AN ANALYSIS OF NUTRIENT INTAKE FOR SELECTED FAMILIES IN FLORIDA'S EXPANDED NUTRITION PROGRAM*

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Since spring 1967 when the late Sen. Robert Kennedy and former Sen. Joseph Clark "officially" discovered hunger in less-visited areas of the South, hundreds of newspaper and magazine articles, several books, a television documentary and numerous committees conferences, and agencies have focused on the incidence and consequences of inadequate nutrition in America.[1] Several private and public programs have been created to help alleviate food and nutrition problems of the poor.[2] Among the nutrition education programs, the expanded Food and Nutrition Education Program (ENP) is perhaps the most notable. The major aim of ENP is to improve the diets of low-income families by offering homemakers free instruction in food budgeting and shopping, choice and preparation of nutritious meals and in other topics. Instruction is given by aides who personally visit the homes of participating families to discuss these topics with the homemaker.[3]

Florida's ENP began in February 1969 with 220 aides in 12 counties. Currently, 232 aides are working with homemakers in 34 of Florida's 67 counties. At the time of enrollment and at six-month intervals, the aides determine the food intake of homemakers by recording the number of servings in the four major food groups. This information is obtained by asking the homemaker to recall from memory her food intake during the previous 24-hour period. Aides also record several socioeconomic characteristics of the family at the time of enrollment. Of the first group of Florida homemakers enrolled in ENP, the percentage having adequate food intake in the four food groups increased from 21 to 35 percent over a two-year period.[4] This very general measure of program success provides little insight into the factors underlying changes in nutrient intake by ENP families and why some homemakers experience greater increases in nutrient intake than others.

The purpose of this paper is to analyze changes in nutrient intake over food recalls and to determine whether or not family characteristics can be used to explain and predict nutrient intake for selected ENP families in Florida. The latter issue has a direct bearing on the enrollment policy and overall performance of Florida's ENP. Under present policy, aides are instructed to enroll any low-income family that is willing to participate in the program. Since there is not basis for selecting particular low-income families, this policy has not been questioned. If, however, changes in nutrient intake of ENP homemakers can be predicted accurately from the family's socioeconomic characteristics, program benefits could be increased (relative to costs) by selecting homemakers who are likely to experience the greatest overall increases in nutrient intake. Admittedly, this selection criterion overlooks the possiblity that small gains in nutrient intake for some people may actually be more beneficial than larger

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* This paper is based on the results of J. Michael Gorham's M. S. thesis [2].

[1] Examples include the CBS-TV documentary, "Hunger in America," the Senate's ad hoc Committee on Nutrition and Human Needs, the National Council on Hunger and Malnutrition in America, the USDA's Food and Nutrition Service and the White House Conference on Food, Nutrition, and Health.

[2] Programs having a direct and/or indirect effect on nutrient intake include the Family Assistance Program, School Breakfast and Lunch Programs, Food Stamp Program, and others.

[3] A more detailed discussion of the U.S. ENP is given by Feaster [1] and the Florida ENP program by Gorham [2].

[4] Adequate food intake is defined as two servings of meat, two servings of milk, four servings of fruits or vegetables and four servings of bread or cereal per 24 hours.

gains by others. For example, if an individual has a very inadequate diet, then even modest gains in nutrient intake are extremely beneficial, whereas large gains for an individual with a slightly inadequate diet are less beneficial.

Other studies of the ENP have been made by Feaster [1], Plovanich [4], Trotter [5], the Synectics Corp. [6], Wang and Ephross [7], Walker [8], and Williams [9].

