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ECONOMIC AND SOCIODEMOGRAPHIC VARIABLES AFFECTING NUTRITIONAL QUALITY OF DIETS

A Review

by

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DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS

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ABSTRACT

Eleven studies of United States Populations were reviewed to ascertain what significant effects economic and sociodemographic variables were found to have on nutritional quality of diets. Nutrient intake was found to increase as income increased, but income had little effect at higher income levels. Education of the female household head, which especially affects vitamin C, and employment of the male household head had positive effects on nutrient intake and dietary quality. Household size, life-cycle stage, age, and sex were the most significant determinants of nutrient intake and dietary quality. Household size seemed to have a negative impact on children; and race, region, and urbanization had much less of an effect than expected. Hispanics were found to consume relatively more calcium, iron, and vitamin B_{12} than other ethnic groups; and Blacks consumed more vitamins A and B_{12}. Economic and sociodemographic variables have the most consistent impact on intakes of calories and vitamin C.

REVIEW OF THE LITERATURE

Awareness of the economic and sociodemographic variables that affect nutrient intake and dietary quality is requisite if nutrition education efforts are to be appropriately targeted. This review of the literature was undertaken to ascertain what is already known about which of these variables affects intakes of which nutrients and/or nutritional dietary quality in the United States. In this review, the level of aggregation of the data (i.e., households versus individuals) serves as the basis for classification of the studies of nutrient intake. Only relevant studies of populations in the United States which examined nutrients other than calories and protein were included (although all but one included both of these as well (Tables 1 and 2)].

Unit of observation. Economists, except for studies focused on specific sex or age groups, for the most part work with models at the household level. (See distribution of studies in Tables 1 and 2.) Economists' reliance on household data arises primarily from consideration of the household as the basic decision-making unit and the decisions of individual members as being so interdependent as to make modeling them a horrendous problem. Household level data, moreover, are, at times, all that are available. For example, the early U. S. Department of Agriculture (USDA) food consumption surveys reported only household food availability. When analyzing nutrient intake or dietary quality, however, allocation of food within the household can be of specific interest, as, for example, in determining whether a school lunch is providing enough of a particular nutrient in view of what the child is eating at home [Kennedy et al. (13)].

TABLE 1

Determinants of Nutrient Intake in Studies of Individuals

Studies \ Nutrients Analyzed	Calories	Protein	Carbohydrates	Fat	Calcium
Price, West, Scheier, and Price (1) Subjects: 728 children, ages 8-12 Washington State, 1971-1973 Surveyed by authors	Age (+)[a] Sex: female (-)	Age (+) Sex: female (-) Household size (-)	[b]		Age (+) Sex: female (-) Ethnicity: White (+) Mother: Education (-) Urban (-) Education (+)
Akin, Guilkey, and Popkin (2) Subjects: 1,544 children, ages 6-18 Continental United States Data Source: U. S. Department of Agriculture, Nationwide Food Consumption Survey of 1977-78 (For a description of the sample selection and survey methodology, see Rizak (3). Where Nationwide Food Consumption Survey of 1977-78 data were not used, see individual articles.)	Age (+)[c] Mother: Hours worked[d] Education (+) Sex: male (+) Urban (+) Household size (-) Age standardized: Height (+) Ethnicity: Black (+) Spanish (-)				
Windham, et al. (4)[e] Subjects: 6,910 individuals, ages 4 and older Continental United States Data Source: U. S. Department of Agriculture Nationwide Food Consumption Survey of 1977-78	Male head of household: Employment status (+)		Household size (-) Male head of household: Employment status (-) Education (-)	Household size (-)	Region South (-) Ethnicity: Black (-) Spanish Female head of household: Employment status

(Continued on next page.)

TABLE 1--continued.

