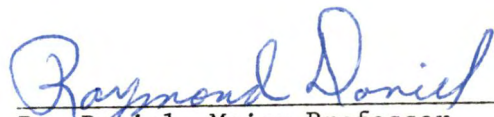
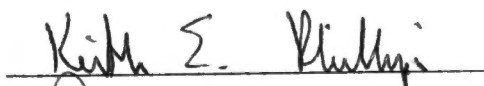


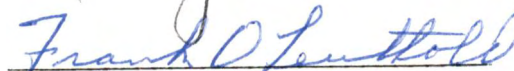
To the Graduate Council:

I am submitting herewith a dissertation written by John Louie Adrian, Jr., entitled "Specification of the Effects of Income and Other Socioeconomic Factors on the Consumption of Food Nutrients." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Agricultural Economics.


Ray Daniel, Major Professor

We have read this dissertation
and recommend its acceptance:





Accepted for Council:


Vice Chancellor
Graduate Studies and Research

SPECIFICATION OF THE EFFECTS OF INCOME AND
OTHER SOCIOECONOMIC FACTORS ON THE
CONSUMPTION OF FOOD NUTRIENTS

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee

John Louie Adrian, Jr.

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ABSTRACT

The objectives of this study were: (1) to estimate the effect of income and other selected socioeconomic characteristics of the household and female head of household on consumption of food energy, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamine (vitamin B₁), riboflavin (vitamin B₂), niacin, and ascorbic acid (vitamin C) by households in the United States and the four census regions of the United States, (2) to separate the quantity of protein consumed per household into two groups by source, plant or animal, and to estimate a household consumption relationship for each source for the United States and the four census regions of the United States, (3) to estimate income elasticities for each respective nutrient at specified income levels for all regions of the United States and for the United States, (4) to compare the relationship of household consumption of each respective nutrient and income, ceteris paribus, with the Recommended Dietary Allowance for the United States, and (5) to examine the policy implications of the findings relative to income distribution and nutritional adequacy, nutrition education programs, and future production and marketing decisions.

Data from approximately 7,150 households located in the contiguous states of the United States were utilized to specify household nutrient consumption relationships. Also, these data were separated by geographic location of the household to facilitate the estimation of nutrient consumption relationships for households in the South, Northeast, North Central, and West regions of the United States. These relationships were developed using multiple regression analysis.

Characteristics of the household and female head of household hypothesized to influence household consumption of food nutrients were: income, location, race, education of the homemaker, stage in the family life cycle, family size, eating habits, and employment status of the homemaker.

Major implications drawn from the results of this study were:

1. Increases in household disposable income in the United States should result in increases in household consumption of food energy, animal protein, fat, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid up to some income level. This increase in consumption should be especially true for animal protein, fat, vitamin A, and vitamin C. Therefore, consumption of meats and fruits (especially citrus fruits) may increase in the future in response to increases in income. A leveling-off of consumption with increases in income was reflected at income levels above \$8,000.
2. A trend toward a more urban society in the United States would result in a possible decline in consumption of most food nutrients.
3. Diets of Negro households were comparable or superior to diets of white households in all regions except the South. Diets of Negro households were weakest in the consumption of calcium.
4. Increases in the level of education attained by the homemaker resulted in declines in the consumption of food energy, fat, carbohydrate, iron, thiamine, and vegetable protein and increases in the consumption of calcium, vitamin C, and animal protein by the household.
5. A trend toward smaller families would result in smaller quantities of most nutrients being consumed by households.
6. A trend away from the traditional three meals per day pattern

to fewer meals per day would result in declines in household nutrient consumption.

7. Increased employment of housewives outside the home would result in greater household consumption of food energy, fat, and carbohydrates.

8. On the average, the distribution of income among households in the United States and regions of the United States was sufficient to generate adequate levels of consumption of all nutrients, ceteris paribus. The greatest possibility of a deficiency existed for calcium, iron, vitamin A, and vitamin C consumption. These deficiencies were not limited to the lowest income households or to any particular income level.

9. The problem of nutritional excesses in household consumption of food nutrients should be a major nutritional concern in the United States.

