1976

Effects of Economic Variables and Food Delivery Programs on Nutrient Intake*

by

David W. Price, Donald A. West,

Genevieve E. Scheier**

**Price and West are Associate Professors in Agricultural Economics and Scheier is an Associate Home Economist in the Home Economics Research Center, Washington State University

Paper presented, AAEA annual meetings, Aug. 15-18, 1976, Penn State University.

ABSTRACT

A sample of 849 Washington school children showed the National School Lunch Program to be increasing intakes of some nutrients for children receiving free lunches. Liquid assets and school breakfast participation influenced intakes of some nutrients while current income had little impact. The effects of food stamps are inconclusive.

Effects of Economic Variables and Food Delivery Programs on Nutrient Intake*

by

David W. Price, Donald A. West and Genevieve E. Scheier

Introduction

There is continuing concern over the cost and effectiveness of government food delivery programs. Eligibility criteria for food stamps are under review as attempts are made to reduce the cost of the program. Some school districts faced with reduced revenues either cut back or terminate their school lunch programs. When these food programs are critically reviewed, the intent is to make them more effective by distributing the benefits to persons with the greatest need. Unfortunately the nutritionally needy groups in our society are not well identified and little is known about the impact of the food programs on nutrient intake. Policy makers need such knowledge in order to design or improve programs to make them more effective and efficient.

The research that has been done in this area is limited in program coverage and geographic scope. The results are valuable, however, in that they identify some of the dimensions and complexities of the problem. The work of Madden and Yoder in two rural counties of Pennsylvania indicates the diets of households who participated in "CD" (commodity distribution) programs were no more nutritious than diets of similar households not receiving commodities. Their study, which analyzed the effects of food stamps as well, indicated that the stamps provided some dietary improvement among households experiencing temporary shortage of funds, i.e., more than two weeks after payday. A similar study by Lane in Kern County, California, indicated that use of food stamps resulted in significantly higher levels for participants' intake of calories, protein, calcium, thiamin and riboflavin as compared to nonparticipants. These improvements were observed among subsets of the sample but were not consistent across the sample as a whole.

This paper contributes to the knowledge of program effectiveness by reporting the results of somewhat larger study conducted in the State of Washington. In the study, relationships between nutrient intake and relevant socio-economic variables, including participation in the Food Stamps and National School Lunch and Breakfast Programs, were explored using a sample of 849 school aged children. Data were collected on a large number of variables so that regression models could be specified to estimate the net effect of participation in food delivery programs on nutrient intake.

The Sample

The sample was drawn from children aged 8-12 years who were attending public schools in Washington in 1972 and 1973. It was stratified by poverty level and by ethnic group, and contained larger numbers of below-poverty children and Black and Mexican American children than would have been obtained by a random sample of the state's population. Forty-nine percent of the sample were Anglos, 26 percent were Blacks, and 25 percent were Mexican Americans. Thirty-eight percent of the sample were from households with incomes below 125 percent of the poverty level and just over one-fourth of the sample were from households receiving food stamps. Two-thirds of the sample participated in the National School Lunch Program. Slightly over one-half of these, or about one-third of the total sample, received free or reduced price lunches.

While the sample is not representative of the entire population of school-aged children in the State of Washington, it does provide some advantages for regression analysis. There are an adequate number of children from below-poverty households to identify the effects of low income on nutrient intake, while retaining a large sample of children from above poverty households for comparison.

The same types of advantages arise from the disproportionately large share of Black and Mexican American children, i.e. the effect of ethnic group can be measured.

Nutrient intakes were obtained from three separate 24-hour recalls from each child. These were spaced to have recalls for one weekend day and two weekdays. In addition, spacing was such that different weeks of the month were represented.[1]

Selection of Variables

Ten separate models were constructed, one for energy and one for each of nine nutrients (Table 1). The dependent variables were expressed as the percent of RDA (Recommended Dietary Allowance for 1974). These excluded intakes from vitamin and mineral supplements. Many of the RDAs change substantially at age 11. This caused a discontinuity which was accounted for by including a dummy variable for the 11-12 year old child on the right hand side of the equations.

In this study a large number of variables were measured that were hypothesized to affect nutrient intake. They included psychological variables, selected anthropometric measurements on the child, household food patterns, food preferences of the child as well as the usual socio-economic and program participation variables measured in this type of study. All hypothesized variables are listed in Table 1. This paper concentrates on the socio-economic and program participation variables.

