of the REA, ranging from 70 to 88 percent with WICP intake at only 70 percent (fig.13). WICP pregnant women had significantly lower total carbohydrate and total added sugar intakes than WICNP and TS groups. WICP women had significantly lower percent of kilocalories from saturated fat than TS (Appendix B-5). The percent of kilocalories from total fat and saturated fatty acids for all three groups were higher than the current recommendation, while that from carbohydrate is lower than recommended. Dietary fiber intakes were very low for all three groups, indicating low intake of fresh fruits and vegetables and high-fiber grains.

Figure 13. Comparison of Total Energy Intake of All Groups of Pregnant Women



WICP pregnant women had significantly lower total added sugar intakes than WICNP and TS groups (Table 22), but they exceeded Dietary Guidelines recommendations for added sugar. These women had significantly higher fructose and glucose intakes than WICNP women, indicative of fruit juices or fruit juice-based beverage or sweet drinks consumption. Such food choices may have substituted for milk products, as both lactose and calcium intakes were lower than expected or recommended for these women.

Table 22. Amounts of Carbohydrates, Sugars, Fiber, and Cholesterol Consumed by Pregnant Women by WIC Participation Category

Pregnant Women	WIC participating	WIC Eligible Non-participating	Total Sample
Total Carbohydrate (gm)	228.6	294.2*	288.2**
Total Sugars (gm)	144.3	125.9	136.6
Sucrose	44	50	46
Fructose	39	23*	27
Glucose	39	23*	28**
Lactose	12	16	17
Maltose	2	2	2
Total Added Sugar (gm)	90.9	88.6	84.8
Total Natural Sugar (gm)	51.8	45.1	50.9
Total Dietary Fiber (gm)	11.5	12.8	14.6
Cholesterol (mg)	206	246	225

*WIC Participating is significantly higher or lower than WIC Eligible Non-participating
**WIC Participating is significantly higher or lower than Total Sample

Table 23. Amounts of Carbohydrate, Sugars, Fiber, and Cholesterol Consumed by Breast- feeding Women by WIC Participation Category

Breast-feeding Women	WIC participating	WIC Eligible Non-participating	Total Sample
Total Carbohydrate (gm)	346.4	331.6	323.9
Total Sugars (gm)	143.8	142.5	146.6
Sucrose	38	55	45
Fructose	24	20	23
Glucose	24	22	23
Lactose	32	31	31
Maltose	2	2	2
Total Added Sugar (gm)	69.5	83.8	83.8
Total Natural Sugar (gm)	73.01	53.01	62.2
Total Dietary Fiber (gm)	12.1	28	17.7
Cholesterol (mg)	429	219*	253**

*WIC Participating is significantly higher or lower than WIC Eligible Non-participating
**WIC Participating is significantly higher or lower than Total Sample

The distribution of intake of the target nutrients by pregnant women at the 10th percentile (Table 24) or lowest end of intake shows that WICP pregnant women meet a higher percentage of the RDA for vitamin C and protein but a lower percentage of the RDA for calcium than both WICNP and TS groups. WIC pregnant women consumed higher amounts of vitamin A than non-WIC women. Iron intakes at this low consumption percentile were similar across groups.

Table 24. Intake of Target Nutrients [percent of RDA] at the 10th Percentile: Pregnant Women

Pregnant Women	WIC	Non-WIC	Total
Total vitamin A (IU)	36%	27%	47%
Vitamin C (mg)	22%	17%	18%
Calcium (mg)	23%	28%	29%
Iron (mg)	23%	23%	23%
Protein (gm)	69%	64%	65%

The distribution of intake of the target nutrients by women breast-feeding, first 12 months at the 10th percentile (Table 25) or lowest end of intake, shows that WICP women meet a higher percentage of the RDA for vitamins A and C than WICNP women, but a lower percentage of the RDA for iron, calcium, and protein than both WICNP and TS groups.

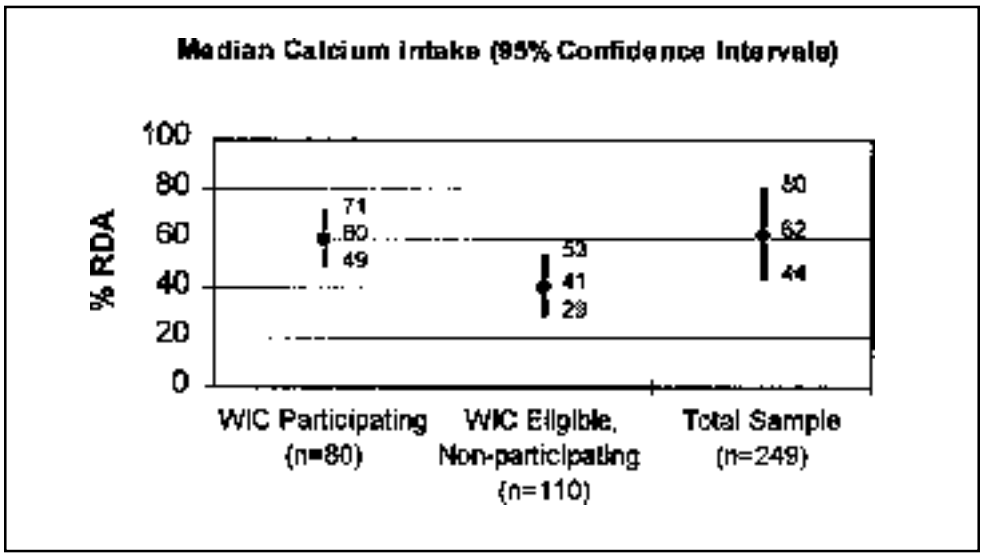
Table 25. Intake of Target Nutrients [percent of RDA] at the 10th Percentile: Breast-feeding Women

Breast-feeding Women	WIC	Non-WIC	Total
Total vitamin A (IU)	68%	43%	47%
Vitamin C (mg)	24%	15%	18%
Calcium (mg)	52%	54%	64%
Iron (mg)	64%	81%	68%
Protein (gm)	85%	99%	110%

5. Package VI: Non-Breast-feeding Women

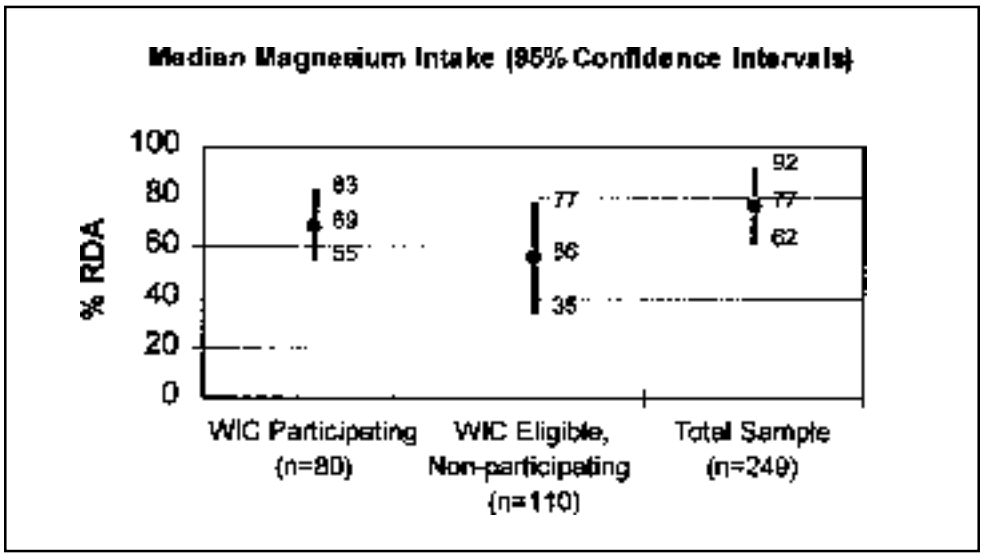
While WICP non-breast-feeding women consumed significantly more calcium than WICNP women, actual intake was only 60 percent of the RDA (fig.14). WICP non-breast-feeding women failed to meet the RDAs for four of the five target nutrients. However, their intakes of these nutrients were higher (except for vitamin C) than those of the WICNP non-breast-feeding women but lower than TS.

Figure 14. Comparison of Calcium Intake of All Groups of Non-breast-feeding Women



WICP non-breast-feeding, postpartum women fall significantly short of RDA recommended intake levels for calcium, vitamin C, and magnesium ($p < .05$) (magnesium shown in fig.15). Intakes of all other nutrients except protein and vitamin A are below the RDA; however, these deficits are not statistically significant (95 percent confidence interval contains 100 percent).

Figure 15. Comparison of Magnesium Intake of All Groups of Non-breast-feeding Women



Both breast-feeding and non-breast-feeding women 6 months postpartum had kilocalorie intakes less than the REA, with WICP at 89 percent and 87 percent, respectively, for breast-feeding and non-breast-feeding women (fig.16). Also, both breast-feeding and non-breast-feeding women in all three groups had percent kilocalories from carbohydrates at less than 55 percent and percent kilocalories from total fat at above 30 percent as well as very low intakes of dietary fiber (Appendix B-6 and B-7). WICP breast-feeding women had significantly higher cholesterol than the other two groups (Table 26). Small sample sizes in these groups should be taken into consideration in interpreting these results. The diets of these women are low in carbohydrate and dietary fiber and high in fat, indicating that these women are not eating recommended amounts of fresh fruits and vegetables and high-fiber grains.

Figure 16. Comparison of Total Energy Intake of All Groups of Non-breast-feeding Women

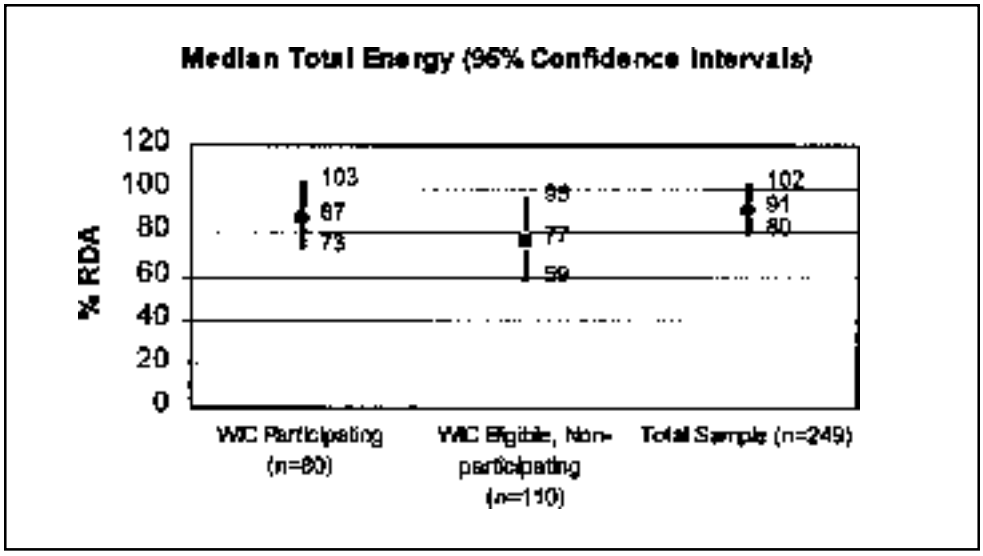


Table 26. Amounts of Carbohydrate, Sugars, Fiber, and Cholesterol Consumed by Non-Breast- feeding Women by WIC Participation

Non-Breast-feeding Women	WIC participating	WIC Eligible Non-participating	Total Sample
Total Carbohydrate (gm)	211.7	214.3	218.7
Total Sugars (gm)	108.5	128.2	112.2
Sucrose	39	35	35
Fructose	23	26	25
Glucose	26	26	25
Lactose	8	6	9
Maltose	1	1	2
Total Added Sugar (gm)	63.2	78.4	74.4
Total Natural Sugar (gm)	36.8	34.4	36.1
Total Dietary Fiber (gm)	11	7.9	10
Cholesterol (mg)	230	151	208

For breast-feeding and non-breast-feeding women, there were no significant differences in intakes of sugars among the three groups (Table 26). Breast-feeding WICP women had lower intakes of sucrose and less total intake of added sugar than the WICNP and TS groups. Non-breast-feeding WICP women had somewhat higher intakes of sucrose but less total added sugar than the WICNP and TS groups.

The distribution of intake of the target nutrients by non-breast-feeding women at the 10th percentile (Table 27) or lowest end of intake, shows that WICP non-breast-feeding women meet a higher percentage of the RDA for vitamin C, calcium, iron, and protein, but a lower percentage of the RDA for vitamin A than both WICNP and TS groups.

Table 27. Intake of Target Nutrients [percent of RDA] at the 10th Percentile Level: Non-breast- feeding Women

Non-Breast-feeding Women	WIC	Non-WIC	Total
Vitamin A (IU)	17%	27%	31%
Vitamin C (mg)	20%	7%	20%
Calcium (mg)	32%	19%	25%
Iron (mg)	50%	21%	37%
Protein (gm)	64%	39%	57%

Additional Information: Comparisons with groups above 185 percent of the poverty level

After weighting, intakes of above poverty groups are near the intakes of the total sample. Median intake levels changed slightly, but comparisons with WIC participants for the majority of nutrients did not change in significance. Following are the exceptions:

For infants 2-3 months of age, there was no significant difference in median iron intake compared to the total sample, but when compared to the above 185 percent of poverty group, WIC infants consumed significantly more iron. However, all infants regardless of income group consumed above 100 percent of the RDA for all WIC target nutrients and nutrients of concern.

For infants 4-11 months of age, there was no change in significant differences between groups. As compared to the total sample, WIC infants consumed more iron and less calcium, vitamin A, and magnesium than the above poverty sample. Again, all groups consumed above 100 percent of the RDA for all WIC target nutrient and nutrients of concern.

Consumption of protein was nearly 300 percent of the RDA by all groups of children aged 1-3 years old and about 250 percent for 4-year-old children. When compared to the above poverty group the WIC children aged 1-3 years old did consume significantly more protein. There were no significant differences in protein consumption between 4-year-old WIC children and all children or children above 185 percent of poverty level.

All groups of women in all income categories consumed less than 100 percent of the RDA for many nutrients. Pregnant women participating in WIC consumed less calcium than all comparison groups, including WIC income-eligible, non-participating, above 185 percent of poverty, and the total sample. Differences were only statistically significant between WIC women and women above poverty. Consumption of calcium ranged from 60 percent (WIC) to 82 percent (above poverty and total sample). Comparisons of intake of other nutrients with the above poverty group were similar to the total sample.

Comparisons between WIC breast-feeding women and the above poverty group were similar to the total sample. WIC breast-feeding mothers consumed significantly less iron than both the total sample and the above poverty sample. Comparisons between WIC non-breast-feeding postpartum women and the above poverty groups remained unchanged.