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CHAPTER I

INTRODUCTION

The availability of an adequate supply of food at relatively low prices has not been a major problem confronting most consumers in the United States in the past two decades, although recent price increases have caused some concern. Rapid development and adoption of technological advances have resulted in phenomenal increases in food production in America. An adequate food supply coupled with innovations in the food industry has provided Americans with many alternatives in food consumption. Consumers may purchase foods requiring various degrees of preparation, food in different storable forms (fresh, frozen, canned, dried, etc.), and foods considered out of season in certain areas.

Despite the availability of a plentiful and varied food supply, some Americans consume nonoptimal quantities of food nutrients. Unequal distribution of economic and other resources in the United States has resulted in pockets of poverty and malnutrition. The incidence of malnutrition is not only a problem of the poor, but also affects some of the more affluent. Some of these individuals suffer nutritional excesses and/or imbalances primarily because of affluent life styles or the lack of nutritional information. The diversity and complexity of both the channels used to purchase food and the economic and sociological factors affecting food consumption behavior make the study of food nutrients in the United States difficult (Giffit, Washbon, and Harrison, 1972, pp. 219-246).

I. PROBLEM

Previous research dealing with the demand for food has emphasized the relationship between selected socioeconomic factors and traditional quantity or expenditure measures. The major limitation of each of these two approaches is that there is no guarantee that a large quantity of food or a large expenditure for food will generate acceptable levels of nutrient consumption. Research has shown that consumers tend to purchase and consume more food as income increases; however, there is little information available to indicate the level of income or expenditure which would result in a nutritionally adequate diet (Gifft, Washbon, and Harrison, 1972, p. 219).

Greater awareness of "consumerism" and increased public interest in nutritional levels has heightened the need for a more complete understanding of nutrient consumption patterns. Although the United States is considered to be one of the most developed countries in the world, if not the most developed, some Americans are malnourished (Gifft, Washbon, and Harrison, 1972, p. 219). Therefore, research is needed to specify the relationship between socioeconomic characteristics of the household and its consumption of food nutrients.

Knowledge of the relationship between nutrient consumption and selected socioeconomic factors could be utilized to evaluate the relationship between income distribution and nutritional status of American households. Also, knowledge of these relationships could be used by extension personnel in the development of programs dealing with nutrition education.

Certain commodities or commodity groups are primary sources of

specific nutrients. Specification of the relationship between the quantity of the respective nutrients consumed and socioeconomic characteristics of American households could provide insight into future demand trends which will directly affect the types of agricultural products produced and marketed in the United States.

II. OBJECTIVES

The objectives of this study were:

1. to estimate the effect of income and other selected socioeconomic characteristics of the household on the consumption of food energy, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamine (vitamin B₁), riboflavin (vitamin B₂), niacin, and ascorbic acid (vitamin C) by households in the United States and the four census regions of the United States.
2. to separate the quantity of protein consumed per household into two groups by source, plant or animal, and to estimate a household consumption relationship for each source for the United States and the four census regions of the United States.
3. to estimate income elasticities for each respective nutrient at specified income levels for all regions of the United States and for the United States.
4. to compare the relationship of household consumption of each respective nutrient and income, ceteris paribus, with the Recommended Dietary Allowance for the United States.
5. to examine the policy implications of the findings relative to income distribution and nutritional adequacy, nutrition education programs, and future marketing and production decisions.

The primary emphasis of this study will involve identifying the above specified relationships; however, some effort will be made to develop projected trends in nutrient consumption which could have direct bearing on future food consumption patterns.

III. PROCEDURE

National and regional surveys can be expensive in terms of time and financial requirements; therefore, extensive use of available national and regional data to analyze relevant problems is imperative. This study was based on data collected in the 1965-66 nationwide survey of household food consumption.¹ Approximately 7,500 households were surveyed in the contiguous states of the United States in the spring of 1965. Individuals residing in institutions, on military reservations, and in rooming and boarding houses were not included. Households were selected to adequately represent consumption patterns in metropolitan areas, cities of various sizes, and rural farm and nonfarm areas in each of four census regions of the United States, Figure 1 (U.S. Department of Agriculture, 1969, p. 2).