A simple correlation matrix of all hypothesized variables was estimated. The regression models (one for energy and each of the nine nutrients) were then specified. The variables included in the regression models were chosen on the basis of their theoretical justification for inclusion and the degree of simple correlation with the dependent variable. Theoretically strong variables were included whether or not the simple correlation was statistically significant. Theoretically weak variables were included only if the simple correlations were significant. This procedure has several limitations including biasing the

Table 1. List of Hypothesized Variables

I. Dependent Variables (% of RDA)

1. Energy
2. Protein
3. Calcium
4. Phosphorous
5. Iron
6. Vitamin A
7. Thiamin
8. Riboflavin
9. Niacin
10. Vitamin C

II. Independent Variables

Nos. indicate which dependent variable each was regressed with	
1-10	1. Household income in $ per month per adult equivalent[a]
1-10	2. Liquid assets in $ per adult equivalent[a]
1-4,6-10	3. Food expenditures in $ per month per adult equivalent[b]
1-10	4. Value of bonus food stamps in $ per month per adult equivalent[a]
1-10	5. Child received free lunch
1-10	6. Age of child
1-10	7. Sex of child
	8. Lunch participation
	a) Full participants (4-5 times per week)
1-10	b) Partial participants (2-3 times per week)
1-10	c) Nonparticipants (0-1 times per week)
	9. Breakfast participation
1-10	a) Full participants (4-5 times per week)
1-10	b) Partial participants (2-3 times per week)
	c) Nonparticipants (0-1 times per week)
	10. Ethnic status
1-10	a) Black
1-10	b) Mexican American
	c) White
	11. Degree of urbanization where now living
1,2,4, 6-10	a) City 50,000 or more
	b) City 10,000-49,999
1,2,4, 6-10	c) Area 9,999 or less
	12. Geographic origin of person in household primarily responsible for food preparation
1-9	a) Southeastern U.S.
2-9	b) Mexico
2,5-9	c) Northeast and central U.S.
	d) Western U.S.
3-5,8	e) Foreign other than Mexico

Table 1. Continued

	13.	Occupation of major income earner
		a) White collar
3,4,6, 8,10		b) Blue collar
		c) Service
1-6,8-10		d) Armed forces
		e) Unemployed
		f) Other
	14.	Frequency of pay for major income earner
2-4,8,9		a) Weekly
		b) Biweekly
2-4,8,9		c) Monthly
		d) Other
1-10	15.	Household size in number of persons
1-4,6-8, 10	16.	Education of female head of household in number of years
	17.	Working mother
8		a) None
		b) Part time
		c) Full time
4	18.	Home produced meat
	19.	Frequency of serving by the household in number of times per month
5-8		a) Fresh, canned or frozen vegetables
1,2,4,6, 8-10		b) Dried vegetables
1,2,4,5, 7-9		c) Meat, poultry or fish
2,4,5,7, 8,9		d) Eggs
10		e) Juice
3,4,8		f) Milk
10		g) Fruit
3,4,6, 7-10	20.	Mexican food factor
3,6,7,8	21.	Soul food factor
2,4	22.	Seafood factor
5,6,10	23.	Frozen green vegetable factor
1-3,7-10	24.	Weight of child as a percent of standard for height and age
1-4,6-9	25.	Height of child as a percent of standard for age
1-3,4,8	26.	Hours since child had eaten in morning interview (long period shows no breakfast)
	27.	Food preference indices of child
1		a) Energy
2		b) Protein
3		c) Calcium
4		d) Phosphorous
		e) Iron
6		f) Vitamin A
7		g) Thiamin
8		h) Riboflavin
		i) Niacin
10		j) Vitamin C

Table 1. Continued

2-6,8,9	28.	No. of foods unwilling to try by child	
	29.	Psychological need levels of mother	
1		a)	Physiological
1		b)	Security
		c)	Love
1-4		d)	Self esteem
1-4		e)	Self actualization
	30.	Management patterns of mother	
		a)	Traditional
1,10		b)	Organizational
		c)	Humanistic
1,3,4	31.	Real/Ideal self concept difference score of child	
	32.	School districts	
1,2,4, 7-9		a)	Spokane
1,2,4, 7-10		b)	Cheney, Walla Walla
		c)	Tacoma
1,3,4-6,8		d)	Clover Park
		e)	Brererton, Edmonds
7,8,10		f)	Seattle
1-5,7-9		g)	Port Angeles (nonparticipating district)
3		h)	Grandview, Toppenish
1-3		i)	Warden, Quincy, Othello
10		j)	Yakima, Pasco
5,7		k)	Arlington, Lynden

[a]The source of the income scale used to obtain the adult equivalents was the 1960 Monthly Labor Review.

