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Nutrient Consumption Patterns of Low-Income Households

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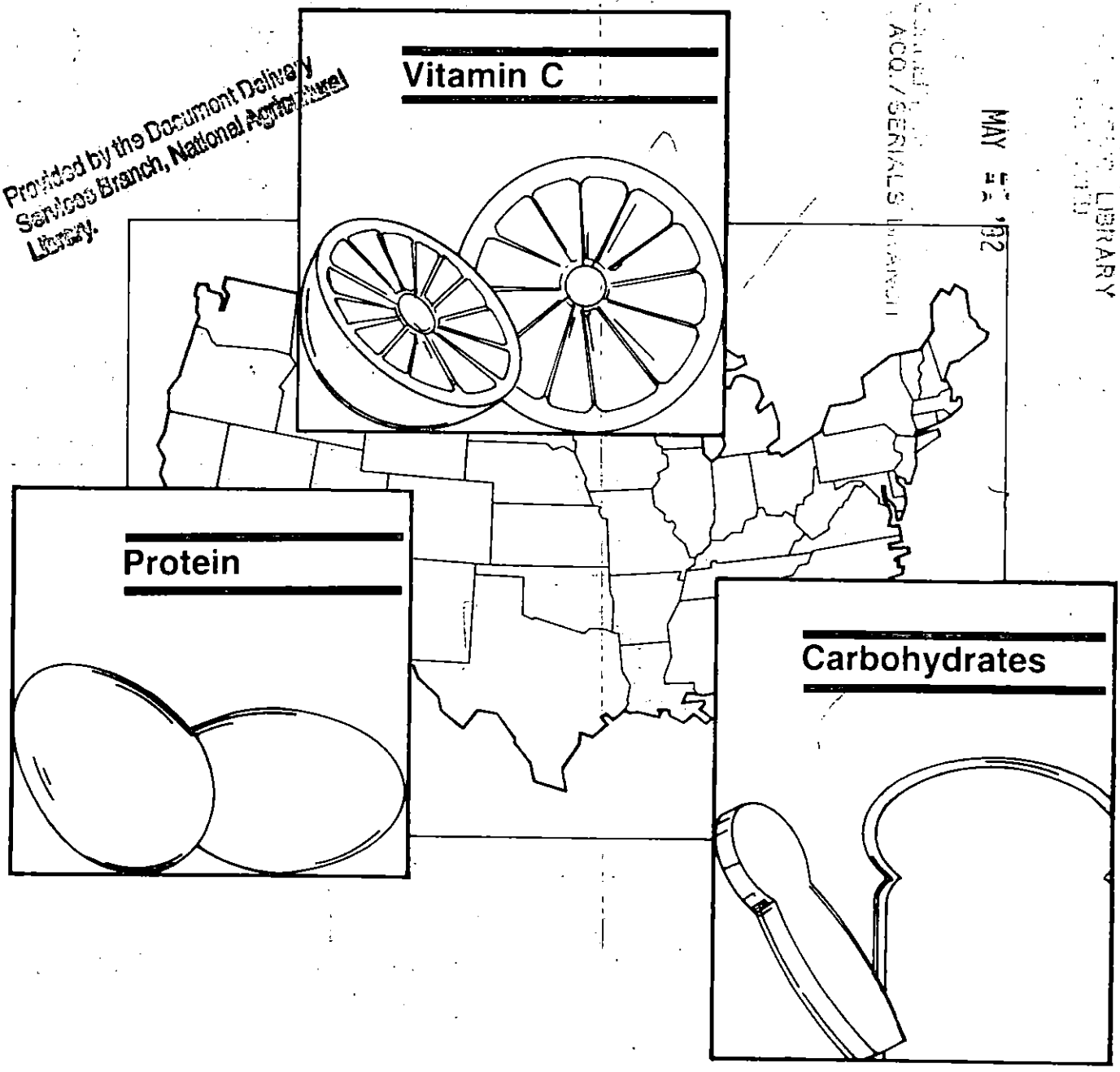

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ABSTRACT

Nutrient consumption patterns of low-income households differ significantly by location of residence. The rural West, the rural North Central region, and the urban South generally have the highest proportion of low-income households with nutrient levels below the Recommended Dietary Allowances (RDAs). More than 20 percent of all low-income households in this study consumed food (from household food supplies) that furnished less than the RDAs for vitamin A, vitamin B_6, calcium, magnesium, and food energy. Participation in the Food Stamp Program has a positive and significant influence on nutrient consumption. Overall, nutrient consumption is more responsive to increases in bonus stamp value than to increases in income but is not highly responsive to either.

KEYWORDS: Nutrients, consumption, location of residence, region, urbanization, food stamps, marginal propensity to consume, elasticity, socioeconomic characteristics.

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CONTENTS

SUMMARY

The nutrient consumption patterns of low-income households vary widely from one section of the Nation to another. The rural West, the rural North Central region, and the urban South generally have the highest proportion of low-income households with nutrient levels below the Recommended Dietary Allowances (RDAs). This report compares the nutritive value of food used at home by low-income households in the rural South with the nutritive value of food used at home by low-income households in seven other locations. The focus is on the rural South because it has a high concentration of poverty.

Although the diets of low-income households, on average, furnish the quantities of nutrients suggested by the RDAs, not all households use foods that contain the recommended amounts of individual nutrients. The household food supplies of more than 20 percent of all low-income households in the study contained less than the RDAs for vitamin A, vitamin B_6, calcium, magnesium, and food energy. Low-income households in the rural West, rural North Central region, and urban South were least likely to have household food supplies that furnished the RDAs for the 15 nutrients studied.

Other research findings show that:

- Based on straight computation of the data, low-income households in the urban North Central region had higher average nutrient levels than low-income households in

other regions. Generally, low-income households in the rural West had the lowest nutrient levels. These households also had the lowest level of participation in the Food Stamp Program.

- The average proportion of income allocated to food, after accounting for the receipt of bonus food stamps, differed substantially by location of residence, ranging from 34.8 percent among low-income rural Westerners to 40.5 percent among low-income urban Northeasterners. Low-income rural Southerners, on average, spent a slightly larger share of their income on food than did low-income households in all other regions combined.

- Some of the observed differences in nutrient levels by location of residence are due to differences in income and other socioeconomic factors. The household food supplies of low-income rural Southerners, after a control for socioeconomic factors, generally provide significantly more thiamin, calcium, iron, phosphorus, food energy, fat, and carbohydrate per person than do the food supplies of low-income households in any other location. However, the food supplies of low-income rural Southerners generally provide less vitamin B_{12} compared with the food supplies of other low-income households.

- Participation in the Food Stamp Program significantly influences nutrient levels. Food stamp households use significantly larger quantities of each nutrient studied than do households eligible but not participating in the Food Stamp Program.

- Food stamps are more effective than cash income in increasing food expenditures and nutrient levels. A $1 increase in cash income would lead to an additional 12-cent increase in food expenditures among low-income households. However, an additional dollar's worth of bonus food stamps would generate about 24 cents in additional food expenditures, with the balance freeing up income that would have been spent for food.

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Joyce E. Allen
Kenneth E. Gadson*

INTRODUCTION

Household food consumption patterns are based on such socio-economic and demographic factors as location of residence (urbanization and region), income, education, race, and household composition (6, 18, 19).1/ The same factors that influence food consumption patterns will likely influence consumption patterns of the different nutrients needed for growth and health.

This report describes the nutrient consumption patterns of low-income households based on location of residence.2/ The information should interest policymakers and administrators of food assistance programs, particularly the Food Stamp Program. Converting federally funded food assistance programs, such as the Food Stamp Program, into a categorical or block grant continues to be a policy issue. A better understanding of the nutrient consumption patterns of low-income households by location of residence and the nutrient responses of these households to changes in income and bonus food stamps should help policymakers develop food assistance programs.

The influence of regional location on food consumption has its foundation in the different natural resources, climate, soil, topography, and ethnic heritage that existed among the regions when the United States was first settled (6). These differences, along with economic factors related to occupation, income, prices of nonfood goods and services, and the existing state of technology influenced the types and quantities of foods that were produced and consumed by persons in various locations.

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1/ Underscored numbers in parentheses refer to items in the References section.

2/ In this report, the terms "nutrient consumption" and "nutrient use" are used interchangeably to represent nutrients available for consumption.

Improvements in transportation, marketing, and communication facilities have made regional and urbanization differences less important today. Other factors moderating regional differences in household food consumption patterns include national advertising of food products and smaller regional differences in income levels (4).

A continuing decline in the fertility rate combined with a pronounced shift in net migration patterns has caused a significant change in regional population trends since 1960 (22). These factors have resulted in a higher proportion of the total population living in the South and West and a lower proportion living in the Northeast and North Central regions. During the same period, the population became more urban. In 1980, 73.6 percent of the total population lived in urban areas compared with 69.8 percent in 1960. Although households may change their food consumption patterns following changes in locations, these changes in food consumption patterns are often gradual (6).

Another factor that may affect average consumption patterns is the geographical distribution of the poor. The South was overrepresented among the poverty population in 1979. About 42 percent of all poor persons lived in the South; 58 percent lived in the Northeast, North Central, and West regions combined. Slightly more than 33 percent of the total population lived in the South at that time. Moreover, 1980 census data show that 35 percent of the persons in the South lived in nonmetropolitan areas, the highest percentage of the four regions (23). Approximately 15 percent of all families in nonmetropolitan areas had incomes below the poverty level according to the 1980 census data, but in the South about 19 percent of all families in nonmetropolitan areas had incomes below the poverty level (21). The focus of this analysis is the rural South because it has a high concentration of poverty.3/

DATA SOURCE

This study used data from the 1977-78 Nationwide Food Consumption Survey (NFCS). This survey, the sixth conducted by the U.S. Department of Agriculture (USDA) since 1935-36, is the most recent nationwide survey of the food consumption and dietary levels of households. The complete NFCS contains the basic national survey, a bridging survey, and six supplemental surveys (17). The data for this study were obtained from the 1977-78 supplemental NFCS of low-income households.4/ From

3/ Metropolitan-nonmetropolitan and urban-rural terminology are not completely interchangeable. For example, the population residing in standard metropolitan statistical areas (SMSAs) constitutes the metropolitan population. Approximately 17 percent of the farm population lived inside SMSA's in 1980. These farm residents would be considered a part of the rural population in an urban-rural distribution.

4/ Low-income households were defined either as receiving food stamps or as eligible to receive food stamps.

November 1977 through March 1978, a stratified probability sample of approximately 4,600 low-income households from the 48 contiguous States and the District of Columbia was surveyed.5/ Detailed information on the at-home food consumption of these households was collected during personal interviews with the household member(s) primarily responsible for food planning and preparation. Trained interviewers used the food list recall method to obtain information on the kinds, forms, quantities, and costs (if purchased) of food and beverage used in each household during the 7 days prior to the interview.

After preliminary editing of the 1977-78 low-income supplemental NFCS data tape, 3,850 housekeeping households had usable records for this study.6/ Housekeeping households are households in which at least one member ate 10 or more meals from home food supplies during the week prior to the survey. The NFCS data tape contains not only information on food use but also information on household characteristics and nutrient levels. The nutrient levels of households, on which this analysis is based, were calculated from the edible portion of food brought into the household.7/ Adjustments were made in the nutrient levels for vitamin loss during the cooking process, but not for nutrient loss due to food waste. For example, the nutrient content of diets includes the nutrients in food once usable and discarded, such as fat trimmed from meat, as well as leftovers fed to animals. Thus, the data on nutrient levels of foods consumed in many households is somewhat overestimated.

5/ The sample design was a disproportionate area probability sample. To assure a representative sample in the tabular analysis, we used sampling weights developed by the Human Nutrition Information Service. However, since rural farm households were not oversampled in the survey, the rural observations may be subject to greater sampling errors than would have occurred if a different sort (for example, SMSA central city, SMSA suburban, and nonmetropolitan) had been used.

6/ Households were eliminated from this analysis if their records contained missing information on income, household size, participation in the Food Stamp Program, or other relevant data. Further, some households with inconsistent or inaccurate information about the purchase price for food stamps, the allotment received, and number of household members participating in the Food Stamp Program were also eliminated.

