THE EFFECT OF PARTICIPATION IN THE WIC PROGRAM ON PRESCHOOLERS' DIETS

ANNA MARIA SIEGA-RIZ, PHD, SIBYLLE KRANZ, PHD, DAN BLANCHETTE, PAMELA S. HAINES, DRPH,
DAVID K. GUILKEY, PHD, AND BARRY M. POPKIN, PHD

Objective To evaluate nutrient, food intake, and snacking behavior by participation in the WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) program.

Study design Secondary data analysis of a nationally representative cross-sectional survey conducted by USDA in 1994 to 1996 and 1998.

Methods Statistical analysis was performed correcting for sample design effects and weighting for children in two income groups (<130%, n = 1772 and 130% to 185% of poverty, n = 689).

Results Among WIC participants, the prevalence of snacking was significantly lower (68%) compared with nonparticipants (72%) (χ^2 = 5.9, *P* = .01). For those <130% of poverty, WIC had a beneficial effect on the intake of fat, carbohydrates, added sugar, and fruit from the total diet as well as on added sugar from snacks. These were independent of food stamp participation. For those with higher incomes, the beneficial effects were limited to added sugar, iron density, and fruit intake for the total diet. A similar significant effect of decreased added sugar intake from snacks was also seen.

Conclusions Our results are in line with previous research showing beneficial effects of WIC participation among preschoolers, primarily for nutrients targeted by the program. This study shows that the effect can reach beyond those targeted nutrients. *(J Pediatr 2004;144:229-34)*

Trends in the nutritional status of children include increased obesity and selected improvements in micronutrient status as well as increased added sugar intake.[1-3] In addition, there is a gap in health status between children of lower and higher socioeconomic households.[2] Children born to parents of higher socioeconomic status are more likely to be born healthy and continue being healthy throughout their childhood. Furthermore, for some age and sex groupings, children from lower income households consumed relatively greater amounts of fat and saturated fat than do children from higher income households.[4]

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) has great potential to improve the diets of low income children. In 1974, WIC was authorized by congress to eliminate nutritional inadequacies of the most vulnerable US population. The program serves individuals who are considered at medical risk and that are below 185% of the poverty level. Pregnant, breastfeeding, or postpartum women, infants, and children up to the age of 5 years old are eligible to participate if they meet the specific medical nutritional criteria and priority level. Children are at a lower priority level than pregnant women and infant and thus have been historically one of the last groups to be served. In 1990, there was an expansion of the WIC program at the national level, with an 81% increase in the participation rates for children.[5]

CSFII	Continuing Survey of Food Intakes by Individuals
MSA	Metropolitan Statistical Area
USDA	United States Department of Agriculture
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

From the Departments of Nutrition, Maternal and Child Health, and Economics, University of North Carolina, and the Carolina Population Center, Chapel Hill, North Carolina; the Department of Nutritional Sciences, Pennsylvania State University, Pennsylvania.

Submitted for publication Feb 26, 2003; revision received Aug 7, 2003; accepted Oct 28, 2003.

Reprint requests: Reprints not available from the authors. Please address correspondence to Anna Maria Siega-Riz, PhD, RD, Carolina Population Center, University of North Carolina at Chapel Hill, CB #8120 University Square, 123 W Franklin St, Chapel Hill, NC 27516-3997. E-mail: am_siegariz@unc.edu.

0022-3476/$ - see front matter

Copyright © 2004 Elsevier Inc. All rights reserved.

10.1016/j.jpeds.2003.10.052

There are limited analyses of the effects of WIC on child nutrient intake because most studies have focused on pregnancy outcome and iron status, among others.[6-8] Evaluation studies of the program for children are limited. Four such studies indicated that participation in the program was associated with increased intakes of vitamin C[5,9,10] protein,[10,11] iron,[5,10,11] vitamin B6,[5,9] vitamin A, and folate.[5] However, fat, fruit, and vegetable and added sugar intake as well as snacking behavior have not been evaluated by participation in the WIC program to date. Nearly everyone snacks, and there is a higher energy density and proportion of energy from fat with snacks as opposed to non–snack-eating occasions.[12] The increased obesity among children even at this young age, which may in part be due to snacking,[1,13] is imperative to evaluate the impact of the WIC program on eating behaviors. We evaluated the effect of the WIC program, stratified by income levels that differentiate income eligibility for both food stamp and WIC, from those who live in families with incomes too high to be eligible for food stamps.

