Multivariate Regression Analysis

The primary objective of this report is to determine the effect of WIC participation on the nutrient intake of children by comparing the nutrient intake of children participating in WIC to a comparison group of income-eligible nonparticipants. The lack of statistically significant differences in mean nutrient intake between WIC recipients and income-eligible nonparticipants in the univariate analysis shown in table 2 does not necessarily mean that the WIC program had no effect on nutrient intakes. There may be differences between WIC recipients and WIC-eligible nonparticipants that influence nutrient intake; that is, in the absence of WIC, the children now on WIC may have had significantly lower nutrient intake than the group of income-eligible nonparticipants. For example, since children on WIC must be at nutritional risk in order to participate, they may be at poorer nutritional status to begin with than children not in the WIC program. The effect of WIC may have been to reduce initial differences between the groups.

The Model

To control for observable differences between participants and nonparticipants, a single-equation multivariate regression analysis was used where the dependent variable was the nutrient adequacy ratio. It is assumed that the lower a subpopulation's nutrient adequacy ratio, the greater the risk of inadequate nutrient intake. An alternative probit regression model that uses a fixed cutoff (e.g., 100 percent of the RDA) as the dependent variable could also have been used. However, since the RDA is set above the nutritional needs of most healthy people, intakes below the RDA do not necessarily indicate inadequate diets. The use of any other cutoff (e.g., 75 percent of the RDA) is arbitrary and difficult to interpret (Fraker et al., 1990). In addition, because an individual's nutrient intake can vary substantially from day to day, estimates of intakes below the RDA, or some other cutoff, based on only 2 days may be biased. Two-day intake measures, on the other hand, should give an accurate measure of the mean.

A number of socioeconomic characteristics thought to influence nutrient intake were included as independent variables:

Characteristics of the child: The main variable of interest for this analysis was WIC status, that is, whether or not the child participated in the WIC program. Variables representing sex, race/ethnicity, and age of the child were also constructed. Age-of-child variables were included in the model for three reasons. First, WIC participation declines as children's age increases (see table 1). This decline may be due, in part, to rationing, in which younger children may be given higher priority than older children when funds are not sufficient to serve all eligible children. This decline may also be due to the participation decisions of households: parents of younger children may choose to apply or reapply for WIC to a greater degree than parents of older children.[16] Second, because children 1 to 3 years old share the same RDA, the nutrient adequacy ratio (which uses the RDA as the denominator) will not totally account for the increase in food consumption as children age.[17] Third, the tastes and preferences of children (and/or the allocation of food by parents) change over time regardless of whether the children participate in WIC.

Household characteristics:[18] Since a lack of money may restrict the purchase of nutritious foods, a variable representing the annual income of the household expressed as a percentage of the poverty threshold was included as an independent variable.[19] Since the household's assets may affect its ability to withstand unexpected decreases in income, two measures of household wealth were considered—homeownership, since a home is the largest asset for most households; and whether the household had cash assets of more

[16]Consider two similar households (in which only the age of the child differs) that are now eligible to participate in WIC but were not eligible previously. The first household, with a child 18 months old, may decide to participate because they anticipate that they will be able to receive WIC benefits for several years. The second household, with a child 4 years old, may decide not to participate because they could not receive WIC benefits for more than 1 year.

[17]Children 4 years old have the same RDA as children 5 and 6 years old.

[18]The CSFII defines a household as all persons who regularly share a house, an apartment, a room, or a group of rooms used as separate living quarters.

[19]Poverty thresholds are based on household income and household size. A ratio of income to poverty threshold above 100 indicates that a household's income was above the poverty threshold, while a ratio below 100 indicates that a household was in poverty.

than $5,000. Household structure as measured by whether it was a dual-headed or single-headed household may influence the amount of time available to prepare meals. Single-headed households may have less time to spend shopping for nutritious foods and preparing better quality meals. A variable indicating whether the household received food stamps was also included.

Geographic characteristics: Variables based on region of residence and metropolitan status were constructed to account for regional differences in food consumption practices and prices.

Characteristics of the household head: Number of years of schooling completed by the head of household was included in the model as a proxy for nutrition knowledge.

Year of the survey: A variable based on the year of the survey was constructed to account for the increase in the participation of children in WIC due, in part, to increased Congressional funding between 1994 and 1996.[20]

Definitions of the variables used in the regression model are presented in appendix A.