NUTRITION INDEX

To identify changes in the nutrient intake of ENP homemakers and analyze their relationship to family characteristics, the food intake of homemakers was converted to a single index of nutrient intake. Ideally, the nutrition index should depend on the quantities of all foods consumed, the nutrient composition of these foods, and the nutritional requirements of the individual. Unfortunately, the ideal index cannot be computed from ENP data because food intake is recorded in terms of the number of servings in each of four major food groups. Given ENP's food servings data and the structure of the ideal index, the following nutrition index was specified:

$$N = w_1 \frac{n_1}{2} + w_2 \frac{n_2}{2} + w_3 \frac{n_3}{4} + w_4 \frac{n_4}{4}$$

where N = nutrient intake index defined on the interval [0, 100];

N_i = number of servings from food group i consumed by the homemaker during the 24-hour period preceeding the food recall (i = 1 for milk, 2 for meat, 3 for fruit/vegetable and 4 for bread/cereal) and

w_i = weight assigned to food group i, where $\sum_i w_i = 100$.

The divisors of n_i (2, 2, 4, 4) are the USDA recommended number of servings from the respective food groups. Restrictions on w_i and n_i ($n_i = 2$ for $i = 1, 2$; $n_j = 4$ for $j = 3, 4$) were imposed to insure that N = 100 reflects adequate nutrient intake and to prevent the occurrence of certain substitution effects. In particular, if n_i is allowed to exceed the recommended number of servings from food group i, then an excess of group i nutrients could offset (substitute for) an inadequate intake of nutrients from group j ($j \neq i$). To prevent these substitution effects, n_i was not permitted to exceed the recommended number of servings for group i. In addition, the weights restriction $\sum_i w_i = 100$ is required to prevent N from exceeding 100. Following the Madden-Yoder procedure of assigning equal weights to the nutrients, i.e., $w_i = 25$ for all i, gives the nutrition index used in this study:[5]

$$N = 12.5n_1 + 12.5n_2 + 6.25n_3 + 6.25n_4.$$

SAMPLE SELECTION

The sample used in this study was drawn from the families enrolled during the second six months of ENP's existence in Florida (September 1969 to March 1970). This group of enrollees is referred to as group II. Specifically, a predominately urban (Hillsborough) and a predominately rural (Polk) county were selected, and all group II families remaining in the program after 18 months, i.e., four food recalls, were included in the sample. Gerald Feaster's national

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[5] Madden and Yoder [3] developed an index of nutrient intake to evaluate the effectiveness of the food stamp and commodity distribution programs in two Pennsylvania counties. Their Mean Adequacy Ratio (MAR) of nutrient intake contained 10 essential nutrients that received equal weight ($w_i = 1/10$ for all i). The Madden-Yoder (MAR) index is

$$N = \sum_{i=1}^{t} \sum_{j=1}^{m} \frac{w_i q_j n_{ij}}{R_i},$$

where

N = index of nutrient intake defined on the interval [0,100],

q_j = number of units of food j consumed in a 24-hour period,

n_{ij} = amount of nutrient i in one unit of food j,

R_i = recommended daily dietary allowance of nutrient i, and

w_i = weight indicating the relative importance of nutrient i,

where

$$0 \leq w_i \leq 100; \sum_{i=1} w_i = 100, i = 1, \ldots, t$$

where t is the total number of nutrients, and j= 1...., m where m is the total number of foods consumed.

study of the program [1] showed that the characteristics of the dropouts were almost identical to those families remaining in the program. So, unless these two counties are atypical, the degree of bias introduced by excluding dropouts should be small. This sampling procedure gave a sample size of 168; 85 from Hillsborough and 83 from Polk.

METHOD OF ANALYSIS

The analysis involved two separate phases. First, the nutrition index was used to measure the level and changes in nutrient intake for sample homemakers over the four food recalls. Second, relationships between the nutrition index and family characteristics were estimated by ordinary least squares. Dependent variables included the nutrition index for all sample homemakers at each food recall and changes in the index between food recalls. Explanatory variables were as follows:

X_1 = residence: urban = 0, rural = 1;

X_2 = family on welfare (other than donated food): yes = 0, no = 1;

X_3 = food assistance (excluding donated food): yes = 0, no = 1;

X_4 = presence of family garden: yes = 0, no = 1;

X_5 = number of children (17 years and younger);

X_6 = number of adults (18 years and older);

X_7 = highest grade in school completed by homemaker;

X_8 = home status: own = 0, rent or tenant = 1;

X_9 = ownership of freezer: yes = 1, no = 0;

X_{10} = buys most food at: supermarket = 0, elsewhere = 1;

X_{11} = family participants in Donated Food Program, yes = 1, no = 0;

X_{12} = race of homemaker:white = 0, black = 1, and

X_{13} = income:[6]

less than \$1,000 = 0	\$3,000 to \$3,999 = 3
\$1,000 to \$1,999 = 1	\$4,000 to \$4,999 = 4
\$2,000 to \$2,999 = 2	\$5,000 to \$5,999 = 5

These 13 variables exhaust the socioeconomic family information obtained by the aides.