The original data were collected by personal interview with household members, usually the homemaker. The interviewees were asked to recall the kinds, quantities, and costs of foods used in the household during the week preceding the interview. Also, data concerning the

¹The original survey was conducted by the Consumer and Food Economics Research Division, Agricultural Research Service, United States Department of Agriculture (USDA). National Analysts, Inc., under contract with the USDA, designed the sample and collected the data. Tabulation of the data was accomplished by the General Electric Company, also under USDA contract (U.S. Department of Agriculture, 1969, p. 1).

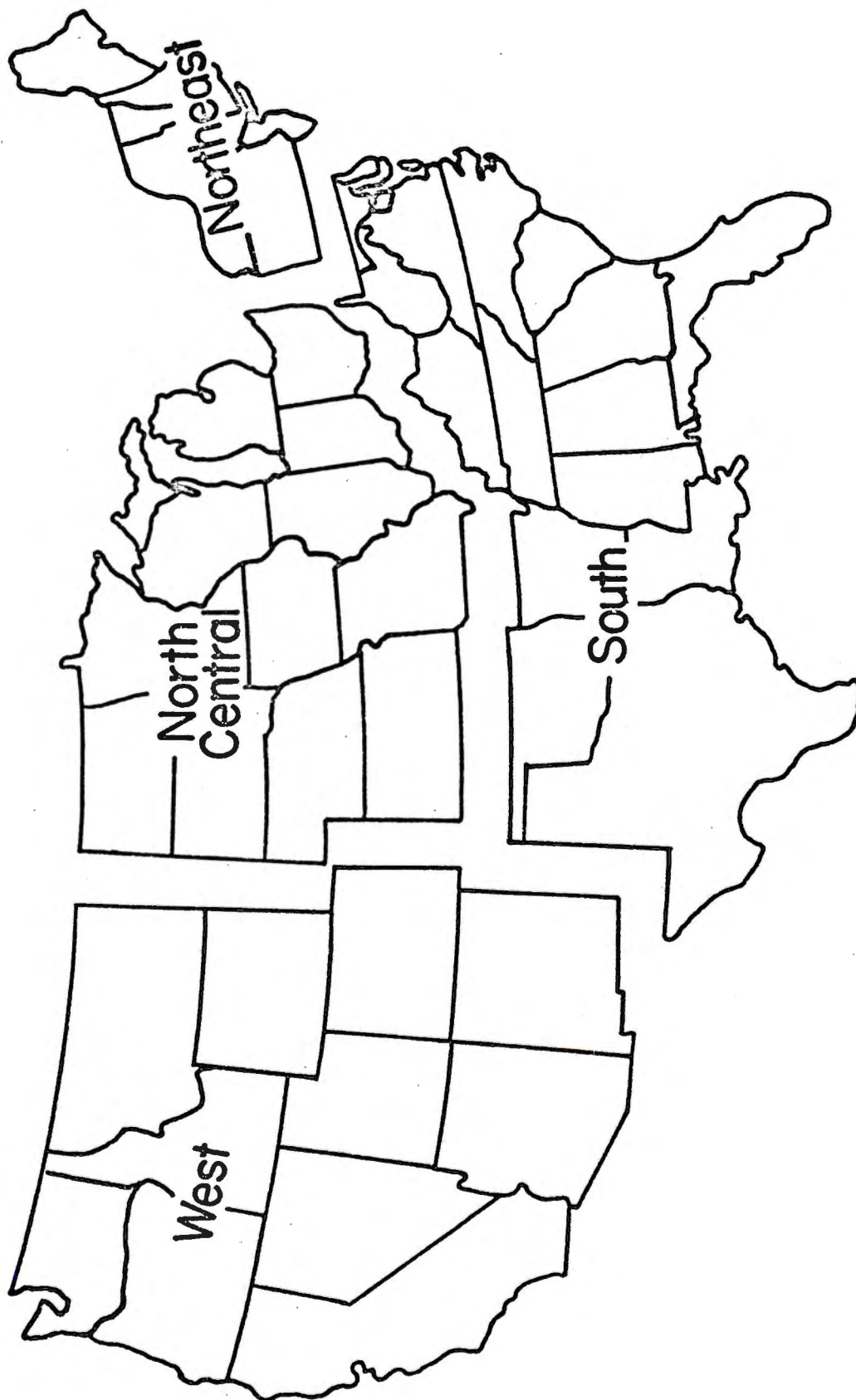


Figure 1. Census Regions of the United States.

expenditures for meals and snacks away from home were included.² Characteristics of the household and household members were collected (U.S. Department of Agriculture, 1969, p. 2).