D. NUTRITIONAL CONTRIBUTION OF WIC PACKAGES

The total micro- and macronutrient content of prototype WIC maximum package allowances can be found in appendices C and D. Total nutrient intake of WIC beneficiaries for the same nutrients are included for comparison.

None of the WIC Food Packages provide less than 25 percent of the 1989 Recommended Dietary Allowances (RDAs) for any of the WIC target nutrients or other nutrients of concern. In fact, in most instances the amounts of these nutrients contributed by the WIC foods range from 50 percent to more than 100 percent of the RDAs.

For infants 2-3 months old, the maximum package (WIC I) provides over 100 percent of the RDA for vitamins A and C, calcium, and iron, as well as the B vitamins. Protein is provided at 90 percent of the RDA, magnesium at 80 percent, and zinc at 78 percent of the RDA. Total intake of zinc is 102 percent of the RDA (Appendix C-1). These infants are certainly benefitting nutritionally from this package.

For infants 4-11 months old, the maximum package (WIC II) provides over 100 percent of the RDA for vitamins A and C, calcium, and iron, as well as folic acid and magnesium (Appendix C-2). Protein is provided at 94 percent of the RDA, zinc at 88 percent, phosphorus at 97 percent, vitamin B6 at 80 percent, and vitamin D at 85 percent of the RDA. These infants meet 100 percent of the RDA for these nutrients from their total diet.

For children 1-3 years old, the maximum package (WIC IV) provides over 100 percent of the RDA for vitamins A and C, calcium, protein and iron, but provides only 41 percent of the RDA for zinc (Appendix C-3). This package also provides less than 100 percent of the RDA for niacin at 94 percent and vitamin D at 87 percent, although zinc RDA appears somewhat controversial. (Bier, personal communication, 1998) If these children are truly deficient in zinc (due to inappropriately high RDA for zinc), this package may need addition of foods higher in zinc content.

For children 4 years of age, the maximum package (WIC IV) provides over 100 percent of the RDA for vitamins A and C, calcium, protein, and iron, but only 41 percent of RDA for zinc (Appendix C-4). This package also provides less than 100 percent of the RDA for niacin at 71 percent and vitamin D at 87 percent. Again, zinc may be a limiting nutrient in this WIC food package if children of this age are truly deficient in zinc.

For pregnant women, the maximum package (WIC V) provides over 100 percent of the RDA for vitamins A and C, and 99 percent of the RDA for calcium, but only 37 percent of the RDA for iron, 71 percent of the RDA for protein, 81 percent of the RDA for folic acid, 60 percent of the RDA for magnesium, 31 percent of the RDA for zinc, and 50 percent of the RDA for

vitamin B6 (Appendix C-5). Consumption of a mix of total foods in the diet ensures that the vitamin C and protein intakes are at 100 percent of the RDA. However, intake of calcium in the total diet is only at 60 percent, iron at 44 percent, magnesium at 69 percent, folic acid at 58 percent, niacin at 77 percent, and vitamin B6 at 77 percent of the RDA. It appears these women must not be consuming the full package complement of most nutrients, and they fail to supplement their diets appropriately with non-WIC foods to ensure adequate nutritional status from food.

For breast-feeding women, the maximum package (WIC V) provides over 100 percent of the RDA for vitamins A and C, 98 percent for calcium, but 76 percent for iron, 64 percent for protein, 52 percent for magnesium, 25 percent for zinc, and 52 percent for vitamin B6 (Appendix C-6). Total daily intakes of magnesium, zinc, and vitamin B6 are less than 100 percent of the RDA at 84 percent, 72 percent, 84 percent of the RDA, respectively. For these women zinc, magnesium, and vitamin B6 may be limited in the WIC food package. As with the pregnant women, it appears breast-feeding women neither consume the amounts of nutrients provided by the package nor supplement their diet appropriately with non-WIC foods to ensure adequate nutritional status.

For non-breast-feeding women, 6 months postpartum, the maximum package (WIC VI) provides over 100 percent of the RDA for vitamins A and C, but less than the RDA for calcium at 93 percent, for iron at 71 percent, for protein at 69 percent, for magnesium at 46 percent, for zinc at 31 percent, for thiamin at 82 percent, for niacin at 46 percent, for vitamin B6 at 63 percent, for vitamin D at 63 percent, and for phosphorus at 87 percent (Appendix C-7). With the exception of protein, these women fail to meet 100 percent of the RDA for target nutrients as well as for magnesium, folic acid, zinc, and vitamin B6 with their daily intake of total foods. Non-breast-feeding women appear not to be consuming much of the WIC food package. In addition, these women fail to supplement their diet with appropriate nutrient-dense foods.

IV. CONCLUSIONS

In this section we summarize results related to the WIC target groups and highlight nutrient shortfalls in the diets of WIC population subgroups.

A. OVERALL RESULTS

Among **infants 2-3 months old,** there is no detectable ground for concern in achieving recommended nutrient intakes among any of the three groups. Median energy intakes exceed 100 percent REA. Consumption of the WIC-targeted nutrients exceeds 100 percent RDA. Other nutrients of public health importance: folic acid, magnesium, zinc, and vitamin B6 exceed 100 percent RDA in the diets of all infants 2-3 months old.

For **infants 4-11 months old** energy intakes by each of the three groups exceeds 100 percent of the REA and no micronutrient deficiencies are evident in terms of achieving the RDA. Consumption of the WIC-target nutrients exceeds 100 percent RDA. Nutrients of public health importance exceed 100 percent RDA in the diets of all infants 4-11 months old.

For children 1-3 years old most consume adequate kilocalories and, in general, WICP children 1-3 years old do particularly well. These children achieve 96 percent of the RDA for calcium and obtain 100 percent of the RDA for the other target nutrients, consuming significantly more vitamin C, iron, and protein than the other two comparison groups. WIC children 1-3 years old have significantly higher intake of magnesium than WICNP and significantly more folic acid and vitamin B6 than WICNP and TS groups. The lowest nutrient intake for WICP is for zinc at 69 percent of the RDA. This is similar for the other two groups. WICP children 1-3 years old appear to benefit from the WIC package for most nutrients, especially for protein, calcium, iron, folic acid, magnesium, and vitamin E. WICP zinc intakes are comparable to the other two groups.

Similarly, for the WICP **children 4 years of age,** zinc intake is at 76 percent of the RDA. Zinc is found in higher amounts in red meat, fluid milks and cheese, and grain products, and smaller amounts in legumes and vegetables. Energy intake is low in this group; however the REA for children 4-6 years old may be set too high based on dietary intakes of corresponding samples from the 1989-94 CSFII and current opinions of the Dietary Guidelines for Americans Committee.

WICP pregnant women met only 70 percent of the REA and did not meet 100 percent of the RDA for four out of the five WIC-target nutrients and for folic acid, magnesium, zinc, and vitamin B6. A problem with the dietary intake of these pregnant women is low caloric intakes, low nutrient-density, and higher fat intakes than recommended. To improve the intakes of kilocalories, dietary fiber, calcium, iron, and vitamin A of WICP pregnant women,

consideration needs to be given to promoting more nutrient-dense foods, such as lowfat milks, enriched grains, fruits, and vegetables in the diets of these women. Many of these foods are already in the WIC packages but must be consumed as part of a balanced diet. Recent dietary surveys indicate that American women of childbearing age consume 74-82 percent of the RDA for zinc (CSFII, 1996). These are higher levels than consumed by the WIC participants. The significance of low dietary intakes of zinc requires further study (Federation of American Societies for Experimental Biology, Life Sciences Research Office, 1995), but certainly human zinc deficiency may be a health concern for WIC participants, particularly during periods of growth and development and metabolic stress in children and in pregnancy.

For Breast-feeding women, first 12 months, WICP women reported food intakes at only 89 percent of the REA. Additionally, they failed to meet the RDA for WIC-target nutrients, vitamin A, vitamin C, and iron as well as for vitamin B6, magnesium, and zinc. Thus, despite the supplemental foods received, WICP breast-feeding women fared less well than WICNP and TS breast-feeding women for the target nutrients—vitamin A, vitamin C, and iron.

For Non-breast-feeding, 6 months postpartum women all three groups consumed less than 100 percent of the REA. Except for protein, WICP non-breast-feeding women are consuming less than 100 percent of the RDA for the WIC-target nutrients and nutrients of concern. They are most likely not consuming their WIC food package, as the package supplies adequate quantities of these nutrients; however, the reasons for this are unclear from the nutrient analysis.

B. IDENTIFIED TARGET NUTRIENT SHORTFALLS IN THE WIC POPULATION SUBGROUPS

- Pregnant women consumed inadequate amounts of iron and calcium
- Non-breast-feeding women failed to meet the RDA for calcium and vitamin C

C. IDENTIFIED POTENTIAL TARGET NUTRIENTS–FOLIC ACID, VITAMIN B6, MAGNESIUM, AND ZINC

- For all children and women, zinc intakes were below 100 percent of the RDA
- Pregnant women did not meet 100 percent of the RDA for any of these four nutrients
- Breast-feeding women did not meet 100 percent of the RDA for vitamin B6, magnesium, and zinc
- Non-breast-feeding women did not meet 100 percent of the RDA for any of these four nutrients.

D. IDENTIFIED CONCERNS FOR FOOD ENERGY, MACRONUTRIENT, CHOLESTEROL, DIETARY FIBER, AND SUGAR INTAKE

- The energy intakes of children 4 years of age, and for pregnant, breast-feeding and non-breast-feeding women were below the REA for these groups.

- Breast-feeding women had significantly higher cholesterol intakes (above recommended levels) than WICNP and the total sample.

- WICP children and women had less intake of added sugar than comparison groups. Added sugar intake was significantly lower by children 1-3 years old and by pregnant women than by TS. However, added teaspoons still exceeded dietary recommendations.

E. MAJOR POINTS OF CONSIDERATION FROM THIS STUDY

1. Protein as a Target Nutrient

Clearly, protein is one nutrient being consumed at or above the RDA by all the age groups in the three study populations (WIC participating, WIC eligible non-participating, and total sample groups), excluding infants whose dietary intakes are not judged by these standards. An analysis of the percent of kilocalories from macronutrients shows that for all study groups, except infants, protein intakes meet or exceed the recommendation of 12-14 percent of total kilocalories.

More research needs to be done regarding the effects of excessive protein intakes. The 1988 *Surgeon General's Report on Nutrition and Health* (DHHS, 1988) stated that "studies that have associated diets containing 20 percent of total kilocalories from protein (as compared to the 12-14 percent usually recommended) with a higher risk of premature deliveries and neonatal mortality suggest that protein intakes significantly higher than those recommended may be harmful."

2. Food Sources of Target Nutrients and Nutrients of Concern

Table 28 indicates that the approved WIC foods do supply some of the nutrients of concern, but in variable amounts, as well as being rich sources of the WIC-target nutrients. Foods as noted are not necessarily "rich" sources of a particular nutrient but may make important contributions to a diet low in a nutrient. For example, foods included in the package to target only protein, such as peanut butter, eggs, and canned tuna (for recipients of Package VII—Breast-feeding Enhanced Food Package) are also important sources of folic acid (peanut butter, eggs), zinc (tuna, eggs), and magnesium (peanut butter). Zinc was highlighted in the table, because of the low intakes of zinc by WIC participants. The basis for determining a food's nutrient contributions was the U.S. Food Supply Series and USDA ARS's on-line nutrient data, Standard Reference 12.

Table 28. WIC Foods and Related Target Nutrients[15] and Nutrients of Concern[16]

WIC FOODS	Minimum WIC (or other) Federal nutrient requirements	WIC target nutrients	Nutrients of concern present in varying amounts
Infant formulas	At standard dilution: 10 mg of iron per liter 67 kilocalories per 100 ml (20 kilocalories per fluid ounce)[17]	iron, calcium, protein, vitamins A and C	*also provides folic acid, vitamin B6, magnesium, zinc*
Whole milk	400 IU vitamin D per quart[18]	calcium, protein, vitamin A	*also provides zinc, magnesium*
Lowfat and skim milk	400 IU vitamin D per quart[18] 2000 IU vitamin A per quart[18]	calcium, protein, vitamin A	*also provides zinc, magnesium*
Cheese (domestic)	none	calcium, protein	*also provides zinc, magnesium*
Fruit/vegetable juices (100%)	30 mg of vitamin C per 100 ml of single strength juices[17]	vitamin C	*orange juice provides folic acid*
Infant cereal (dry)	45 mg of iron per 100 gm of dry cereal[17]	iron	*also provides magnesium, zinc*
Adult cereals	28 mg of iron per 100 gm of dry cereal and a maximum of 21.2 gm sucrose and other sugars per 100 gm dry cereal (6 gm per ounce)[17]	iron	*some cereals, such as **Total,** provide folic acid, zinc, magnesium, vitamin B6*
Dried peas and beans	none	protein, iron	*also provides folic acid, zinc, magnesium*
Peanut butter	none	protein	*also provides folic acid, zinc, magnesium*
Eggs	none	protein	*also provides folic acid, zinc*
Carrots[19]	none	vitamin A	
Tuna (canned)[19]	none	protein	also provides iron, zinc, magnesium

[15] Target nutrients include protein, calcium, iron, vitamin A and vitamin C

[16] Nutrients of concern include folic acid, vitamin B6, magnesium and zinc

[17] Nutrient level defined by WIC Program Regulations (7CFR Part 246.10(c))

[18] Nutrient level defined by FDA Standard of Identity (21 CFR Parts 100-169 (as well as WIC Program Regulations (7 CFR 246,10(c)))

[19] Food only in WIC Food Package VII (Breast-feeding Women, enhanced)

Zinc requirements increase with increased intake of dietary protein. Dietary phosphorus and iron can depress zinc absorption. Good sources of zinc are of animal origin, particularly meat, liver, eggs, and seafood. Fortified ready-to-eat cereals contain zinc, but the zinc is in a less available form for absorption and utilization.

Folic acid occurs widely in foods, with the best natural sources being liver, kidney beans, and dark-green leafy vegetables. A major contributor of folic acid in the American diet is fortified ready-to-eat cereals. Vegetables, legumes, nuts, and soy are also important sources in the diet, but vegetables are the most commonly eaten and provide a substantial contribution to total dietary folic acid intakes. Citrus fruits and juices, particularly orange juice, are rich sources of dietary folic acid. Good sources of folic acid in the WIC food packages for women include ready-to-eat cereals, dried beans and peas, and orange juices.

Fortified cereals are an important source of vitamin B6. The CSFII 1995 data indicate the greatest contribution to vitamin B6 intake by the U.S. population comes from fortified ready-to-eat cereals; mixed foods (including sandwiches) with a main ingredient of meat, fish, or poultry; white potatoes and other starchy vegetables; and noncitrus fruits.