One might suspect high correlations among certain explanatory variables, namely between the welfare variables (X_2, X_3, and X_{11}) and income (X_{13}). Correlations between welfare and income variables were relatively small, ranging from .01 between X_3 and X_{13} to -.416 between X_2 and X_{11}. Of the correlations between all pairs of explanatory variables, only three exceed .4, with the highest correlation between X_5 and X_{13} (.45). These findings indicate that multicollinearity will not be a problem in the regression analyses of these data. In addition, it should be noted that variables X_2, X_3, and X_{11} can be mutually exclusive. That is, a family may receive only one of the three sources of welfare represented by X_2, X_3, and X_{11} without receiving welfare from the other two. Therefore, X_2, X_3, and X_{11} are not dependent on one another.

RESULTS

Average Response

The average index of nutrient intake (N) for all 168 families increased 10 points (63.10 to 73.55) between the first and fourth food recall. A one-point increase in the nutrient index is equivalent to a one percentage point increase in nutrient intake, since the latter is measured on the interval [0,100]. It is not possible, however, to interpret a change in the nutrient index in terms of changes in individual nutrients. Average indices show the greatest increase during the first six months (63.10 to 71.61), followed by a negligible decline during the second six months (71.61 to 71.17), and a small increase over the last six months (71.17 to 73.55). While average indices exhibit an increase-decrease-increase pattern, individual indices for only 29 families follow this pattern. The number of homemakers with indices greater than or equal to 81.25 increased from 34 to 73 between the first and second recall. Number of homemakers having the USDA recommended (number of) servings in a particular food group showed an increase-decrease-increase pattern for all groups except bread/cereal, for which the number increased monotonically over consecutive recalls. The number of homemakers with recommended servings in all four food groups followed the same increase-decrease-increase pattern, namely 6, 24, 12,

[6] Income was also coded as dummy (0-1) variables but this procedure did not improve the results. In particular, dummy variables were used to represent five income categories: $<$\$1,000, \$1,000-\$1,999; \$3,000-\$3,999; \$4,000-\$4,999, and $>$\$5,000. Income category \$2,000-\$2,999was used as the base income category. For the regressions with N_i or C_{ij} (i, j=1, 2, 3, 4, i $<$ j) as dependent variable, only the dummy variable for the $>$\$5,000 income category in the N_1 equation was statistically significant and, contrary to expectations, negative in value. However, the reliability of dummy variable coefficients associated with the $>$\$5,000 category are somewhat suspect because only five percent of the 168 families included in the sample fell into this income category.

Table 1. DISTRIBUTION OF SAMPLE HOMEMAKERS OVER THREE CATEGORIES WITH RESPECT TO CHANGES IN NUTRITION INDEX BETWEEN CONSECUTIVE FOOD RECALLS

Change Between Recalls	Regressors[a]	Non-achievers[b]	Achievers[c]
		-Number-	
1 and 2	39	48	81
2 and 3	52	65	51
3 and 4	39	74	55

[a] $\Delta N < -6.25$

[b] $-6.25 \leqslant \Delta N \leqslant 6.25$

[c] $\Delta N > 6.25$

and 20.

Homemakers were placed into three categories according to whether their nutrition index fell (regressors), remained the same (non-achievers) or increased (achievers) between food recalls. Table 1 shows the distribution of sample families over these categories. Since the smallest non-zero change in the nutrition index is 6.25, this figure was used to define the boundaries of the non-achiever category. The largest number of achievers (81) is attained between the first and second recalls, and the largest number of non-achievers (74) between the third and fourth recalls. Regressors increased from 39 to 52, then dropped back to 39 between consecutive food recalls.