The regression analysis was restricted to children who were income eligible for WIC, proxied by income less than 200 percent of poverty or participation in the Food Stamp or AFDC Programs. Of the 1,206 WIC child recipients and income-eligible nonparticipating children in the original sample, 31 WIC recipients were dropped from this analysis because they reported household income above 200 percent of the poverty threshold.[21] An additional 40 children were dropped because of missing data for one or more independent variables. Of the remaining 1,135 children in the data set used in this analysis, 396 participated in the WIC program and 739 were income-eligible nonparticipants.

[20]Expenditures for WIC increased from $3.2 billion in fiscal 1994 to $3.7 billion in fiscal 1996, an increase of 16.6 percent. At the same time, average costs (including food and administrative costs) per recipient increased by only 5.1 percent (USDA 1998d).

[21]Since the group of WIC income-eligible but nonparticipating children was limited to children with incomes at or below 200 percent of poverty, the inclusion of WIC children with incomes above 200 percent of poverty could have resulted in a biased sample. The authors also ran a regression model that included these 31 children in the group of WIC participants. Results were similar to those found when excluding WIC participants with incomes above 200 percent of poverty from the analysis.

Since the use of sampling weights in regression models can lead to inefficient analysis, an unweighted regression model that included variables used to determine sampling rates, including socioeconomic characteristics, geographic location, and degree of urbanization, was utilized. A least squares regression model was estimated separately for each of the five targeted WIC nutrients, and for the three nutrients recommended as WIC target nutrients, as well as for food energy.

Results

The results of the regression analysis for each of the nine dependent variables are shown in table 3. Regression coefficients were considered to be significantly different from zero at $P<.05$.

After controlling for differences in socioeconomic characteristics, children receiving WIC had significantly higher intake of three of the WIC-targeted nutrients—iron, vitamin C, and vitamin A. Although WIC's effect on protein was insignificant, results from table 2 indicated that virtually all of the children, regardless of WIC status, attained the RDA, thereby indicating more than adequate intake of the nutrient.

Among the three additional nutrients recommended to be included for targeting in the program, WIC participation was associated with a significantly higher intake of vitamin B-6 and folate. At the same time, WIC participation was associated with a negative, although statistically insignificant, effect on food energy. Thus, the significant increase in the intakes of iron, vitamin C, vitamin A, vitamin B-6, and folate occurred as a result of increased nutrient density and not increases in the amount of food energy consumed.

Among the other independent variables included in the models, residence in a nonmetro area had a statistically significant negative effect on the consumption of calcium, vitamin A, vitamin B-6, and folate. Boys had a significantly positive coefficient for protein and food energy compared with girls. The variables related to age of child were significant to a large degree, but the sign was inconsistent across the nutrients. In most cases, the coefficients for the age variables increased as age increased (relative to children 4 years of age), reflecting increased consumption relative to the RDA by older children.

In a separate analysis, a model including interaction effects of age of child and WIC participation was also estimated for each of the nutrients. These interaction models indicate whether age has an independent effect on the impact of WIC on nutrition or if age has an

effect only through its influence on the WIC participation decision. Except for a negative interaction of 1-year-old children and WIC participation on the intake of protein, there was no evidence of significant interaction effects of WIC participation and age on the nutrient intake of children.