The utilization of data which has been collected for other purposes can present problems for the researcher. This study was not an exception. A part of the original data was discarded because of the lack of applicability to the present study. Also, the configuration of some of the data necessitated a conversion of the data to a more appropriate form to improve the analysis. In some instances, data elements could not be converted so less than ideal forms were used in the analysis.

Data from approximately 350 households were eliminated from the original survey to form the sample utilized for this study. These observations were excluded because data elements were missing or the household was not an economic unit.³ After adjusting the sample for these occurrences, 7,143 households were included in the United States sample utilized for this study. The South, West, North Central, and Northeast regions had 2,554, 956, 2,093, and 1,540 observations per region, respectively. Distribution of these households among the respective race, income, and urbanization categories was sufficient for analysis, Table 1.

The interest of the present study involved the specification of

²Data were collected on the quantity of food used from only the home food supply. The quantity of food eaten away from home was not included (U.S. Department of Agriculture, 1969, p. 3).

³An economic unit was a household which made expenditures from a common pool of income.

Table 1. Distribution of Households in the Sample for Income, Race, and Urbanization Categories, the United States and Regions of the United States, Spring 1965

Category	United States ^a	South ^b	Northeast ^c	North Central ^d	West ^e
Income:					
Under \$1,000	351	211	36	78	26
\$1,000-1,999	649	325	83	165	76
\$2,000-2,999	688	326	104	176	82
\$3,000-3,999	730	328	146	173	83
\$4,000-4,999	708	273	150	191	94
\$5,000-5,999	1051	303	248	367	133
\$6,000-6,999	753	213	192	253	95
\$7,000-7,999	634	166	164	211	93
\$8,000-8,999	454	127	113	145	69
\$9,000-9,999	327	77	90	94	66
\$10,000-11,999	339	84	88	111	56
\$12,000-14,999	243	58	73	75	37
\$15,000-24,999	164	45	44	42	33
\$25,000 or more	52	18	9	12	13
Race:					
Negro	799	478	142	114	65
White	6203	2045	1354	1956	848
Other	141	31	44	23	43
Urbanization:					
Rural farm	1656	811	118	591	136
Rural nonfarm	1377	598	307	386	86
Urban	4110	1145	1115	1116	754

^aThe United States sample was composed of 7,143 households.

^bThe South region sample was composed of 2,554 households.

^cThe Northeast region sample was composed of 1,540 households.

^dThe North Central region sample was composed of 2,093 households.

^eThe West region sample was composed of 956 households.

the quantity of each respective nutrient consumed by household members during the week preceding the interview. Thus, the quantity of each respective food consumed per household was multiplied, respectively, by the percent of each nutrient available in each unit of the food. The summation of this product over all foods for each respective nutrient provided an approximation of the quantity of each nutrient available for consumption by the household.⁴

In objective one, nutrient consumption analyses were conducted for the United States and the four census regions of the United States. The regional analyses divisions were for the same geographic areas as were collected originally; that is, they corresponded to census regions. The influence of economic and sociological factors on food nutrient consumption was specified using multiple regression analysis.

Objective two was accomplished using the same statistical technique and geographic location criteria as used in objective one. Quantity of protein consumed by the household was partitioned into two segments using the source of the protein as the criterion. Consumption relationships were then estimated for plant protein and animal protein.

Income elasticities were computed from the consumption relationships estimated in objectives one and two for the United States and the four census regions of the United States. Since income data were

⁴The quantity of food and nutrients consumed by the household considered total quantity available for consumption and not necessarily the quantities eaten by household members. Some food was discarded in the kitchen and at the table. Thus, the number of households with adequate diets could be overestimated. On the other hand, nutrient supplements (vitamins, etc.) were not included in the survey so some households could have consumed larger quantities of some nutrients. Average nutritional content of the various foods were adjusted for loss of nutrients during preparation (U.S. Department of Agriculture, 1969, pp. 1-4).

collected in mutually exclusive classes, each income class was represented by the midpoint of that class and the open-ended class was represented by the initial income level of that class. Average income elasticities were computed for these various income ranges. The goal of objective three was to ascertain how changes in income, ceteris paribus, affected nutrient consumption.