Studies \ Nutrients Analyzed	Iron	Vitamin C	Vitamin A	Thiamine	Niacin
Lund and Burk (5) Subjects: 136 children, ages 9-11 St. Paul, Minnesota, 1964 Surveyed by authors					
Price, West, Scheier, and Price (1) Subjects: children, ages 8-12 Washington State	Age (+) Sex: female (-)	Age (+) Total assets (+) Mother: Education: (+)	Household size (-) Mother: Education (+)	Sex: female (-) Household size (-) Ethnicity: Mexican American (+)	Age (+) Sex: female (-) Household size (-) Ethnicity: Mexican American (-)
Akin, Guilkey, and Popkin (2) Subjects: children, ages 6-18 Continental United States	Age (+) Mother: Education (+) Sex: male (+) Urban (+) Household size (-)[c] Ethnicity: Spanish (+)	Age (+) Mother: Eduction (+) Sex: male (+) Income (+) Household size (-) Ethnicity: Black (+) Spanish (+)	Mother: Education (+) Hours worked (-) Sex: male (+) Age standardized: Height (+) Ethnicity: Spanish (+)		
Windham, et al. (4)[e] Subjects: individuals, age 4 and older Continental United States		Region: Urban (+) Household size (-)[c] Female head of household: Education (+)	Ethnicity: Black (+) Spanish (-)	Ethnicity Black (+) Spanish (+)	Urban (+)
Lund and Burk (5) Subjects: children, ages 9-11 St. Paul, Minnesota		Father: Education (+) Income (+)	No significant economic or sociodemographic variables		

(Continued on next page.)

TABLE 1--continued.

[a]Coefficients of all variables shown were significant at the 0.05 level. The (+) and (-) signs designate the sign of the respective coefficients.

[b]Empty cells designate nutrient intake was not included in the study.

[c]Akin, Guilkey, and Popkin (2) separated their sample by age and used a switching regression technique. The result is four coefficients for each explanatory variable. Household size was significant and negative in two equations for iron; positive in one. However, significant parameters may have appeared in only one of the equations or possibly in all four.

[d]Indeterminant because variable is a composite.

[e]Windham et al. (4) used nutrient density for the dependent variable.

TABLE 2

Determinants of Nutrient Intake in Household Studies

Studies \ Nutrients Analyzed	Calories	Protein	Carbohydrates	Fat	Calcium
La France (6) Population: 1,000 households Continental United States Data Source: U. S. Department of Agriculture Nationwide Food Consumption Survey of 1977-78	Ethnicity: Spanish (+)[a] Age composition[b] Sex composition[b] Male head of household: Hours worked (+) Occupation Prices: Calories (+) Magnesium (+) Iron (+) Vitamin C (-)	Age composition[b] Sex composition[b]	c		Age composition[b] Sex composition[b] Prices: Vitamin C (-)
Blanciforti, Green, and Lane (7)[d] Population: 9,464 households Continental United States Data Source: U. S. Bureau of Labor Statistics Consumer Expenditure Survey of 1972-73					
Johnson, Burt, and Morgan (8)[e] Population: 5,000 Low-income households in Continental United States Data Source: U. S. Department of Agriculture Nationwide Food Consumption Survey of Low-Income Households, 1977-78					
Scearce and Jensen (9) Population: 1,360 Southern low-income households Data Source: U. S. Bureau of Labor Statistics Consumer Expenditure Survey of 1972-73	Income (+) Household size (+) Urban (-) Stage in life cycle[b]	Income (+) Household size (+) Stage in life cycle[b]			Income (+) Household size (+) Stage in life cycle[b]

(Continued on next page.)

TABLE 2--continued.

Studies \ Nutrients Analyzed	Iron	Vitamin C	Vitamin A	Thiamine	Niacin	Nutrient index
La France (6) Population: Continental United States	Ethnicity: Spanish (+) Age composition[b] Sex composition[b] Prices: Calories (-)	Ethnicity: White (-) Age composition[b] Sex composition[b] Male head of household: Hours worked (+) Occupation Prices: Vitamin C (-) Calories (-) Calcium (-) Magnesium (-)	Ethnicity: Black (+) Age composition[b] Sex composition[b] Prices: Vitamin C (-)	Ethnicity: Spanish (+) Age composition[b] Sex composition[b] Male head of household: Hours worked (+)	Age composition[b] Sex composition[b] Male head of household: Hours worked (+)	
Blanciforti, Green, and Lane (7)[d] Population: Continental United States						Income (+) Stage in life cycle (+)
Johnson, Burt, and Morgan, (8)[e] Population: Low-income households in Continental United States						Income (+) Region: North Central (+) South (+) West (+) Urban: Suburban (+) Nonmetropolitan (+) Household size and composition (-)
Scearce and Jensen (9) Population: Low-income households Southern United States	Income (+) Household size (+) Stage in life cycle[c]	Income (+) Household size (+) Stage in life cycle[c] Homemaker: Education (+)	Income (+) Household size (+) Stage in life cycle[c] Homemaker: Education (+)	Income (+) Household size (+) Stage in life cycle[c]	Income (+) Household size (+) Stage in life cycle[c]	

(Continued on next page.)