Intake-Characteristics Relationships

Relationships between nutrient intake and socioeconomic characteristics of homemakers were used to investigate two issues. First, what is the strength and direction (positive or negative) of the relationship between each characteristic and the level of changes in nutrient intake?

Linear relationships were fitted by ordinary least squares using the entire sample (168 observations). Results appear in Table 2. N_i refers to the value of the nutrition index at food recall i and $C_{ij} = N_j - N_i$, i,j = 1, 2, 3, 4. In general, the set of 13 characteristics does not adequately explain in the level and changes in the nutrition index as indicated by the relatively low R^2. In addition, very few coefficients are statistically significant above the 90 percent level. However, some equations contain statistically significant coefficients which require interpretation. Equation 1 shows that homemakers owning freezers have a higher initial nutrient intake (11 points) than homemakers without freezers. Freezer ownership indicates sound planning and enables a family to buy food in bulk and take advantage of sale items. Equations 1, 3, and 4 indicate that one-grade advancements in education are associated with a .94 increase in initial intake (N_1) and increases in intake at recalls two, three, and four of 1.10, 1.52, and 1.59 points, respectively. Advancements in education generally increase an individual's literacy and hence the ability to understand the importance of proper nutrition. Consequently, more educated individuals are expected to select and maintain a more adequate diet. A somewhat surprising result was the relatively low magnitudes of the education coefficients.

The positive food assistance coefficient (equation 1) implies that families receiving food assistance other than food stamps and donated food have a lower nutrient intake than families not receiving food assistance. This result is contrary to expectations. An increase in food assistance was expected to increase nutrient intake. Perhaps a homemaker whose children receive nutritious meals at school (the main source of food assistance) may be less concerned with providing adequate nutrition in the home.

Equation 2 shows that the number of adults is negatively related to nutrient intake at the second food recall. Since all families in the sample have relatively low incomes (95 percent had incomes less than $5,000), an increase in family size was expected to decrease nutrient intake. The positive coefficient

Table 2. REGRESSION COEFFICIENTS, STANDARD ERRORS AND RELATED STATISTICS OF NUTRIENT INTAKE EQUATIONS FOR A SAMPLE OF 168 ENP FAMILIES IN FLORIDA

Equation No.	1		2		3		4		5		6		7		8	
Dep. Var.	N_1		N_2		N_3		N_4		C_{12}		C_{23}		C_{34}		C_{14}	
Indep. Var.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.
residence	3.20	3.52	3.10	3.59	2.44	2.98	1.72	3.28	-0.10	4.24	-0.66	3.59	-0.73	3.51	-1.48	4.50
welfare	-2.76	3.65	4.26	3.73	-0.52	3.10	0.24	3.41	7.02	4.40	-4.78	3.73	0.75	3.65	3.00	4.68
food asst.	6.97*	3.83	4.90	3.91	1.49	3.25	-1.95	3.58	-2.08	4.61	-3.40	3.92	-3.44	3.83	-8.92*	4.91
garden	-1.15	4.54	-6.93	4.63	-2.96	3.85	1.63	4.23	-5.78	5.47	3.96	4.63	4.59	4.53	2.78	5.80
num. children	-0.42	0.64	-1.01	0.65	-0.63	0.54	-0.83	0.60	-0.59	0.77	0.39	0.65	0.45	0.64	0.25	0.82
num. adults	-1.27	1.87	-3.08*	1.91	-0.73	1.58	0.50	1.74	-1.81	2.25	2.35	1.90	1.23	1.86	1.77	2.39
education	0.94*	0.57	1.10*	0.58	1.52***	0.48	1.59***	0.53	0.16	0.69	0.42	0.58	0.07	0.57	0.65	0.73
home status	4.05	3.60	6.04*	3.67	-2.08	3.05	-0.54	3.36	1.20	4.33	-8.12**	3.67	1.54	3.59	-4.58	4.60
freezer	11.33**	4.81	1.81	4.92	2.78	4.08	0.70	4.50	-9.53*	5.80	0.98	4.92	2.05	4.81	-10.60*	6.16
food shopping	8.69	5.70	-0.51	5.82	3.51	4.84	3.54	5.32	-9.20	6.87	4.02	5.82	0.03	5.70	-5.15	7.29
don. food	-0.08	3.54	4.88	3.61	-6.74**	3.00	-0.34	3.30	4.96	4.26	-11.63***	3.61	6.41*	3.53	-0.26	4.53
race	-1.71	3.63	-3.27	3.71	0.82	3.08	-6.46*	3.39	-1.56	4.38	4.09	3.71	-7.28**	3.63	-4.76	4.65
income	-0.30	1.69	0.59	1.73	-0.12	1.44	-0.55	1.58	0.90	2.04	-0.71	1.73	0.43	1.69	-0.24	2.17
Intercept	52.03		65.06		67.67		66.56		13.03		2.61		-1.109		14.52	
R^2	.112		.124		0.134		.089		.067		.140		.08		.087	
F	1.50		1.67		1.83**		1.159		.845		1.929**		1.05		1.14	