7/ These calculations were based on composition data in USDA's Agriculture Handbook No. 8, its revised supplements, and on data supplied by manufacturers. Food composition values for magnesium and for vitamins B_6 and B_{12} are limited for some foods. Although values for these three nutrients are less reliable than those for other nutrients, they were considered the best available at the time of the NFCS.

HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS AND NUTRIENT LEVELS

Nutrient levels may be related to income, food expenditures, age, number of people living in the household, and other socio-economic characteristics. In a market-oriented economy such as the U.S. economy, access to food nutrients is determined primarily by income. Data from the 1977-78 NFCS indicate, in general, that at each successively higher level of income, a slightly greater percentage of households used food that met the 1974 Recommended Dietary Allowances (RDAs) (27).8/ The Food Stamp Program provides food purchasing power to low-income households in inverse proportion to their income. Thus, food expenditures may also be indicative of nutritional status.

Since a direct relationship exists between household size, economic need, and household nutrient requirement, increases in household size will have an adverse affect on the household's nutritional status if there is not an increase in the amount of nutrients available to the household. Researchers analyzing the 1977-78 NFCS data have found that food stamp households with one member were more likely to meet the RDAs for all 11 nutrients studied than were larger food stamp households (26).

Lack of access to foodstores may be a problem even if a person has the money or food stamps for food. Elderly persons, persons living in central cities of large metropolitan areas, and persons living in remote areas are more likely to experience problems purchasing food than other segments of the population (5).

The distribution of income and food expenditures among the low-income population provides some insights into their relative well-being. For this study, income represents the household's weekly income before taxes and was derived in two ways; the household's annual income divided by 52 or, for households not reporting annual income, weekly income represents the sum of the different sources of monthly income divided by 4. In general, income is limited to cash income and does not include the value of goods and services that a household may have received. Food expenditures refer to the household's total food expenditures (that is, the amount paid for food at home plus the amount paid for food away from home). Food-at-home expenditures represent the usual amount that households spent per week in grocery stores, specialty stores, vegetable stands, and farmer's markets for food and nonalcoholic beverages during the 3 months preceding the NFCS. Food-away-from-home expenditures represent the actual amount that households paid for meals and

8/ The Recommended Dietary Allowances are daily estimates for levels of intake of essential nutrients. These allowances, which are designed for healthy people, are formulated by the Food and Nutrition Board of the National Research Council, and are updated periodically based on the latest scientific evidence about nutritional needs. The 1974 Recommended Dietary Allowances, used in the NFCS, were revised in 1980. The 1980 revision slightly increased the allowances for vitamin C, vitamin B_6, and food energy.

snacks bought and eaten away from home during the week prior to the NFCS. It includes expenditures for alcoholic and non-alcoholic beverages.

Low-income households in the urban Northeast represented about 16 percent of all low-income households included in this study, but they received 19 percent of the total income and accounted for 21 percent of total food expenditures (table 1).9/ This distribution indicates that households in the urban Northeast received a disproportionate share of income. However, they spend a disproportionate share of their income on food, probably

Table 1--Distribution of income and food expenditures among low-income households

Location of residence	Low-income households	Income before taxes	Total food expenditures	Food-at-home expenditures	Food-away-from-home expenditures
			Percent		
Urban Northeast	16.4	19.3	21.1	21.7	17.3
Rural Northeast	4.3	5.8	5.0	4.9	6.1
Urban North Central	17.5	16.0	16.0	16.5	13.0
Rural North Central	5.7	5.7	5.9	5.7	7.7
Urban South	25.9	22.8	24.4	24.6	23.2
Rural South	16.6	15.9	15.3	14.9	17.8
Urban West	11.7	12.4	10.6	10.1	13.6
Rural West	1.8	2.1	1.7	1.7	1.3
Total 1/	100.0	100.0	100.0	100.0	100.0

1/ Numbers may not sum to 100 due to rounding.

Source: (28).

9/ Urban--Households in places with at least 2,500 inhabitants and in closely settled fringe areas surrounding cities of 50,000 or more inhabitants; and Rural--Households outside of urban places. Northeast--Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; North Central--Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin; South--Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia; and West--Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

because food costs are higher in the Northeast than in the other census regions. The USDA Moderate Cost Food Plan for a four-person family with two school-age children cost $433.20 in the Northeast in January 1983, or 8 percent higher than the average costs for the United States ($402.90). The costs in the West, the North Central region, and the South were $419.60, $408.60, and $395.60, respectively.10/

The share of income and food expenditures of households in the rural South was roughly equivalent to their representation in the sample. Households in the rural South accounted for 17 percent of the total households used in this analysis. Sixteen percent of the total pretax income accrued to these households. These same households accounted for 15 percent of total food expenditures, 15 percent of food-at-home expenditures, and 18 percent of food-away-from-home expenditures.

Average characteristics of households in the rural South differed from all other households (table 2). The average age of the low-income household head in the rural South was 51 years compared with an average of 47 years for all other low-income households.11/ The average age of the household head exceeded that of the rural South in only one location, the rural West. Average household size varied significantly by residence in the eight locations, but only slight differences were observed between average household size in the rural South and average household size for all other households.

Low-income households in the rural South had slightly lower average household income than households in all other regions combined. Annualized household income, before taxes, for these households averaged $4,904 compared with $5,159 for all other low-income households. Low-income households in all locations except the urban North Central region and the urban South had higher average incomes than did households in the rural South. Differences in household size between the rural South and other locations are slight, so the disparity in income is about the same when the comparisons are made on a per capita basis. Per capita income of low-income residents in the rural South averaged $1,723 per year, about 5 percent less than average per capita income for all other low-income households. On an individual basis, low-income households in the urban Northeast, urban North Central, rural North Central, urban West, and rural West averaged slightly higher per capita income than did low-income households in the rural South. Conversely, low-income

10/ USDA does not estimate the cost of their food plans by urbanization. The Bureau of Labor Statistics reports average retail food prices for selected foods for the four census regions and also reports average U.S. city prices for the same foods. However, the Bureau of Labor Statistics does not conduct food price surveys in rural areas.

11/ The age of the male head was used for households with both a male and female head.

Table 2--Characteristics and weekly food expenditures of low-income households, 1977-78

Item	Units	All low-income households (average)	Location of residence: Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
Average household size	Number	3.35	3.73	4.36	2.96	3.57	3.43	3.31	2.79	3.41
Average age of head	Years	47.6	42.9	38.8	47.7	50.3	49.6	51.4	45.6	52.4
Annualized household income before taxes	Dollars	5,116	6,014	6,913	4,691	5,058	4,512	4,904	5,390	5,828
Weekly food expenditures 1/	Dollars	42.55	54.62	50.20	38.94	43.91	40.14	39.18	38.30	38.44
Food at home	Dollars	36.78	48.56	41.96	34.64	36.17	34.98	32.99	31.60	34.38
Food away from home	Dollars	5.77	6.06	8.24	4.29	7.73	5.16	6.18	6.69	4.06
Money value of at-home food consumption 2/	Dollars	3/42.78	47.66	58.13	41.47	47.07	41.77	39.37	37.66	40.16

1/ Sum of expenditures for food at home and food away from home. May not add due to rounding.

2/ The Human Nutrition Information Service (HNIS) reported the money value of at-home food consumption based on the amount the household paid for purchased food used during the week prior to the Nationwide Food Consumption Survey (NFCS). The sales tax paid on food was excluded. The HNIS derived the money value of nonpurchased foods (home produced, gift, or pay) based on the cost per pound for comparable purchased items.

3/ The money value of at-home food consumption can be less than, equal to, or greater than food-at-home expenditures because of the definition of food expenditures used in this study and because of the NFCS design. Food-at-home expenditures represent the usual amount that households spent for food per week during the 3 months prior to the NFCS. It is subject to over or under estimation by survey respondents since they had to recall expenditures for a relatively long time period. In comparison, the money value of at-home food consumption is based on the recall of food used from household food supplies during the 7 days prior to the NFCS. Households were contacted in advance and asked to keep informal notes to assist them in recalling the food used.

Source: (28).

households in the rural Northeast and urban South averaged slightly lower per capita income than did low-income households in the rural South.

On the average, low-income rural Southerners spent less on total food expenditures and food-at-home expenditures than did all other low-income households.12/ Weekly expenditures for total food, food at home, and food away from home by low-income households living in the rural South were $39.18, $32.99, and $6.18, respectively. In contrast, all other low-income households had average outlays of $43.22 for total food expenditures, $37.54 for food-at-home expenditures, and $5.68 for food-away-from-home expenditures. Although low-income households in the rural South had lower food expenditures than average for all low-income households across the Nation, weekly food expenditures in three locations (urban North Central, urban West, and rural West) were lower than expenditures in the rural South. Households in the rural South also consumed food with a lower money value than did households in all regions combined.13/ Average money value of food used at home by low-income households in the rural South was $39.37, compared with $43.46 for all other low-income households. Only low-income households in the urban West consumed food with a lower money value than did low-income households in the rural South.

The proportion of its income that a household spends on food is an indicator of its economic well-being; poorer households spend a larger proportion on food than do other households. The usual amount that households spent for food purchases in food-stores, which was obtained directly from the NFCS data tape, includes food bought with food stamps. To account for the receipt of the food stamp subsidy, the weekly value of this subsidy was subtracted from the household's usual food expenditures per week during the 3 months prior to the NFCS. This procedure gives the out-of-pocket food purchases for food stamp households.

The proportion of income allocated to food, after accounting for the receipt of food stamps, differed substantially by location of residence (table 3). Low-income households in the rural South spent a slightly larger share of their income on food than did households in all other regions combined. Rural southern households spent about 39.4 percent of their income for food at home and away ($13.11 per person per week). All other low-income households used in the analysis spent an

12/ Food expenditures consist of total cash expenditures and the expenditure of food stamps to buy food.

13/ Money value of food includes the value of food that was bought, home produced, or received as gift or pay and used by household members and guests during the week prior to the NFCS. The value of food not obtained in the marketplace was based on average price per pound for that food by survey households in the same region.

Table 3--Percentage of before-tax income spent on total food, food at home, and food away from home by low-income households

Location of residence	Food at home 1/	Food away from home	Total food 2/
	Percentage of before-tax income 2/		
Urban Northeast	35.2	5.3	40.5
Rural Northeast	29.8	5.2	34.9
Urban North Central	33.6	5.3	38.3
Rural North Central	32.8	6.8	39.6
Urban South	32.5	5.7	38.2
Rural South	33.1	6.3	39.4
Urban West	29.4	7.5	36.9
Rural West	31.6	3.2	34.8
All households	32.8	5.9	38.6

1/ Adjusted for the receipt of the food stamp subsidy.
2/ May not add due to rounding.

Source: (28).

average of 38.5 percent of their income on food ($14.10 per person per week).

NUTRIENT CONSUMPTION PATTERNS

The Recommended Dietary Allowances vary according to age and sex. Thus, a nutrition unit is one basis for assessing the dietary levels of households with different age-sex compositions and different numbers of meals consumed from household food supplies.

A nutrition unit is equal to the RDAs for a nutrient for males aged 23 to 50 years (27). USDA's Human Nutrition Information Service (formerly a part of the Science and Education Administration) calculated the household nutrition units. For a given nutrient, the number of nutrition units in a household is the sum of the RDA for that nutrient for persons eating in the household (adjusted for meals eaten away from home) divided by the RDA for the base person, the adult male 23-50 years of age (27). The scale value for the base person is set equal to 1.00 and the nutritional needs of males of other ages, women, and children are expressed as a ratio of the nutritional needs for the base person.

The nutritive value of food used in households per nutrition unit as a percentage of the RDAs is compared by location of residence in table 4. On average, daily consumption per nutrition unit for all low-income households and low-income households in each location exceeded the RDAs for all nutrients

Table 4--Average nutritive value of household food used per nutrition unit as a percentage of the 1974 Recommended Dietary Allowances 1/

Nutrient	1974 RDAs 2/	All low-income households	Location of residence							
			Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
			Percentage							
Vitamin A	5,000 I.U.	250	205	194	430	173	236	196	218	218
Vitamin C	45 mg	309	283	250	424	260	284	269	337	252
Thiamin	1.4 mg	199	175	161	262	173	187	197	201	175
Riboflavin	1.6 mg	230	213	193	315	204	206	215	231	200
Niacin	18 mg N.E.	3/213	194	174	290	183	194	203	219	170
Vitamin B_6	2.0 mg	135	127	111	173	113	125	122	151	124
Vitamin B_{12}	3.0 mcg	292	298	212	476	206	265	211	271	202
Calcium	800 mg	131	122	123	154	124	119	141	129	115
Iron	10 mg	179	142	142	244	158	165	182	187	165
Magnesium	350 mg	142	131	133	171	136	128	141	151	120
Phosphorus	800 mg	236	197	193	319	198	221	242	232	190
Food energy	2,700 kcal	149	127	128	191	130	142	151	153	124
Protein	56 g	245	239	219	316	209	233	226	234	210

1/ Nutrition unit is the number of adult male equivalent persons in the household, calculated separately for food energy and each nutrient. The relative needs of other household members are expressed as a ratio of the nutritional needs of the adult male 23-50 years of age.