TABLE 2--continued.

Studies / Nutrients Analyzed	Calories	Protein	Carbohydrates	Fat	Calcium
Abdel-Ghany (10)[f] Population: 936 North Carolina households Data Source: North Carolina Nutrition Survey of 1970		Household size (+) Ethnicity: Nonwhite (+)			No significant explanatory variables
Adrian and Daniel (11) Population: 6,950 households Continental United States Data Source: 1965-66 U. S. Department of Agriculture Nationwide Food Consumption Survey		Income (+) Income squared (-) Rural nonfarm (-) Urban (-) Ethnicity White (+) Other (+) Household size (+) Stage in life cycle[b]	Rural nonfarm (-) Urban (-) Ethnicity: White (+) Other (+) Homemaker: Education (-) Household size (+) Stage in life cycle[b] Employment status: Household manager(+)	Income (+) Income squared (-) Rural nonfarm (-) Urban (-) Ethnicity: Other (-) Homemaker: Education (-) Household size (+) Stage in life cycle[b] Employment status: Household manager(+)	Income (+) Urban (-) Rural nonfarm (-) Ethnicity: White (+) Other (+) Household size (+) Stage in life cycle[b]
Madden and Yoder (12)[g] Population: 463 Low-income households in Rural Central Pennsylvania Data Source: Authors' Survey 1969-1970	Income frequency (-) Food expenditure per person (+)	Income (+) Income frequency (-) Food expenditure per person (+) Homemaker: Age (-) Household size (+)			Income (+) Income frequency (-)

(Continued on next page.)

TABLE 2--continued.

Studies \ Nutrients Analyzed	Iron	Vitamin C	Vitamin A	Thiamine	Niacin	Nutrient index
Abdel-Ghany (10)[f] Population: North Carolina	Household size (-)	Homemaker: Education (+) Nonparticipant in labor force (+) Urban (+)	No significant explanatory variables	Household size (+) Urban (-)	Homemaker: Education (+)	
Adrian and Daniel (11) Population: Continental United States	Income (+) Income squared (-) Urban (-) Rural nonfarm (-) Ethnicity: Other (+) Homemaker: Education (-) Household size (+) Stage in life cycle[b]	Income (+) Income squared (-) Urban (-) Ethnicity: Other (+) Homemaker: Education (+) Household size (+) Stage in life cycle[b]	Income (+) Income squared (-) Ethnicity: White (-) Other (-) Household size (+) Stage in life cycle[b]	Income (+) Urban (-) Rural nonfarm (-) Ethnicity: Other (-) Homemaker: Education (-) Household size (+) Stage in life cycle[b]		
Madden and Yoder (12) Population: Low-income households in Rural Central Pennsylvania	Income Frequency (-) Food expenditures per person (+) Homemaker: Age (+)	Food expenditure per person (+)	Income Homemaker: Age (-)	Food expenditure per person (+) Homemaker: Age (-)	Income frequency (-) Food expenditure per person (+)	Income (+) Income frequency (-) Food expenditure per person (+) Homemaker: Age (-) Household size (+)

(Continued on next page.)

TABLE 2--continued.

[a]All coefficients of variables shown were significant at the 0.05 level or better. The (+) and (-) signs designate the sign of the respective coefficients.