METHODS

The study uses information from the USDA CSFII 1994 to 1996 and 1998 surveys. Data were collected through the use of a stratified, multistage, area probability sample with the goal to obtain a nationally representative sample of noninstitutionalized persons living in households.[14] Two days of dietary data were collected using the 24-hour recall method. Adults reported the diets of children under 6 years of age. The first recall was collected during a household interview, whereas the second, which was collected 3 to 10 days after day 1 but not on the same day of the week, could be reported during a phone interview. Detailed description of the study design can be found in a report by Tippet et al.[15] In 1998, the same sample collection and selection method were used to obtain a nationally representative sample of noninstitutionalized children 9 years of age or younger (n = 5200). The total sample of children 2 to 18 years of age for the two surveys combined was 9008. For the purpose of our study, only children of 2 through 5 years of age, not in school, who supplied dietary intake and household level data are included (n = 5137). Mean dietary intake from the first day of recall was used for children that did not provide dietary information for both days (4% of the total population), whereas 2-day average was used if both days were available. All days of the week were equally represented for the first day of data collection, whereas on the second day, Fridays and Saturdays were underrepresented (7% and 9%). Nutrient intakes from multivitamin and or mineral supplements were not included with the dietary data for this analysis.

In the CSFII, for each food consumed, the respondent was asked whether the eating occasion was a meal or snack and which type of meal it was (breakfast, lunch, brunch, or dinner). To investigate the effect of participation in WIC on nutrient intake, we chose to separate out nutrients that were from snacks.

An added sugar category was developed by USDA to capture all caloric carbohydrate sweeteners (monosaccharides, disaccharides, and higher saccharides), excluding all naturally occurring sugars (such as fructose in fruits) including all other sugars and sugar containing ingredients added during processing or preparation. Sugars eaten separately (candy) or added at the table (syrups, white or brown sugar, and so forth) are included as well.[16]

Sociodemographic information, including age, sex, race, education, employment status, child receiving a meal at the daycare or school, multivitamin use, vegetarianism, whether the child is on any diet, average daily hours spent watching TV or video, household size, urbanicity (MSA central city and MSA outside central city), food stamp participation, and total household income were ascertained during the survey and were included as control variables. Season of data collection was included as well.

Current participation in WIC of the child and anyone in the household was recorded at the time of the household interview. For this study, we used the information on participation only for the child. Since one of the eligibility requirements for participation is having an income $<185\%$ of poverty, we only included children with a family income less than $<185\%$ (n = 2461). This subpopulation was further stratified by income to reflect the different cut points used for participation in the food stamp and WIC programs ($<130\%$, n = 1772, and 130% to 185% of poverty, n = 689). The CSFII does not collect information to allow one to determine medically eligibility for WIC.

Statistical analysis was performed using STATA (Version 7.0) correcting for sample design effects and weighting. Descriptive statistics and means and standard errors were ascertained to describe the sample. Average dietary intake for each child from all eating occasions and then snacks separately was determined. Statistical testing was not performed for Tables I and II because their purpose was only to provide background descriptive information on the population. Using multivariable linear regression, we modeled the effect of participation in WIC on dietary intakes for total energy, total and saturated fat, calcium, iron, fiber, added sugar, and servings of fruit (including 100% fruit juices) and vegetables while controlling for other sociodemographic and behavioral characteristics. Energy was ascertained as kilocalories per day. Added sugar, fat, and saturated fat density were determined in terms of percent of total energy. Other nutrients (calcium, iron, and fiber) were tallied as nutrient content in milligrams or grams per 1000 kcal to adjust for the difference in energy intake with increasing age, whereas fruit and vegetable consumption was ascertained as servings per day.