Consumption relationships for the United States which were estimated in objectives one and two were compared with the established Recommended Dietary Allowance (1963) in objective four. The consumption relationships were utilized to compute the quantities of each respective nutrient consumed by households in the various income classes, ceteris paribus. The quantities representing the Recommended Dietary Allowance of each respective nutrient per household were computed for the various income classes from male equivalent units and the quantity of each respective nutrient necessary for a 20-35 year old male to meet the Recommended Dietary Allowance.⁵ The comparison was made to add clarity to the estimated nutrient consumption relationships. The Recommended Dietary Allowance offered a basis for judging general nutritional status in the United States and how shifts in income might influence nutritional well-being in the United States.

⁵Adult-male equivalent units for income classes were developed by the USDA using the 1963 Recommended Dietary Allowances to relate the needs of individuals of different age and sex to those of the 20-35 year old man (U.S. Department of Agriculture, 1969, p. 107).

IV. REVIEW OF LITERATURE

Nutritional status studies can be categorized into three types: (1) food consumption, (2) chemical analysis of body fluids, and (3) physical examinations (Babcock, 1972, p. 56). Biochemical or clinical evaluations, based on the latter two types of data, accounted for 50 published nutritional status studies involving approximately 30,000 people in the United States, the Virgin Islands, and Puerto Rico during the 1957-1967 years. Approximately 60 published studies with over 30,000 people participating included some type of dietary evaluation during this period (Kelsay, 1969, p. 124).

Little research effort has been devoted to the analysis of the impact of income and other socioeconomic characteristics of the household on the consumption of food nutrients. Studies which have addressed this problem have been primarily involved with localized areas or particular groups of people. Generally, these studies reflected a greater incidence of malnutrition in lower-income, less well-educated, and minority groups (Dairy Council Digest, 1970, p. 8). In a 1967 study conducted by the United States Department of Agriculture in Sunflower County, Mississippi, race, urbanization, and income were found to have significant impacts on the diets of families (Kelsay, 1969, pp. 119-123). In another study, education and income were found to be significant factors affecting the consumption of nutrients by male industrial workers. Age and ethnic group were found to have little influence (Babcock, 1972, p. 86).

Several studies of various groups of United States citizens have isolated insufficient levels of consumption of some nutrients. A study of the food preferences of college students found vitamin A, vitamin C,

and calcium consumption to be deficient (Einstein and Horstein, 1970, p. 433). The Department of Health, Education, and Welfare conducted a nutritional survey of over 83,000 persons in 23,000 households in Texas, Louisiana, New York, Kentucky, Michigan, New York City, West Virginia, California, Washington, South Carolina, and Massachusetts during the 1968-1970 years. Preliminary results from Texas, Louisiana, New York, Kentucky, and Michigan data indicated that vitamin A and vitamin C were deficient in many households. Adolescents (10 to 16 years old) tended to be deficient in vitamin A, vitamin C, and iron consumption. Only 32 percent of the households with incomes below the poverty level (then \$3,335) consumed adequate quantities of calories (Babcock, 1972, pp. 62-67). In the 1955 national food consumption survey, vitamin A, vitamin C, and calcium intake were reported to be low in all regions of the United States (Kelsay, 1969, p. 123).

A review of several studies by Giff, Washbon, and Harrison (1972, p. 64) indicated that Americans have changed their food nutrient consumption patterns over the last 60 years. The proportion of total calories consumed which were of fat origin increased from 32 to 41 percent. Utilization of animal fat declined from five-sixths to two-thirds of total fat consumed. An increase in vegetable oil consumption, a shift from butter to margarine, and a shift from lard to shortening precipitated this relationship. A decline in consumption of flour and cereal products resulted in the percentage of calories derived from the carbohydrate source decreasing from 56 to 47 percent. Increased consumption of soft drinks resulted in 50 percent of the available carbohydrates being sugar derived as compared to a former 33 percent. The percentage of protein derived calories remained rather constant over this period at 12 percent. Protein

from animal sources comprised two-thirds of total protein in 1965 while only one-half of the total protein was from animal sources formerly.