[b]Sign is indeterminant because variable is a composite. Life-cycle stage designations were used in Adrian and Daniel (11), Blanciforti, Green and Lane (7), and Searce and Jensen (9). They are:

Life-cycle stage 1: no children are present, and the housewife is 40 years of age or less.
Life-cycle stage 2: average age of children is less than six years.
Life-cycle stage 3: average age of children is between 6 and 12 years.
Life-cycle stage 4: average age of children is between 12 and 17 years.
Life-cycle stage 5: average age of children is over 17 years.
Life-cycle stage 6: no children are present, and the housewife is over 40 years of age.

[c]Empty cells designate this nutrient was not included in the analysis.

[d]Nutrient index used was expenditures on nutritious versus less-nutritious foods.

[e]Two nutrient indices are studied in Johnson, Burt, and Morgan (8). The modified diet score is the sum of the ratios of nutritive value per nutrition unit with respect to the RDA for the adult male for food energy and seven nutrients truncated at 1.2. The other was the food energy per nutrition unit truncated at 4,050 kilo calories. The signs of the coefficients were the same for both indices.

[f]Nutrient index used in Abdel-Ghany (10) is the index of nutritional quality (INQ), i.e., quantity of nutrients in quantity of food containing x calories divided by Recommended Dietary Allowances for nutrients divided, in turn, by x calories.

[g]Madden and Yoder (12) used the percentage intake of the RDA, etc., in equations for all nutrients shown. The index they used (shown in the last column of the table) is the mean (average) of the percentages intakes of the RDAs for the 10 nutrients in their analysis (termed by them as Mean Adequacy Ratio ratio, or MAR.

[h]La France (6) presented the effects of prices of nutrients heading table columns on other nutrients.

Measures of dietary quality (the dependent variables). The two measures of dietary quality most often used as dependent variables in the studies reviewed were the actual intake of each nutrient of interest [Lund and Burk (5); Akin, Guilkey, and Popkin (2); Adrian and Daniel (11); La France (6); Price, West, Scheier and Price (1); and Scearce and Jensen (9)] or intake as a percentage of the recommended dietary allowance standardized according to age and sex [Madden and Yoder (12)]. A more recently formulated measure is an index of nutrient density or quality of diet [Sorensen and Hansen (14)]. The index of nutrient density [used in Windham, Wyse, Hansen and Hurst (4)] is defined by the amount of each nutrient per 1,000 or x kilocalories. It can also be used to construct a measure of dietary quality by dividing the nutrient density of the food by the amount of each nutrient recommended divided by the same 1,000 or x kilocalories [used in Abdel-Ghany (10)]. The measure of household dietary quality, actually a measure of the nutritional quality of the food in the diet, is averred to be a better indicator of household performance as relates to dietary adequacy than is nutrient intake [Abdel-Ghany (10)].

Two other measures which appear in the literature are the Nutrient Sum (NS) [Abdel-Ghany (10)] and the Mean Adequacy Ratio (MAR) [used in Madden and Yoder (12)]. For the NS, one simply counts the number of nutrients for which some minimum percentage of the Recommended Dietary Allowance (RDA) is met by the reported diet. The MAR is the average of individual or household nutrient intake/recommended intake ratios [RDAs in Madden and Yoder (12)] where no ratio is allowed to exceed 100 or, as in Madden and Yoder, 200 percent. The purpose of the NS and MAR is to develop an easily computable scalar measure of dietary quality. However, overly simplistic measures used to address the inherently complex nutritient/nutritional adequacy problem may yield questionable and, perhaps, meaningless conclusions. For example, using the MAR index, a person or a household which meets or exceeds recommended intakes for every nutrient except vitamin A--which is at health-threatening levels--could appear to have a higher quality diet than a person or household marginally (or only on the edge of being) below recommended intakes for all nutrients [Abdel-Ghany (10)]. (In the case of the MAR, this can be resolved by using the geometric instead of the arithmetic mean.) Clearly, an excess of one nutrient does not compensate for a deficiency in another.

Johnson, Burt, and Morgan (8) found that use of aggregate indices of nutrient intake, such as their Modified Diet Score (which is a sum of nutritional adequacy ratios such as the Nutrient Sum) or their Minimum Nutrient Density Ratio (i.e., the lowest density ratio for the household for seven nutrients analyzed), yields conflicting results insofar as the effects of sociodemographic variables on dietary quality are concerned. The use of these indices is, therefore, questionable. The significant variables affecting indices in the Johnson et al. (8) and Madden and Yoder (12) models in which they are used are shown in Table 2, but with the caveat that they can only be considered suggestive.