*Significant at 90% level.

**Significant at 95% level.

***Significant at 99% level.

of home status (equation 2) suggests that families who rent their homes have a slightly higher intake than those who own their homes. This result is contrary to expectations. Home ownership is viewed as a sign of personal motivation and planning, traits which are expected to carry over to the choice of a diet. Perhaps the financial burdens of home ownership on low-income families necessitates making sacrifices in other areas such as food and diet. The negative race coefficient (equation 4) implies that blacks have a lower nutrient intake at the fourth recall than whites.

Estimated effects of socioeconomic characteristics on changes in nutrient intake appear in equations 5 through 8. Equation 5 suggests that homemakers owning freezers experience changes in intake of 9.5 points below homemakers without freezers. This finding is not inconsistent with the positive freezer coefficient in equation 1. Taken together, they imply that families owning freezers experience declines in intake between recalls one and two and have higher initial nutrient intakes than families who do not own freezers. Although the freezer coefficient is not significant at the second and third recalls, it was significant over the entire 18-month period, with a value of -10.6 (equation 8). The mixed sign of the donated food coefficients (negative in equation 6, positive in equation 7) cannot be reconciled with its anticipated positive effect on changes in nutrient intake. A negative race coefficient (equation 7) suggests that blacks experience smaller changes in nutrient intake between the third and fourth recalls than whites. This may indicate that blacks lose interest in the program sooner than whites. Although the food assistance coefficient was not significant for consecutive recalls, it was negative and significant between the first and last recalls (equation 8).

Equations 2 through 7 were re-estimated using N_1 (initial nutrient intake) as an explanatory variable. The purpose of this re-estimation was to test the hypotheses that initial nutrient intake had a positive effect on nutrient intake at the second, third, and fourth recalls and a negative effect on changes in nutrient intake between food recalls. For the most part, the regression analysis supported these hypotheses. However, inclusion of N_1 as an explanatory variable reduced the significance of the socioeconomic variables. Five socioeconomic coefficients that are statistically significant in Table 2 are insignificant in Table 3, although the same coefficients are significant in the N_3 and C_{23} equations. In addition, four of the six regression equations with N_1 as an explantory variable (Table 3) are statistically significant at the 95 or 99 percent level (F test of $R^2 = 0$) compared to two of the eight equations excluding N_1 (Table 2). In general, it appears that initial nutrient intake is an important

Table 3. REGRESSION COEFFICIENTS, STANDARD ERRORS AND RELATED STATISTICS OF NUTRIENT INTAKE EQUATIONS FOR A SAMPLE OF 168 ENP FAMILIES IN FLORIDA