A two-step regression modeling technique was used to examine the effect of participation in WIC on dietary intakes for dependent variables that had $>5\%$ of the population being nonconsumers.[17] These were primarily all the nutrients as well as added sugar and servings of fruit and vegetables from snacks. Step one in the modeling process was a probit model to ascertain the probability of food consumption only for the individuals who consumed that nutrient from snacks. Consequently, a second regression model was used to measure the effect of the selected sociodemographic variables on the

Table I. Sample description (frequencies) by selected sociodemographic characteristics in percent for 2- to 5-year-olds not in school participating in the CSFII 1994-1996 and 1998 survey (n = 2461)

	Income groups		WIC participation*	
Characteristics	<130% n = 1772	130% to 185% n = 689	Yes n = 792	No n = 1647
Female	50	49	48	50
Ethnicity				
Non-Hispanic white	36	57	35	46
Non-Hispanic black	31	19	30	26
Non-Hispanic other	6	5	6	5
Hispanic	27	19	29	23
Vitamin use (yes)	36	48	38	41
Vegetarian (yes)	2	3	2	2
On any diet (yes)	0.6	0.5	1	0.4
WIC (yes)	37	21	100	NA
Food Stamp (yes)	56	NA	59	33
Season				
Summer	27	26	25	28
Fall	22	24	23	23
Spring	26	28	27	26
Winter	25	22	25	23
Urbanicity				
MSA central city	46	33	49	38
MSA outside city	31	42	29	37
Non-MSA	23	25	22	25
Education†				
Less than high school	41	16	39	31
High school	38	43	36	41
More than high school	21	41	25	28
Employment†				
Full-time	27	35	21	33
Part-time	18	23	19	20

*Sample size adds up to 2439 because of some missing data.
†Of female head of household.

consumption of the dietary intakes under investigation. Thus, our model assessing the effect of WIC participation on dietary intakes was adjusted for individuals who did not chose to consume snacks that contained the nutrients in question. By combining these two steps, our final results essentially take into consideration the decision of consuming a selected eating occasion and nutrient or food group. In effect, the adjusted results incorporate the different effects of WIC on consumption of the food group or nutrient for a meal or snack. It is important to note that we also examined the effect of nonrandom selection bias and did not find any significant results that would have allowed us to control for this bias.

RESULTS

Children whose family incomes were below 130% of poverty were roughly one third of white, black, and Hispanic ethnicity, about one third reported taking supplements, and the same number reported receiving WIC; slightly more than half reported being on food stamps (Table I). Female head of households in this income group had a high percentage, with less than 12 years of schooling, and only about one quarter reported working full time. In contrast, children in whose family incomes were between 130% and 185% of poverty were predominately white, almost half reported taking supplements, 1 of 5 were receiving WIC, the female head of household had more education, and about a third reported working full time.

Children who participated in WIC were evenly distributed among the 3 major ethnic groups, the majority were receiving food stamps as well, a quarter of their female head of household had a more than a high school education, and only 1 in 5 reported working full time. Children who were not in the program were predominately white, only a third participated in food stamps, and approximately a third of the female head of household reported more than 12 years of education as well as working full time.

Table II. Means and standard errors of selected nutrient intakes for 2- to 5-year-olds not in school participating in the CSFII 1994-1996 and 1998 survey by income strata for all meals and from snacks

	<130% of poverty (n = 1772)				130 to 185% of poverty (n = 689)			
	Total		Snacks		Total		Snacks	
Nutrients	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Energy (kcal)	1546	13.4	409.2	9.7	1567	13.4	427.3	11.7
% Energy from fat	33.3	0.2	28.4	0.4	32.3	0.3	27.3	1.0
% Energy from saturated fat	12.7	0.1	11.4	0.1	12.1	0.1	10.4	0.3
% Energy from carbohydrates	53.2	0.3	65.7	0.5	55.2	0.3	67.4	1.2
% Energy from added sugar	14.3	0.2	23.8	0.7	16.4	0.5	27	1.2
Iron (mg)*	8.3	0.1	5.3	0.1	8.2	0.1	4.9	0.1
Calcium (mg)*	518.2	4.9	515.2	13.9	516.9	8.4	451.9	17.8
Fiber (g)*	6.9	0.1	8.3	0.3	6.8	0.1	7.6	0.2
Servings of fruit	2.2	0.1	1.2	0.0	2.3	0.1	1.2	0.1
Servings of fruits and vegetables	4.7	0.1	1.4	0.0	4.7	0.1	1.4	0.1

*Density (per 1000 kcal).