<u>Variables affecting dietary quality</u>. Determinants of nutrient intake and dietary quality usually considered can be classified according to whether they are economic, sociodemographic, or attitudinal/behavioral variables. Only economic and sociodemographic independent variables are considered herein.

Economic variables used in the studies surveyed are income, food expenditures, assets, prices, and frequency of receipt of income (Tables 1 and 2). Except for a few studies, though, income is the only variable used from this group. Little is known about the effect of prices because all nutrient intake studies found have been based on cross-sectional data sets. The 1977-78 National Food Consumption Survey, however, did include price information for use in verifying the consistency of food expenditures and income. This information can be used in deriving implicit prices for nutrients. But, food commodity prices in these data sets do not vary sufficiently to permit the direct estimation of the effect of a change in price on the quantity of nutrient consumed.

Sociodemographic variables are those that describe household members' characteristics and imply the household's niche in the social structure. The heads of the household in the studies reviewed are characterized by level of education, occupation, and employment status. The other sociological variables usually used are members' race or ethnic background, location of household, urbanization status, household size, and stage in the life cycle (see Table 2).

All of the papers discussed are primarily statistical analyses of nutrient intake. Only recently have there been published attempts at deriving the appropriate functional forms for analysis using microeconomic theory which assumes households seek to maximize utility or satisfaction from food as well as other commodities subject to a budget constraint [La France (6); Knudsen and Scandizzo (15); and Ladd and Suvennant (16); Note 1].

Ten of the studies in this survey used some form of multiple regression analysis. However, a recent study of nutrient intake of school-age children used switching regressions [Akin, Guilkey, and Popkin (2)].

Our review of the literature stresses exogenous variables (Note 2) that have been considered. Variables described were only those found to have a statistically significant effect on nutrient intake and/or dietary quality.

For a general summary of the papers included in the survey, see Tables 1 and 2.

Economic variables. In general, most household level studies surveyed concluded money income had a positive effect on nutrient intake and on dietary quality--at least for some nutrients. Nonetheless, even when significant, the marginal effect of income tended to be small [Adrian and Daniel (11); La France (6); Madden and Yoder (12); and Searce and Jensen (9)]. Studies in which income was found to be nonsignificant used nutrient density as the dependent variable [Abdel-Ghany (10)].

The reason the income-nutrient effect is so small in the United States is that the income elasticity (ratio of percentage increase of quantity of commodity purchased to percentage increase in income) of food demand is fairly low as a result of the relatively high incomes of Americans. Moreover, lower-income Americans may often eat more carefully due to necessity and/or the special nutrition programs designed for them--such as the Expanded Food and Nutrition Education Program (EFNEP) [Abdel-Ghany (10); Family Economic Review (19), Bivens and Abdel-Ghany (20), and Windham et al. (4)].

Instead of income, several studies in this literature (but not, except for Price, included in the survey) have used food expenditure as an independent variable. Surprisingly, there is even less consensus in the findings from these studies than in those that used income. Lane (21) and Allen and Gadson (20) found food expenditures had a significant positive effect on nutrient intake while Price et al. (1) and Sanderson (23) found it to be insignificant. It should be noted that, in studies where food expenditures were found to be insignificant, data on special subpopulations were used (i.e., data on low-income children in Washington, D. C., and the elderly).

In the studies of individual nutrient intake and dietary quality reviewed, income appears to be even less important. Windham et al. (4), using nutrient density, found no significant income effect. (It should be noted, however, that they did not control for food stamps, which are income legally constrained to the purchase of food, and used .01 instead of .05 as the cut-off level in their significance test.) In two studies of children, Lund and Burk (5) found that income only positively and significantly affected vitamin C intake; and Akin, Guilkey, and Popkin (2) found that income only had a positive significant effect on consumption of vitamins B_6 and C. However, because of the lack of knowledge concerning B_6 content in foods, the results may be spurious [Hihn and Lane (24)]. Overall, it appears income has its most significant effect on the intakes of vitamin C.