2/ Recommended Dietary Allowances for an adult male aged 23-50 years. I.U. = International Units; mg = milligrams; N.E. (niacin equivalent) = 1 mg niacin or 60 mg dietary tryptophan; mcg = micrograms; kcal = kilocalories; g = grams.

3/ Data are for performed niacin only and do not account for tryptophan (an amino acid) that is converted to niacin in the cells.

Source: (28).

studied.14/ Low-income households in the urban North Central region had the highest average nutrient levels relative to the RDAs.

Intake above the RDAs does not necessarily imply adequacy of the diet. A safety margin of 10 to 15 percent, depending on the nature of the nutrient, has been incorporated into the RDAs to provide a buffer for physical and emotional stress that could affect the need for nutrients.15/ The safety margin also takes into account that nutrient loss could occur in food storage and preparation, and that a wide range of nutrient requirements exist in the U.S. population (10). The body tolerates most nutrients in amounts that exceed two to three times the RDAs. However, excess intakes of some nutrients over an extended time period are associated with specified health problems. For example, an intake of food energy in excess of the requirement will lead to obesity, and high intakes of vitamin A can be toxic (14).

Average at-home consumption of nine nutrients by low-income households in the rural South was lower than average at-home consumption for all low-income households used in the analysis. These nutrients were vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, magnesium, and protein.16/ Conversely, low-income households in the rural South had higher average at-home consumption for calcium, iron, phosphorus, and food energy than the average for all low-income households.

Low-income households living outside the rural South had lower average at-home consumption for several nutrients compared with households in the rural South. Low-income households in the rural Northeast, rural North Central region, rural West, urban Northeast, and urban South tended to use food at home with lower nutritive values than did households in the rural South. However, low-income households in the urban North Central region and the urban West tended to use food at home with relatively higher nutritive values.

14/ The nutrient levels were calculated using household-to-household averages. In general, household-to-household averages give larger average nutrient levels than those obtained from the population-ratio procedure.

15/ The energy allowance, in contrast to the allowance for other nutrients, represents the average needs of people in each age-sex category. It does not have an added safety margin.

16/ For the purpose of establishing the RDAs for niacin, the National Research Council assumed that when 60 milligrams of tryptophan (an amino acid) are ingested, enough is oxidized to provide about 1 milligram of niacin. The RDAs for niacin are expressed as niacin equivalents. The data used in this study do not reflect the niacin equivalent values for foods. Thus, the data are for performed niacin only. A comparison of nutrient levels for performed niacin with the RDAs for niacin underestimates the value of the diet in meeting the RDAs.

Average nutrient consumption figures can hide nutritional problems among specific segments of the population. That is, households on the average consume sufficient quantities of the selected nutrients as suggested by the RDAs, but not all households consumed adequate amounts of each nutrient. Distributional data could expose some of the nutritional problems.

It should be emphasized that the nutrient levels are based on food used at home and on food obtained from home supplies but eaten away from home. The nutrients in school breakfasts or lunches and other meals eaten away from home are excluded. Some persons, for example infants, young children, and the elderly, consume nearly all their meals at home. Among the low-income population in the United States, males from 9 to 34 years, and females from 9 to 22 years, obtain about 15 to 25 percent of their total food energy from foods and beverages obtained and eaten away from home. These persons are also likely to consume a relatively large proportion of their other food nutrients away from home.

The data on nutrient levels can not be used to determine nutritional status since it excludes nutrients consumed away from home, but the data can be used to compare the at-home nutrient levels of households with various socioeconomic characteristics. In this study, the data are used to compare at-home nutrient levels of households in selected geographic locations.

The at-home diets of more than one-fifth of all low-income households in the study fell below the RDA for vitamin A, vitamin B_6, calcium, magnesium, and food energy (table 5). Some of these households may have used food away from home which combined with at-home food use furnished the nutrients needed to meet the RDAs. Since the RDAs are guidelines and not requirements, consumption below the RDAs does not necessarily indicate an inadequate diet. However, the risk of having an inadequate diet increases when combined consumption at home and away is less than the recommended level (14).

The percentage of households that used foods at home with nutritive values below the RDAs varies by location. Generally, low-income households in the rural West, rural North Central region, and urban South had the highest incidence of at-home consumption below the RDAs. The percent of low-income households in the rural South with household food supplies that did not meet the RDAs was lower than all low-income households for thiamin, riboflavin, niacin, calcium, iron, magnesium, phosphorus, food energy, and protein, but higher for vitamins A, C, B_6, and B_{12}.

The chi-square test was used to evaluate whether or not the proportions of households with nutrient levels below the RDAs differed significantly (at the 95-percent and 99-percent level) from the proportions expected based on theoretical assumptions. Once again we emphasize that these results are based only on food nutrients used from household food supplies. The proportions of households in each location with at-home diets below

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Nutrient	All low-income households	Location of residence: Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
				Percent					
Vitamin A	21.3	27.5**	10.7**	11.7**	28.0**	23.5*	25.1	16.9**	24.9
Vitamin C	10.4	6.3**	6.6**	7.3**	16.0*	12.7*	14.0	9.4**	9.7**
Thiamin	11.1	15.4**	7.2	8.2	10.0**	12.2**	7.6	13.4**	16.0**
Riboflavin	7.5	10.9**	4.4**	6.9	1.9**	8.7**	6.4	5.8	14.1**
Niacin 1/	9.2	12.4**	6.5	5.8**	9.9**	11.2**	7.1	8.6**	13.3**
Vitamin B_6	34.2	35.2**	39.1	20.5**	42.2	38.7	40.1	29.2**	36.9
Vitamin B_{12}	17.9	13.7**	17.8*	12.1**	13.5**	24.9**	20.3	16.3**	16.2*
Calcium	36.7	39.8**	29.8	29.6	37.1**	43.7**	29.9	40.1**	34.6*
Iron	19.1	31.4**	34.3**	12.6	14.9**	18.9**	12.6	17.7**	17.1**
Magnesium	28.4	28.7**	23.5*	20.3**	24.2*	37.0**	26.6	26.3	37.5**
Phosphorus	6.0	8.2**	5.8*	4.8**	7.5	6.7**	4.5	3.5*	13.5**
Food energy	27.6	35.8**	35.1**	24.2**	27.0**	27.4**	19.1	31.2**	28.6**
Protein	4.2	5.9**	5.8**	3.1	3.0	3.9	3.3	5.5**	7.3**

1/ Data are for performed niacin only whereas the Recommended Dietary Allowance (RDA) includes niacin derived from tryptophan.

An asterisk means that the proportion of households with nutrient levels below the RDA for the specified nutrient is significantly different from the proportion of households in the rural South with nutrient levels below the RDA. Differences between all households and households in the rural South cannot be tested for statistical significance.

* Significant at 95-percent level.

**Significant at 99-percent level.

Source: (28).

the RDAs were compared with the proportions for the rural South. Generally, the differences between the rural South and the other locations were statistically significant. For example, the proportion of low-income households in the urban Northeast and the rural North Central region with low levels of vitamin A consumption as measured by the RDAs was significantly higher than the proportion in the rural South. However, the proportion of low-income households in the rural Northeast, the urban North Central region, and the urban West with low levels of vitamin A consumption was significantly lower than the proportion in the rural South.

The percentage of low-income households consuming food at home with relatively low levels of vitamin B_6 and protein varied the least by location. In contrast, the percentage of low-income households with low levels of vitamins C and B_{12} and food energy differed significantly between the rural South and each location. Only the rural North Central region had a significantly higher proportion of low-income households with at-home food supplies that did not meet the RDA for vitamin C than did the rural South. Similarly, only low-income households in the urban South were more likely to fall below the RDA for vitamin B_{12} than were their counterparts in the rural South. Compared with the rural South, low-income households in all other locations were significantly more likely to fall below the RDA for food energy.

Several factors may contribute to the observed differences in at-home nutrient levels by location of residence. Prior studies have indicated that race has a significant impact on consumer food purchases and nutrient intake (1, 2, 19). Racial dispersion among the different locations is substantial (table 6). White households accounted for 54 percent of all low-income households used in this analysis; black and other nonwhite households accounted for 38 percent and 8 percent, respectively. Some locations were relatively homogeneous in terms of racial composition. For example, in the rural North Central region, white households represented 99 percent of all households. In contrast, 35 percent of all low-income households in the urban South were white and 65 percent were nonwhite.

Other factors known to affect nutrient consumption include participation in the Food Stamp Program, family composition, and education (1, 2, 8, 20). Some studies have shown that psychological needs also affect nutrient intake (15, 31).

ECONOMETRIC MODEL AND RESULTS

An econometric model was specified to isolate the impacts of specific locations on nutrient consumption and to compare nutrient consumption patterns among the locations. This model controlled for differences in income, household characteristics, and other socioeconomic variables that may account for some of the observed differences in nutrient levels among the various locations of residence. Per capita (that is, per member) weekly consumption of 15 selected nutrients was expressed as a function of per capita weekly household income, per capita

Table 6--Race of household head by location of residence, for low-income households

Location of residence	White	Black	Hispanic	Other
	Percent			
Urban Northeast	55.6	28.9	14.6	1.0
Rural Northeast	97.0	.7	2.3	0
Urban North Central	40.9	51.1	4.1	3.9
Rural North Central	98.6	0	1.4	0
Urban South	34.9	62.5	2.4	.2
Rural South	68.2	29.2	2.6	0
Urban West	55.3	27.2	16.7	.8
Rural West	64.2	9.0	26.8	0
All households	54.1	38.1	6.9	1.0

Source: (28).

weekly household income squared, per capita weekly value of bonus food stamps received, location of the household, race of the household head, stage of the household in the family life cycle, education of the person most responsible for meal planning, and housing tenure.17/ The nutrient values were derived from food used from the home food supply during the week prior to the NFCS. These foods included food purchased from food-stores and other outlets, home-produced food, and food received as a gift or for payment.

A dummy (binary) variable with a zero-one format was used to represent location of the household. To apply ordinary least squares regression under the usual assumptions, one location must be excluded (3). The excluded location, which is the rural South in this model, forms the basis of comparison with the remaining locations. The results from the model will differ from results obtained from straight computations of the NFCS data (as cited in the section on nutrient consumption patterns) because the model controlled for differences in household

17/ The basic assumption underlying the family life cycle variable is that the pattern of household development is sequential (9). Each stage in the family life cycle is distinctive from the other stages because of the events the family faces at that stage. The life cycle concept provides insights into a wide variety of consumption behaviors (7). Other researchers including Adrian and Daniel, Davis and Neenan, and Scearce and Jensen have used the life cycle concept in their studies on the effects of socioeconomic factors on the availability of nutrients.

socioeconomic characteristics. The regression parameters in table 7 show the estimated differences in nutrient levels of low-income households in the rural South compared with low-income households in seven other locations. These results were obtained from the model. A more complete description of the model and the remaining parameter estimates appear in the appendix.

Vitamins

Households in the rural Northeast used an average of 15,577 more international units (I.U.) of vitamin A per person per week than did households in the rural South (table 7). This amount, on a per day basis, is equivalent to 45 percent of the daily RDA for vitamin A for an adult male. Similarly, average vitamin A consumption by households in the urban North Central region exceeded that of households in the rural South by 5,869 I.U. or about 17 percent of the daily RDA.

Some of the differences in nutrient consumption among the various locations are not statistically significant.18/ For example, average vitamin A consumption in the urban Northeast and the rural West is higher than average consumption in the rural South, but these differences are not statistically significant.

