Multivariate Regression Analysis Controlling for Selection Bias

In an ideal evaluation, the effects of WIC on children would be obtained by randomly selecting from a group of eligible children some children to receive and some not to receive benefits. On average, the characteristics (both observable and unobservable) of the two groups of children would not differ other than whether or not they participated in the WIC program (assuming that all children selected to receive WIC benefits did so). Differences in nutrient intake between the two groups could be attributed solely to the effects of WIC, and not the result of a bias due to self-selection or rationing. However, because of ethical concerns associated with withholding benefits from needy children, a random assignment design is not possible.

There are statistical techniques that can control for selection bias (for example, see Heckman 1979). However, they require the model to include one or more explanatory variables (or identification variables) that explain program participation (i.e., whether or not a person participates in the WIC program) but do not directly influence nutrition intake.[26] However, because the CSFII does not provide enough information on why some income-eligible children do not participate in the program, we did not use a statistical model that corrects for self-selection bias.[27] Nonetheless, we did use an indirect method to address the issue of self-selection—comparing the nutrient intake of children by WIC status in households in which some person other than a child is participating in WIC, that is, a pregnant woman, a breastfeeding or postpartum mother, or an infant. In this model, since the households already receive WIC, the parents (or proxies) presumably are aware of the program, and are nutritionally concerned and motivated to improve the WIC participant's nutrition. Thus, the biases listed in examples 1, 2, and 4 in table 4 are controlled for. The bias resulting from example 3, whereby a parent does not enroll an eligible child in WIC because the parent does not believe the child has a high nutritional risk, is also controlled for since it is unlikely that a parent, who already takes the time to pick up WIC vouchers for another member of the household, would willingly choose not to enroll an eligible child in the program. Even if the nutritional benefits of participating in WIC for the child in question are small, participating in the program would free up food dollars that could be spent on other nutritionally at-risk household members.[28]

While the alternative model controls for self-selection, it does not control for the biases resulting from rationing (examples 5 and 6 in table 4). Since the biases from rationing are likely to be downward, the results from this analysis will be conservative, understating the effect of WIC.

A total of 191 income-eligible children in the sample resided in households in which some person other than a child was currently participating in WIC. The same regression models specified earlier for the full sample of WIC income-eligible children were run on these children. Eleven of these children were dropped from the analysis because of missing data for one or more independent variables. Of the remaining 180 children in the analysis, 110 participated in WIC and 70 did not.[29] The results of this analysis are shown in table 5.

As with the results based on the full sample of WIC income-eligible children (described in table 3), the estimate of WIC participation on the intake of iron based on this subset of children was positive and statistically significant. Although the coefficients for vitamin C (P=.07) and vitamin A (P=.10) were positive, they were not statistically significant. The lack of statistical significance for these nutrients, however, may be the result of the smaller sample size; also a spillover effect, whereby a person's participation in WIC affects the nutrient intake of other persons in the household, may be a factor. This could happen when: (1) WIC's referrals to Food Stamps and other food-assistance pro-

[26] One such explanatory variable, for example, might be distance to the local WIC office. People who live near a WIC office may be less inconvenienced, and thus more likely to apply for WIC, than people who must travel longer distances.

[27] See (Fraker et al. 1990) for a discussion of the lack of variables in the CSFII that could serve as identifiers in models designed to estimate WIC program effects on dietary outcomes while controlling for selection bias.

[28] Even if parents in households in which someone participates in WIC chose not to enroll their eligible child in the program because they do not perceive their child as having a high level of nutritional risk (example 3 in table 4), the bias would be downward (similar to that due to rationing in examples 5 and 6) and would not affect our conclusions.

[29] The socioeconomic and demographic characteristics of these children by WIC status are shown in appendix table 1 and the nutrient intake of these children by WIC status is shown in appendix table 2.

Table 5—Results of multiple regression models on WIC income-eligible children residing in households in which another adult or infant household member participates in WIC