Table III. Beta-coefficients for participation in the WIC program from models predicting dietary intakes from all meals and snacks separately for children in households < 130% of poverty (n = 1772)

	All meals		Snacks only*	
Dependent variables	β-coefficient	*P* value	β-coefficient	*P* value
Energy	24.9	.41	11.7	.30
% Energy from fat	−0.96	.02	−0.31	.60
% Energy from saturated fat	−0.25	.20	−.22	.60
% Energy from carbohydrates	1.16	.03	−.06	.90
% Energy from added sugar	−1.44	.007	−4.24	.003
Iron (mg)†	0.63	.003	0.58	.05
Calcium (mg)†	18.9	.20	23.7	.30
Fiber (g)†	0.23	.10	−1.0	.10
Servings of fruits	0.54	.05	0.08	.70
Servings of fruits and vegetables	0.64	.003	0.33	.06

All models controlled for age, sex, ethnicity, female head of household age, employment and education status, household income and size, MSA, food stamp participation, TV watching, supplement use, dietary restrictions, seasonality, and attendance at child care.
*Two-step regression equations.
†Density (per 1000 kcal).

Nutrient intakes for the total diet (includes all meals and snacks) and for snacks only by income group are shown in Table II.

The prevalence of snacking in each income group was similar; 93.5% and 94%, respectively, for children with family incomes <130% and 130% to 185% of poverty (χ^2 = 4.6, P = .55). Among WIC participants, the prevalence of snacking was significantly lower (68%) compared with non-participants (72%) (χ^2 = 5.9, P = .01).

The results of the multivariable modeling to isolate the effect of WIC on dietary intakes by income group are shown in Tables III and IV. For those <130% of poverty, WIC had a beneficial effect on the intake of fat, carbohydrates, added sugar, and fruit intake from the total diet (Table III). For nutrient intake attributable to snacking, WIC had a beneficial effect only on added sugar intake and a suggestive beneficial effect on iron and fruit intake. For those with higher incomes, the beneficial effects of WIC participation was limited to added sugar, iron density, and fruit intake for the total diet. A similar significant effect of decreased added sugar intake from snacks was seen in this income group as in the lower income group.

DISCUSSION

It is important to continually evaluate the effects of public food assistance and nutrition programs on the

Table IV. Beta-coefficients for participation in the WIC program from models predicting dietary intakes from all meals and snacks separately for children in households 130% to 185% of poverty (n = 689)

	All meals		Snacks only*	
Dependent variables	β-coefficient	*P* value	β-coefficient	*P* value
Energy	92.3	.06	2.2	.9
% Energy from fat	0.77	.1	1.05	.4
% Energy from saturated fat	0.13	.7	−0.92	.2
% Energy from carbohydrates	−1.05	.1	−2.5	.2
% Energy from added sugar	−3.23	.000	−5.97	.01
Iron (mg)†	1.06	.002	0.53	.1
Calcium (mg)†	24.8	.36	−21.2	.7
Fiber (g)†	−0.29	.3	0.12	.8
Servings of fruits	0.4	.02	0.12	.8
Servings of fruits and vegetables	0.64	.01	−0.12	.6

All models controlled for age, sex, ethnicity, female head of household age, employment and education status, household income and size, MSA, food stamp participation, TV watching, supplement use, dietary restrictions, seasonality, and attendance at child care.
*Two-step regression equations.
†Density (per 1000 kcal).

nutritional and health status of the population they serve. Over the past 30 years, the eating patterns and dietary intakes of Americans have changed drastically, with a greater proportion eating out, an increasingly higher proportion who are snacking, and a higher consumption of invisible fats.[12,18,19] Thus, the effects of the WIC program may be potentially beneficial for other nutrients besides those that have been specifically targeted because of the nutrition education that the participants receive.