3. WIC Target Groups at Nutritional Risk Despite Receiving WIC Supplemental Foods

Pregnant women

Pregnant women did not meet 100 percent of the RDA for four of the five target nutrients and for the four nutrients of concern. A problem with the dietary intake of these pregnant women is low caloric intakes, low nutrient density, and higher fat intakes than recommended. An increase in kilocalories and intake of targeted nutrients requires reemphasis on nutrient-dense food choices to include lowfat dairy products, high-fiber grains, fruits, and vegetables.

Breast-feeding women

This study shows that WICP breast-feeding women did not meet 100 percent of the RDA for the WIC-target nutrients—vitamin A, vitamin C and iron—as well as 100 percent of the RDA for vitamin B6, magnesium, and zinc. Low intakes of zinc and vitamin B6 have been reported previously (Mackey, 1998), but the effect of these low intakes on infant growth and the mother's nutritional status needs future research. The evaluation of food choices or sources of these six nutrients in the diets of WICP breast-feeding women may help explain the low intakes. Also, these women are at a greater risk of nutritional adequacy and have limited resources for food purchasing. Nutrition programs for breast-feeding women need to more effectively target food sources of vitamin A, vitamin C, iron, vitamin B6, magnesium, and zinc, as well as calcium and folic acid, as a step towards improving their daily intakes.

Non-breast-feeding, postpartum women

This study identified non-breast-feeding, postpartum women as having serious dietary intake inadequacies. A supposition may be made that they are not consuming their WIC food package; however, the reasons for this cannot be assessed from the nutrient analysis alone. Completion of the food package analysis will provide more detailed information about this group's eating behavior and better insight into this observation.

One hypothesis for this behavior might be that WIC non-breast-feeding, postpartum women are self- restricting food intake in an effort to return to their pre-pregnancy weight. Also, non-breast-feeding, postpartum women may not realize the importance of continuing to eat well after the birth of their baby. This could be an issue handled through WIC's nutrition education mechanism. Another reason for inadequate nutrition could be related to the convenience issue. A newborn baby in the household may present challenges in available time for preparation of nutritious meals. These women may rely on a diet of convenience or fast-foods, rather than preparing meals using WIC food package foods. In support of this are two issues. First, the sodium intakes of WIC non-breast-feeding, postpartum women are extremely high (3,735 mg/day) (Appendix A). Second, their total caloric intakes are below the RDA and the percent of kilocalories from the macronutrients does not meet the current recommendation: percent of kilocalories from total carbohydrates is low at 47 percent; percent of kilocalories from protein, fat, and saturated fat are high at 16 percent, 36 percent and 12 percent, respectively, but are comparable to all women 18 and over. A strikingly similar caloric intake pattern exists for both the WIC eligible, non-participating and total sample study populations, indicating a general trend among non-breast-feeding, postpartum women regardless of WIC participation. Again, this could be an issue handled through WIC's nutrition education mechanism.

F. FUTURE RESEARCH QUESTIONS

- Is there a particular link between sugar (or starch) consumption and obesity? (No, says a 1997 WHO Report). (Food and Agriculture Organization, World Health Organization, 1997.)
- What about dietary sugars and dental carries? Are varied diet, oral hygiene, and fluoride use more important to dental health than reducing sugar consumption, and if so, then what?
- Is there a meaningful link between diets with "high glycemic load and low cereal fiber intake" and non-insulin-dependent diabetes mellitus?
- What about links among sugars and cardiovascular health, colon cancer?
- Behavioral research should be conducted to assess household distribution of foods and the impact on the nutritional status of WIC participants
- What is the effect of excessive protein on other nutrient requirements in pregnant and breast-feeding women?
- Multivariate regression analysis should be conducted to better understand the factors related to nutritional deficiencies.

V. REFERENCES

Ahluwalia IB, Hogan VK, Grummer-Strawn L, Colville SR, and Peterson A. 1998 The effect of WIC participation on small-for-gestational-age births: Michigan, 1992. Am J Public Health Sep;88(9):1374-7.

American Academy of Pediatrics. Committee on Nutrition. 1998. Pediatric Nutrition Handbook. 3rd ed. Elk Grove, Ill. American Academy of Pediatrics.

American Academy of Pediatrics. 1997. Cholesterol in Childhood. Pediatrics. Vol 101: 141-147.

American Diabetes Association. 1996. American Diabetes Association Complete Guide to Diabetes. American Diabetes Association.

American Dietetic Association. 1996. Nutrition Management of the Infant. Handbook of Clinical Dietetics. pp. 167-183.

American Dietetic Association. 1998. Position of the American Dietetic Association: Use of nutritive and non-nutritive sweeteners.. J Am Diet Assn. 98:580-587.

Bantle JP. 1989. Clinical aspects of sucrose and fructose metabolism. Diabetes Care; 12:56- 61.

Bantle JP, Laine DC, Castle GW, Thomas JW, Hoogwerf BJ, Goetz FC. 1983. Postprandial glucose and insulin responses to meals containing different carbohydrates in normal and diabetic subjects. N.Engl.J.Med.; 309:7-12.

Basiotis P, Kramer-LeBlanc CS, Kennedy ET. 1998. Maintaining Food and Nutrition Security: The Role of the Food Stamp Program and WIC. Family Economics and Nutrition Review. Vol 11(1&2): p. 4-16.

Bier D. 1998. Personal communication.

Bowman SA, Lino M, Gerrior SA, and Basiotis PP. 1998. The Healthy Eating Index: 1994-96. U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. CNPP-5.

Brennan RE, Kohrs JW, Nordstrom JW, Sauvage JP, and Shank RE. 1983. Composition of diets of low-income pregnant women: comparison of analyzed with calculated values. J.Am. Diet.Assoc. 83:538-545.

Buzzard IM, Feskanich D. 1987 Maintaining a food composition data base for multiple research studies: The NCC Food Table: Rand WM (ed.). Food Composition Data: A User's Perspective. The United Nations University.:115-122.

Cleveland, LE, Cook, AJ, Wilson, JW, Friday, JE, Ho, JW, and Chahil, PS. 1997. Pyramid Servings Data Results from USDA's 1994 Continuing Survey of Food Intakes by individuals. U.S. Department of Agriculture. Agricultural Research Service. Riverdale, MD.

Daly ME, Vale C. 1997. Walker M, Alberti KG, Mathers JC. Dietary carbohydrates and insulin sensitivity: a review of the evidence and clinical implications. Am.J.Clin.Nutr.; 66:1072-1085

Devaney, B., Bilheimer, L.T., and Schore, J. 1990. The Savings in Medicaid Costs for Newborns and Their Mothers from Prenatal Participation in the WIC Program. Alexandria, Virginia: U.S. Department of Agriculture.

Devaney B, and Schirm A. 1993. Infant Mortality Among Medicaid Newborns in Five States:The Effects of Prenatal WIC Participation. U. S. Department of Agriculture, Food and Nutrition Service. Office of Analysis and Evaluation.

Endres JM, Poell-Odenwald K, Sawicki M, and Welch P. 1985. Dietary assessment of pregnant adolescents participating in a supplemental-food program. J. Reprod. Med. 30:10-17.

Endres J, Dunning S, Poon S, Welch P, and Duncan H. 1987. Older pregnant women and adolescents: nutrition data after enrollment in WIC. J.Am. Diet. Assoc. 87:1011-1019.

Fattet I, Hovell FD, Orskov ER, Kyle DJ, Pennie K, and Smart RI. 1984. Undernutrition in sheep. The effect of supplementation with protein on protein accretion. Br. J. Nutr. 52:561-574.

Federation of American Societies for Experimental Biology, Life Sciences Research Office. 1995. Prepared for the Interagency Board for Nutrition Monitoring and Related Research. Third Report on Nutrition Monitoring in the United States. Volume 1. U.S. Government Printing Office, Washington, DC, 365 pp.

Food and Agriculture Organization, World Health Organization. 1997. Carbohydrates in human nutrition: Report of a Joint FAO/WHO Expert Consultation. 14-18 April, 1997. FAO Food and Nutrition Paper 66.

Gerrior, S., Bente, L. Nutrient Content of the U.S. Food Supply, 1909-94. 1997. U.S. Department of Agriculture. Center for Nutrition Policy and Promotion. Home Economics Research Report No 53.

Glinsmann, W.H., Bartholmey, S.J., Coletta, F. 1996. Dietary Guidelines for Infants: A Timely Reminder. Nutrition Reviews. Vol 54: 50-57.

Glinsmann WH and Park YK. 1995. Perspective on the 1986 Food and Drug Administration Assessment of the Safety of Carbohydrate sweeteners: Uniform Definitions and Recommendations for Future Assessments. Am J Clin Nutr. 62(5): pp.161-169S

Glinsmann WH, Iransquin H and Park YK. 1986. Report from FDA's Sugars Task Force: Evaluation of Health Aspects of Sugars Contained in Carbohydrate Sweeteners. J Nutr. Vol 116(115): pp. 51-216.

Guyton and Hall. 1996. Textbook of Medical Physiology, 9th Edition. W.B. Saunders, Philadelphia.

Hambidge KM, Casey CD and Krebs NF. 1986. Zinc. Pp. 1-137 in W. Mertz, ed. Trace Elements in Human and Animal Nutrition, 5th ed., Vol. 2. Academic Press, Orlando, Fla.

Heird, W.C. 1996. Nutritional Requirements During Infancy. In Present Knowledge in Nutrition. 7th ed. ILSI Press. Washington, DC.

Institute of Medicine (U.S.). 1990. Food and Nutrition Board. Committee on Nutritional Status and Weight Gain During Pregnancy. Nutrition During Pregnancy. National Academy Press. Washington, D.C.

Institute of Medicine (U.S). 1991. Food and Nutrition Board. Subcommittee on Nutrition During Lactation. Nutrition During Lactation. National Academy Press. Washington, D.C.

Institute of Medicine (U.S.). 1997. Food and Nutrition Board. Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intake for Calcium, Phosphorus, Magnesium, Vitamin D and Fluoride. National Academy Press. Washington, DC.

Lederman SA and Rosso P. 1980. Effects of protein and carbohydrate supplements on fetal and maternal weight and on body composition in food-restricted rats. Am. J. Clin. Nutr. 33:1912-1916.

Lee BM, Wolever TM. 1998. Effect of glucose, sucrose and fructose on plasma glucose and insulin responses in normal humans: comparison with white bread. Eur.J.Clin.Nutr.; 52:924-928.

Loris P, Dewey KG and Poirier-Brode K. 1985. Weight gain and dietary intake of pregnant teenagers. J.Am. Diet.Assoc. 85:1296-1305.

Lucas, B. 1996. Nutrition in Childhood. In Krause's Food, Nutrition and Diet Therapy. 9th ed. W.B. Saunders Company. Philadelphia.

Ludwig D.S., Majzoub J.A., Al-Zahrani A., Dallal G.E., Blanco I., and Roberts S.B. 1998. High Glycemic Index Foods, Overeating, and Obesity. Pediatrics: 103(3); E26 http://www.pediatrics.org/cgi/content/full/103/3/e26.

Mackey, A.D., Picciano, M.F., Michell, D.C., Smiciklas-Wright, H. 1998. Self-selected diets of lactating women often fail to meet dietary recommendations. J Am Diet Assoc. 98:297-302.

Mahon LK, Escott-Stump S (eds.), 1996. Krause's Food, Nutrition and Diet Therapy. W.B. Saunders Co. Philadelphia.

Moss N, and Carver K. 1998. The effect of WIC and Medicaid on infant mortality in the United States. Am J Public Health Sep;88(9):1354-61.

National Center for Health Statistics. April 1998. Third National Health and Nutrition Examination Survey (NHANES III), 1988-94. NHANES III Individual Foods Data File from the Dietary Recall Documentation, Series 11, No. 2A.

National Research Council. Committee on Diet and Health. Food and Nutrition Board. 1989. Diet and Health: Implications for Reducing Chronic Disease Risk. National Academy Press. Washington, D.C.

National Research Council, Commission on Life Sciences, Food and Nutrition Board, Subcommittee on the Tenth Edition of the RDAs. Recommended Dietary Allowances. 10th ed. 1989. National Academy Press. Washington, DC.

Olson, R.E. 1995. The Folly of Restricting Fat in the Diet of Children. Nutrition Today. Vol 30: 234-245.

Picone TA, Allen LH, Schramm MM and Olsen PN. 1982. Pregnancy outcome in North American women. I. Effects of diet, cigarette smoking, and psychological stress on maternal weight gain. Am. J. Clin. Nutr. 36:1205-1213.

Pond WG, Yen JT, and Yen LH. 1988. Body weight deficit in the absence of reduction in cerebrum weight and nucleic acid content in progeny of swine restricted in protein intake during pregnancy. Proc. Soc. Exp. Biol. Med. 188:117-121.

Putnam J and Allshouse J. 1997. Food Consumption, Prices and Expenditures. Unites States Department of Agriculture, Economic Research Service. Statistical Bulliten 939. Washington D.C.

Rickard K., date? Personal communication with Karyl Rickard, Ph.D., RD, CP, FADA, Indiana University.

Rose D; Habicht JP; Devaney B. 1998. Household participation in the Food Stamp and WIC programs increases the nutrient intakes of preschool children. J Nutr Mar;128(3):548-55.

Rosso P and Streeter MR. 1979. Effects of food or protein restriction on plasma volume expansion in pregnant rats. J. Nutr. 109:1887-1892.

Rush D, Sloan NL, Leighton J, Alvir JM, Howvitz DG, Seaver WB, Garbowski GC, Johnson SS, Kulka RA, Holt M, Devore JW, Lynch JT, Woodside MB and Shanklin DS. 1988. The National WIC Evaluation: Evaluation of the Special Supplemental Food Program for Women, Infants, and Children. V. Longitudinal study of pregnant women. Am. J. Clin. Nutr. 48:439-483.

Salmeron J, Ascherio A, Rimm EB, Colditz GA, Spiegelman D, Jenkins DJ, et al. 1997a. Dietary fiber, glycemic load, and risk of NIDDM in men. Diabetes Care; 20:545-550.

Salmeron J, Manson JE, Stampfer MJ, Colditz GA, Wing AL, Willett WC. 1997b. Dietary fiber, glycemic load, and risk of non-insulin-dependent diabetes mellitus in women [see comments]. JAMA; 277:472-477.

SAS Institute Inc. 1990. SAS Language: Reference, Version 6, First Edition Cary, NC: SAS Institute Inc., 1042 pp.

Shah BV, Barnwell BG, and Bieler GS. 1997. SUDAAN Users Manual, Release 7.5. Research Triangle Park, NC: Research Triangle Institute.

Suitor CJW, Gardner J, and Willett WC. 1989. A comparison of food frequency and diet recall method in studies of nutrient intake of low-income pregnant women. J. Am. Diet. Assoc. 89:1786-1794.