Increased consumption of dried milk, ice cream, and cheese more than compensated for a decline in fluid milk consumption over this period. This resulted in an increase in the consumption of calcium and riboflavin. Consumption of iron and the B vitamins also increased because of the enrichment of cereal products and increased meat consumption. Consumption of vitamins A and C remained constant over this period (Giffit, Washbon, and Harrison, 1972, pp. 64-65).

After reviewing these nutritional studies, implications are that a limited number of national or regional studies have been conducted. The reasons for this are rather obvious. Such research is costly in terms of money, time, and effort. Those studies which have considered national or regional nutritional relationships have primarily utilized tabular analysis. Relationships were analyzed by compiling averages for various economic and sociological characteristics. Tabular analysis is useful and utilization of this approach has revealed many important relationships.

Both nutritional status and dietary evaluations studies reflect the fact that nutritional quality is related to economic status, level of education, and other sociological factors. Additional information can be derived by the application of statistical analysis to specify the relationship between various socioeconomic factors and the consumption of the respective food nutrients. This was the primary goal of this study.

CHAPTER II

THEORETICAL FRAMEWORK

The primary purpose of this chapter was to identify the socio-economic factors which may have an impact on the consumption of food nutrients. These nutrients were: food energy, protein (plant, animal, and total), fat, carbohydrate, calcium, iron, vitamin A, thiamine (vitamin B₁), riboflavin (vitamin B₂), niacin, and ascorbic acid (vitamin C). Selection of the variables to be included in the nutrient consumption models was based on relevant economic and sociological theoretical concepts, previous research studies, and the researcher's knowledge of the area under study.

I. MODEL SPECIFICATION

Economic, sociological, and demographic factors have been shown to have an influence on the consumption of food nutrients. In this section, these factors were merged into a theoretical model explaining the consumption of food energy, protein (plant, animal, and total), fat, carbohydrate, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid, respectively.

All the nutrients are constituent parts of food; therefore, the same factors affect the consumption of each nutrient. True, each nutrient may be affected differently by the various factors, but there were no justifiable reasons to include or delete a variable for any one nutrient estimate. Thus, a consumption relationship was specified using the same socioeconomic behavioral model for each nutrient. Also, the same model

was utilized to specify nutrient consumption relationships for regions of the United States and for the United States. The socioeconomic model was implicitly specified as follows:

$$Q_{i,j} = f(I,U,R,E,L,S,M,F) \quad (1)$$

where:

$Q_{i,j}$ = the quantity of the i th nutrient ($i=1...13$) consumed by households located in the j th region ($j=0...4$) with

$i=1$ = food energy
 $i=2$ = protein (total)
 $i=3$ = animal protein
 $i=4$ = plant protein
 $i=5$ = fat
 $i=6$ = carbohydrate
 $i=7$ = calcium
 $i=8$ = iron
 $i=9$ = vitamin A
 $i=10$ = thiamine (vitamin B₁)
 $i=11$ = riboflavin (vitamine B₂)
 $i=12$ = niacin
 $i=13$ = ascorbic acid (vitamin C)

and

$j=0$ = United States
 $j=1$ = South region
 $j=2$ = Northeast region
 $j=3$ = North Central region
 $j=4$ = West region

I = income of the household

U = location of the household (urbanization)

R = race of the household

E = education of the homemaker

L = development of the family unit (number of children, age of children and homemaker, and the presence of the homemaker)

S = number of members in the household

M = total number of meals consumed by household members and guests

F = employment status of the homemaker

II. ECONOMIC AND SOCIOLOGICAL CONCEPTS

Leftwich (1970, p. 29) defines demand for a good as the various quantities of a commodity which would be taken from the market at all possible alternative prices per unit of time, other things being equal or constant. Factors assumed to be constant are: consumer tastes and preferences, the number of consumers under consideration, consumer incomes, the price of related goods, and the range of goods available to consumers. Traditional demand and consumption research is primarily concerned with the development and study of a demand schedule, indicating how quantity varies with price or income with other factors constant using either time series or cross-sectional data.