The differences in vitamin C levels by location of residence are significant in only one location, the urban West. Daily vitamin C consumption per person was 11 milligrams higher in the urban West than in the rural South. This difference in consumption represents about 25 percent of the 1974 RDA for vitamin C for adults.

Location exerts a significant influence on thiamin levels. Average per capita consumption of thiamin was significantly lower in all locations, except for the rural Northeast, than was average per capita consumption in the rural South. The urban Northeast and the rural West had the lowest levels of thiamin consumption, relative to the rural South.

There are significant variations in riboflavin levels by location of residence. Per capita weekly riboflavin consumption was 2.3 milligrams higher in the rural Northeast than in the rural South. In contrast, per capita riboflavin consumption was 2.7 milligrams lower in the rural West compared with the rural South. Riboflavin consumption in the urban Northeast and the urban South was also significantly lower than in the rural South.

Households in the rural South used significantly more performed niacin than did households in the urban Northeast and the rural West. Per capita weekly consumption of performed niacin was 14 milligrams higher in the rural South compared with the urban Northeast versus 40 milligrams higher in the rural South compared with the rural West. The differences in niacin

18/ Significance levels of 95 percent and 99 percent were used.

consumption in the remaining five locations were not significant.

Location was not a significant factor affecting vitamin B_6 consumption, but location did affect vitamin B_{12} consumption. Households in the urban and rural Northeast and the urban South had significantly higher vitamin B_{12} levels than households in the rural South. Per capita weekly consumption of vitamin B_{12} was greatest in the rural Northeast, relative to the rural South. Households in the rural Northeast consumed an average of 16 milligrams more vitamin B_{12} per person than did households in the rural South.

Minerals

Average calcium consumption was significantly lower in all locations, except for the rural Northeast, than it was in the rural South. Compared with the rural South, calcium levels were lowest in the rural West. Per capita consumption there was 1,521 milligrams below average weekly consumption in the rural South.

The relationship between location of residence and per capita iron consumption was significant in all but two locations. The exceptions were the rural Northeast and the urban North Central region. The most striking contrasts in iron consumption arose between the urban Northeast and the rural South; consumption was 25 milligrams lower per person in the urban Northeast than in the rural South.

Magnesium consumption was also affected by location of residence. On average, households in the rural South used 511 more milligrams of magnesium per person per week than did households in the rural West. Similarly, households in the rural South used significantly more magnesium than did households in the urban Northeast and urban South--326 and 162 milligrams more, respectively.

The results indicate that phosphorus levels differ significantly by location. The difference in phosphorus consumption, however, between the rural South and the rural Northeast was not significant. Consumption in the remaining locations was significantly lower than in the rural South. Relative to the rural South, per capita consumption of phosphorus was lowest in the rural West. Weekly per capita consumption was 3,202 milligrams lower than in the rural South.

Food Energy and Energy Providing Nutrients

Energy is needed by the body to support physical activity and growth and for metabolic processes (13, 14).19/ Energy is provided when the body metabolizes carbohydrate, fat, protein,

19/ The energy value of a food is commonly expressed as a kilocalorie. A kilocalorie is the amount of heat required to raise the temperature of 1 kilogram of water 1 degree centigrade.

and alcohol components of foods.20/ Carbohydrate provides 50 to 60 percent of the energy in the average U.S. diet; fat provides from 35 to 45 percent; and protein provides from 10 to 15 percent (10).

Location of residence, after a control for income and other factors, exerted a significant influence on the amount of food energy that was consumed. Per capita consumption in the rural South was significantly higher than in all other locations except the rural Northeast. Among the locations, the differences in food energy levels relative to the rural South varied greatly. For example, weekly per capita consumption of food energy was 4,320 calories higher in the rural South than in the rural West versus 1,351 calories higher in the rural South than in the urban South.

The influence of location of residence was not as strong for protein consumption as for the other nutrients. The differences in weekly per capita consumption, relative to the rural South, were significant in only two locations--the rural Northeast and the rural West. Per capita protein consumption averaged about 99 grams higher in the rural Northeast than in the rural South, whereas per capita consumption in the rural West averaged about 95 grams lower than in the rural South.

Weekly per capita fat consumption for six locations differed significantly from consumption in the rural South. Again, households in the rural West had the lowest average nutrient level compared with households in the rural South. Households in the rural West consumed 233 fewer grams of fat per capita than did households in the rural South. In contrast, households in the urban South consumed only 54 fewer grams of fat per capita than did households in the rural South.

Per capita carbohydrate consumption was highly responsive to location of residence. Only the difference in carbohydrate consumption between households in the rural Northeast and the rural South was not statistically significant. Per capita consumption was 501 grams higher in the rural South than in the urban Northeast. The smallest differences in carbohydrate consumption occurred between households in the urban South and the rural South. Per capita consumption in the rural South was 223 grams greater than that in the urban South.

Marginal Propensities

The increased purchasing power of low-income households who receive food stamps influences the amount of food they buy and also affects their nutritional status. The marginal propensities to spend for food from income and bonus food stamps provide an estimate of the respective effects of cash and bonus food stamps

20/ The energy conversion factors are: fats, 9 kilocalories per gram; alcohol, 7 kilocalories per gram; proteins, 4 kilocalories per gram; and carbohydrates, 4 kilocalories per gram.

Table 7--Differences in weekly per capita nutrient consumption: Low-income households of various locations compared with low-income households in the rural South

Nutrient	Unit 2/	Location of residence 1/						
		Urban North-east	Rural North-east	Urban North Central	Rural North Central	Urban South	Urban West	Rural West
Vitamin A	I.U.	2,264.311 3/ (0.7)	15,576.55* (2.5)	5,869.445* (2.0)	-2,840.66 (-0.7)	-338.667 (-0.2)	-626.499 (-0.2)	3,137.481 (0.5)
Vitamin C	mg	25.109 (.6)	65.937 (.9)	54.133 (1.5)	-27.422 (-.6)	-34.814 (-1.5)	78.973* (2.0)	-25.652 (-.3)
Thiamin	mg	-2.947** (-6.8)	-.014 (-.0)	-1.250** (-3.2)	-2.010** (-3.8)	-1.000** (-3.8)	-1.800** (-4.1)	-2.930** (-3.5)
Riboflavin	mg	-1.11* (-2.0)	2.320* (2.3)	-.292 (.6)	-1.057 (-1.6)	-.767* (-2.4)	-1.000 (-1.8)	-2.741** (-2.6)
Performed niacin	mg	-13.560* (-2.4)	14.009 (1.3)	-4.710 (-.9)	-12.719 (-1.8)	-6.175 (-1.8)	-9.147 (-1.6)	-40.214** (-3.7)
Vitamin B_6	mg	-.679 (-1.5)	.943 (1.1)	.234 (.6)	-.814 (-1.5)	-.353 (-1.3)	.017 (.0)	-1.039 (-1.2)
Vitamin B_{12}	mcg	14.148** (4.1)	15.735* (2.4)	5.257 (1.7)	2.069 (.5)	4.192* (2.0)	1.255 (.4)	-2.609 (-.4)
Calcium	mg	-1,108.53** (-4.5)	237.662 (.5)	-538.203* (-2.5)	-1,040.18** (-3.5)	-645.759** (-4.4)	-836.038** (-3.4)	-1,520.91** (-3.2)
Iron	mg	-24.673** (-5.5)	8.125 (1.0)	-6.045 (-1.5)	-13.458* (-2.4)	-6.812* (-2.5)	-10.648* (-2.3)	-18.841* (-2.2)
Magnesium	mg	-325.709** (-4.0)	187.385 (1.2)	-110.007 (-1.5)	-169.472 (-1.7)	-161.891** (-3.3)	-97.409 (-1.2)	-510.515** (-3.3)
Phosphorus	mg	-2,460.5** (-6.1)	-541.206 (-.7)	-1,108.25** (-3.0)	-2,257.3** (-4.6)	-1,155.2** (-4.8)	-1,630.93** (-4.0)	-3,201.61** (-4.1)

See footnotes at end of table.

Continued--

Table 7--Differences in weekly per capita nutrient consumption: Low-income households of various locations compared with low-income households in the rural South--Continued

Nutrient	Unit 2/	Location of residence 1/						
		Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Urban West	Rural West
Food energy	kcal	-3,405.48**	1,259.403	-1,803.94**	-2,549.92**	-1,350.78**	-2,411.36**	-4,319.92**
		(-5.7)	(1.1)	(-3.3)	(-3.5)	(-3.8)	(-4.0)	(-3.7)
Protein	g	-17.401	99.467**	28.477	-21.878	-.703	-7.717	-94.557*
		(-.9)	(2.6)	(1.6)	(-.9)	(-.06)	(-.4)	(-2.4)
Fat	g	-150.191**	70.814	-71.278*	-99.701*	-53.719**	-112.938**	-232.721**
		(-4.6)	(1.2)	(-2.4)	(-2.5)	(-2.8)	(-3.4)	(-3.7)
Carbohydrate	g	-500.892**	53.549	-328.379**	-395.836**	-222.778**	-361.455**	-450.090**
		(-6.8)	(.4)	(-4.9)	(-4.4)	(-5.0)	(-4.8)	(-3.2)

1/ The rural South, the excluded location, forms the basis of comparison with the remaining locations.
2/ I.U. = International Units; mg = milligrams; mcg = micrograms; kcal = kilocalories; g = grams.
3/ T-ratio in parentheses.
4/ Data are for performed niacin only whereas the RDA includes niacin derived from tryptophan.
* Significant at 95-percent level.
**Significant at 99-percent level.

on increasing food expenditures.21/ Similarly, the marginal propensities to consume provide an estimate of the effects of cash and bonus food stamps on nutrient levels.

Data used in this study were collected from November 1977 through March 1978 when all food stamp households of the same size received an equal allotment of food stamps. However, households paid for the food stamps based on their net income. Bonus food stamps were the difference between the allotment and the value of the cash payment.22/

The estimated marginal propensities to spend for total (at home and away) food from income and bonus food stamps for all low-income households were 0.12 and 0.24, respectively. This marginal propensity to spend from income indicates that low-income families tend to increase their food expenditures by $1.20 when they receive a $10 increase in income. Similarly, each additional $10 increase in the value of bonus food stamps is associated with an additional $2.40 increase in food purchases that would not have been made in the absence of the Food Stamp Program. In general, the difference between the additional bonus food stamps ($10) and the resulting increase in food demand ($2.40) represents the tendency of food stamp households to substitute foods purchased with bonus food stamps for foods which otherwise would have been purchased with the household's own money. Thus, bonus food stamps free some of the household's funds for discretionary expenditures (16).

The models for estimating the marginal propensities to spend and the marginal propensities to consume are based on all low-income households. It was assumed that households participating in the Food Stamp Program and eligible nonparticipant households had similar preference curves. The value of the bonus food stamps was set equal to zero for eligible nonparticipant households. The appendix presents the model used to obtain estimates of the marginal propensities to spend and appendix table 2 presents the regression results from this model.

We estimated marginal propensities to consume food nutrients from income and bonus food stamps to determine if the nutrient-income responses and the nutrient-bonus stamp responses among the locations were different. It should be emphasized that the marginal propensities to consume nutrients were derived from food used from household supplies during the week prior to the NFCS. These marginal propensities to consume measure the change in at-home nutrient consumption resulting from a change in income and in bonus food stamps.

21/ The marginal propensity to spend is defined as the additional food expenditure resulting from a $1 increase in either income or bonus food stamps.

22/ Since January 1, 1979, food stamp households are no longer required to pay for a portion of their allotments. These households now receive food stamps that are equivalent to the bonus stamp value under the previous program rules.

Table 8 summarizes the marginal propensities to consume for the rural South and for all other locations combined.23/ The appendix presents the marginal propensities to consume for all low-income households and for each location of residence.

The marginal propensities to consume food nutrients are higher from bonus stamps than from income partly because the use of food stamps is legally restricted to the purchase of food whereas income can be used to purchase a wide variety of products. However, some households participating in the Food Stamp Program substitute bonus stamps for cash income when making food purchases. For these households, the nutritional effectiveness of an additional $1 in food stamps would not be substantially different from the nutritional effectiveness of an additional $1 in cash income.