Equation No.	1		2		3		4		5		6	
Dep. Var.	N_2		N_3		N_4		C_{12}		C_{23}		C_{34}	
Indep. Var.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.	coef.	std.er.
residence	2.08	3.49	1.96	2.97	1.34	3.29	2.53	3.49	-0.12	3.58	-0.62	3.54
welfare	4.81	3.61	-0.26	3.08	0.44	3.41	5.60	3.61	-5.07	3.71	0.70	3.66
food asst.	3.53	3.80	0.85	3.24	-2.45	3.59	1.44	3.81	-2.68	3.91	-3.30	3.86
garden	-6.26	4.49	-2.65	3.82	1.87	4.23	-7.51*	4.49	3.60	4.61	4.52	4.55
num. children	-0.98	.63	-0.61	.54	-0.16	.60	0.68	0.63	0.37	0.65	0.45	0.64
num. adults	-2.89	1.84	-0.64	1.57	0.58	1.74	2.31	1.85	2.25	1.89	1.21	1.87
education	0.91	.57	1.43***	.48	1.52	0.53	0.65	0.57	0.52	0.58	0.09	0.57
home status	4.54	3.58	-2.79	3.05	-1.09	3.38	5.89	3.58	-7.33**	3.68	1.70	3.63
freezer	-1.02	4.83	1.45	4.11	-0.31	4.55	-2.23*	4.83	2.47	4.96	-1.75	4.90
food shopping	-2.70	5.67	2.48	4.83	2.74	5.34	-3.55	5.67	5.18	5.82	0.26	5.75
don. food	4.93	3.49	-6.72**	2.98	-0.32	3.29	4.84	3.50	-11.65***	3.59	6.40*	3.54
race	-2.45	3.60	1.22	3.06	-6.16	3.39	-3.74	3.50	3.64	3.69	-7.37**	3.65
income	0.77	1.68	-0.03	1.43	-0.48	1.58	0.44	1.68	-0.80	1.72	-0.45	1.70
N_1	3.52***	1.04	1.66*	.89	1.29	.98	-9.07***	1.04	-1.86*	1.07	-0.37	1.05
Intercept	39.76		55.75		57.31		78.28		15.99		1.56	
R^2	.185		.153		.099		.376		.157		.082	
F	2.47***		1.98**		1.20		6.59***		2.03**		.98	

*Significant at 90% level.

**Significant at 95% level.

***Significant at 99% level.

variable in explaining the level and changes in nutrient intake by sample families.

SUMMARY AND CONCLUSIONS

The overall relationship between the 13 socioeconomic characteristics and the level of nutrient intake at each food recall, as well as changes in nutrient intake between food recalls, is very weak. Characteristics having a significant effect on the nutrition indices include: ownership of a freezer, level of education, home status, race, number of adults, donated food, and food assistance. However, the coefficients of these variables were not statistically significant in all equations, and in some cases their signs were contrary to expectations. Results from the estimated relationships indicate that a homemaker's nutrient intake cannot be accurately predicted from her socioeconomic characteristics at the time of enrollment. Using the socioeconomic data collected by ENP and the estimated relationships presented here, it is not possible to predict accurately which families are most likely to benefit from the Expanded Nutrition Program. Hence, there does not appear to be any basis for arguing that the ENP program will benefit by more careful selection of participants. More specifically, current program policy of enrolling low-income families regardless of their socioeconomic profile seems justified. However, evidence does suggest that families with lower initial nutrient intake are likely to make greater improvements in nutrient intake in response to the ENP program than families with higher initial nutrient intakes. In fact, results for two Florida counties suggest that a family's initial nutrient intake is a better predictor of improvements in nutrient intake than the socioeconomic characteristics of the family.

Several factors contribute to the generally poor statistical results obtained here. First, the food intake data obtained by ENP aides is quite crude. Consequently, the nutrition index computed from these data is of necessity only an approximation of nutrient intake, i.e., the dependent variables contain errors of measurement. A more potential source of specification error is the implicit assumption that the instruction provided by ENP aides is of constant quality. Specifically, the model does not account for variation in the ability, motivation, and nutritional knowledge of the aides. Program administrators admit this variation is considerable. The only available data related to ENP input was the number of aide visits to the family per month. While including this variable in

the regression equations may have improved the statistical results, it would have been much like trying to measure the effectiveness of a teacher by the number of times the class meets.

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