In spite of the general finding with respect to income and nutrient intake in the United States, it should be noted that, as expected, for low levels of income, income becomes a very important constraint; hence, we generally find income to be more significant for the poorest of the poor. The importance of income at low income levels is supported by Knudsen and Scandizzo (15) in a study of calorie consumption in eight developing countries where they found income had a significant and substantial effect on calorie intake.

Another interesting point is that Foytik (25), using a linear programming model in the Stigler tradition, and others he cites who used the same technique, have found it possible to purchase a nutritionally adequate diet with an income below the official poverty level in the United States. To achieve a nutritional diet required substituting foods in a manner which provided increased quantities of carbohydrates and fats and an increasingly monotonous diet as incomes declined.

Another result which reflects the effect of income is that the frequency of the receipt of income appears to be negatively correlated with nutrient intake [Madden and Yoder (12)]. One reason for this could be that the more frequently someone is paid, the more times during the month there is an end-of-check time. Another is that those who are paid more frequently may also be those who have lower-level jobs and, therefore, lower capabilities. They may also be the ones who have more difficulty budgeting. Assets appear to have about the same effect as income [Price et al. (1)].

One of the few studies incorporating some measure of prices was done by La France (6). A shadow price for nutrients is computed which reflects the combined effect of food prices and household income. The only direct price effects are for calories and vitamin C. There are some cross-price effects but these, also, primarily center around calories and vitamin C. It appears that what is being reflected in these results is the income effect on these two nutrients. One interesting result, however, is that the approach used by La France (6) yields a measure of the interrelationships between the consumption of different nutrients.

Sociodemographic variables. Individual sociodemographic variables used in the household studies reviewed can include the education, occupation, and employment status of the male and female heads of household. In studies of individuals, the same variables, as well as age and sex, are included for the specific individual. Occupation is highly correlated with income and education and, therefore, is usually omitted. Age, in household studies, is often indexed by a life-cycle variable.

In household studies, education of the female head of household is found to be positively and significantly correlated with intakes of vitamin C, and niacin and negatively correlated with intakes of carbohydrates, fat, iron, and thiamine [Searce and Jensen (9); Adrian and Daniel (11); and Abdel-Ghany (10)]. In studies of individuals, the correlation is with intakes of calories (positive) [Akin, Guilkey, and Popkin (2)]; calcium (negative) [Price et al. (1)]; vitamin C (positive) [Price et al. (1); Windham et al. (4); and Akin, Guilkey, and Popkin (2)]; and vitamin A (positive) [Price et al. (1); and Akin, Guilkey, and Popkin (2)].

Employment status of the female head of household is found to influence vitamin C (positive for nonparticipants in the labor force) [Abdel-Ghany (10)], carbohydrates and fats (positively) [Adrian and Daniel (11)], and vitamin B_{12} (positively as hours worked increased) [La France (6)] in household studies. In studies of individuals, Akin, Guilkey, and Popkin (2) found it negatively affected vitamin A intake of older children and energy in younger children. Windham et al. (4) only found a significant positive effect on vitamin C.

Information concerning the male head of household is often not included since his characteristics have been found to have a less important influence on nutrient intake than the characteristics of the homemaker. When it is used, employment status is far more important than education. La France (6) found no significant influence for education. Employment status, measured by number of hours worked, had a positive effect on calories, iron, thiamine, niacin, vitamin B_6, and vitamin C. Windham et al. (4) found significant positive correlations with employment status for calories and negative correlations for carbohydrates and magnesium. They, also, found a significant negative relation between carbohydrate consumption and the education of the male head of household. This is probably a result of the high correlation between male employment status and education level--the more highly educated being more weight/health conscious.

In individual studies reviewed, age and sex are, generally, major determinants of intake for many nutrients [Akin, Guilkey, and Popkin (2); Windham et al. (4); and Lund and Burk (5); Table 1].

Household sociodemographic variables in the surveyed articles, as previously noted, (also see Tables 1 and 2) include region, urbanization, ethnicity and race, stage in the life cycle, and household size. Overall, household size and life-cycle stage are the most significant determinants, other than age and sex, of all of the exogenous variables usually considered.