Economic theory suggests that as income increases, a smaller proportion of the increase in income will be consumed and a larger proportion of the increase will be saved. Following this concept, one would expect that the marginal propensity to consume food and, thus, food nutrients will be higher for lower income households than for upper income households. Average per capita household income in the rural South was 5.2 percent lower than average per capita income in all other locations combined. As shown in table 8, the marginal propensities to consume nutrients out of income are higher for persons in the rural South than for persons in all other locations combined.

The marginal propensities to consume from bonus stamps for vitamin C, thiamin, riboflavin, performed niacin, vitamin B_{12}, and iron were slightly higher in the rural South than in all other locations. Conversely, the marginal propensities to consume from bonus stamps for vitamin A, vitamin B_6, calcium, magnesium, phosphorus, food energy, protein, fat, and carbohydrate were lower in the rural South than in all other locations.

In table 9, the marginal propensities to consume are expressed as a percentage of the RDAs. Since the nutrients are in different units, the data in this table provide a base for comparison across nutrients.

23/ We used multiple regression analysis to estimate the relationships between nutrient levels and household characteristics and to obtain the coefficients for calculating the marginal propensities to consume and the elasticities. Alternative functional forms were tested and the linear form provided the best statistical fit. The weekly quantity of nutrients consumed per person was expressed as a function of per capita weekly income, per capita weekly value of bonus food stamps, per capita number of meals consumed from at-home food supplies, race of the household head, stage of the household in the family life cycle, educational attainment of the person most responsible for planning meals, and housing tenure. This model was estimated for each location using ordinary least squares regression. Both food stamp participants and eligible nonparticipants were included in the same model.

Table 8--Estimated marginal propensities to consume, by location of residence 1/

Nutrient	Unit 2/	Out of income		Out of bonus stamps	
		Rural South	All locations except the rural South	Rural South	All locations except the rural South
Vitamin A	I.U.	546.568	294.678	1,008.952	1,179.183
Vitamin C	mg	6.960	5.933	19.491	16.410
Thiamin	mg	.037	.020	.231	.206
Riboflavin	mg	.076	.041	.286	.269
Performed niacin	mg	.893	.466	3.388	3.028
Vitamin B_6	mg	.071	.055	.253	.257
Vitamin B_{12}	mcg	.390	.099	.996	.995
Calcium	mg	19.699	15.168	106.271	108.638
Iron	mg	.688	.323	2.897	2.127
Magnesium	mg	11.106	8.360	41.020	42.806
Phosphorus	mg	34.539	28.308	216.507	235.509
Food energy	kcal	64.661	47.411	260.905	360.906
Protein	g	2.932	2.211	10.226	11.742
Fat	g	3.357	2.733	11.801	18.361
Carbohydrate	g	5.825	3.157	28.514	37.249

1/ Weekly consumption per person. The marginal propensities to consume are the result of a $1 increase in either income or bonus food stamps. All the marginal propensities to consume are significant at the 95-percent level.

2/ I.U. = International Units; mg = milligrams; mcg = micrograms; kcal = kilocalories; g = grams.

Table 9--Marginal propensities to consume as a percentage of the 1974 Recommended Dietary Allowances 1/

Nutrient	Out of income		Out of bonus stamps	
	Rural South	All locations except the rural South	Rural South	All locations except the rural South
	Percentage			
Vitamin A	1.56	0.84	2.88	3.37
Vitamin C	2.21	1.88	6.19	5.21
Thiamin	.38	.20	2.36	2.10
Riboflavin	.68	.37	2.55	2.40
Niacin 2/	.71	.37	2.69	2.40
Vitamin B_6	.51	.39	1.81	1.84
Vitamin B_{12}	1.86	.47	4.74	4.74
Calcium	.35	.27	1.90	1.94
Iron	.98	.46	4.14	3.04
Magnesium	.45	.34	1.67	1.75
Phosphorus	.62	.51	3.87	4.21
Food energy	.34	.25	1.38	1.91
Protein	.75	.56	2.61	3.00

1/ Recommended Dietary Allowances for an adult male aged 23-50 years.

2/ Data are for performed niacin only whereas the Recommended Dietary Allowances include niacin derived from tryptophan.

In the rural South, the marginal propensities to consume out of income as a percentage of the RDAs are lower for food energy than for all other nutrients, indicating that an additional dollar of income received by each person in a rural southern household would lead to the smallest increase (relative to the RDAs for an adult male) in food energy consumption. In contrast, an additional dollar of income received by these persons would lead to the greatest relative increase in vitamin B_{12} consumption. For low-income persons in all other locations combined, the smallest relative increase from an additional dollar of income would occur for thiamin consumption whereas the largest relative increase would occur for vitamin C consumption.

The marginal propensities to consume from bonus stamps as a percent of the RDAs vary with location. Vitamin B_{12} levels exhibit the greatest responsiveness (relative to the RDA) to an increase in bonus stamp value. In both the rural South and all other locations, a $1-per-week increase in per capita bonus stamps would increase per capita vitamin B_{12} consumption by 4.7 percent of the RDA.

Elasticities

An increase in either income or the value of bonus food stamps will lead to increased consumption of individual nutrients. Income elasticity measures the degree to which consumption of a particular nutrient will change with increases in income. Similarly, bonus stamp elasticity measures the degree to which consumption of a particular nutrient will change with increases in bonus food stamps. Elasticities can either be greater than 1 (elastic), less than 1 (inelastic), or equal to 1 (unitary) and can be either positive or negative.

Income and bonus stamp elasticities were estimated to measure the sensitivity of nutrient levels to changes in income and bonus food stamps. The elasticities, which are based on food nutrients from household supplies, were estimated at mean income and bonus stamp values for each location. The appendix contains the nutrient-income elasticities and the nutrient-bonus stamp elasticities for each location of residence. Table 10 shows the elasticities associated with a 1-percent change in per capita income and bonus stamp value for the rural South and all other locations. These values were positive for the ranges of income and bonus stamp values considered in this study. A positive income and bonus stamp elasticity implies that the consumption of a nutrient will increase when income and the value of bonus food stamps increases (30). One study found negative income elasticities for some nutrients (protein, iron, and thiamin) at higher levels of income (1).

The nutrient responses were inelastic but the elasticities vary widely. A relatively high elasticity for a particular nutrient indicates that household members consume more of that nutrient at home as income increases than of other nutrients.

The income elasticity for vitamin B_{12} consumption in the rural South was relatively high compared with the elasticities for the other nutrients. Vitamin B_{12} had an income elasticity of about 0.33, indicating that a 10-percent increase in per capita income would result in a 3.3-percent increase in per capita vitamin B_{12} consumption. The largest nutrient consumption response to income changes for all locations, except the rural South, is for vitamin C. The nutrients that were least responsive to changes in income were carbohydrate for the rural South and thiamin and carbohydrate for all other locations combined.

The nutrient bonus stamp elasticities for vitamin C, performed niacin, vitamin B_{12}, and iron were higher in the rural South than in all other locations. The elasticities for the remaining 11 nutrients were either higher in all the other locations or equal to the elasticities for the rural South. In all locations

Table 10--Estimated nutrient elasticities, by location of residence 1/

Nutrient	Out of income		Out of bonus stamps	
	Rural South	All locations except the rural South	Rural South	All locations except the rural South
Vitamin A	0.309	0.163	0.103	0.111
Vitamin C	.278	.233	.135	.109
Thiamin	.080	.050	.086	.088
Riboflavin	.132	.080	.089	.089
Performed niacin	.149	.087	.100	.095
Vitamin B_6	.156	.128	.098	.100
Vitamin B_{12}	.332	.074	.145	.122
Calcium	.079	.075	.076	.092
Iron	.146	.077	.107	.086
Magnesium	.125	.110	.083	.097
Phosphorus	.079	.078	.086	.109
Food energy	.095	.081	.068	.105
Protein	.136	.108	.085	.097
Fat	.106	.098	.066	.111
Carbohydrate	.074	.050	.065	.100

1/ Percentage change in intake per person estimated at sample mean for each location. The elasticities are based on a 1-percent change in income or bonus food stamps. All elasticities, except the nutrient-income elasticity for vitamin B_{12}, are significant at the 95-percent level.

except the rural South, vitamin B_{12} had the highest nutrient bonus elasticity and iron had the lowest nutrient bonus elasticity.

The nutrient elasticities were generally higher with an increase in income than with an increase in bonus stamps, especially in the rural South. The higher income elasticities may be caused by the larger income levels in comparison with the bonus stamp values. For example, in the rural South, per capita weekly income averaged $35.56 whereas per capita weekly bonus stamp

value averaged $5.57. If income were to increase by 10 percent, households in the rural South would consume 3.09 percent more vitamin A per capita. If the value of bonus stamps were to increase by 10 percent, these households would consume 1.03 percent more vitamin A per capita. Thus, a 56-cent increase in per capita bonus stamp value is associated with a 1.03-percent increase in per capita vitamin A consumption but a $3.56 increase in per capita income is associated with only a 3.09-percent increase in per capita vitamin A consumption.

THE FOOD STAMP PROGRAM

USDA administers most of the food programs designed to help low-income households obtain a nutritious diet. The feeding programs for the elderly are under the auspices of the Department of Health and Human Services. These food programs were established in recognition that the limited purchasing power and education of low-income persons contribute to hunger and malnutrition. Most food programs are designed to meet the nutritional needs of specified segments of the low-income population, such as infants, preschool, and school-age children; pregnant, postpartum, and breastfeeding women; and the elderly. However, eligibility for the Food Stamp Program (FSP) and the Expanded Food and Nutrition Education Program (EFNEP) is based solely on income and is, therefore, available to all low-income households. Both programs are specifically designed to upgrade the at-home diets of participants. For example, food stamps may only be used to purchase food products for human consumption. Alcoholic beverages and ready-to-eat hot foods cannot be purchased with food stamps. To encourage the purchase of nutritious foods, the Food Stamp Act of 1977, as amended, authorizes USDA to use the EFNEP techniques for conducting nutrition activities for food stamp participants. The EFNEP emphasizes knowledge and skills that will enable low-income households to consume a more adequate diet. Under the program, paraprofessional aides teach families on a one-to-one basis about nutrition, food preparation, and related topics. USDA is currently conducting EFNEP/Food Stamp Nutrition Pilot Projects in six States.

Participation in the Food Stamp Program allows low-income households to increase their food purchasing power and, therefore, consume an adequate diet. This program is the largest domestic food assistance program in terms of total program benefits. In fiscal 1982, an average of 20.4 million persons received bonus food stamps valued at $9.5 billion.

Participation in the FSP varied by region and urbanization (table 11). The rural South was underrepresented among the food stamp population. These households accounted for about 17 percent of all low-income households in the sample, but only 11 percent of the food stamp households. The number of food stamp households in rural areas was not proportional to the number of rural low-income households in the survey. Rural households represented 28 percent of all low-income households. However, rural food stamp households represented only 18 percent of all food stamp households.

Table 11--All households and food stamp households used in the analysis, by location of residence

Location of residence	All low-income households	Food stamp households
	Percent	
Urban Northeast	16.4	24.0
Rural Northeast	4.3	2.4
Urban North Central	17.5	20.7
Rural North Central	5.7	4.0
Urban South	25.9	29.3
Rural South	16.6	11.2
Urban West	11.7	8.0
Rural West	1.8	.4
Total 1/	100.0	100.0

1/ Numbers may not sum to 100 due to rounding.

Source: (28).

Historically, FSP participation by rural households has been low. Factors that may explain this phenomenon include differences between urban and rural people's attitudes towards welfare and differences in the availability of public transportation (11). Further, the purchase requirement may have been a barrier to participation in the FSP for many low-income households (24). After elimination of the purchase requirement in January 1979, participation in rural areas increased dramatically. Participation in food stamp project areas with 5,000 or fewer participants (generally categorized as rural) rose by 1.3 million or nearly 42 percent between November 1978 and May 1979, whereas participation in the largest urban project areas of more than 50,000 participants rose by 569,000 or nearly 8 percent (25).

Food stamp households had a lower average income than eligible nonparticipant households. Annual per capita income of food stamp households was about $1,533, whereas eligible nonparticipant households had an average per capita income of about $1,984. FSP benefits boosted the annual food purchasing power of food stamp households by $293 per person.