Taper LJ, Oliva JT and Ritchey SJ. 1985. Zinc and copper retention during pregnancy: the adequacy of prenatal diets with and without dietary supplementation. Am. J. Clin. Nutr. 41:1184-1192.

Tippett, Katherine S. and Yasmin S. Cypel, eds. 1998. Design and Operation: The continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey, 1994-96. U.S. Department of Agriculture, Agricultural Research Service, Nationwide Food Surveys Report No. 96-1, 264 pp.

U.S. Bureau of the Census. 1988-1994. Current population reports: Consumers income. Series P-60. U.S. Government Printing Office.

U.S. Department of Agriculture. Agricultural Research Service. 1998. Documentation: 1994-96 Continuing Survey of Food Intakes by Individuals (CSFII) and 1994-96 Diet and Health Knowledge Survey (DHKS).

U.S. Department of Agriculture. Agricultural Research Service. 1998. Data Tables: Results from USDA's 1994-96 Continuing Survey of Food intakes by Individuals and 1994-96 Diet and Health Knowledge Survey.

U.S. Department of Agriculture, Human Nutrition Information Service, 1987-88. Nationwide Food Consumption Survey 1987-88.

U.S. Department of Agriculture, Agricultural Research Service. Survey nutrient data bases for NHANES III, Phase 1 (1993) and Phase 2 (1995). Riverdale, MD.

U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. 1999. Food Guide Pyramid for Young Children: A Daily Guide for 2- to 6-year-olds. Program Aid 1648.

U.S. Department of Agriculture. Food and Nutrition Service. 1991. Technical Papers. Review of WIC Food Packages. Prepared by The Pennsylvania State University, Department of Nutrition. Mary Frances Picciano, PhD, Principal Investigator.

U.S. Department of Agriculture. Food and Nutrition Service. 1993. Infant Nutrition and Feeding. A Reference Handbook for Nutrition and Health Counselors in the WIC and CSF Programs. FNS-288.

U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis and Evaluation. 1994. Study of WIC Participant and Program Characteristics 1992. FNS 53-3198-9-002.

U.S. Department of Agriculture, Food And Consumer Service. Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): WIC Cereal Sugar Limit and Food Package Review. Federal Register. December 31, 1997. Number 62:68233.

U.S. Department of Agriculture, Human Nutrition Information Service. 1992. The Food Guide Pyramid. Home and Garden Bulletin No. 252.

U.S. Department of Agriculture, U.S. Department of Health and Human Services. 1995. Nutrition and Your Health: Dietary Guidelines for Americans, fourth edition. Home and Garden Bulletin No. 232.

U.S. Department of Health and Human Services. 1988. The Surgeon General's Report on Nutrition and Health. DHHS (PHS) publication 88-50210. Washington, DC.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. 1992. Recommendations for the use of folic acid to reduce the number of cases of spina bifida and other neural tube defects. Morbidity and Mortality Weekly Report. 41:1-7.

U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. National Center for Health Statistics. April 1998. Third National Health and Nutrition Examination Survey (NHANES III), 1988-94. NHANES III Individual Foods Data File from the Dietary Recall Documentation, Series 11, No. 2A.

U.S. Department of Health and Human Services. National Center for Health Statistics. Third National Health and Nutrition Examination Survey, 1988-94, Reference manuals and reports (CD-ROM). Hyattsville, MD: Centers for Disease Control and Prevention, 1996.

U.S. Department of Health and Human Services. Food and Drug Administration. 1996. Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): WIC Cereal Sugar Limit Notice. Federal Register. March 18, 1996. Number 61: 10903.

University of Minnesota, Nutrition Coordinating Center. 1996. Nutrient database versions 15-27. Minneapolis, MN.

Williams, C.L., Bollella, M, Wynder, E.L. 1995. A New Recommendation for Dietary Fiber in Childhood. Pediatrics. Vol 96: 985-988.

Yates, A.L., Schlicker. S.A., Suitor, C.W. 1998. Dietary Reference Intakes: the new basis for recommendations for calcium and related nutrients, B vitamins, and choline. Journal of the American Dietetic Association. 98: 699-706.

APPENDIX A-1. Median 24-Hour Total Nutrient Intake of Infants 2-3 Months Old

	RDA	WIC Participating			WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.[c]	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		155				52					315				
Protein (gm)	13		14.88	0.67	114%		14.65	1.06		113%		14.82	0.30		114%
Iron (mg)	6		14.28	0.78	238%		12.93	1.23		216%		12.65	0.44		211%
Calcium (mg)	400		567.43	27.50	142%		552.73	41.57		138%		543.06	16.54		136%
Vitamin A (IU)	1250		1952.61	85.84	156%		1840.25	170.79		147%		1900.63	40.23		152%
Vitamin A (RE)[a]	375		640.85	36.05	171%		578.72	65.21		154%		629.04	23.27		168%
Vitamin C (mg)	30		68.66	4.63	229%		68.46	7.69		228%		67.64	3.21		225%
Folic acid (mcg)	25		91.93	4.00	368%		91.16	5.21		365%		93.39	1.52		374%
Zinc (mg)	5		5.11	0.15	102%		5.30	0.45		106%		5.13	0.14		103%
Vitamin B6 (mg)	0.3		0.45	0.01	150%		0.43	0.04		143%		0.44	0.01		147%
Magnesium (mg)	40		61.40	3.89	154%		61.41	4.82		154%		59.12	2.12		148%
Other Nutrients															
Thiamin (mg)	0.3		0.76	0.03	253%		0.60	0.05	<.01	200%		0.68	0.01	<.05	227%
Riboflavin (mg)	0.4		1.04	0.04	260%		0.91	0.08		228%		0.98	0.02		245%
Niacin (mg)	5		7.89	0.48	158%		6.99	0.90		140%		7.71	0.23		154%
Vitamin B12 (mcg)	0.4		1.64	0.07	410%		1.72	0.19		430%		1.71	0.05		428%
Vitamin D (mcg)	7.5		9.18	0.29	122%		8.38	0.66		112%		9.12	0.13		122%
Vitamin E (mg)	3		10.33	0.88	344%		10.38	1.01		346%		10.59	0.54		353%
Phosphorus (mg)	300		402.65	24.26	134%		398.06	36.94		133%		393.96	12.34		131%
Copper (mg)	0.5		0.52	0.03	104%		0.48	0.04		96%		0.51	0.01		102%
Selenium (mcg)[b]			14.84	0.65			14.17	0.97				15.01	0.38		
Sodium (mg)	120		194.88	8.36	162%		204.72	20.08		171%		195.72	6.28		163%
Potassium (mg)[b]			771.36	33.70			764.74	74.61				750.24	19.72		
Beta-carotene (mcg)[b]			7.96	2.74			6.96	3.73				5.96	1.13		
Total carotenes (RE)[a,b]			0.37	(e)			0.81	(e)				0.33	(e)		
Retinol (mcg)[b]			550.83	17.60			489.35	41.08				550.07	11.90		
Pantothenic Acid (mg)[b]			2.99	0.10			3.01	0.37				3.06	0.07		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX A-2. Median 24-Hour Total Nutrient Intake of Infants 4-11 Months Old

	RDA	WIC Participating			WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.[c]	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		155				52					315				
Protein (gm)	9		16.85	0.50	187%		12.88	0.77	<.001	143%		15.10	0.31	<.005	168%
Iron (mg)	554		616.24	13.20	111%		748.07	42.96	<.005	135%		659.10	10.55	<.02	119%
Calcium (mg)	1250		3005.92	146.01	240%		3227.58	196.26		258%		3382.54	97.22	<.05	271%
Vitamin A (IU)	375		742.59	21.28	198%		733.64	44.01		196%		765.59	16.22		204%
Vitamin A (RE)[a]	34		103.69	4.83	305%		88.59	5.20	<.05	261%		97.64	2.95		287%
Vitamin C (mg)	33		112.52	3.27	341%		111.58	2.80		338%		110.92	1.57		336%
Folic acid (mcg)	5		5.65	0.15	113%		5.67	0.16		113%		5.57	0.09		111%
Zinc (mg)	0.5		0.65	0.01	130%		0.69	0.03		138%		0.67	0.01		134%
Vitamin B6 (mg)	55		97.01	2.47	176%		127.76	6.64	<.001	232%		107.55	2.37	<.005	196%
Magnesium (mg)															
Other Nutrients	0.4		0.96	0.03	240%		0.89	0.04		223%		0.90	0.02		225%
Thiamin (mg)	0.5		1.31	0.02	262%		1.47	0.04	<.05	294%		1.33	0.02		266%
Riboflavin (mg)	6		10.22	0.25	170%		9.07	0.28	<.005	151%		9.58	0.16	<.05	160%
Niacin (mg)	0.45		1.84	0.06	409%		2.27	0.11	<.001	504%		2.02	0.04	<.02	449%
Vitamin B12 (mcg)	9.4		8.19	0.19	87%		8.39	0.21		89%		8.00	0.13		85%
Vitamin D (mcg)	4		10.14	0.34	254%		7.27	0.62	<.001	182%		8.91	0.25	<.005	223%
Vitamin E (mg)	454		525.64	11.37	116%		668.98	34.96	<.001	147%		567.91	11.92	<.02	125%
Phosphorus (mg)	0.62		0.65	0.02	105%		0.57	0.02	<.005	92%		0.61	0.01		98%
Copper (mg)			24.60	0.90			29.97	1.35	<.001			26.22	0.54		
Selenium (mcg)[b]	182		342.47	24.27	188%		529.28	77.26	<.05	291%		375.73	18.93		206%
Sodium (mg)			1154.04	20.61			1349.77	57.12	<.002			1226.33	21.63	<.02	
Potassium (mg)[b]			600.40	93.02			878.63	85.51	<.05			904.36	56.21	<.01	
Beta-carotene (mcg)[b]			96.66	14.20			132.70	14.72				141.41	9.57	<.01	
Total carotenes (RE)[a,b]			493.83	8.39			444.19	21.43	<.05			476.09	8.71		
Retinol (mcg)[b]			3.37	0.07			3.51	0.09				3.46	0.05		
Pantothenic Acid (mg)[b]			3.37	0.07			3.51	0.09				3.46	0.05		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX A-3. Median 24-Hour Total Nutrient Intake of Children 1-3 Years Old

	RDA	WIC Participating				WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.[c]	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		803				1474					3309				
Protein (gm)	16		49.33	1.29	308%		48.22	0.74		301%		46.66	0.6		292%
Iron (mg)	10		9.64	0.33	96%		8.8	0.2	<.05	88%		9.12	0.14		91%
Calcium (mg)	800		788.22	28.38	99%		727.56	22.73		91%		763.44	12.55		95%
Vitamin A (IU)	1400		2781.2	131.29	199%		2576.33	66.39		184%		2686.31	50.74		192%
Vitamin A (RE)[a]	400		575.14	24.76	144%		544.92	16.46		136%		575.89	11.57		144%
Vitamin C (mg)	40		60.19	3.79	150%		51.52	1.95	<.05	129%		54.19	1.65		135%
Folic acid (mcg)	50		161.38	6.19	323%		153.92	4.04		308%		158.46	2.27		317%
Zinc (mg)	10		6.55	0.14	66%		6.59	0.16		66%		6.43	0.08		64%
Vitamin B6 (mg)	1		1.17	0.03	117%		1.13	0.03		113%		1.16	0.01		116%
Magnesium (mg)	80		175.83	6.06	220%		170.83	4.72		214%		177.73	1.94		222%
Other Nutrients															
Thiamin (mg)	0.7		1.16	0.03	166%		1.16	0.03		166%		1.14	0.02		163%
Riboflavin (mg)	0.8		1.61	0.04	201%		1.51	0.03		189%		1.56	0.02		195%
Niacin (mg)	9		11.84	0.44	132%		12.86	0.3		143%		12.4	0.17		138%
Vitamin B12 (mcg)	0.7		3.06	0.13	437%		2.81	0.07		401%		2.77	0.05	<.05	396%
Vitamin D (mcg)	10		5.53	0.29	55%		5.03	0.23		50%		5.33	0.13		53%
Vitamin E (mg)	6		4.45	0.18	74%		4.82	0.14		80%		4.65	0.11		78%
Phosphorus (mg)	800		937	27.39	117%		883.99	19.88		110%		905.94	12.54		113%
Copper (mg)	0.85		0.68	0.02	80%		0.65	0.02		76%		0.65	0.01		76%
Selenium (mcg)[b]			61.28	1.37			64.07	1.61				61.05	0.97		
Sodium (mg)	262		2000.21	63.92	763%		2097.74	55.09		801%		1995.4	32.28		762%
Potassium (mg)[b]			1833.61	54.91			1730.78	35.79				1825.65	20.7		
Beta-carotene (mcg)[b]			720.97	47.52			662.58	35.1				698.85	22.06		
Total carotenes (RE)[a,b]			90.88	6.64			100.23	4.87				101.79	3.46		
Retinol (mcg)[b]			341.71	20.28			331	10.82				348.81	8.3		
Pantothenic Acid (mg)[b]			3.37	0.12			3.14	0.07				3.15	0.03		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX A-4. Median 24-Hour Total Nutrient Intake of Children 4 Years Old

	RDA	WIC Participating				WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.c	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		130				526					1000				
Protein (gm)	24		59.74	4.66	249%		56.95	1.9		237%		53.86	1.48		224%
Iron (mg)	10		11.27	0.64	113%		10.64	0.38		106%		10.38	0.28		104%
Calcium (mg)	800		794.68	60.3	99%		759.47	39.55		95%		778.44	26.72		97%
Vitamin A (IU)	1400		2635.97	317.99	188%		2822.69	157.04		202%		2922.7	126.71		209%
Vitamin A (RE)[a]	500		585.05	55.5	117%		621.72	38.95		124%		658.26	31.07		132%
Vitamin C (mg)	45		54.12	9.38	120%		62.9	5.32		140%		63.81	3.09		142%
Folic acid (mcg)	75		180.33	20.75	240%		219.98	10.37		293%		195.6	6.32		261%
Zinc (mg)	10		7.63	0.53	76%		8.08	0.37		81%		7.49	0.27		75%
Vitamin B6 (mg)	1.1		1.43	0.06	130%		1.38	0.06		125%		1.34	0.03		122%
Magnesium (mg)	120		178.61	13.55	149%		203.4	8.2		170%		194.95	7.44		162%
Other Nutrients															
Thiamin (mg)	0.9		1.43	0.08	159%		1.41	0.03		157%		1.38	0.03		153%
Riboflavin (mg)	1.1		1.72	0.14	156%		1.68	0.09		153%		1.68	0.06		153%
Niacin (mg)	12		16.4	0.61	137%		15.73	0.57		131%		15.26	0.36		127%
Vitamin B12 (mcg)	1		3.46	0.26	346%		2.96	0.12		296%		2.92	0.1		292%
Vitamin D (mcg)	10		4.8	0.37	48%		4.89	0.28		49%		5.16	0.21		52%
Vitamin E (mg)	7		5.64	0.65	81%		5.52	0.24		79%		5.64	0.21		81%
Phosphorus (mg)	800		960.59	55.25	120%		1014.16	42.89		127%		986.16	27.95		123%
Copper (mg)	1.3		0.75	0.06	58%		0.78	0.03		60%		0.74	0.02		57%
Selenium (mcg)[b]			81.95	3.84			76.71	2.9				74.76	2.26		
Sodium (mg)	300		2305.75	204.04	769%		2498.62	135.11		833%		2348.21	60.09		783%
Potassium (mg)[b]			1828.1	182.14			1931.57	80.21				1849.13	57.26		
Beta-carotene (mcg)[b]			736.15	134.78			735.04	49.67				739.88	34.59		
Total carotenes (RE)[a,b]			106.26	26.62			109.54	10.86				111.21	6.32		
Retinol (mcg)[b]			351.18	49.44			378.6	36.67				408.79	23.13		
Pantothenic Acid (mg)[b]			3.3	0.34			3.55	0.22				3.36	0.12		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX A-5. Median 24-Hour Total Nutrient Intake of Pregnant Women