[b]The source of the food expenditure scale used to obtain the adult equivalents was Price (1970).

statistical tests of the regression coefficients by (1) using the degree of simple correlation to select variables, and (2) excluding variables that may not have significant simple correlations but may be significant with the effects of other variables taken into account. Due to the relatively low multicollinearity found in most cross section data, the authors believe these limitations are not serious. They are in essence a compromise between being statistically pure and developing a model that either has a profusion of variables or one that has only variables that previous studies have shown to be significant.

Results

The mean intake ranged from a low of 79 percent of RDA for energy to a high of 176 percent of RDA for protein (Table 2).[2] Thus, most children in the sample were adequately fed in terms of meeting RDAs. The standard deviations are relatively large, however, indicating that some children still had relatively low intakes. Lower intakes (as a percentage of RDA) were prevalent among 11 and 12 year olds because most of the RDA standards increased markedly at age 11. The regression results show only moderate increases in intake of most nutrients associated with age (Table 2).[3]

The number of variables included in each regression model ranged between 27 and 47 (Table 2). The R^2 values ranged from a low of .091 for Vitamin C to a high of .367 for iron. Only one regression run was made for each nutrient. As expected, the models each include several variables with t values less than 1.64.[4] This has the limitation of reducing efficiency of the estimates by including variables of dubious significance. However, it has the advantages of not biasing the coefficients by omitting variables which happen to be collinear. It also has the advantage of not further biasing the t values themselves by retaining variables in subsequent models solely on the basis of their statistical significance.

Table 2. Relationship of Nutrient Intake to Socio-Economic and Food Program Variables

Independent Variable	Dependent Variable (Intake as % of RDA)									
	Energy	Protein	Calcium	Phos-phorous	Iron	Vitamin A	Thiamin	Ribo-flavin	Niacin	Vitamin C
Mean Intake (% RDA)	79.0	175.8	97.0	128.5	96.1	113.4	89.5	142.2	84.3	157.2
Standard Deviation	20.8	48.7	39.2	42.4	38.7	70.9	35.8	48.3	26.3	112.8
No. of Variables in Model	37	39	39	43	27	32	34	47	33	31
No. of Variables t > 1.64	13	14	15	14	11	7	9	14	12	9
R^2	.173	.182	.290	.314	.367	.117	.132	.212	.122	.091
	Regression Coefficients									
Lunch Participation										
a) Partial	- 4.0*	- 9.6*	- 8.7*	- 7.0✓			- 6.8✓	- 9.2*		
b) Non			- 7.5✓		7.4*					
Breakfast Participation										
a) Full					- 13.5✓					74.8**
Free Lunch		8.4✓		7.5✓	5.8✓		10.5**	8.5✓		
Hours Fasting	- .45		- .72*	- .78*				- 1.02*		
Nonparticipating District		17.2*	19.3**	15.3*				22.4**		
Liquid Assets			.037*	.032*	.023✓					
Household Size						- 3.3*	- 1.7*	- 1.8✓	- 0.9✓	- 4.9*
Education Female Head						1.87*				
Occupation										
a) Armed forces	11.6**	23.1**	16.4*	17.5*	16.8**			23.3**	12.1**	32.9✓
Origin of Parent										
a) Southeast U.S.	- 3.6*		- 10.9**	- 9.7**				- 10.9*		
b) Northeast & central U.S.						13.6✓	8.0*	8.9✓	5.4*	
Ethnic Group										
a) Black			- 11.0*					- 12.3*		
Age of Child	4.2**	5.3*			3.2*		2.7*		3.5**	14.6**
Female Child	- 7.4**	- 16.5**	- 7.8**	- 10.8**	- 8.9**		- 12.8**	- 16.2**	- 10.4**	

** t value = 2.58 or more * 1.96 < t < 2.58 ✓ 1.64 < t < 1.95

The School Lunch Program participation variables show partial participants have lower intakes of many nutrients than either full or nonparticipants. Milk is a good source for many of the nutrients which are relatively low among partial participants. This suggests that milk is not as accessible to partial participants as to full participants or nonparticipants.