The consumption analysis approach is less developed than the demand analysis approach.⁶ The theoretical background for consumption analysis is less developed and refined. The relationships of some economic, sociological, and psychological factors to consumption are still inadequately defined (Burk, 1968, pp. 3-13). This study was more similar to the consumption analysis approach because many of the factors affecting food nutrient consumption were outside the traditional economic realm; that is, they had multidisciplinary implications.

The utilization of the consumption analysis approach could improve knowledge of household food consumption patterns by specifying the relation of economic and sociological factors to nutrient consumption.

⁶Burk (1968, pp. 3-5) defines consumption as the quantities of goods and services taken from the market. This definition includes both the selection and use of goods and services by consumers and the durability of the products. Consumption economics involves more emphasis on the multidisciplinary approach than it does the traditional demand approach.

Consumers purchase the respective nutrients indirectly through their allocation of dollars to various food products. In allocating their income to various food items, consumers are assumed to be making decisions which reflect their desire to have and maintain a balanced and adequate diet. This assumption is not without exception because some of the food consumed by individuals is based on nonnutritive criteria such as habit or impulse consumption. Nevertheless, consumers must make some effort to consume at least minimal quantities of the basic nutrients for the sustenance of life.

The household was the basic consuming unit utilized in this study for analysis.⁷ This approach has several advantages on a per capita analysis. Per capita analysis necessitates the division of income among the household members. Generally, no a priori reasons exist to justify this allocation among family members. Since food is generally purchased on a household basis, the per capita approach would also entail some formula for the distribution of the household food supply among household members. The procedure chosen for this allocation, either equal or weighted distribution, could possibly alter the results obtained from the analysis. Since data were not collected on the individual basis and a justification for allocation was not available, the per capita approach was abandoned.

The primary disadvantage of utilizing the household as the basic unit of consumption was that inferences could not be developed with respect to individual family members. The household unit could have

⁷A household was defined as a family or a group of unrelated persons who lived together. Guests, boarders, and hired help were included (U.S. Department of Agriculture, 1969, p. 110).

adequate quantities of all nutrients available, but a family member could be malnourished. In this study, all members of a family were assumed to be adequately nourished if sufficient quantities of all nutrients were available at the household level.

Income

Economically, income was considered the primary allocative factor affecting household nutrient consumption. The household was assumed to allocate available income among many alternative and competing goods and services so as to maximize satisfaction. A proportion of their income must be allocated for food for the maintenance of life. This allocation is affected by the food consumption capacity of the members of the household and the desire or necessity of purchasing other goods and services. In actuality, consumers probably attempt to consume an adequate and balanced diet although nutritional information may not be available for knowledgeable evaluations of alternative expenditures of their income.

The availability of income influences the nature of the food-mix that the household purchases and thus, the respective quantities of nutrients consumed. At low income levels, consumption of goods and services is more constrained than at high income levels. As income increases, consumers were hypothesized to increase the consumption of all food nutrients except protein (animal, plant, and total), food energy, and carbohydrate. This increase in consumption may not be in proportion to the increase in income. This relationship was hypothesized based on findings by Burk (1968, p. 86) in several food research studies. Therefore, income was hypothesized to have a positive impact on the quantity of fat, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and vitamin C consumed per household.

Since protein is provided by both plant and animal sources, income could be related differently to each source. Income was hypothesized to have a positive impact on consumption of animal protein and a negative impact on consumption of vegetable protein.⁸ Consumption of vegetable protein may increase slightly at low income levels until sufficient income is present to purchase relatively higher priced meats. Total protein consumption was hypothesized to be positively related to income because the animal source was expected to provide the largest part of total protein consumed by Americans. In summary, Burton (1965, pp. 54-55) stated that the more prosperous countries consume larger relative quantities of animal protein than do their less prosperous peers who consume relatively more vegetable protein. This relationship was expected to be appropriate for the populace within a country and thus, should apply to households in the United States. That is, as income increases consumption of animal protein should increase and consumption of vegetable protein should decline.