	RDA	WIC Participating				WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.[c]	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		71				171					346				
Protein (gm)	60		62.64	11.54	104%		82.20	6.13		137%		80.53	4.40		134%
Iron (mg)	30		13.18	2.39	44%		13.16	0.60		44%		13.20	0.44		44%
Calcium (mg)	1200		716.04	119.17	60%		910.41	147.38		76%		980.91	71.54		82%
Vitamin A (IU)	2650		3221.42	421.44	122%		3546.96	349.97		134%		4043.82	378.33		153%
Vitamin A (RE)[a]	800		680.42	88.74	85%		709.61	97.30		89%		743.39	84.36		93%
Vitamin C (mg)	70		70.20	25.80	100%		52.91	13.70		76%		75.56	13.85		108%
Folic acid (mcg)	400		233.64	45.93	58%		236.11	25.09		59%		239.59	14.58		60%
Zinc (mg)	15		9.14	1.33	61%		11.21	0.81		75%		10.36	0.71		69%
Vitamin B6 (mg)	2.2		1.70	0.31	77%		1.88	0.12		85%		1.72	0.11		78%
Magnesium (mg)	320		221.31	41.47	69%		267.67	29.02		84%		280.45	22.65		88%
Other Nutrients															
Thiamin (mg)	1.5		1.46	0.28	97%		1.80	0.20		120%		1.75	0.07		117%
Riboflavin (mg)	1.6		1.84	0.30	115%		2.27	0.25		142%		2.04	0.13		128%
Niacin (mg)	17		17.74	1.90	104%		21.83	1.37		128%		21.81	1.03		128%
Vitamin B12 (mcg)	2.2		3.41	0.51	155%		4.46	0.59		203%		3.98	0.33		181%
Vitamin D (mcg)	10		4.14	0.60	41%		5.21	1.45		52%		4.81	0.67		48%
Vitamin E (mg)	10		6.10	1.79	61%		8.24	0.57		82%		8.00	0.45		80%
Phosphorus (mg)	1200		1026.73	150.54	86%		1376.42	154.54		115%		1369.81	102.84		114%
Copper (mg)[b]			1.06	0.15			1.08	0.09				1.13	0.05		
Selenium (mcg)	65		77.76	14.92	120%		123.77	9.26	<.01	190%		113.00	7.60		174%
Sodium (mg)	569		3426.86	308.94	602%		3726.72	263.65		655%		3545.79	211.22		623%
Potassium (mg)[b]			2068.96	281.23			2854.58	348.63				2742.72	192.69	<.05	
Beta-carotene (mcg)[b]			1214.91	178.70			964.36	135.50				1238.59	171.80		
Total carotenes (RE)[a,b]			164.19	78.86			144.50	28.97				220.32	32.70		
Retinol (mcg)[b]			227.13	80.53			383.48	102.34				388.31	31.97		
Pantothenic Acid (mg)[b]			3.62	0.87			4.56	0.56				4.45	0.34		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX A-6. Median 24-Hour Total Nutrient Intake of Breast-feeding Women

	RDA	WIC Participating			WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.[c]	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		33				23					83				
Protein (gm)	65		97.66	4.19	150%		105.74	(e)		163%		102.69	7.04		158%
Iron (mg)	15		13.22	2.06	88%		20.99	4.51		140%		22.82	3.49	<.02	152%
Calcium (mg)	1200		1442.60	228.49	120%		1215.62	(e)		101%		1359.58	148.79		113%
Vitamin A (IU)	4350		4809.28	1292.48	111%		7337.11	2540.80		169%		7603.76	1289.24		175%
Vitamin A (RE)[a]	1280		1141.38	134.98	89%		1505.27	331.68		118%		1372.00	235.12		107%
Vitamin C (mg)	94		66.97	30.54	71%		189.52	65.89		202%		136.40	21.95		145%
Folic acid (mcg)	277		284.47	133.90	103%		422.44	(e)		153%		421.26	44.37		152%
Zinc (mg)	19		13.59	1.36	72%		14.71	1.53		77%		14.76	1.39		78%
Vitamin B6 (mg)	2.1		1.77	0.22	84%		2.79	(e)		133%		2.41	0.35		115%
Magnesium (mg)	353		297.69	71.55	84%		463.19	(e)		131%		397.51	44.18		113%
Other Nutrients															
Thiamin (mg)	1.6		1.93	0.30	121%		2.38	(e)		149%		2.30	0.23		144%
Riboflavin (mg)	1.8		2.49	0.16	138%		2.26	(e)		126%		2.99	0.32		166%
Niacin (mg)	20		20.58	2.83	103%		29.89	(e)		149%		28.68	2.85	<.05	143%
Vitamin B12 (mcg)	2.6		5.77	1.23	222%		4.25	0.39		163%		5.45	0.73		210%
Vitamin D (mcg)	10		7.07	1.10	71%		9.17	(e)		92%		10.87	2.25		109%
Vitamin E (mg)	12		6.86	1.00	57%		11.79	(e)		98%		10.15	1.69		85%
Phosphorus (mg)	1200		1663.95	186.31	139%		2106.14	(e)		176%		1803.68	145.59		150%
Copper (mg)[b]			1.17	0.36			2.00	0.27				1.55	0.21		
Selenium (mcg)[b]			118.84	4.06			143.87	19.87				135.49	5.33	<.02	
Sodium (mg)	635		3174.63	211.14	500%		4410.65	724.74		695%		3454.70	347.71		544%
Potassium (mg)[b]			3152.25	464.97			4286.89	(e)				3423.28	365.03		
Beta-carotene (mcg)[b]			1414.22	867.52			2242.54	755.63				1468.04	354.07		
Total carotenes (RE)[a,b]			276.14	155.23			357.34	110.57				206.61	70.65		
Retinol (mcg)[b]			508.97	63.64			556.88	278.06				897.07	178.31	<.05	
Pantothenic Acid (mg)[b]			4.96	0.40			6.37	(e)				6.17	0.87		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX A-7. Median 24-Hour Total Nutrient Intake of Non-breast-feeding Women

	RDA	WIC Participating			WIC Eligible Non-participating				Total Sample			
		n	median	s.e.[c]	%RDA	n	median	s.e.[c]	p[d]	%RDA	n	median	s.e.[c]	p[d]	%RDA
Target Nutrients and Nutrients of Concern		80				110					249				
Protein (gm)	48		77.65	9.84	162%		58.77	9.12		122%		74.38	4.22		155%
Iron (mg)	15		12.55	1.25	84%		11.01	1.51		73%		12.63	0.94		84%
Calcium (mg)	1069		636.35	60.43	60%		437.75	65.87	<.05	41%		660.09	98.28		62%
Vitamin A (IU)	2650		2999.52	534.54	113%		2325.65	421.69		88%		3323.08	478.83		125%
Vitamin A (RE)[a]	800		580.37	98.02	73%		509.26	104.78		64%		639.10	101.83		80%
Vitamin C (mg)	60		35.88	6.07	60%		42.98	11.26		72%		42.24	4.80		70%
Folic acid (mcg)	180		174.49	8.82	97%		141.86	19.07		79%		182.17	11.83		101%
Zinc (mg)	12		11.70	1.80	98%		8.23	1.48		69%		9.76	0.63		81%
Vitamin B6 (mg)	1.6		1.42	0.13	89%		1.09	0.23		68%		1.34	0.09		84%
Magnesium (mg)	285		196.16	20.88	69%		158.70	30.66		56%		220.48	22.29		77%
Other Nutrients															
Thiamin (mg)	1.1		1.39	0.21	126%		1.20	0.18		109%		1.40	0.13		127%
Riboflavin (mg)	1.3		1.62	0.21	125%		1.12	0.13	<.05	86%		1.58	0.11		122%
Niacin (mg)	15		19.57	2.69	130%		17.70	3.04		118%		17.79	1.82		119%
Vitamin B12 (mcg)	2		3.48	0.67	174%		2.52	0.43		126%		3.30	0.29		165%
Vitamin D (mcg)	10		3.51	0.59	35%		2.33	0.80		23%		3.07	0.69		31%
Vitamin E (mg)	8		7.66	0.88	96%		6.35	0.87		79%		8.05	0.78		101%
Phosphorus (mg)	1200		1066.26	101.87	89%		903.45	76.19		75%		1080.89	94.24		90%
Copper (mg)[b]			0.86	0.15			0.84	0.11				1.10	0.10		
Selenium (mcg)[e]			90.61	18.93			91.71	10.92				101.80	10.22		
Sodium (mg)	500		3734.92	517.14	747%		3199.55	476.88		640%		3495.44	229.49		699%
Potassium (mg)[b]			1704.84	279.28			1587.98	255.15				2111.73	250.91		
Beta-carotene (mcg)[b]			725.89	183.96			844.60	186.06				1173.65	235.33		
Total carotenes (RE)[a,b]			100.97	31.08			189.96	64.09				242.11	52.46	<.05	
Retinol (mcg)[b]			351.07	65.23			149.96	63.61	<.05			318.72	40.05		
Pantothenic Acid (mg)[b]			3.91	0.40			3.24	0.35				3.78	0.26		

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] s.e.=standard error
[d] p value that median is significantly different than WIC participating group
[e] Sample size too small for reliable estimate

APPENDIX B-1. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Infants 2-3 Months old

	Reference	WIC Participating				WIC Eligible Non-participating					Total Sample				
		n	median	s.e.[c]	% rec	n	median	s.e.[c]	p[d]	% rec	n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	650	155	665.72	19.59	102%	52	663.82	52.03		102%	315	667.16	10.87		103%
Total carbohydrates (gm)			78.80	2.17			78.60	5.74				76.81	1.65		
Sucrose (gm)			1.99	0.77			0.80	(e)				1.72	0.51		
Fructose (gm)			0.77	0.31			1.23	0.54				0.92	0.24		
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			1.62	0.63			2.65	2.34				1.66	0.59		
Lactose (gm)			56.01	3.07			43.72	14.60				55.30	2.31		
Maltose (gm)			(e)	(e)			0.27	(e)				(e)	(e)		
Total sugars (gm)			65.31	1.60			58.64	6.81				64.90	1.38		
Added sugars:sucr+gala+gluc+malt (gm)			5.07	1.26			7.31	5.70				5.08	1.22		
Natural sugars:fruc+lact (gm)			59.66	3.35			45.26	12.56				58.87	2.86		
% kcal from carbohydrates (%kcal)[a]			44.76	0.76			46.65	1.51				44.56	0.59		
% kcal from sucrose (%kcal)			1.07	0.42			0.66	(e)				1.04	0.27		
% kcal from total sugars (%kcal)			41.77	0.58			36.87	2.68				42.11	0.28		
% kcal from added sugars (%kcal)			2.92	0.83			4.60	4.27				2.91	0.73		
% kcal from natural sugars (%kcal)			38.61	1.25			29.73	6.88				38.93	0.95		
% of carbohydr. from sucrose (%)[b]			2.30	0.87			1.61	(e)				2.15	0.59		
% of carbohydr. from total sugars (%)			87.54	2.80			69.70	5.95	<.01			87.94	1.81		
% of carbohydr. from added sugars (%)			6.06	1.56			9.11	8.13				6.05	1.39		
% of carbohydr. from natural sugars (%)			79.82	3.70			64.27	15.34				79.72	3.31		
% kcal from protein (%kcal)			8.56	0.03			8.76	0.30				8.55	0.01		
Dietary fiber (gm)			0.09	0.09			0.11	(e)				0.09	0.07		
Starch (gm)			7.83	2.61			14.70	4.90				8.75	1.84		
Cholesterol (mg)			5.12	0.39			3.96	1.45				4.97	0.30		
Total fats (gm)			33.47	0.96			29.13	2.7				33.08	0.45		
% of kcals from total fat (%kcal)			45.81	0.68			44.37	1.63				45.90	0.45		
Total saturated fatty acids (gm)			17.20	0.77			14.80	1.48				16.28	0.55		
% of kcals from saturated fat (%kcal)			22.23	0.74			20.78	0.55				22.08	0.37		

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX B-2. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Infants 4-11 Months old

	Reference	WIC Participating				WIC Eligible Non-participating					Total Sample				
		n	median	s.e.[c]	% rec	n	median	s.e.[c]	p[d]	% rec	n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	803	555	872.49	15.39	109%	277	917.64	18.22		114%	1305	878.84	10.80		109%
Total carbohydrates (gm)			115.32	1.64			122.55	2.89	<.05			117.55	1.70		
Sucrose (gm)			10.00	0.83			11.19	1.27				11.89	0.58		
Fructose (gm)			8.15	0.49			8.53	0.97				8.67	0.39		
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			7.14	0.44			8.03	0.86				7.67	0.38		
Lactose (gm)			48.63	2.20			41.69	2.66	<.05			43.38	1.13	<.05	
Maltose (gm)			0.50	0.08			0.57	0.08				0.68	0.05		
Total sugars (gm)			79.98	1.65			79.83	2.20				79.45	1.09		
Added sugars:sucr+gala+gluc+malt (gm)			20.29	1.25			22.42	2.41				23.30	0.93		
Natural sugars:fruc+lact (gm)			57.16	1.98			53.24	2.32				54.71	1.02		
% kcal from carbohydrates (%kcal)[a]			52.03	0.43			52.63	0.79				53.21	0.33	<.05	
% kcal from sucrose (%kcal)			4.59	0.35			5.13	0.49				5.35	0.20		
% kcal from total sugars (%kcal)			37.28	0.54			35.78	0.94				37.01	0.45		
% kcal from added sugars (%kcal)			8.90	0.55			10.41	1.20				10.43	0.38		
% kcal from natural sugars (%kcal)			27.80	0.85			23.60	0.91				25.08	0.57		
% of carbohydr. from sucrose (%)[b]			8.57	0.68			9.61	0.85				9.85	0.39		
% of carbohydr. from total sugars (%)			69.48	1.19			65.94	1.32				67.40	0.74		
% of carbohydr. from added sugars (%)			16.75	0.75			19.58	1.93				19.04	0.71	<.05	
% of carbohydr. from natural sugars (%)			50.98	1.53			43.69	1.90				45.73	1.13	<.01	
% kcal from protein (%kcal)			9.29	0.16			11.42	0.57				9.86	0.17	<.02	
Dietary fiber (gm)			3.92	0.17			4.64	0.25	<.02			4.60	0.13	<.002	
Starch (gm)			28.26	1.49			32.01	1.96				29.77	0.83		
Cholesterol (mg)			15.07	2.19			50.86	11.51	<.005			22.05	2.16	<.05	
Total fats (gm)			36.22	0.61			35.82	0.92				34.88	0.51		
% of kcals from total fat (%kcal)			37.77	0.29			35.80	0.73	<.01			36.41	0.22	<.001	
Total saturated fatty acids (gm)			16.60	0.34			17.31	0.53				16.36	0.18		
% of kcals from saturated fat (%kcal)			17.34	0.24			16.90	0.36				16.88	0.16		