Few differences existed between lunch nonparticipants and full lunch participants. However, five of the coefficients on the free lunch variable had t values greater than 1.64. This indicates that the school lunch is raising the nutrient intake of those below 125 percent of poverty, but is having no significant effect on those above that poverty level.[4]

One of the 18 districts sampled did not participate in the NSLP. The sample from this district included 121 students. Their intakes for four of the nutrients were higher than those from other districts. Milk is a good source of most of these nutrients. Thus, the children in the nonparticipating district appear to have been consuming more milk while retaining their consumption of other foods. Since only one district was sampled, however, there is a danger in generalizing these results. Certainly, there is not sufficient evidence to conclude that the lunch program should be dropped in Washington schools.

The hours of fasting variable shows that children coming to school without breakfast have lower intakes for four of the ten nutrients. Ten percent of the sample came to school without breakfast. By weighing various subparts of the sample, estimates for the state of Washington can be obtained. On this basis, we estimate that 7 percent of the White, 12 percent of the Black, and 13 percent of the Mexican American children come to school without breakfast. Only 20 children in our sample of 849 fully participated in the school breakfast program. The intake of vitamin C was 48 percent higher for breakfast participants than for nonparticipants. The regression coefficient had a t value of over 2.58 (Table 2). Thus, the school breakfast program appears to be a useful instrument for increasing nutrient intake of children. In about 8-10 percent of the cases, it does not replace a meal furnished by parents (as is the usual case for the lunch) but it supplies a meal where none exists.

Current income of the child's household was not related to intakes of any of the ten nutrients (t values were all less than 1.65).[5] The amount of liquid assets owned did affect intakes of calcium, phosphorous and iron (Table 2). This shows that the amount of cash reserves available affects nutrient intake more than does current income. This phenomenon is similar to that found by Madden and Yoder which they showed the length of pay period affected intake. Both pay period and liquid assets are a measure of cash reserves available for food purchases.

Surprisingly, food expenditures were not significant in any of the models. The reason why liquid assets and not food expenditures affect intake may be the variation in allocation of food expenditures over the pay period. Households lacking liquid assets may spend as much for food in a given month but have few resources left at the end of a pay period to procure food items.

It may be argued that the large number of variables included in the model led to high multicollinearity and thus to the non-significant effects of current income and food expenditures. Examination of the simple correlation matrix (Table 3) shows current income to be related significantly with five of the ten intake variables. In contrast, liquid assets are significantly related to nine of these variables. For all nutrients liquid assets is more highly correlated with nutrient intake than is current income. Food expenditure was significantly correlated with only three intake variables.

The regression model showed household size to be negatively related with all the vitamins (Table 2). This indicates that types of foods served are different for large households. These types of food likely contain lower percentages of vitamins. Large households may be serving smaller quantities of fresh fruits and vegetables.

Table 3. Simple Correlations Between Nutrient Intake and Economic Variables

	Income	Liquid Assets	Food Expenditure	Free Lunch	Bonus Value Food Stamps
Energy	*	.071	*	*	*
Protein	.072	.097	*	*	- .069
Calcium	.100	.183	.089	- .085	*
Phosphorous	.076	.151	*	- .075	- .069
Iron	*	.073	*	*	*
Vitamin A	.069	.079	.071	*	*
Thiamin	*	.070	*	*	*
Riboflavin	.118	.169	.089	- .093	- .071
Niacin	*	*	*	*	- .077
Vitamin C	*	.076	*	*	*

* t value not significantly different from zero at .05 level.

The only occupational grouping that showed t values above 1.64 was persons in the armed forces (Table 2). Nutrient intake was higher for children in households whose major income earner was in the armed forces for eight of the ten nutrients. The explanation for this is not clear. The evidence suggests that there are some groups which have high nutrient intakes due to circumstances that we have not taken into account. One can speculate that things such as the amount of organized physical activities or eating habits developed by adults in mess halls and carrying over into the home may affect nutrient intake.

The geographic origin of the parent affected the intake for seven of the ten nutrients (Table 2). Children whose parents were raised in the southeastern U.S. had lower intakes of energy, calcium, phosphorous and riboflavin while those children whose parents were raised in the northeast or central U.S. had higher intakes of Vitamin A, thiamin, riboflavin and niacin.