Our analysis shows that for preschoolers participating in the program, the prevalence of snacking and the percentage of energy from added sugar was lower compared with non-participants. This effect did not differ by income strata. There were no other benefits of the program on foods or nutrient intakes attributed to snacks. WIC had more effect on the nutrient quality of nonsnack meals. For preschoolers living in households eligible for both Food Stamps and WIC, we saw an independent effect of WIC participation on the total diet for fat, carbohydrates, iron, added sugar, and fruit intakes. Interestingly, for those who are above the Food Stamp cutoff but still income-eligible for WIC, the magnitude of the effect of WIC participation was greater for added sugar and iron but similar for fruit intakes compared with those income eligible for both programs. In addition, there was no significant effect on fat or carbohydrate intake; in fact, the effect of WIC participation on these nutrient intakes were in the opposite direction than that seen for those who are income eligible to participate in both programs.

As a number of studies have shown, dietary intakes of preschools are in need of improvement. Vitamin and mineral consumption is low, whereas fat and added sugar intakes are high.[3,20–26] Cereal is part of the WIC food package for children, and our previous analysis indicates that the major contributor to iron intake in this population are fortified cereals (Kranz, unpublished). Since children of lower income families are more likely to lack good diet quality, programs targeted at this subpopulation, such as the WIC program, might greatly improve preschooler's diets.

Snacks are an important part of young children's diets to achieve the necessary nutrients and energy intake[27]; thus, enhancing the nutrient quality of snacks might be one route to improve diet quality. Adding fruits and vegetables seem to be one possibility. However, as our previous research has indicated, an observed increase of fruit consumption over the past 22 years in preschool children was paralleled by an upward trend of fruit juice consumption. Analysis revealed that indeed, the rise of the average number of servings of fruit per day could be attributed to the increase of 100% fruit juice consumption (Kranz, unpublished). The American Dietetic Association currently recommends the intake of fruit juice in an effort to increase the number of servings of fruits consumed by children.[28] However, the American Academy of Pediatrics recently released a recommendation to limit juice consumption to 6 oz per day in preschoolers.[29] This recommendation is based on the concern that high juice intake leads to higher energy consumption and lacks the benefit of increased fiber intake, as would be observed when children consumed additional servings of whole fruit.

A limitation of using the USDA data set to examine the effect of WIC participation is the lack of data on eligibility for the program aside from income. Thus, we may be comparing WIC individuals with some who may not be at medical risk but are income eligible and this would result in a bias toward the null. In addition, we did not have information on how long the child participated in the program in order to examine if those with the longest duration of participation benefited the most. And, last, we were unable to control for the types of biases associated with self-selection previously described.[5] The USDA survey did not collect reasons for nonparticipation, and our ability to correct by using econometric techniques of creating exogenous variables that predict program participation was hampered by the lack of state specific identifiers.

We are also aware of the limitation associated with the diet methodology used by the survey.[30] Only two 24-hour recalls were collected by proxy, which comes with its inherent measurement problems. However, until newer methods are validated and proven feasible in large population studies, particularly for children of this age group, then two 24-hour recalls can provide reasonable estimates of intake at the group level.

Our results are in line with the previous four studies, which have shown beneficial effects of WIC participation among preschoolers primarily for nutrients targeted by the WIC program. Our study shows that the effect can reach beyond those targeted nutrients. For future studies, it would be helpful to have databases that can overcome the biases inherent in this type of research when for ethical reasons, a randomized trial is not feasible. In addition, the effect of WIC on other eating and lifestyle behaviors is worthy of study, since WIC is increasingly becoming the public health program that links individuals to other public health interventions (ie, immunizations and physical activity programs).