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX B-3. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Children 1-3 Years Old

	Reference	WIC Participating				WIC Eligible Non-participating					Total Sample				
		n	median	s.e.[c]	% rec	n	median	s.e.[c]	p[d]	% rec	n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	1300	803	1313.20	26.52	101%	1474	1349.42	23.42		104%	3309	1318.21	12.81		101%
Total carbohydrates (gm)			168.46	3.56			172.37	3.47				173.06	2.17		
Sucrose (gm)			24.29	1.10			27.14	1.17				26.96	0.60	<.05	
Tructose (gm)			18.62	1.33			17.15	0.52				18.96	0.54		
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			17.24	1.06			17.62	0.55				18.20	0.39		
Lactose (gm)			19.83	1.27			18.10	0.68				19.56	0.50		
Maltose (gm)			0.74	0.07			1.11	0.06	<.001			1.10	0.05	<.001	
Total sugars (gm)			90.52	3.00			89.90	2.48				93.37	1.37		
Added sugars:sucr+gala+gluc+malt (gm)	20		45.86	1.56	229%		48.75	1.55		244%		49.70	0.74	<.05	249%
Natural sugars:fruc+lact (gm)			42.78	1.70			39.67	1.02				41.94	0.69		
% kcal from carbohydrates (%kcal)[a]			51.41	0.93			52.30	0.60				53.40	0.35	<.05	
% kcal from sucrose (%kcal)			7.43	0.26			8.50	0.31	<.01			8.50	0.15	<.001	
% kcal from total sugars (%kcal)			27.75	0.87			27.20	0.41				28.86	0.32		
% kcal from added sugars (%kcal)	6.154		13.97	0.59	227%		14.97	0.48		243%		15.52	0.23	<.02	252%
% kcal from natural sugars (%kcal)			13.05	0.55			11.71	0.27	<.05			12.81	0.19		
% of carbohydr. from sucrose (%)[b]			14.98	0.37			16.69	0.50	<.01			16.03	0.22	<.02	
% of carbohydr. from total sugars (%)			55.35	1.01			53.08	0.52	<.05			54.88	0.31		
% of carbohydr. from added sugars (%)			28.53	0.70			28.66	0.62				29.45	0.29		
% of carbohydr. from natural sugars (%)			25.09	0.59			22.38	0.47	<.001			23.95	0.31		
% kcal from protein (%kcal)			15.08	0.25			14.31	0.21	<.02			14.47	0.11	<.05	
Dietary fiber (gm)			7.90	0.25			8.26	0.26				8.33	0.16		
Starch (gm)			60.85	1.32			69.81	1.50	<.001			65.40	1.23	<.02	
Cholesterol (mg)			164.40	9.79			150.51	5.96				136.51	3.84	<.01	
Total fats (gm)			48.42	1.70			50.51	1.43				47.59	0.78		
% of kcals from total fat (%kcal)			35.15	0.71			34.23	0.48				33.54	0.35	<.05	
Total saturated fatty acids (gm)			19.66	0.58			19.28	0.57				18.96	0.28		
% of kcals from saturated fat (%kcal)			13.69	0.36			13.10	0.20				13.07	0.15		

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX B-4. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Children 4 Years Old

	Refere nce	WIC Participating n	median	s.e.[c]	% rec	WIC Eligible Non-participating n	median	s.e.[c]	p[d]	% rec	Total Sample n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	1800	130	1584.22	65.01	88%	526	1599.71	49.33		89%	1000	1542.17	40.17		86%
Total carbohydrates (gm)	247.5		213.70	9.45	86%		205.16	4.78		83%		207.97	3.85		84%
Sucrose (gm)			38.12	4.37			36.80	1.98				39.66	1.39		
Fructose (gm)			25.04	1.41			19.69	0.87	<.002			20.88	0.86	<.02	
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			24.85	2.05			19.48	0.82	<.02			20.91	0.51		
Lactose (gm)			13.50	2.28			17.48	1.14				17.77	0.82		
Maltose (gm)			1.35	0.19			1.37	0.14				1.58	0.13		
Total sugars (gm)			110.54	5.68			103.98	3.46				108.40	2.34		
Added sugars:sucr+gala+gluc+malt (gm)	32		67.37	5.75	211%		60.33	2.19		189%		65.47	1.77		205%
Natural sugars:fruc+lact (gm)			40.30	3.09			40.90	1.45				42.30	0.93		
% kcal from carbohydrates (%kcal)[a]			54.96	1.47			52.94	0.68				54.34	0.71		
% kcal from sucrose (%kcal)			8.90	1.32			9.45	0.46				10.59	0.35		
% kcal from total sugars (%kcal)			27.20	2.41			27.22	0.41				28.81	0.65		
% kcal from added sugars (%kcal)	7.111		16.26	1.67	229%		16.69	0.56		235%		17.49	0.41		246%
% kcal from natural sugars (%kcal)			10.71	0.64			10.38	0.31				11.08	0.20		
% of carbohydr. from sucrose (%)[b]			17.04	2.15			18.26	0.83				19.06	0.59		
% of carbohydr. from total sugars (%)			54.23	1.85			51.70	0.63				52.93	0.68		
% of carbohydr. from added sugars (%)	12.93		31.82	2.27	246%		31.78	0.92		246%		32.48	0.74		251%
% of carbohydr. from natural sugars (%)			20.28	0.98			19.84	0.82				20.56	0.41		
% kcal from protein (%kcal)	15		14.26	0.69	95%		14.03	0.33		94%		13.93	0.20		93%
Dietary fiber (gm)	9		9.66	0.94	107%		10.65	0.48		118%		10.22	0.48		114%
Starch (gm)			85.57	5.04			85.88	3.59				81.87	2.32		
Cholesterol (mg)			167.82	28.24			175.70	10.33				150.33	5.81		
Total fats (gm)			54.77	5.89			58.51	3.59				54.68	2.53		
% of kcals from total fat (%kcal)			32.77	1.43			33.60	0.62				32.41	0.56		
Total saturated fatty acids (gm)			21.18	2.04			22.14	1.00				21.06	0.84		
% of kcals from saturated fat (%kcal)			12.85	0.55			12.39	0.25				12.35	0.29		

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX B-5. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Pregnant Women

	Refere nce	WIC Participating n	median	s.e.[c]	% rec	WIC Eligible Non-participating n	median	s.e.[c]	p[d]	% rec	Total Sample n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	2500	71	1757.94	243.40	70%	171	2199.71	119.45		88%	346	2186.29	114.57		87%
Total carbohydrates (gm)	343.8		228.60	24.87	67%		294.23	14.92	<.05	86%		288.34	13.37	<.05	84%
Sucrose (gm)			43.65	2.36			49.55	4.82				46.16	2.22		
Fructose (gm)			39.42	6.02			22.67	3.29	<.02			27.15	2.66		
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			39.34	4.67			22.82	2.62	<.005			28.28	2.21	<.05	
Lactose (gm)			11.68	4.28			16.33	3.98				17.25	3.32		
Maltose (gm)			1.54	0.43			1.48	0.27				1.57	0.16		
Total sugars (gm)			144.28	9.41			125.94	17.80				136.57	8.94		
Added sugars:sucr+gala+gluc+malt (gm)	60		90.94	5.09	152%		88.64	9.02		148%		84.79	4.55		141%
Natural sugars:fruc+lact (gm)			51.78	5.88			45.10	7.48				50.92	4.14		
% kcal from carbohydrates (%kcal)[a]	55		52.65	3.25	96%		50.64	0.85		92%		50.24	1.00		91%
% kcal from sucrose (%kcal)			9.41	1.24			9.11	0.64				8.34	0.41		
% kcal from total sugars (%kcal)			29.86	2.23			25.55	1.43				26.60	1.13		
% kcal from added sugars (%kcal)	9.6		19.00	1.61	198%		15.42	0.91		161%		15.52	0.73	<.05	162%
% kcal from natural sugars (%kcal)			10.90	1.23			8.94	1.17				9.44	0.65		
% of carbohydr. from sucrose (%)[b]			17.77	1.47			17.58	1.32				17.26	0.86		
% of carbohydr. from total sugars (%)			54.35	4.04			47.89	1.89				50.80	1.18		
% of carbohydr. from added sugars (%)	17.45		34.24	2.67	196%		29.88	1.36		171%		30.55	1.02		175%
% of carbohydr. from natural sugars (%)			21.31	1.74			16.48	2.11				18.72	1.14		
% kcal from protein (%kcal)	15		13.92	0.69	93%		14.95	0.46		100%		14.56	0.42		97%
Dietary fiber (gm)	41.5		11.48	2.98	28%		12.77	1.91		31%		14.64	1.24		35%
Starch (gm)			83.86	19.65			119.73	4.97				111.35	4.13		
Cholesterol (mg)	<300		206.38	32.71	69%		245.48	26.69		82%		225.30	13.81		75%
Total fats (gm)	83		74.34	7.89	90%		84.45	6.97		102%		79.24	5.17		95%
% of kcals from total fat (%kcal)	30		34.55	1.90	115%		34.77	0.55		116%		35.01	0.51		117%
Total saturated fatty acids (gm)	28		25.11	3.38	90%		31.40	3.55		112%		29.39	2.35		105%
% of kcals from saturated fat (%kcal)	10		11.31	0.56	113%		12.64	0.47		126%		12.77	0.36	<.05	128%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX B-6. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Breast-feeding Women

	Refere nce	WIC Participating n	median	s.e.[c]	% rec	WIC Eligible Non-participating n	median	s.e.[c]	p[d]	% rec	Total Sample n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	2700	33	2410.96	194.23	89%	23	2536.73	(e)		94%	83	2425.65	228.46		90%
Total carbohydrates (gm)	371.3		346.44	(e)	93%		331.62	(e)		89%		323.87	40.22		87%
Sucrose (gm)			38.42	(e)			54.96	18.18				45.47	11.96		
Fructose (gm)			23.79	(e)			19.53	10.18				23.00	5.99		
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			23.99	(e)			21.85	11.31				22.98	5.92		
Lactose (gm)			31.55	4.93			30.89	10.71				30.95	6.19		
Maltose (gm)			1.74	0.62			2.13	0.59				1.66	0.43		
Total sugars (gm)			143.80	(e)			142.53	46.84				146.63	16.72		
Added sugars:sucr+gala+gluc+malt (gm)	68		69.46	(e)	102%		83.83	20.11		123%		83.82	18.86		123%
Natural sugars:fruc+lact (gm)			73.09	16.51			53.07	13.80				62.17	6.87		
% kcal from carbohydrates (%kcal)[a]	55		54.58	2.90	99%		52.98	(e)		96%		53.56	1.35		97%
% kcal from sucrose (%kcal)			7.60	(e)			7.65	1.26				7.75	1.34		
% kcal from total sugars (%kcal)			24.60	4.66			20.12	2.81				24.02	1.39		
% kcal from added sugars (%kcal)	10.07		12.14	3.86	121%		11.27	1.67		112%		11.98	2.10		119%
% kcal from natural sugars (%kcal)			12.52	1.57			8.19	0.94				9.45	0.62		
% of carbohydr. from sucrose (%)[b]			14.13	(e)			12.56	1.68				13.86	2.56		
% of carbohydr. from total sugars (%)			49.44	(e)			33.18	2.82				43.87	1.63		
% of carbohydr. from added sugars (%)	18.32		26.91	(e)	147%		20.38	2.09		111%		24.30	3.10		133%
% of carbohydr. from natural sugars (%)			23.90	3.67			13.60	0.73	<.01			17.25	2.21		
% kcal from protein (%kcal)	15		17.38	0.92	116%		17.24	1.57		115%		17.24	0.97		115%
Dietary fiber (gm)	31		12.06	7.46	39%		27.96	(e)		90%		17.72	3.52		57%
Starch (gm)			101.56	14.88			174.32	(e)				127.58	18.42		
Cholesterol (mg)	<300		428.93	59.90	143%		219.26	23.19	<.002	73%		253.25	38.42	<.02	84%
Total fats (gm)	90		86.48	(e)	96%		74.05	(e)		82%		82.10	7.76		91%
% of kcals from total fat (%kcal)	30		33.11	1.67	110%		35.22	4.19		117%		30.28	3.12		101%
Total saturated fatty acids (gm)	30		32.43	(e)	108%		25.34	5.95		84%		27.46	3.15		92%
% of kcals from saturated fat (%kcal)	10		13.08	1.22	131%		9.46	(e)		95%		11.30	1.31		113%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX B-7. Median 24-Hour Carbohydrate, Fat, Fiber Intake of Non-breast-feeding Women