In household level studies, household size, negatively correlated, and life-cycle stage (mixed) are almost always significant for all nutrients (Note 3). In individual studies, household size is usually thought to be a reflection of potential economies of scale not just a way of standardizing the results. However, in general, household size is found to have a negative impact on nutrient intakes of children [Price et al. (1); Akin, Guilkey, and Popkin (2)], hence, reflecting increasing costs. The effect of the other variables is more varied. La France (6) finds that household members of Spanish extraction consume relatively more calories, iron, and vitamin B_{12} while Blacks consume relatively more vitamins A and B_{12} than Whites and other ethnic groups.

Other than in Adrian and Daniel (11), race or ethnicity appears to be significant more often in individual studies reviewed than in the household studies. It especially seems to affect calcium and vitamin A intake at the individual level [Price et al. (1); Windham et al. (4); and Akin, Guilkey, and Popkin (2)] but it also does so at the household level [Adrian and Daniel (11); La France (6)]. In general, however, it can be argued that race and ethnicity

affect food choices more significantly than they do nutrient intakes [Windham et al. (4)].

Urbanization appears mainly to affect vitamin C. However, Adrian and Daniel (11) found urban households consumed significantly fewer calories; Searce and Jensen (9) found urban households consumed less of all nutrients except vitamins A and C; and Akin, Guilkey, and Popkin (3) found urban households had significantly higher intakes of calories and iron.

SUMMARY AND CONCLUSIONS

In general, it appears economic and sociodemographic variables have a consistent influence on intakes of calories, protein, vitamin A, vitamin C, and the B vitamins. Race has a strong influence on calcium probably due to lactose intolerance in some groups. Unfortunately, sociodemographic and economic variables do not explain a very large portion of the variation in nutrient intake or nutritional dietary quality. Many of the papers included in this survey reported R^2 from .1 to .2 for many equations. Furthermore, there is not always agreement as to how these variables influence nutrient intake and/or dietary quality.

To summarize the results, we can tell the following story although with many caveats: At very low levels of income, nutrient intake and dietary quality increase significantly across the board as income increases. However, at higher income levels, while income appears to have a positive effect on intake and dietary quality, it is small at the margin (i.e., on its effect on an additional amount of intake). We do not know very much about the effect of prices. Education of the female head of household, which especially affects vitamin C intake, does have a positive influence on diet when it appears to be

significant. An employed male head of household has a positive effect on diet even beyond the correlated income effect. As expected, males consume more food than females, and this increases until they are adults. The more people in a household, the more they eat. One surprising result is that, for individual children, household size seems to have a negative impact on diet. Finally, race and ethnicity, region, and urbanization have less of an effect than expected in the United States.

From this review, it would appear, that in order to be most cost effective in improving dietary nutritional quality, nutrition education efforts should concentrate on (a) the poorest of the poor, (b) the home manager (particularly if that person is female), (c) larger households with children, and should stress the importance of vitamin C. Education of the female home manager appears more important than income as a variable explaining dietary quality in the United States (Note 4).

NOTES

1 Translating the language of economists, this means attempts to formulate equations which reflect the process by which people try to do the best they can in dividing up their limited income available for spending among different goods and services--of which food is one category.

2 Exogenous variables are those whose values are not influenced by any of the other variables in the model.

3 Households with children under six years of age (stage 2) and households without children and with the female household manager over forty years of age (stage 6) consume smaller quantities of all nutrients than do households with the average age of the children between six and twelve years (stage 3). Households with no children and a female houshold manager under forty years of age (stage 1) consume less of all nutrients--except carbohydrate, iron and thiamine--than do households in stage 3. Households with children from twelve to seventeen years of age (stage 4) consume the largest quantities of all nutrients except vitamin A [(Adrian and Daniel (11)].

4 This is supported by the 1979 findings of O'Connor and Madden (17) from the North Carolina phase of the Negative Income Tax Experiments and accords with the emphasis of EFNEP (the Expanded Food and Nutrition Education Program of the Extension Service of the United States Department of Agriculture) and of the Special Supplemental Food Programs for Women, Infants and Children on educating the female household food manager if nutrition education is to be the most cost effective [Weimer (18)].

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