Table 3—Results of multiple regression models on WIC income-eligible children

	Iron	Calcium	Vit. C	Vit. A	Protein	Vit. B-6	Folate	Zinc	Food energy
Intercept	107.86*	103.78*	223.27*	137.22*	226.26*	127.76*	262.60*	73.07*	79.02*
	(10.70)	(12.29)	(7.35)	(5.40)	(11.35)	(11.61)	(7.32)	(11.74)	(13.62)
WIC recipient	17.33*	3.21	29.54*	28.20*	-5.05	9.49*	28.00*	1.34	-0.75
	(4.88)	(1.08)	(2.76)	(3.15)	(.72)	(2.45)	(2.21)	(.61)	(.37)
Percent of poverty	.01	-0.03	-0.15	-0.03	-.14*	-0.00	0.08	-0.03	-0.04
	(.35)	(1.15)	(1.38)	(.38)	(2.01)	(.02)	(.68)	(1.62)	(1.74)
Food Stamp recipient	-6.47	-2.01	-17.93	-9.71	5.50	-7.20	-23.98	1.41	-0.06
	(1.60)	(.60)	(1.47)	(.95)	(.69)	(1.63)	(1.67)	(.57)	(.03)
Assets of $5,000	.22	3.60	4.79	10.02	-2.70	-1.48	13.63	1.14	-2.15
	(.03)	(.65)	(.24)	(.60)	(.21)	(.20)	(.58)	(.28)	(.56)
Homeownership	-6.74	.38	-2.37	-13.22	-1.32	-4.13	-10.89	-1.84	1.96
	(1.81)	(.12)	(.21)	(1.41)	(.18)	(1.02)	(.82)	(.80)	(.91)
Male	5.79	4.18	4.84	8.42	12.48*	4.47	14.57	2.52	5.63*
	(1.80)	(1.55)	(.50)	(1.04)	(1.97)	(1.28)	(1.28)	(1.27)	(3.05)
Black	3.30	-10.36*	1.42	-35.07*	3.22	-5.77	-12.04	3.70	-1.86
	(.69)	(2.59)	(.10)	(2.91)	(.34)	(1.10)	(.71)	(1.25)	(.68)
Hispanic	-10.62*	-2.06	22.28	4.43	1.50	4.15	21.94	-3.98	-4.69
	(2.31)	(.53)	(1.61)	(.38)	(.16)	(.83)	(1.34)	(1.40)	(1.77)
Other racial/ethnic	-21.41*	-4.33	12.99	.44	-14.72	-7.76	-21.09	-5.95	-10.66*
	(2.92)	(.71)	(.59)	(.02)	(1.02)	(.97)	(.81)	(1.32)	(2.53)
Midwest	1.22	-2.59	-3.90	18.31	15.77	3.03	11.92	7.43*	6.24*
	(.22)	(.57)	(.24)	(1.34)	(1.47)	(.51)	(.62)	(2.21)	(1.99)
South	-4.59	-10.07*	-27.20	1.76	-5.59	-7.15	-11.43	-0.59	-2.65
	(.91)	(2.39)	(1.80)	(.14)	(.56)	(1.30)	(.64)	(.19)	(.92)
West	-2.23	-3.70	-27.67	-2.22	-6.68	-4.56	3.35	1.59	-3.66
	(.42)	(.82)	(1.71)	(.16)	(.63)	(.78)	(.18)	(.48)	(1.19)
Metro-central city	3.48	-3.36	11.90	-4.71	-10.84	0.06	9.42	-.32	0.61
	(.89)	(1.03)	(1.01)	(.48)	(1.40)	(.01)	(.68)	(.13)	(.27)
Nonmetro	-8.45	-10.02*	-18.47	-42.30*	-5.00	-15.13*	-45.38*	-2.05	-2.25
	(1.95)	(2.76)	(1.41)	(3.87)	(.58)	(3.19)	(2.94)	(.77)	(.90)
Age-1 year	-19.92*	15.38*	15.86	15.56	76.69*	-2.74	63.32*	-10.33*	13.80*
	(4.27)	(3.94)	(1.13)	(1.32)	(8.31)	(.54)	(3.81)	(3.59)	(5.14)
Age-2 years	-11.24*	-7.46*	47.24*	10.21	86.11*	6.74	108.23*	-6.93*	21.80*
	(2.48)	(1.96)	(3.45)	(.89)	(9.60)	(1.36)	(6.71)	(2.47)	(8.35)
Age-3 years	-1.43	-5.53	37.40*	16.45	91.61*	12.11*	143.05*	-2.92	27.71*
	(.29)	(1.34)	(2.52)	(1.33)	(9.40)	(2.25)	(8.16)	(.96)	(9.77)
Head's education (years)	.90	0.62	-0.26	2.45	1.87	0.46	.76	0.58	0.60
	(1.65)	(1.37)	(.16)	(1.79)	(1.73)	(.78)	(.39)	(1.74)	(1.93)
Single headed household	6.60	-6.12	-13.27	5.64	-.03	2.92	6.12	1.34	2.35
	(1.58)	(1.75)	(1.05)	(.54)	(.00)	(.64)	(.41)	(.52)	(.97)
Year95	2.66	1.03	19.08	.95	-6.26	-2.81	2.40	7.36*	.26
	(.70)	(.32)	(1.66)	(.10)	(.83)	(.68)	(.18)	(3.13)	(.12)
Year96	.02	3.30	13.33	-.64	-.83	-3.21	-5.73	5.99*	1.80
	(.01)	(.97)	(1.09)	(.06)	(.10)	(.73)	(.40)	(2.40)	(.77)

Notes: The dependent variable is the nutrient intake of children expressed as a percentage of the RDA. Numbers in parentheses are the t values. *=Significant at the 95-percent confidence level. Sample size=1,135 observations.