	Refere nce	WIC Participating n	median	s.e.[c]	% rec	WIC Eligible Non-participating n	median	s.e.[c]	p[d]	% rec	Total Sample n	median	s.e.[c]	p[d]	% rec
Total kilocalories (kcal)	2200	80	1913.35	152.43	87%	110	1689.24	205.28		77%	249	1997.40	128.62		91%
Total carbohydrates (gm)	302.5		211.72	13.02	70%		214.31	23.61		71%		218.68	19.01		72%
Sucrose (gm)			39.48	10.18			35.47	7.85				34.88	3.31		
Fructose (gm)			22.71	6.62			25.61	5.96				25.14	4.10		
Galactose (gm)			(e)	(e)			(e)	(e)				(e)	(e)		
Glucose (gm)			26.16	5.46			25.59	6.53				24.95	3.17		
Lactose (gm)			8.39	2.94			5.62	2.70				8.51	1.87		
Maltose (gm)			1.33	0.42			1.44	0.27				1.54	0.23		
Total sugars (gm)			108.53	15.50			128.17	16.95				112.21	11.08		
Added sugars:sucr+gala+gluc+malt (gm)	48		63.22	9.74	132%		78.39	13.94		163%		74.35	6.86		155%
Natural sugars:fruc+lact (gm)			36.81	6.37			34.37	6.35				36.05	4.76		
% kcal from carbohydrates (%kcal)[a]	55		46.91	2.94	85%		48.06	1.82		87%		47.19	1.32		86%
% kcal from sucrose (%kcal)			6.91	1.97			8.77	1.74				7.90	1.01		
% kcal from total sugars (%kcal)			24.64	3.25			23.59	3.12				23.72	1.51		
% kcal from added sugars (%kcal)	8.727		14.02	2.24	161%		13.69	1.81		157%		15.04	1.27		172%
% kcal from natural sugars (%kcal)			7.75	1.26			8.64	1.00				7.65	1.01		
% of carbohydr. from sucrose (%)[b]			14.41	3.03			16.74	2.63				16.09	1.99		
% of carbohydr. from total sugars (%)			52.25	4.77			48.28	6.47				49.92	2.65		
% of carbohydr. from added sugars (%)	15.87		29.78	4.47	188%		28.97	3.95		183%		29.35	2.31		185%
% of carbohydr. from natural sugars (%)			17.50	2.55			18.20	1.87				16.55	1.08		
% kcal from protein (%kcal)	15		15.60	1.05	104%		13.97	1.57		93%		13.95	0.80		93%
Dietary fiber (gm)	28		11.04	0.94	39%		7.88	1.34		28%		10.04	1.18		36%
Starch (gm)			92.13	14.93			94.21	10.90				96.79	9.34		
Cholesterol (mg)	<300		229.95	31.25	77%		181.04	28.11		60%		207.97	23.58		69%
Total fats (gm)	73		70.29	8.08	96%		63.38	9.32		87%		76.71	8.15		105%
% of kcals from total fat (%kcal)	30		36.27	2.02	121%		36.76	2.58		123%		34.93	1.23		116%
Total saturated fatty acids (gm)	24		24.35	2.71	101%		20.22	3.17		84%		25.50	1.90		106%
% of kcals from saturated fat (%kcal)	10		12.22	0.74	122%		11.22	0.56		112%		11.67	0.57		117%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] standard error
[d] p value that median is significantly different than WIC participating group
[e] sample size too small for reliable estimate

APPENDIX C-1. Nutrient Content of Maximum WIC Package I and Total Dietary Nutrient Intake of Infants 2-3 Months old.

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vitamin A (IU)	1250	1591	127%	1952.61	85.84	156%
Vitamin A (RE) - USDA[a]	375			640.85	36.05	171%
Vit C (mg)	30	47	157%	68.66	4.63	229%
Calcium (mg)	400	399	100%	567.43	27.50	142%
Iron (mg)	6	9.5	158%	14.28	0.78	238%
Protein (gm)	13	11.7	90%	14.88	0.67	114%
Folic acid (mcg)	25	80	320%	91.93	4.00	368%
Zinc (mg)	5	3.9	78%	5.11	0.15	102%
Vitamin B6 (mg)	0.3	0.3	100%	0.45	0.01	150%
Magnesium (mg)	40	32	80%	61.40	3.89	154%
Other Nutrients						
Thiamin (mg)	0.3	0.52	173%	0.76	0.03	253%
Riboflavin (mg)	0.4	0.8	200%	1.04	0.04	260%
Niacin (mg)	5	5.6	112%	7.89	0.48	158%
Vitamin B12 (mcg)	0.4	1.3	325%	1.64	0.07	410%
Vitamin D (mcg)	7.5	8	107%	9.18	0.29	122%
Vitamin E (mg)	3			10.33	0.88	344%
Phosphorus (mg)	300	306	102%	402.65	24.26	134%
Copper (mg)	0.5			0.52	0.03	104%
Selenium (mcg)[b]	-			14.84	0.65	
Sodium (mg)	120			194.88	8.36	162%
Potassium (mg)[b]	-			771.36	33.70	
Beta-carotene (mcg)[b]	-			7.96	2.74	
Total carotenes (RE) - USDA[a,b]	-			0.37	(e)	
Retinol (mcg)[b]	-			550.83	17.60	
Pantothenic Acid (mg)[b]	-			2.99	0.10	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX C-2. Nutrient Content of Maximum WIC Package II and Total Dietary Nutrient Intake of Infants 4-11 Months old.

	Maximum Package			Total Nutrient Intake in 24-Hour Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vit A (IU)	1250	1602	128%	3005.92	146.01	240%
Vitamin A (RE) - USDA[a]	375			742.59	21.28	198%
Vit C (mg)	34	85	250%	103.69	4.83	305%
Calcium (mg)	554	592	107%	616.24	13.20	111%
Iron (mg)	9	26.4	293%	16.85	0.50	187%
Protein (gm)	14	13.2	94%	21.25	0.54	152%
Folic acid (mcg)	33	86	261%	112.52	3.27	341%
Zinc (mg)	5	4.4	88%	5.65	0.15	113%
Vitamin B6 (mg)	0.5	0.4	80%	0.65	0.01	130%
Magnesium (mg)	55	80	145%	97.01	2.47	176%
Other Nutrients						
Thiamin (mg)	0.4	1.12	280%	0.96	0.03	240%
Riboflavin (mg)	0.5	1.31	262%	1.31	0.02	262%
Niacin (mg)	6	12.7	212%	10.22	0.25	170%
Vitamin B12 (mcg)	0.45	1.3	289%	1.84	0.06	409%
Vitamin D (mcg)	9.4	8	85%	8.19	0.19	87%
Vitamin E (mg)	4			10.14	0.34	254%
Phosphorus (mg)	454	442	97%	525.64	11.37	116%
Copper (mg)	0.62			0.65	0.02	105%
Selenium (mcg)[b]	-			24.60	0.90	
Sodium (mg)	182			342.47	24.27	188%
Potassium (mg)[b]	-			1154.04	20.61	
Beta-carotene (mcg)[b]	-			600.40	93.02	
Total carotenes (RE) - USDA[a,b]	-			96.66	14.20	
Retinol (mcg)[b]	-			493.83	8.39	
Pantothenic Acid (mg)[b]	-			3.37	0.07	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX C-3. Nutrient Content of Maximum WIC Package IV and Total Dietary Nutrient Intake of Children 1-3 Years Old.

	Maximum Package			Total Nutrient Intake in 24-Hour Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vit A (IU)	1400	2913	208%	2781.20	131.29	
Vitamin A (RE) - USDA[a]	400			575.14	24.76	144%
Vit C (mg)	40	139	348%	60.19	3.79	150%
Calcium (mg)	800	986	123%	788.22	28.38	99%
Iron (mg)	10	11.4	114%	9.64	0.33	96%
Protein (gm)	16	37.4	234%	49.33	1.29	308%
Folic acid (mcg)	50	337	674%	161.38	6.19	323%
Zinc (mg)	10	4.1	41%	6.55	0.14	66%
Vitamin B6 (mg)	1	1.1	110%	1.17	0.03	117%
Magnesium (mg)	80	158	198%	175.83	6.06	220%
Other Nutrients						
Thiamin (mg)	0.7	1.04	149%	1.16	0.03	166%
Riboflavin (mg)	0.8	1.91	239%	1.61	0.04	201%
Niacin (mg)	9	8.5	94%	11.84	0.44	132%
Vitamin B12 (mcg)	0.7	2.9	414%	3.06	0.13	437%
Vitamin D (mcg)	10	8.7	87%	5.53	0.29	
Vitamin E (mg)	6			4.45	0.18	74%
Phosphorus (mg)	800	926	116%	937.00	27.39	117%
Copper (mg)	0.85			0.68	0.02	80%
Selenium (mcg)[b]	-			61.28	1.37	
Sodium (mg)	262			2000.21	63.92	763%
Potassium (mg)[b]	-			1833.61	54.91	
Beta-carotene (mcg)[b]	-			720.97	47.52	
Total carotenes (RE) - USDA[a,b]	-			90.88	6.64	
Retinol (mcg)[b]	-			341.71	20.28	
Pantothenic Acid (mg)[b]	-			3.37	0.12	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX C-4. Nutrient Content of Maximum WIC Package IV and Total Dietary Nutrient Intake of Children 4 Years Old.

	Maximum Package			Total Nutrient Intake in 24-Hour Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vit A (IU)	1400	2913	208%	2635.97	317.99	
Vitamin A (RE) - USDA[a]	500			585.05	55.50	117%
Vit C (mg)	45	139	309%	54.12	9.38	120%
Calcium (mg)	800	986	123%	794.68	60.30	99%
Iron (mg)	10	11.4	114%	11.27	0.64	113%
Protein (gm)	24	37.4	156%	59.74	4.66	249%
Folic acid (mcg)	75	337	449%	180.33	20.75	240%
Vitamin B6 (mg)	1.1	1.1	100%	1.43	0.06	130%
Magnesium (mg)	120	158	132%	178.61	13.55	149%
Zinc (mg)	10	4.1	41%	7.63	0.53	76%
Other Nutrients						
Thiamin (mg)	0.9	1.04	116%	1.43	0.08	159%
Riboflavin (mg)	1.1	1.91	174%	1.72	0.14	156%
Niacin (mg)	12	8.5	71%	16.40	0.61	137%
Vitamin B12 (mcg)	1	2.9	290%	3.46	0.26	346%
Vitamin D (mcg)	10	8.7	87%	4.80	0.37	
Vitamin E (mg)	7			5.64	0.65	81%
Phosphorus (mg)	800	926	116%	960.59	55.25	120%
Copper (mg)	1.3			0.75	0.06	58%
Selenium (mcg)[b]	-			81.95	3.84	
Sodium (mg)	300			2305.75	204.04	769%
Potassium (mg)[b]	-			1828.10	182.14	
Beta-carotene (mcg)[b]	-			736.15	134.78	
Total carotenes (RE) - USDA[a,b]	-			106.26	26.62	
Retinol (mcg)[b]	-			351.18	49.44	
Pantothenic Acid (mg)[b]	-			3.30	0.34	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX C-5. Nutrient Content of Maximum WIC Package V and Total Dietary Nutrient Intake of Pregnant Women.

	Maximum Package			Total Nutrient Intake in 24-Hour Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vit A (IU)	2650	3775	142%	3221.42	421.44	
Vitamin A (RE) - USDA[a]	800			680.42	88.84	85%
Vit C (mg)	70	141	201%	70.20	25.39	100%
Calcium (mg)	1200	1193	99%	716.04	119.17	60%
Iron (mg)	30	11.1	37%	13.18	2.35	44%
Protein (gm)	60	42.5	71%	62.64	11.54	104%
Folic acid (mcg)	400	323	81%	233.64	45.91	58%
Zinc (mg)	15	4.7	31%	9.14	1.25	61%
Vitamin B6 (mg)	2.2	1.1	50%	1.70	0.31	77%
Magnesium (mg)	320	193	60%	221.31	38.99	69%
Other Nutrients						
Thiamin (mg)	1.5	1.08	72%	1.46	0.28	97%
Riboflavin (mg)	1.6	2.2	138%	1.84	0.30	115%
Niacin (mg)	17	9.6	56%	17.74	1.90	104%
Vitamin B12 (mcg)	2.2	3.5	159%	3.41	0.51	155%
Vitamin D (mcg)	10	10.7	107%	4.14	0.60	41%
Vitamin E (mg)	10			6.10	1.79	61%
Phosphorus (mg)	1200	1065	89%	1026.73	150.54	86%
Copper (mg)[b]	-			1.06	0.15	
Selenium (mcg)	65			77.76	14.92	120%
Sodium (mg)	569			3426.86	308.94	602%
Potassium (mg)[b]	-			2068.96	281.23	
Beta-carotene (mcg)[b]	-			1214.91	178.70	
Total carotenes (RE) - USDA[a,b]	-			164.19	78.86	
Retinol (mcg)[b]	-			227.13	80.53	
Pantothenic Acid (mg)[b]	-			3.62	0.87	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX C-6. Nutrient Content of Maximum WIC Package V and Total Dietary Nutrient Intake of Breast-feeding Women.

	Maximum Package			Total Nutrient Intake in 24-Hour Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vit A (IU)	4350	3723	86%	4809.28	1321.34	
Vitamin A (RE) - USDA[a]	1280			1141.38	138.37	89%
Vit C (mg)	94	141	150%	66.97	31.14	71%
Calcium (mg)	1200	1172	98%	1442.60	212.91	120%
Iron (mg)	15	11.4	76%	13.22	2.23	88%
Protein (gm)	65	41.8	64%	97.66	4.11	150%
Folic acid (mcg)	277	344	124%	284.47	122.12	103%
Zinc (mg)	19	4.7	25%	13.59	1.64	72%
Vitamin B6 (mg)	2.1	1.1	52%	1.77	0.24	84%
Magnesium (mg)	353	183	52%	297.69	71.90	84%
Other Nutrients						
Thiamin (mg)	1.6	1.09	68%	1.93	0.30	121%
Riboflavin (mg)	1.8	2.11	117%	2.49	0.16	138%
Niacin (mg)	20	8.6	43%	20.58	2.83	103%
Vitamin B12 (mcg)	2.6	3.4	131%	5.77	1.23	222%
Vitamin D (mcg)	10	10.1	101%	7.07	1.10	
Vitamin E (mg)	12			6.86	1.00	57%
Phosphorus (mg)	1200	1045	87%	1663.95	186.31	139%
Copper (mg)	2.3			1.17	0.36	51%
Selenium (mcg)[b]	-			118.84	4.06	
Sodium (mg)	635			3174.63	211.14	500%
Potassium (mg)[b]	-			3152.25	464.97	
Beta-carotene (mcg)[b]	-			1414.22	867.52	
Total carotenes (RE) - USDA[a,b]	-			276.14	155.23	
Retinol (mcg)[b]	-			508.97	63.64	
Pantothenic Acid (mg)[b]	-			4.96	0.40	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX C-7. Nutrient Content of Maximum WIC Package VI and Total Dietary Nutrient Intake of Non-Breast-feeding Women.