We used regression analysis to determine if the at-home nutrient levels of food stamp households differed from eligible nonparticipant households. In the regression model, per capita nutrient consumption was expressed as a function of per capita purchasing power (income plus the value of bonus food stamps), participation in the Food Stamp Program, number of meals consumed from at-home food supplies, race of the household head,

stage of the household in the family life cycle, education of the person primarily responsible for planning the family's meals, and housing tenure. All variables except purchasing power and number of meals consumed from at-home food supplies were represented by a series of dummy variables.24/

The results show that differences exist in the nutrients obtained from the at-home food supplies of food stamp households and eligible nonparticipant households, after a control for differences in socioeconomic characteristics. The food consumed at home by food stamp households furnished larger quantities of each nutrient per capita (vitamin A, vitamin C, thiamin, riboflavin, performed niacin, vitamin B_6, vitamin B_{12}, calcium, iron, magnesium, phosphorus, food energy, protein, fat, and carbohydrate) than did households eligible but not participating in the Food Stamp Program. These differences in nutrient levels were significant at the 95-percent level.

Differences in income between food stamp households and eligible nonparticipant households were also observed in the rural South. Average annual per capita income of food stamp households was approximately 72 percent of that of eligible nonparticipant households. If benefits received under the FSP are counted as income, food stamp households in the rural South had an average per capita income equal to 88 percent of that of eligible nonparticipant households in the same location.25/ Although per capita purchasing power was lower for these food stamp households than for eligible nonparticipant households, the former households used food at home that provided more vitamin C, thiamin, riboflavin, performed niacin, vitamin B_6, iron, magnesium, phosphorus, food energy, protein, and carbohydrate per person that did the latter households. Conversely, food stamp households in the rural South had lower average nutrient consumption per person for vitamin A, vitamin B_{12}, calcium, and fat compared with their counterparts who did not participate in the Food Stamp Program. These results are based on straight computation of the data (that is, data unadjusted for differences in household characteristics).

Participation in the Food Stamp Program, after a control for income and other socioeconomic factors, exerts a significant influence on the amount of nutrients obtained from home food supplies. In the rural South, food stamp households consumed significantly more of all nutrients per person, except vitamin A and fat, than did eligible nonparticipant households. Food stamp participation has a positive effect on the consumption of vitamin A and fat, but this effect was not statistically significant at the 95-percent level.

24/ The regression results from this model are available on request.

25/ Income includes cash assistance received from Aid to Families with Dependent Children (AFDC), Supplemental Security Income (SSI), and other welfare programs. Cash assistance received from the social insurance programs such as Social Security and Unemployment Compensation are also counted as income.

CONCLUSIONS

More than one-fifth of all low-income households in the study used food at home that did not meet the RDAs for vitamin A, vitamin B_6, calcium, magnesium, and food energy. Because the analysis is based only on nutrients contained in food used from the household food supply, caution should be used in interpreting these results. Some persons in low-income households (for example, infants, young children, and elderly persons) eat nearly all their meals at home whereas other household members are more likely to eat some of their meals away from home.

In their report on the development of the RDAs, the Food and Nutrition Board of the National Research Council, National Academy of Sciences indicated that the risk of having an inadequate diet increases when total consumption is less than the recommended level. A number of health problems could develop if an individual's combined at home and away from home consumption does not provide required amounts of vitamin A, vitamin B_6, calcium, magnesium, or food energy. For example, insufficient intakes of these nutrients over a long period of time have been associated with xeropthalmia, poor growth, anemia, skin lesions, rickets, bone deformation, and behavioral disturbances (13, 29).26/ These problems could affect human development and labor productivity.

Nutrition education programs are available to inform people about nutritional deficiencies, the nutrients that constitute a proper diet, and ways to incorporate foods that provide those nutrients into the diet. The nutrition education programs, however, have been limited in scope. In fiscal 1976, USDA spent (a minimum of) $64 million on nutrition education programs or about 1 percent of the funds spent for domestic food assistance programs (12). USDA, which is one of the lead agencies in implementing nutrition education, administers three programs that have a nutrition education component--the Expanded Food and Nutrition Education Program, the Nutrition Education and Training Program, and the Special Supplemental Food Program for Women, Infants, and Children.

By location, low-income households in the rural West were less likely to meet the RDAs than were low-income households residing elsewhere. These results are based on straight computation of data from the 1977-78 low-income supplement to the Nationwide Food Consumption Survey. Low-income rural Westerners accounted for 2.1 percent of the income but only 1.7 percent of total food expenditures. Compared with low-income households in other locations, low-income households in the rural West spent the smallest percentage of their income on food. Thus, it is likely that their relatively low nutritional levels are due to either consuming insufficient quantities of a wide variety of foods or consuming relatively large quantities of inexpensive foods that contain few of the nutrients needed for growth and maintenance of health.

26/ Xeropthalmia is an eye condition leading to blindness.

Food stamp participation in the rural West was extremely low. Low-income households there account for 1.8 percent of the low-income households included in this analysis. However, only 0.4 percent of the food stamp households lived in the rural West. These results indicate that the Food Stamp Program is underutilized by low-income households in the rural West. In general, differences in food stamp participation by urbanization may be due to differences in attitudes about using welfare programs and differences in access to the Food Stamp Program (11). Since a relatively large proportion of low-income rural Westerners were Hispanic (about 27 percent), communication problems could also be a factor affecting participation in the Food Stamp Program among rural Westerners.

Significant variations exist in the nutritive values of household food supplies after a control for income and other socioeconomic characteristics. Generally, low-income households in the rural West had the lowest nutrient levels relative to low-income households in the rural South. These results are based on the econometric model which had a per capita specification. That is, toddlers, adolescents, and elderly people were given the same weight even though differences exist in food consumption and nutrient requirements.

Participation in the Food Stamp Program significantly influences the amount of nutrients obtained from home food supplies. Food stamp households consume significantly larger quantities (per capita) of each nutrient studied than do low-income households eligible but not participating in the Food Stamp Program. These findings suggest that the diets of low-income households not participating in the Food Stamp Program could be improved through program participation.

The Food Stamp Program has dual objectives of expanding the demand for food and upgrading the diets of low-income households. We estimated the marginal propensity to spend for food out of cash income to be 0.12 compared with 0.24 for the marginal propensity to spend out of bonus food stamps. These marginal propensities to spend would probably differ if income were expanded to include in-kind income (for example, the value of goods and services such as home-produced food, free or reduced-price school meals, public housing). The estimated marginal propensities to spend indicate that the Food Stamp Program is about twice as effective as cash income in increasing food expenditures. They also suggest that the demand for food by low-income households would decline if cash subsidies were provided in lieu of food stamps.

The data used in this study were collected prior to elimination of the Food Stamp Program's purchase requirement. Elimination of the purchase requirement gives food stamp households more flexibility in allocating their income. Money formerly spent to purchase the food stamp allotment can now be used for non-food purchases. Thus, issuing only bonus stamps may reduce the demand for food by food stamp households.

The nutrient marginal propensities to consume out of bonus food stamps are relatively large compared with the nutrient marginal propensities to consume out of income. As expected, food stamps are also more effective than cash income in increasing nutrient levels.

The nutrient income elasticities and bonus stamp elasticities which are positive for the ranges of income and bonus stamp values considered in this analysis exhibit considerable fluctuations. Vitamin A, vitamin C, and vitamin B_{12} tend to have the highest elasticities whereas calcium, carbohydrate, thiamin, and food energy tend to have the lowest elasticities.

Somewhat more than one-third of the low-income households in the study used food at home that did not furnish the RDA for calcium, probably due to the relatively large number of blacks in the low-income supplement to the Nationwide Food Consumption Survey. Calcium consumption, however, is not highly responsive to increases in either income or bonus food stamps as indicated by the relatively small elasticities. Direct distribution of foods containing nutrients that are generally lacking in the diets of low-income households may be more effective in improving their diets than either food stamps or cash income transfers.

The results of this study indicate that nutrient consumption and nutrient responsiveness to changes in income and the value of bonus food stamps vary by region and urbanization. In general, nutrient consumption is more responsive to increases in bonus stamp value than to increases in income, but is not highly responsive to either. Targeting the Food Stamp Program towards households with the lowest income levels will increase the program's effectiveness in terms of expanding the demand for food and raising nutrient levels.

REFERENCES

(1) Adrian, John, and Raymond Daniel. "Impact of Socioeconomic Factors on Consumption of Selected Food Nutrients in the United States," American Journal of Agricultural Economics, Vol. 58, No. 1, Feb. 1976, pp. 31-38.

(2) Allen, Joyce E., and Kenneth E. Gadson. "The Influence of Selected Socioeconomic Variables on At-Home Nutrient Intake." Paper presented at the Southern Agricultural Economics Association meeting, Orlando, FL, Feb. 1982.

(3) Blalock, Hubert M., Jr. Social Statistics. New York: McGraw-Hill Book Co., 1972.

(4) Blakley, Leo V. "Regional Markets for Agricultural and Food Products: Needed Research," Southern Journal of Agricultural Economics, Vol. 13, No. 1, July 1981, pp. 69-78.

(5) Boehm, William T., Paul E. Nelson, and Kathryn A. Longen. Progress Toward Eliminating Hunger in America. AER-446. U.S. Dept. Agr., Econ. Stat. Coop. Serv., Jan. 1980.

(6) Burk, Marguerite C. Influences of Economic and Social Factors on U.S. Food Consumption. Minneapolis: Burgess Publishing Co., 1961.

(7) Cross, Barbara, Robert O. Herrman, and Rex H. Warland. "Effect of Family Life-Cycle Stage on Concerns about Food Selection," Journal of the American Dietetic Association, Vol. 67, Aug. 1975, pp. 131-134.

(8) Davis, C.G., and P.H. Neenan. "Impact of Food Stamp and Nutrition Education Programs on Food Group Expenditure and Nutrient Intake of Low-Income Households," Southern Journal of Agricultural Economics, Vol. 11, No. 2, Dec. 1979, pp. 121-129.

(9) Duvall, Evelyn R.M. Marriage and Family Development. 5th ed. Philadelphia: J.B. Lippincott, 1977.

(10) Guthrie, Helen A. Introductory Nutrition. St. Louis: C.V. Mosby Co., 1979.

(11) Hoppe, Robert A. Factors Affecting Food Stamp Participation Rates and Per Capita Benefits. ESS Staff Report No. AGESS810409. U.S. Dept. Agr., Econ. and Stat. Serv., May 1981.

(12) Library of Congress, Congressional Research Service. The Role of the Federal Government in Nutrition Education. March 1977.

(13) Michigan Department of Public Health. Basic Nutrition Facts. 1980.

(14) National Research Council, Food and Nutrition Board, Recommended Dietary Allowances. 9th ed. Washington, D.C.: National Academy of Sciences, 1980.

(15) Price, Dorothy Z., and David W. Price. "The Contribution of Basic Need Theory to Household Decision Making." Paper presented at American Agricultural Economics Association meeting, Clemson, S.C., July 1981.

(16) Reese, Robert B., J. Gerald Feaster, and Garey B. Perkins. Bonus Food Stamps and Cash Income Supplements, MRR-1034. U.S. Dept. Agr., Econ. Res. Serv., Oct. 1974.

(17) Rizek, Robert L. "The 1977-78 Nationwide Food Consumption Survey," Family Economics Review, Fall 1978, pp. 3-7.

(18) Salathe, Larry E., and Rueben C. Buse. Household Food Consumption Patterns in the United States. TB-1587. U.S. Dept. Agr., Econ. Stat. Coop. Serv., Jan. 1979.

(19) Salathe, Larry E., Anthony E. Gallo, and William T. Boehm. The Impact of Race on Consumer Food Purchases. ESCS-68. U.S. Dept. Agr., Econ. Stat. Coop. Serv., Aug. 1979.

(20) Scearce, W. Keith, and Robert B. Jensen. "Food Stamp Program Effects on Availability of Food Nutrients for Low-Income Families in the Southern Region of the United States," Southern Journal of Agricultural Economics, Vol. 11, No. 2, Dec. 1979, pp. 113-120.

(21) U.S. Bureau of the Census. Current Population Survey 1981. Unpublished data.

(22) _____. "Estimates of the Population of States with Components of Change: 1970 to 1975." Current Population Reports, Series P-25, No. 640. Washington, D.C., 1976.

(23) _____. "Population Profile of the United States: 1980." Current Population Reports, Series P-20, No. 363. Washington, D.C., 1976.