	Iron	Calcium	Vit. C	Vit. A	Protein	Vit. B-6	Folate	Zinc	Food energy
Intercept	26.68	97.42*	56.00	72.50	213.87*	47.43	-33.14	50.43*	65.28*
	(.94)	(5.04)	(.72)	(1.60)	(4.56)	(1.65)	(.33)	(3.39)	(4.68)
WIC recipient	20.67*	12.67	48.75	26.01	.20	23.49*	91.06*	-3.07	-1.83
	(2.10)	(1.88)	(1.81)	(1.65)	(.01)	(2.34)	(2.61)	(.59)	(.38)
Percent of poverty	.07	.00	-.11	.21	-.22	.09	.21	-.08	-.04
	(.74)	(.02)	(.45)	(1.44)	(1.46)	(.92)	(.66)	(1.57)	(.94)
Food Stamp recipient	1.21	-.59	-41.97	-.89	22.57	1.75	-25.76	3.50	2.07
	(.12)	(.08)	(1.50)	(.05)	(1.33)	(.17)	(.71)	(.65)	(.41)
Assets of $5,000	-17.41	-41.01	89.39	17.12	-69.21	-7.93	57.26	-11.57	-11.20
	(.55)	(1.89)	(1.03)	(.34)	(1.32)	(.25)	(.51)	(.69)	(.72)
Homeownership	-10.05	-1.61	8.51	-27.73	7.72	-6.71	-51.97	-3.40	.94
	(.95)	(.22)	(.29)	(1.63)	(.44)	(.62)	(1.38)	(.61)	(.18)
Male	1.33	21.83*	-21.33	12.18	20.20	12.85	55.37	4.03	8.80*
	(.15)	(3.59)	(.88)	(.85)	(1.37)	(1.42)	(1.75)	(.86)	(2.01)
Black	31.36*	6.19	104.55*	-15.70	57.94*	11.29	37.07	11.16	19.00*
	(2.30)	(.67)	(2.81)	(.72)	(2.56)	(.81)	(.77)	(1.56)	(2.83)
Hispanic	11.92	6.75	134.74*	20.44	47.63*	33.93*	160.57*	9.57	14.08*
	(.98)	(.82)	(4.06)	(1.05)	(2.37)	(2.75)	(3.73)	(1.50)	(2.36)
Other racial/ethnic	-16.14	-36.69*	146.64*	-6.84	-42.94	-13.41	20.43	2.65	-17.01
	(.90)	(2.99)	(2.98)	(.24)	(1.44)	(.73)	(.32)	(.28)	(1.92)
Midwest	6.55	-33.05*	58.04	4.46	-43.49	.52	60.13	13.68	-6.37
	(.35)	(2.60)	(1.14)	(.15)	(1.41)	(.03)	(.91)	(1.40)	(.70)
South	-.37	-25.79*	39.96	-19.96	-69.48*	-3.26	45.98	-5.89	-15.19*
	(.02)	(2.49)	(.96)	(.82)	(2.76)	(.21)	(.86)	(.74)	(2.03)
West	14.02	-14.38	7.68	-24.31	-65.78*	-7.35	30.75	-7.77	-17.91*
	(.93)	(1.40)	(.19)	(1.01)	(2.63)	(.48)	(.58)	(.98)	(2.41)
Metro-central city	16.01	-1.71	34.10	13.73	-19.70	11.53	62.67	3.21	3.78
	(1.50)	(.24)	(1.17)	(.80)	(1.11)	(1.06)	(1.66)	(.57)	(.72)
Nonmetro	1.97	3.46	-13.73	-5.74	-.75	-3.24	8.03	1.15	3.80
	(.15)	(.40)	(.39)	(.28)	(.04)	(.25)	(.18)	(.17)	(.60)
Age-1 year	-6.35	17.90	42.17	36.30	82.09*	13.96	138.99*	-2.10	21.36*
	(.45)	(1.85)	(1.09)	(1.60)	(3.50)	(.97)	(2.77)	(.28)	(3.07)
Age-2 years	10.45	-7.67	85.04*	41.49*	106.76*	28.40*	178.47*	7.17	29.71*
	(.80)	(.87)	(2.40)	(1.99)	(4.96)	(2.15)	(3.88)	(1.05)	(4.65)
Age-3 years	6.64	-7.40	70.60	42.20	99.91*	23.58	167.94*	3.97	31.12*
	(.44)	(.73)	(1.73)	(1.76)	(4.03)	(1.55)	(3.17)	(.51)	(4.23)
Head’s education (years)	4.20*	.26	1.99	2.59	5.07*	2.26	6.89	1.85*	1.68*
	(3.27)	(.29)	(.57)	(1.26)	(2.38)	(1.73)	(1.52)	(2.75)	(2.66)
Single-headed household	-5.52	-14.91	-24.67	1.27	8.05	.02	-1.09	4.96	.21
	(.45)	(1.77)	(.73)	(.06)	(.39)	(.00)	(.03)	(.77)	(.04)
Year95	5.30	-2.07	64.98*	2.06	-19.14	-5.73	-17.54	9.54	-3.13
	(.51)	(.29)	(2.29)	(.12)	(1.11)	(.54)	(.48)	(1.74)	(.61)
Year96	4.09	-12.34	-3.78	-20.62	-40.04	-20.30	-42.21	3.69	-7.15
	(.33)	(1.46)	(.11)	(1.04)	(1.95)	(1.61)	(.96)	(.57)	(1.17)

The dependent variable is the nutrient intake of children expressed as a percentage of the RDA. Numbers in parenthesis are the t values. *=Significant at the 95-percent confidence level. Sample size=180 observations.

grams lead to new-found resources for a household; (2) WIC foods are shared among other non-WIC household members; (3) the nutrition education received by WIC women results in increased dietary quality for all members of the household; or (4) receipt of WIC benefits frees up food dollars that are spent on food for the nonparticipating child.

In addition, another factor could explain the lack of significance for these variables. Limiting the analysis only to children residing in households in which another member participates in WIC controls for self-selection bias; however, it does not address the probable downward bias due to rationing. In households in which the child is not on WIC, but someone else is on WIC, the child probably does not meet the nutritional risk criteria or the child's nutritional risk is low priority. Thus, the exclusion of nutritionally more successful children from the group of participating WIC children will tend to underestimate the effects from participating in WIC.

Among the three nutrients recommended for targeting by WIC, the coefficients for folate and vitamin B-6 were positive and statistically significant. These results are not surprising given the fact that WIC food packages for children are considered to be good sources of both vitamin B-6 and folate (USDA 1991). WIC's effect on the intake of zinc was insignificant. Major sources of zinc, largely red meats, are not included in the WIC food package. Once again, the regression coefficient for energy was negative and insignificant, indicating that the increase in intake of these nutrients occurred as a result of increased nutrient density and not increases in the amount of food energy consumed.