	Maximum Package			Total Nutrient Intake in 24-Hour Recall		
	RDA	Maximum Package Content[c]	Max. Package % RDA	median	s.e.[d]	%RDA
Target Nutrients and Nutrients of Concern						
Vit A (IU)	2650	3382	128%	2999.52	534.54	
Vitamin A (RE) - USDA[a]	800			580.37	98.02	73%
Vit C (mg)	60	101	168%	35.88	5.26	60%
Calcium (mg)	1069	997	93%	636.35	60.43	60%
Iron (mg)	15	10.6	71%	12.55	1.26	84%
Protein (gm)	48	33.2	69%	77.65	9.84	162%
Folic acid (mcg)	180	258	143%	174.49	8.82	97%
Zinc (mg)	12	3.7	31%	11.70	1.64	98%
Vitamin B6 (mg)	1.6	1	63%	1.42	0.14	89%
Magnesium (mg)	285	132	46%	196.16	20.88	69%
Other Nutrients						
Thiamin (mg)	1.1	0.9	82%	1.39	0.21	126%
Riboflavin (mg)	1.3	1.87	144%	1.62	0.21	125%
Niacin (mg)	15	7	47%	19.57	2.69	130%
Vitamin B12 (mcg)	2	2.9	145%	3.48	0.67	174%
Vitamin D (mcg)	10	8.7	87%	3.51	0.59	35%
Vitamin E (mg)	8			7.66	0.88	96%
Phosphorus (mg)	1200	850	71%	1066.26	101.87	89%
Copper (mg)	1.9			0.86	0.15	45%
Selenium (mcg)[b]	-			90.61	18.93	
Sodium (mg)	500			3734.92	517.14	747%
Potassium (mg)[b]	-			1704.84	279.28	
Beta-carotene (mcg)[b]	-			725.89	183.96	
Total carotenes (RE) - USDA[a,b]	-			100.97	31.08	
Retinol (mcg)[b]	-			351.07	65.23	
Pantothenic Acid (mg)[b]	-			3.91	0.40	

[a] Data from USDA, all other data from NCC (University of Minnesota)
[b] RDA not available
[c] values from The Pennsylvania State University, 1991
[d] standard error
[e] Sample size too small for reliable estimate

APPENDIX D-1. Carbohydrate, Fat, Fiber Content of Maximum WIC Package I and Total Dietary Intake of Infants 2-3 Months Old

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Referenc e Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	650	528	81%	665.72	19.59	102%
Total carbohydrates (gm)				78.80	2.17	
Sucrose (gm)				1.99	0.77	
Fructose (gm)				0.77	0.31	
Galactose (gm)				(e)	(e)	
Glucose (gm)				1.62	0.63	
Lactose (gm)				56.01	3.07	
Maltose (gm)				(e)	(e)	
Total sugars (gm)				65.31	1.60	
Added sugars:sucr+gala+gluc+malt (gm)				5.07	1.26	
Natural sugars:fruc+lact (gm)				59.66	3.35	
% kcal from carbohydrates (%kcal)	55			44.76	0.76	81%
% kcal from sucrose (%kcal)[a]				1.07	0.42	
% kcal from total sugars (%kcal)				41.77	0.58	
% kcal from added sugars (%kcal)				2.92	0.83	
% kcal from natural sugars (%kcal)				38.61	1.25	
% of carbohydr. from sucrose (%)[b]				2.30	0.87	
% of carbohydr. from total sugars (%)				87.54	2.80	
% of carbohydr. from added sugars (%)				6.06	1.56	
% of carbohydr. from natural sugars (%)				79.82	3.70	
% kcal from protein (%kcal)				8.56	0.03	
Dietary fiber (gm)				0.09	0.09	
Starch (gm)				7.83	2.61	
Cholesterol (mg)				5.12	0.39	
Total fats (gm)				33.47	0.96	
% of kcals from total fat (%kcal)				45.81	0.68	
Total saturated fatty acids (gm)				17.20	0.77	
% of kcals from saturated fat (%kcal)				22.23	0.74	

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate

APPENDIX D-2. Carbohydrate, Fat, Fiber Content of Maximum WIC Package II and Total Dietary Intake of Infants 4-11 Months Old

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Referenc e Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	803	646	80%	872.49	15.39	109%
Total carbohydrates (gm)				115.32	1.64	
Sucrose (gm)				10.00	0.83	
Fructose (gm)				8.15	0.49	
Galactose (gm)				(e)	(e)	
Glucose (gm)				7.14	0.44	
Lactose (gm)				48.63	2.20	
Maltose (gm)				0.50	0.08	
Total sugars (gm)				79.98	1.65	
Added sugars:sucr+gala+gluc+malt (gm)				20.29	1.25	
Natural sugars:fruc+lact (gm)				57.16	1.98	
% kcal from carbohydrates (%kcal)[1]	55			52.03	0.43	95%
% kcal from sucrose (%kcal)[a]				4.59	0.35	
% kcal from total sugars (%kcal)				37.28	0.54	
% kcal from added sugars (%kcal)				8.90	0.55	
% kcal from natural sugars (%kcal)				27.80	0.85	
% of carbohydr. from sucrose (%)[b]				8.57	0.68	
% of carbohydr. from total sugars (%)				69.48	1.19	
% of carbohydr. from added sugars (%)				16.75	0.75	
% of carbohydr. from natural sugars (%)				50.98	1.53	
% kcal from protein (%kcal)				9.29	0.16	
Dietary fiber (gm)				3.92	0.17	
Starch (gm)				28.26	1.49	
Cholesterol (mg)				15.07	2.19	
Total fats (gm)				36.22	0.61	
% of kcals from total fat (%kcal)				37.77	0.29	
Total saturated fatty acids (gm)				16.60	0.34	
% of kcals from saturated fat (%kcal)				17.34	0.24	

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate

APPENDIX D-3. Carbohydrate, Fat, Fiber Content of Maximum WIC Package IV and Total Dietary Intake of Children 1-3 Years Old

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Referenc e Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	1300	849	65%	1313.20	26.52	101%
Total carbohydrates (gm)				168.46	3.56	
Sucrose (gm)				24.29	1.10	
Fructose (gm)				18.62	1.33	
Galactose (gm)				.	.	
Glucose (gm)				17.24	1.06	
Lactose (gm)				19.83	1.27	
Maltose (gm)				0.74	0.07	
Total sugars (gm)				90.52	3.00	
Added sugars:sucr+gala+gluc+malt (gm)	20			45.86	1.56	229%
Natural sugars:fruc+lact (gm)				42.78	1.70	
% kcal from carbohydrates (%kcal)[1]	55			51.41	0.93	93%
% kcal from sucrose (%kcal)[a]				7.43	0.26	
% kcal from total sugars (%kcal)				27.75	0.87	
% kcal from added sugars (%kcal)	6.153846 15			13.97	0.59	227%
% kcal from natural sugars (%kcal)				13.05	0.55	
% of carbohydr. from sucrose (%)[b]				14.98	0.37	
% of carbohydr. from total sugars (%)				55.35	1.01	
% of carbohydr. from added sugars (%)				28.53	0.70	
% of carbohydr. from natural sugars (%)				25.09	0.59	
% kcal from protein (%kcal)				15.08	0.25	
Dietary fiber (gm)				7.90	0.25	
Starch (gm)				60.85	1.32	
Cholesterol (mg)	<300			164.40	9.79	55%
Total fats (gm)	43			48.42	1.70	113%
% of kcals from total fat (%kcal)	30			35.15	0.71	117%
Total saturated fatty acids (gm)	18			19.66	0.58	109%
% of kcals from saturated fat (%kcal)	10			13.69	0.36	137%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate

APPENDIX D-4. Carbohydrate, Fat, Fiber Content of Maximum WIC Package IV and Total Dietary Intake of Children 4 Years Old

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Referenc e Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	1800	849	47%	1584.22	54.48	88%
Total carbohydrates (gm)				213.70	9.45	
Sucrose (gm)				38.12	4.37	
Fructose (gm)				25.04	1.41	
Galactose (gm)				(e)	(e)	
Glucose (gm)				24.85	2.05	
Lactose (gm)				13.50	2.28	
Maltose (gm)				1.35	0.19	
Total sugars (gm)				110.54	5.68	
Added sugars:sucr+gala+gluc+malt (gm)	32			67.37	5.75	211%
Natural sugars:fruc+lact (gm)				40.30	3.09	
% kcal from carbohydrates (%kcal)[1]	55			54.96	1.47	100%
% kcal from sucrose (%kcal)[a]				8.90	1.32	
% kcal from total sugars (%kcal)				27.20	2.42	
% kcal from added sugars (%kcal)	7.111111 11			16.26	1.67	229%
% kcal from natural sugars (%kcal)				10.71	0.64	
% of carbohydr. from sucrose (%)[b]				17.04	2.15	
% of carbohydr. from total sugars (%)				54.23	1.85	
% of carbohydr. from added sugars (%)				31.82	2.27	
% of carbohydr. from natural sugars (%)				20.28	0.98	
% kcal from protein (%kcal)				14.26	0.69	
Dietary fiber (gm)	9			9.66	0.94	107%
Starch (gm)				85.57	5.04	
Cholesterol (mg)	<300			167.82	28.24	56%
Total fats (gm)	60			54.77	5.89	91%
% of kcals from total fat (%kcal)	30			32.77	1.43	109%
Total saturated fatty acids (gm)	20			21.18	2.04	106%
% of kcals from saturated fat (%kcal)	10			12.85	0.55	129%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate

APPENDIX D-5. Carbohydrate, Fat, Fiber Content of Maximum WIC Package V and Total Dietary Intake of Pregnant Women

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Referenc e Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	2500	863	35%	1757.94	243.40	70%
Total carbohydrates (gm)				228.60	24.87	
Sucrose (gm)				43.65	2.36	
Fructose (gm)				39.42	6.02	
Galactose (gm)				.	.	
Glucose (gm)				39.34	4.67	
Lactose (gm)				11.68	4.28	
Maltose (gm)				1.54	0.43	
Total sugars (gm)				90.94	5.09	
Added sugars:sucr+gala+gluc+malt (gm)	60			51.78	7.1	86%
Natural sugars:fruc+lact (gm)				51.78	7.10	
% kcal from carbohydrates (%kcal)[1]	55			52.65	3.25	96%
% kcal from sucrose (%kcal)[a]				9.41	1.24	
% kcal from total sugars (%kcal)				29.86	2.38	
% kcal from added sugars (%kcal)	9.6			19.00	1.61	198%
% kcal from natural sugars (%kcal)				10.90	1.23	
% of carbohydr. from sucrose (%)[b]				17.77	1.47	
% of carbohydr. from total sugars (%)				54.35	4.04	
% of carbohydr. from added sugars (%)				34.24	2.67	
% of carbohydr. from natural sugars (%)				21.31	1.74	
% kcal from protein (%kcal)				13.92	0.69	
Dietary fiber (gm)	41.5			11.48	2.98	28%
Starch (gm)				83.86	19.65	
Cholesterol (mg)	<300			206.38	32.71	69%
Total fats (gm)	83			74.34	7.89	90%
% of kcals from total fat (%kcal)	30			34.55	1.90	115%
Total saturated fatty acids (gm)	28			25.11	3.38	90%
% of kcals from saturated fat (%kcal)	10			11.31	0.56	113%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate

APPENDIX D-6. Carbohydrate, Fat, Fiber Content of Maximum WIC Package V and Total Dietary Intake of Breast-feeding Women

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Referenc e Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	2700	837	31%	2410.96	I	89%
Total carbohydrates (gm)				346.44	(e)	
Sucrose (gm)				38.42	(e)	
Fructose (gm)				23.79	(e)	
Galactose (gm)				(e)	(e)	
Glucose (gm)				23.99	(e)	
Lactose (gm)				31.55	4.93	
Maltose (gm)				1.74	0.62	
Total sugars (gm)				143.80	(e)	
Added sugars:sucr+gala+gluc+malt (gm)	68			69.46	(e)	102%
Natural sugars:fruc+lact (gm)				73.09	(e)	
% kcal from carbohydrates (%kcal)[1]	55			54.58	2.90	99%
% kcal from sucrose (%kcal)[a]				7.60	(e)	
% kcal from total sugars (%kcal)				24.60	(e)	
% kcal from added sugars (%kcal)	10.07407 41			12.14	(e)	121%
% kcal from natural sugars (%kcal)				12.52	(e)	
% of carbohydr. from sucrose (%)[b]				14.13	(e)	
% of carbohydr. from total sugars (%)				49.44	(e)	
% of carbohydr. from added sugars (%)				26.91	(e)	
% of carbohydr. from natural sugars (%)				23.90	3.67	
% kcal from protein (%kcal)				17.38	0.92	
Dietary fiber (gm)	31			12.06	7.46	39%
Starch (gm)				101.56	14.88	
Cholesterol (mg)	<300			428.93	59.90	143%
Total fats (gm)	90			86.48	(e)	96%
% of kcals from total fat (%kcal)	30			33.11	1.67	110%
Total saturated fatty acids (gm)	30			32.43	(e)	108%
% of kcals from saturated fat (%kcal)	10			13.08	1.22	131%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate

APPENDIX D-7. Carbohydrate, Fat, Fiber Content of Maximum WIC Package VI and Total Dietary Intake of Non-Breast-feeding Women

	Maximum Package			Total Nutrient Intake in 24 hr Recall		
	Reference Value	Max. Food Package[c]	Max. Package % RDA	median (weighted)	s.e.[d]	% rec
Total kilocalories (kcal)	2200	654	30%	1913.35	155.32	87%
Total carbohydrates (gm)				211.72	13.02	
Sucrose (gm)				39.48	10.18	
Fructose (gm)				22.71	6.62	
Galactose (gm)				(e)	(e)	
Glucose (gm)				26.16	5.46	
Lactose (gm)				8.39	2.94	
Maltose (gm)				1.33	0.42	
Total sugars (gm)				108.53	14.08	
Added sugars:sucr+gala+gluc+malt (gm)	48			63.22	9.67	132%
Natural sugars:fruc+lact (gm)				36.81	6.37	
% kcal from carbohydrates (%kcal)[1]	55			46.91	2.94	85%
% kcal from sucrose (%kcal)[a]				6.91	1.97	
% kcal from total sugars (%kcal)				24.64	3.18	
% kcal from added sugars (%kcal)	8.72727273			14.02	2.23	161%
% kcal from natural sugars (%kcal)				7.75	1.26	
% of carbohydr. from sucrose (%)[b]				14.41	3.03	
% of carbohydr. from total sugars (%)				52.25	4.77	
% of carbohydr. from added sugars (%)				29.78	4.47	
% of carbohydr. from natural sugars (%)				17.50	2.55	
% kcal from protein (%kcal)				15.60	1.05	
Dietary fiber (gm)	28			11.04	0.94	39%
Starch (gm)				92.13	14.93	
Cholesterol (mg)	<300			229.95	31.25	77%
Total fats (gm)	73			70.29	8.08	96%
% of kcals from total fat (%kcal)	30			36.27	2.02	121%
Total saturated fatty acids (gm)	24			24.35	2.71	101%
% of kcals from saturated fat (%kcal)	10			12.22	0.74	122%

[a] % of kcal from sucrose=[(gms sucrose)(4kcal/gm)]/total kcal*100
[b] % of carbohydrates from sucrose=(gms sucrose)/(gms carbohydrates)*100
[c] from The Pennsylvania State Review of WIC Packages, 1991
[d] standard error
[e] sample size too small for reliable estimate