(24) U.S. Congress, Senate Committee on Agriculture, Nutrition, and Forestry. Food and Agriculture Act of 1977. Report to accompany S.275. 96th Congress, 1st session. May 16, 1977.

(25) U.S. Department of Agriculture, Food and Nutrition Service. Elimination of the Purchase Requirement in the Food Stamp Program--Effect on Participation and Cost. Oct. 1979.

(26) _____, Science and Education Administration. Food Consumption and Dietary Levels of Low-Income Households, November 1977-March 1978. Nationwide Food Consumption Survey, 1977-78, Preliminary Report No. 8. July 1981.

(27) _____, Science and Education Administration. Nutrient Levels in Food Used by Households in the United States, Spring 1977. Nationwide Food Consumption Survey, 1977-78, Preliminary Report No. 3. Jan. 1981.

(28) _____, Science and Education Administration. 1977-78 Low-Income Nationwide Food Consumption Survey. Data computed from public use data tape.

(29) U.S. Department of Health, Education, and Welfare, Public Health Service. Preliminary Findings of the First Health and Nutrition Examination Survey, United States, 1971-72: Dietary Intake and Biochemical Findings. DHEW Publication No. (HRA) 74-1219-1. Jan. 1974.

(30) Watson, Donald S. Price Theory and Its Uses. Boston: Houghton Miffin Co., 1968.

(31) West, Donald A., David W. Price, and Dorothy Z. Price. "Impacts of the Food Stamp Program on Value of Food Consumed and Nutrient Intake Among Washington Households with 8-12 Year Old Children," Western Journal of Agricultural Economics, Vol. 3, No. 2, Dec. 1978, pp. 131-144.

APPENDIX

Model Relating Socioeconomic Characteristics to Nutrient Consumption

The econometric model utilized was:

$$N_i = A_0 + A_1 Y + A_2 Y^2 + A_3 B + A_4 M + A_5 L_1 + A_6 L_2 + A_7 L_3 + A_8 L_4 + A_9 L_5 + A_{10} L_7 + A_{11} L_8 + A_{12} R_2 + A_{13} R_3 + A_{14} LC_1 + A_{15} LC_3 + A_{16} LC_4 + A_{17} E_2 + A_{18} HT + u$$

where N_i = per capita weekly consumption of the i^{th} nutrient from home food supplies (i=1, 2, 3, ..., 15);

N_1 = International Units of vitamin A;

N_2-N_4 = milligrams of vitamin C, thiamin, and riboflavin;

N_5 = milligrams of performed niacin;

N_6 = milligrams of vitamin B_6;

N_7 = micrograms of vitamin B_{12};

N_8-N_{11} = milligrams of calcium, iron, magnesium, and phosphorus;

N_{12} = kilocalories of food energy; and

N_{13}-N_{15} = grams of protein, fat, and carbohydrate;

The independent variables were:

Y = weekly income of household divided by household size;

Y^2 = weekly income of household divided by household size (quantity squared);

B = weekly value of bonus food stamps divided by household size;

M = number of meals eaten from home food supplies during the survey week divided by household size;

L = vector of 0-1 dummy variables representing location of residence:

L_1 = 1 if urban Northeast,
L_2 = 1 if rural Northeast,
L_3 = 1 if urban North Central,
L_4 = 1 if rural North Central,
L_5 = 1 if urban South,
L_6 = 1 if rural South*,
L_7 = 1 if urban West,
L_8 = 1 if rural West.

R = vector of 0-1 dummy variables representing race of household head:

R_1 = 1 if white*,
R_2 = 1 if black,
R_3 = 1 if other.

LC = vector of 0-1 dummy variables representing stage of household in family life cycle:

LC_1 = 1 if no children in household,
LC_2 = 1 if average age of children is less than 7 years*,
LC_3 = 1 if average age of children is 7 to 13 years, and
LC_4 = 1 if average of children is 14 to 21 years.

E = vector of 0-1 dummy variables representing the highest level of education completed by the person most responsible for meal planning:

E_1 = 1 if completed elementary school or less*
E_2 = 1 if some high school or more.

HT = vector of 0-1 dummy variables representing housing tenure:

HT_1 = 1 if owned and,
HT_2 = 1 if rented for cash or occupied without payment of cash*.

u = stochastic disturbance term.

* = categories excluded from the model to avoid singularity.

Model Used to Estimate the Marginal Propensities to Spend for Food

The statistical model used to obtain estimates of the marginal propensities to spend was:

$$E_i = a + B_1 Y + b_2 B + b_3 \log S + b_4 R_1 + b_5 R_2 + b_6 L_1 + b_7 L_2 + b_8 L_3 + b_9 E_1 + b_{10} H_1 + u$$

where E_i = food expenditures per week (i=1, 2, 3);

E_1 = total (at home and away) food expenditures;

E_2 = at-home food expenditures;

E_3 = away-from-home food expenditures;

Y = weekly household income;

B = weekly value of bonus food stamps;

$\log S$ = log of household size;

R_0-R_2 = race of household head (white, black, other);

L_0-L_3 = stage of the household in the family life cycle; average age of the children is 14 to 21 years - stage 4; no children are present - stage 1; average age of the children is less than 6 years - stage 2; average age of the children is 7 to 13 years - stage 3;

E = educational attainment of the person most responsible for planning meals (grade school, high school);

H = housing tenure (rent, own);

u = stochastic disturbance term.

The initial class of the binary variables, as indicated, was excluded from the model to avoid singularity.

Appendix table 1--Estimated coefficients and relevant statistics obtained by regressing nutrients available for consumption per capita per week on selected independent variables, 1977-78, Low-Income Nationwide Food Consumption Survey

Independent variable 1/	Nutrient							
	Vitamin A	Vitamin C	Thiamin	Ribo-flavin	Performed niacin	Vitamin B6	Vitamin B12	Calcium
Intercept	-26,460.2	-269.141	1.879	1.828	-3.920	-1.174	-6.415	1,575.075
	2/(-5.3)	(-4.5)	(2.8)	(2.2)	(-0.5)	(-1.7)	(-1.2)	(4.3)
Income	593.320	9.879	.042	.084	.948	.094	.349	27.642
	(6.5)	(9.0)	(3.4)	(5.6)	(5.9)	(7.4)	(3.6)	(4.1)
Income squared	-2.045	-.035	-.000	-.000	-.003	-.000	-.001	-.105
	(-3.3)	(-4.8)	(-1.7)	(-3.0)	(-3.0)	(-3.7)	(-2.2)	(-2.3)
Bonus	1,273.078	20.364	.233	.304	3.390	.288	1.080	120.561
	(4.9)	(6.6)	(6.8)	(7.1)	(7.5)	(8.1)	(4.0)	(6.2)
Meals	2,343.496	27.497	.497	.605	6.840	.526	1.247	250.828
	(12.0)	(11.8)	(19.2)	(18.7)	(20.1)	(19.6)	(6.1)	(17.3)
Urban Northeast	2,264.311	25.109	-2.947	-1.11	-13.560	-.679	14.148	-1,108.53
	(.7)	(.6)	(-6.8)	(-2.0)	(-2.4)	(-1.5)	(4.1)	(-4.5)
Rural Northeast	15,576.55	65.937	-.014	2.320	14.009	.943	15.735	237.662
	(2.5)	(.9)	(-.0)	(2.3)	(1.3)	(1.1)	(2.4)	(.5)
Urban North Central	5,869.445	54.133	-1.250	-.292	-4.710	.234	5.257	-538.203
	(2.0)	(1.5)	(-3.2)	(-.6)	(-.9)	(.6)	(1.7)	(-2.5)
Rural North Central	-2,840.66	-27.422	-2.010	-1.057	-12.719	-.814	2.069	-1,040.18
	(-.7)	(-.6)	(-3.8)	(-1.6)	(-1.8)	(-1.5)	(.5)	(-3.5)
Urban South	-338.667	-34.814	-1.000	-.767	-6.175	-.353	4.192	-645.759
	(-.2)	(-1.5)	(-3.8)	(-2.4)	(-1.8)	(-1.3)	(2.0)	(-4.4)
Urban West	-626.499	78.973	-1.800	-1.000	-9.147	.017	1.255	-836.038
	(-.2)	(2.0)	(-4.1)	(-1.8)	(-1.6)	(.0)	(.4)	(-3.4)
Rural West	3,137.481	-25.652	-2.930	-2.741	-40.214	-1.039	-2.609	-1,520.91
	(.5)	(-.3)	(-3.5)	(-2.6)	(-3.7)	(-1.2)	(-.4)	(-3.2)
Black	16,808.58	180.081	-.385	-1.312	-4.571	.533	4.051	-1,250.97
	(9.4)	(8.4)	(-1.6)	(-4.4)	(-1.5)	(2.2)	(2.2)	(-9.4)
Other	2,924.662	188.186	1.009	-.137	1.254	.013	4.119	-605.096
	(.9)	(4.9)	(2.4)	(-.3)	(.2)	(.0)	(1.2)	(-2.6)
LC1	16,881.57	156.842	1.206	1.468	25.373	1.567	8.682	686.348
	(6.7)	(5.2)	(3.6)	(3.5)	(5.8)	(4.6)	(3.3)	(3.7)
LC3	3,262.155	48.717	1.412	1.392	20.986	1.482	3.202	470.403
	(1.4)	(1.8)	(4.7)	(3.7)	(5.3)	(4.7)	(1.3)	(2.8)
LC4	4,848.845	54.195	1.190	1.064	21.439	1.269	4.567	494.948
	(1.8)	(1.7)	(3.3)	(2.4)	(4.6)	(3.4)	(1.6)	(2.5)

Continued--

See footnotes at end of table.

Appendix table 1--Estimated coefficients and relevant statistics obtained by regressing nutrients available for consumption per capita per week on selected independent variables, 1977-78, Low-Income Nationwide Food Consumption Survey--Continued

Independent variable 1/	Nutrient							
	Vitamin A	Vitamin C	Thiamin	Ribo-flavin	Performed niacin	Vitamin B6	Vitamin B12	Calcium
High school	1,768.042	47.791	-.226	.073	-.247	.406	2.140	-149.593
	(1.1)	(2.4)	(-1.0)	(.3)	(-.1)	(1.8)	(1.2)	(-1.2)
Own	1,291.289	34.207	.633	.577	7.143	.387	-1.227	443.159
	(.8)	(1.7)	(2.8)	(2.1)	(2.4)	(1.7)	(-.7)	(3.5)
$\bar{R}^2$	.13	.13	.15	.15	.17	.16	.04	.18
F-ratio	32.43	32.33	38.35	39.65	45.73	41.25	8.85	46.76

	Iron	Magnesium	Phosphorus	Food energy	Protein	Fat	Carbo-hydrate
Intercept	4.997	-25.613	1,019.936	1,484.938	-93.509	-6.22	466.400
	(.7)	(-.2)	(1.7)	(1.6)	(-3.0)	(-.1)	(4.2)
Income	.675	14.018	48.101	79.743	3.798	4.441	6.862
	(5.4)	(6.2)	(4.3)	(4.8)	(6.7)	(4.9)	(3.3)
Income squared	-.002	-.046	-.162	-.229	-.012	-.012	-.025
	(-2.5)	(-3.0)	(-2.1)	(-2.0)	(-3.2)	(-2.0)	(-1.8)
Bonus	2.567	46.672	250.314	358.921	12.391	17.873	37.683
	(7.2)	(7.2)	(7.8)	(7.5)	(7.7)	(6.9)	(6.4)
Meals	5.373	102.544	471.064	730.155	26.717	35.653	76.865
	(20.0)	(21.1)	(19.5)	(20.4)	(22.1)	(18.4)	(17.5)
Urban Northeast	-24.673	-325.709	-2,460.5	-3,405.48	-17.401	-150.191	-500.892
	(-5.5)	(-4.0)	(-6.1)	(-5.7)	(-.9)	(-4.6)	(-6.8)
Rural Northeast	8.125	187.385	-541.206	1,259.403	99.467	70.814	53.549
	(1.0)	(1.2)	(-.7)	(1.1)	(2.6)	(1.2)	(.4)
Urban North Central	-6.045	-110.007	-1,108.25	-1,803.94	28.477	-71.278	-328.379
	(-1.5)	(-1.5)	(-3.0)	(-3.3)	(1.6)	(-2.4)	(-4.9)
Rural North Central	-13.458	-169.472	-2,257.3	-2,549.92	-21.878	-99.701	-395.836
	(-2.4)	(-1.7)	(-4.6)	(-3.5)	(-.9)	(-2.5)	(-4.4)
Urban South	-6.812	-161.891	-1,155.2	-1,350.78	-.703	-53.719	-222.778
	(-2.5)	(-3.3)	(-4.8)	(-3.8)	(-.06)	(-2.8)	(-5.0)
Urban West	-10.648	-97.409	-1,630.93	-2,411.36	-7.717	-112.938	-361.455
	(-2.3)	(-1.2)	(-4.0)	(-4.0)	(-.4)	(-3.4)	(-4.8)
Rural West	-18.841	-510.515	-3,201.61	-4,319.92	-94.557	-232.721	-450.090
	(-2.2)	(-3.3)	(-4.1)	(-3.7)	(-2.4)	(-3.7)	(-3.2)

Continued--

See footnotes at end of table.