Black and Mexican American children generally had lower nutrient intakes than Whites. There were exceptions, Blacks had higher intakes of Vitamin A than Whites (see Price et al., 1975). In the regression model ethnic group affected intakes of only calcium and riboflavin (t values were less than 1.64 for all other nutrients). Blacks had lower intakes of both nutrients. These nutrients indicate lower consumption of dairy products. Thus, the combined results indicate other variables such as household size, liquid assets, and region of origin were stronger than ethnic group for this sample. These other variables are likely measuring the characteristics of Blacks and Mexican Americans that lead to lower nutrient intakes.

The value of bonus food stamps did not positively affect any of the nutrient intakes. The t values on the bonus food stamp coefficients ranged from .18 for Vitamin A to -1.78 for niacin. It can be argued that the value of bonus food stamps affect some of the independent variables in the regression model such as frequency of serving certain foods and food expenditures, and therefore these variables may absorb the effects of food stamps. Therefore, the models were rerun without food expenditures and without any of the household food pattern variables. All other variables with t value less than one in the first regression models were also excluded.

In the revised models, the bonus food stamp variable had t values ranging from -1.53 for niacin to .58 for Vitamin A. Thus, both models show food stamps to have no significant effect on nutrient intake. On the basis of these results above, it is difficult to conclude that food stamps have no effect on nutrient intake. First, to do so with these models may involve making a Type II error. Second, models relating the values of food obtained with the value of bonus stamps have shown that bonus food stamps have more impact on subsets of the data (Mexican Americans) than on the total sample (see West and Price). Thus, the possibility remains that bonus food stamps may significantly affect nutrient intake for particular groups. This has not yet been fully tested.

Implications

Since 8-12 year old Washington children were fairly well off nutritionally, no new drastic feeding programs are warranted for this group. This may not be true for 8-12 year old children in other areas of the country or for other age groups in the State of Washington.

Since liquid assets affected nutrient intake while current income did not, eligibility for feeding programs should take into account the amount of cash reserves available for food. This suggests retaining eligibility standards which make allowances for such things as housing and medical expenses. This also suggests financial management education programs for nutritionally needy households.

School breakfast programs appear to be an important tool for raising nutrient intake. Sufficient numbers of children come to school without breakfast to make the program effective. The school lunch appears to be raising intake of some nutrients for children who receive free lunches but has less effect on other children. The school lunch is not as effective as a sack lunch in raising the intake of iron. Thus, school lunch menus need to be modified in order to increase their iron content.

FOOTNOTES

* Work was conducted under CARC Project No. 0103, Washington State University. The research was partially supported by a grant from the Foods and Nutrition Service, USDA.

1. Further details on the sampling procedure and the interview procedures are given in Price et al. (1975).

2. Energy intakes are usually low with 24-hour recalls because the respondent fails to recall some of the energy sources such as snack items and butter.

3. For further details on the results, see Price (1975).

4. This value approximates the 10% level of significance for a two-tailed test and the 5% level for a one-tailed test.

5. Nearly all free lunch recipients were full participants.

6. Income coefficients were, however, positive for all nutrients but iron.

REFERENCES

Lane, Sylvia. "Food-Aid Program Effects on Food Expenditures and Levels of Nutritional Achievement of Low Income Households." Contributed paper A.A.E.A., August 18-21, 1974.

Madden, J. Patrick, and Marion D. Yoder. "Program Evaluation: Food Stamps and Commodity Distribution in Rural Areas of Central Pennsylvania." The Pennsylvania State University Agr. Exp. Sta. Bul. 780, June, 1972.

Price, David W. "Unit Equivalent Scales for Specific Food Commodities." Amer. J. Agr. Econ. 52 (1970):224-233.

Price, David W., Margaret M. Hard, Irwin Dyer, Madeleine Mitchell, Dorothy Price, Genevieve Scheier, and Donald A. West. "Evaluation of School Lunch and School Breakfast Programs in the State of Washington." Unpublished report to Food and Nutrition Service, USDA, Nov. 1975.

No author given. "Estimating Equivalent Incomes on Budget Costs by Family Type." Monthly Labor Review 83 (1960):1197-1200.

West, Donald A., and David W. Price. "The Effects of Income, Assets, Food Programs, and Household Size on Food Consumption." Amer. J. Agr. Econ. 58 (1976), forthcoming in Nov. issue.