REFERENCES

1. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. JAMA 2002;288:1728-32.
2. Pamuk E, Makus D, Heck K, Reuben C, Lochner K. Socioeconomic Status and Health Chartbook. Health, United States, 1998. Hyattsville, Md: National Center for Health Statistics. 1998.
3. Kranz S, Siega-Riz AM, Herring A. Changes in diet quality of American preschoolers between 1977 and 1998. Am J Public Health 2003. In press.
4. Kennedy E, Goldberg J. What are American children eating? Implications for public policy. Nutr Rev 1995;53:111-26.
5. Olivera V, Gundersen C. WIC increases the nutrient intake of children. Food Rev 2001;24:27-30.
6. Devaney B, Bilheimer L, Schore J. Medicaid costs and birth outcomes: the effects of prenatal WIC participation and use of prenatal care. J Policy Anal Manage 1991;11:573-92.
7. Edozien JC, Switzer BR, Bryan RB. Medical evaluation of the Special Supplemental Food Program for Women, Infants, and Children. Am J Clin Nutr 1979;32:677-92.
8. Kennedy ET, Gershoff S, Reed R, Austin JE. Evaluation of the effect of WIC supplemental feeding on birth weight. J Am Diet Assoc 1982;80:220-7.
9. Rush D. Evaluation of the special supplemental food program for women, infants and children (WIC). Vol 1, Summary. Research Triangle Park, NC. 1986.
10. Fraker T, Long SK, Post CE. Analyses of the 1985 Continuing Survey of Food intakes by Individuals. Vol 1. Washington, DC. September 27, 1990.
11. Rose D, Habicht JP, Devaney B. Household participation in the food stamp and WIC programs increases the nutrient intake of preschool children. J Nutr 1998;128.
12. Jahns L, Siega-Riz AM, Popkin BM. The increasing prevalence of snacking among US children and adolescents from 1977 to 1996. J Pediatr 2001;138:493-8.
13. Drummond S, Crombie N, Kirk T. A critique of the effects of snacking on body weight status. Eur J Clin Nutr 1996;50:779-83.
14. United States Department of Agriculture Agricultural Research Service. Design and Operation: The Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey, 1994-96 and 1998, 2000.
15. Tippet KS, Cypel YS. Design and operation: the Continuing Survey of Food Intake by Individuals and the Diet and Health Knowledge Survey 1994-96. Nationwide Food Surveys Report 96-1. United States Department of Agriculture, Agricultural Research Service, 1997.
16. Welsh S, Davis C, Shaw A. USDA Food Guide: Background and Development. Hyattsville, Md: United States Department of Agriculture; 1993. p. 12-23.
17. Haines PS, Guilkey DK, Popkin BM. Modeling food consumption decisions as a two-step process. Am J Agricul Econ 1988;70:543-52.
18. Popkin BM, Siega-Riz AM, Haines PS, Jahns L. Where is the fat? Trends in US diets 1965-96. Prev Med 2001;32:245-54.
19. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in food locations and sources among adolescents and young adults. Prev Med 2002;35: 107-13.
20. Leung M, Yeung DL, Pennell MD, Hall J. Dietary intakes of preschoolers. J Am Diet Assoc 1984;85:551-4.
21. Thompson FE, Dennison BA. Dietary sources of fats and cholesterol in US children aged 2 through 5 years. Am J Public Health 1994;84:799-806.
22. Dennison BA. Fruit juice consumption by infants and children: a review. J Am Coll Nutr 1996;15:4S-11S.
23. Dennison BA, Rockwell HL, Baker SL. Fruit and vegetable intake in young children. J Am Coll Nutr 1998;17:371-8.
24. McBean LD, Miller GD. Enhancing the nutrition of America's youth. J Am Coll Nutr 1999;18:563-71.
25. Munoz KA, Krebs-Smith SM, Ballard-Barbash R, Cleveland LE. Food intakes of US children and adolescents compared with recommendations. Pediatr 1997;100:323-9.
26. Kant AK, Schatzkin A, Block G, Ziegler RG, Nestle M. Food group intake patterns and associated nutrient profiles of the US population. J Am Diet Assoc 1991;91:1532-7.
27. Wilson JF. Preschoolers' mid-afternoon snack intake is not affected by lunchtime food consumption. Appetite 1999;33:319-27.
28. American Dietetic Association. Dietary guidance for healthy children aged 2 to 11 years: position of ADA. J Am Diet Assoc 1999;99:93-101.
29. American Academy of Pediatrics Committee on Nutrition. The use and misuse of fruit juice in pediatrics (RE0047). Pediatr 2001;107:1210-3.
30. Willett W. Nutritional epidemiology. 2nd ed. New York, NY: Oxford University Press; 1998.