Appendix table 1--Estimated coefficients and relevant statistics obtained by regressing nutrients available for consumption per capita per week on selected independent variables, 1977-78, Low-Income Nationwide Food Consumption Survey--Continued

Independent variable 1/	Nutrient						
	Iron	Magnesium	Phosphorus	Food energy	Protein	Fat	Carbo-hydrate
Black	1.238	-292.890	-383.833	-433.721	19.646	36.985	-229.011
	(.5)	(-6.6)	(-1.7)	(-1.3)	(1.8)	(2.1)	(-5.7)
Other	8.668	-126.559	-600.064	638.515	23.052	21.286	75.373
	(2.0)	(-1.6)	(-1.5)	(1.1)	(1.2)	(.7)	(1.0)
LC1	9.983	448.039	2,001.778	2,152.685	95.029	109.229	208.421
	(2.9)	(7.2)	(6.5)	(4.7)	(6.1)	(4.4)	(3.7)
LC3	6.076	270.669	1,202.228	1,930.482	72.652	81.424	239.308
	(1.9)	(4.8)	(4.3)	(4.6)	(5.1)	(3.6)	(4.6)
LC4	4.743	316.218	1,566.873	2,107.447	89.133	102.755	218.330
	(1.3)	(4.7)	(4.7)	(4.3)	(5.4)	(3.9)	(3.6)
High school	2.192	5.617	-96.657	-14.134	17.656	9.673	-47.602
	(1.0)	(.1)	(-.5)	(-.05)	(1.7)	(.6)	(-1.3)
Own	5.077	122.300	406.802	1,069.144	26.565	40.672	154.842
	(2.2)	(2.9)	(2.0)	(3.5)	(2.5)	(2.4)	(4.1)
$\bar{R}^2$	.15	.23	.18	.17	.19	.14	.16
F-ratio	40.05	63.59	48.36	46.07	51.08	36.56	41.04

1/ See Appendix text for definition of variables.
2/ T-ratio in parentheses.

Appendix table 2--Estimated coefficients and relevant statistics obtained by regressing food expenditures on selected independent variables, 1977-78, Low-Income Nationwide Food Consumption Survey

Independent variables 1/	Food expenditures		
	Total	At home	Away from home
Intercept	7.037	6.280	0.757
	2/(4.7)	(4.8)	(1.1)
Income	.119	.076	.043
	(14.5)	(10.8)	(11.5)
Log of household size 3/	20.142	17.700	2.442
	(21.4)	(21.8)	(5.8)
Bonus	.241	.295	-.054
	(9.0)	(12.9)	(-4.5)
Black	1.159	1.231	-.072
	(1.7)	(2.1)	(-.2)
Other	4.992	5.243	-.251
	(4.3)	(5.2)	(-.5)
LC1	-.689	2.092	-2.780
	(-.5)	(1.9)	(-4.9)
LC2	-6.687	-4.588	-2.098
	(-6.1)	(-4.9)	(-4.3)
LC3	-3.220	-.732	-2.488
	(-3.2)	(-.8)	(-5.4)
High	2.057	.444	1.613
	(3.1)	(.8)	(5.4)
Own	.938	1.380	-.442
	(1.4)	(2.4)	(-1.5)
$\bar{R}^2$	.49	.47	.18
F-Ratio	377.38	348.43	86.43

1/ See appendix text for definition of variables.
2/ T-ratios in parentheses.
3/ The natural logarithm of household size was included to allow for economies of size in food purchasing.

Appendix table 3--Estimated marginal propensities to consume out of income, by location of residence 1/

Nutrient	Unit 2/	All low-income households	Location of residence: Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
Vitamin A	I.U.	364.548**	580.971**	22.947	376.238	407.500	410.321**	546.568**	14.344*	-27.534*
Vitamin C	mg	6.104**	11.954**	.799*	8.813**	6.488**	6.854**	6.960**	1.108*	3.983*
Thiamin	mg	.015**	.038	-.060	.023	.043	.041**	.037**	.008*	.082
Riboflavin	mg	.044**	.094**	-.098	.043	.067	.060**	.076**	.005*	.101
Performed niacin	mg	.524**	.595	-.575*	.465	.337*	.790**	.893**	.079*	.731
Vitamin B_6	mg	.056**	.079**	-.021*	.044	.053	.077**	.071**	.019	.069*
Vitamin B_{12}	mcg	.205**	.608	-.149*	.078*	.080*	.073*	.390**	-.029*	.051*
Calcium	mg	11.532**	13.753	-45.293	36.588**	54.705**	20.973**	19.699**	-1.036*	27.436
Iron	mg	.359**	.470	-.465*	.322	.266*	.592**	.688**	.136*	.835
Magnesium	mg	7.912**	7.335	.281*	9.712**	11.835	13.300**	11.106**	.438*	8.164*
Phosphorus	mg	21.203**	22.062	-34.092*	30.722	61.390**	50.720**	34.539**	4.596*	33.723
Food energy	kcal	40.986**	50.452	-62.032*	82.799**	76.643	73.249**	64.661**	28.834	58.857*
Protein	g	2.331**	1.994	-2.432	2.340	2.750	3.645**	2.932**	.636*	.600*
Fat	g	2.443**	3.662	-2.013*	3.746**	4.543	4.494**	3.357**	1.380	.497*
Carbohydrate	g	2.155**	3.098*	-9.129	9.743**	7.974	4.767**	5.825**	1.807*	13.002

* Not significant at .40 level.
**Significant at .05 level.
1/ Weekly consumption per person.
2/ I.U. = International Units; mg = milligrams; mcg = micrograms; kcal = kilocalories; g = grams.

Appendix table 4--Estimated marginal propensities to consume out of bonus, by location of residence 1/

Nutrient	Unit 2/	All low-income households	Location of residence							
			Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
Vitamin A	I.U.	1,133.431**	988.889*	1,301.793*	2,627.355**	2,534.098**	925.416**	1,008.952**	1,263.870	2,148.838
Vitamin C	mg	17.801**	27.996**	50.254**	22.434	32.004**	15.040**	19.491**	15.131	-30.304*
Thiamin	mg	.210**	.185	.248*	.166	.395**	.041**	.231**	.256	.254
Riboflavin	mg	.276**	.302	.553	.384**	.540**	.269**	.286**	.227	.517
Performed niacin	mg	3.124**	5.072**	6.155	3.542**	4.621**	2.876**	3.388**	3.034	7.430
Vitamin B_6	mg	.262**	.391**	.465	.297**	.491**	.269**	.253**	.178	.207
Vitamin B_{12}	mcg	1.061**	2.438	3.332	2.486**	2.030**	.330*	.996**	.716*	2.667
Calcium	mg	107.354**	81.568	97.480*	117.802	200.365	126.661**	106.271**	108.534	213.430
Iron	mg	2.302**	2.190	5.929*	1.894	3.444**	2.428**	2.897**	1.921	2.815*
Magnesium	mg	41.715**	53.306**	80.213	42.865	98.124**	44.891**	41.020**	30.391	87.501
Phosphorus	mg	228.011**	253.383**	231.755	313.792**	273.939	248.318**	216.507**	282.882**	364.763
Food energy	kcal	327.239**	464.416**	330.845*	418.741**	425.434	361.975**	260.905**	488.614**	835.059**
Protein	g	11.549**	21.801**	8.872*	11.511	12.566	12.391**	10.226**	12.239	19.090
Fat	g	16.408**	28.578**	-.848*	19.050**	16.869	19.533**	11.801**	23.238**	37.926
Carbohydrate	g	33.321**	30.452	59.415	48.605**	61.328**	35.930**	28.514**	50.023**	107.783

* Not significant at .40 level.
**Significant at .05 level.
1/ Weekly consumption per person.
2/ I.U. = International Units; mg = milligrams; mcg = micrograms; kcal = kilocalories; g = grams.

Appendix table 5--Estimated nutrient-income elasticities, by location of residence 1/

Nutrient	All low-income households	Location of residence							
		Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
Vitamin A	0.203**	0.337**	0.012	0.186	0.290	0.209**	0.309**	0.011*	-0.019*
Vitamin C	.241**	.455**	.034*	.316**	.306**	.261**	.278**	.048*	.199*
Thiamin	.037**	.107	-.146	.055	.114	.095**	.080**	.024*	.268
Riboflavin	.083**	.187**	-.168	.081	.129	.113**	.132**	.013*	.253
Performed niacin	.094**	.115	-.101*	.084	.064*	.137**	.149**	.018*	.192
Vitamin B_6	.128**	.190**	-.049*	.097	.133	.169**	.156**	.054	.200*
Vitamin B_{12}	.160**	.374	-.102*	.057*	.071*	.052*	.332**	-.029*	.057*
Calcium	.053**	.072	-.192	.174**	.252**	.098**	.079**	-.006*	.164
Iron	.082**	.125	-.105*	.073	.066*	.131**	.146**	.040*	.248
Magnesium	.098**	.104	.003*	.123**	.145	.166**	.125**	.007*	.136*
Phosphorus	.054**	.068	-.092*	.080	.178**	.127**	.079**	.016*	.127
Food energy	.067**	.095	-.097*	.140**	.135	.116**	.095**	.062	.134*
Protein	.112**	.101	-.111	.107	.141	.167**	.136**	.039*	.040*
Fat	.084**	.145	-.068*	.131**	.172	.147**	.106**	.064	.026*
Carbohydrate	.032**	.054*	-.128	.157**	.125	.070**	.074**	.036*	.247

* Not significant at .40 level.
**Significant at .05 level.
1/ Percentage change in consumption per person estimated at sample means for each location.

Appendix table 6--Estimated nutrient-bonus elasticities, by location of residence 1/

Nutrient	All low-income households	Location of residence							
		Urban Northeast	Rural Northeast	Urban North Central	Rural North Central	Urban South	Rural South	Urban West	Rural West
Vitamin A	0.109**	0.075*	0.093*	0.211**	0.295**	0.096**	0.103**	0.119	0.154
Vitamin C	.120**	.137**	.268**	.136	.243**	.116**	.135**	.083	-.330*
Thiamin	.086**	.068	.084*	.069	.157**	.107**	.086**	.096	.121
Riboflavin	.090**	.079	.129	.121**	.161**	.100**	.089**	.067	.166
Performed niacin	.096**	.127**	.146	.108**	.137**	.100**	.100**	.085	.239
Vitamin B_6	.102**	.123**	.143	.107**	.188**	.117**	.098**	.063	.086
Vitamin B_{12}	.135**	.193	.276	.279**	.297**	.048*	.145**	.091*	.221
Calcium	.086**	.057	.057*	.096	.151	.118**	.076**	.080	.172
Iron	.091**	.076	.175*	.073	.136**	.107**	.107**	.069	.111*
Magnesium	.092**	.099**	.130	.095	.189**	.113**	.083**	.059	.185
Phosphorus	.101**	.101**	.086	.135**	.130	.123**	.086**	.121**	.178
Food energy	.092**	.112**	.073*	.119**	.122	.114**	.068**	.126**	.239**
Protein	.095**	.143**	.057*	.089	.106	.113**	.085**	.092	.167
Fat	.097**	.143**	-.004*	.111**	.106	.127**	.066**	.129**	.246
Carbohydrate	.086**	.069	.112	.133**	.152**	.014**	.065**	.117**	.254

* Not significant at .40 level.
**Significant at .05 level.
1/ Percentage change in consumption per person estimated at sample means for each location.