Consumption of carbohydrates was hypothesized, a priori, to be negatively related to income although the relationship may exhibit an increase in consumption at the lower income levels. Consumers generally shift from starchy foods such as potatoes, sweet potatoes, and cereal products to meats as income increases and as society becomes less active (Giffit, Washbon, and Harrison, 1972, p. 64).

Food energy is provided by proteins, fats, and carbohydrates. Since income was hypothesized to have different influences on the

⁸This relationship was hypothesized from changes in food consumption patterns in the United States as isolated by Burk (1968, p. 242).

nutrients comprising food energy, the hypothesized impact of income on food energy consumption was indeterminate, a priori.

Uses of Income Elasticity

Income elasticity measures the responsiveness of consumption to changes in income. An income elasticity is defined as the percentage change in the quantity of a commodity purchased relative to the percentage change in income, ceteris paribus. The value of an income elasticity may be negative, positive, or zero (Henderson and Quandt, 1971, p. 28). If the income elasticity is greater than one ($E_I > 1$), income elasticity is "high"; that is, quantity consumed increases by a greater percentage than income. If the coefficient is less than one ($E_I < 1$), income elasticity is "low"; that is, quantity consumed increases by a smaller percentage than income. An income elasticity of zero ($E_I = 0$) signifies that changes in income do not affect consumption. A negative income elasticity ($E_I < 0$) indicates that consumption declines with increases in income (Watson, 1968, pp. 107-109).

Urbanization

Degree of urbanization (rural farm, rural nonfarm, and urban) was a factor which could reflect the impact of several variables. Some of these were: (1) the potential for home food production, (2) accessibility to diverse types of stores including food stores providing a wide variety of foods, (3) distinctions in the social, cultural, and economic environment such as occupational opportunities and education, and (4) the effects of mass media, information availability (Burk, 1961, p. 54).

Relative to urban and rural nonfarm households, rural farm families

were hypothesized, a priori, to consume larger quantities of all nutrients. This was rationalized from the fact that farmers have the expertise, land, and equipment to facilitate home food production. Generally, rural farm households would have gardens which would affect the quantity of plant derived nutrients available for consumption. Also, some farm families could produce animals which could be custom slaughtered in the local area. Urban households would be expected to consume a smaller volume of each respective nutrient. Since the sources of energy (proteins, fats, and carbohydrates) were included, food energy consumption should be greatest for rural farm families. This relationship follows from the fact that physiological needs of farm operators are great; that is, farm work generally involves the utilization of large volumes of body energy.

Geographic Area

For the purposes of this study, households were classified in one of four geographic categories: (1) Northeast, (2) North Central, (3) South, and (4) West. Geographic location could reflect differences in natural resource availability and mix, climate, soil type, and topography. Also, regional price variations could be reflected in this variable. These factors could affect the economic, social, cultural, and demographic development of a region with respect to such factors as occupations, education, increasing urbanization, and level of living. These factors as reflected by the geographic location of the household could affect food consumption and thus, they could have an impact on nutrient consumption. Inferences of regional effect on nutrient consumption were limited because there were no well defined, a priori, information concerning these relationships.

Race

The different races of people possess various ethnic traits which could influence their food consumption patterns and thus, their nutrient consumption patterns. The isolation of these influences is complicated by the possible interrelationship of race with other economic and social factors. Therefore, a priori, hypotheses concerning the impact of race on nutrient consumption were not ascertained.

Education of the Homemaker

The level of education achieved by the female head of household was hypothesized to have a positive impact on nutrient consumption. Educational achievement generally reflects the ability, desires, and resourcefulness of the individual. In many instances, this factor could be applied to all members of the family and to the aspirations of the family and family members. The attainment of education should improve the individual's ability to relate consumption of certain food items to nutritional content. Therefore, an increase in the educational level of the female should result in improved diets for the household and thus increased consumption of food nutrients.

Development of the Family Unit

As people grow older, their attitudes and behavior change; however, this change may be more of a reflection of the impact of age upon the individual's family membership than of the biological process of aging. Thus, analysis of the change in the status of the family may be an important step in explaining the actions and reactions of a household relative to nutrient consumption. The problem is in ascertaining when these changes in status take place and the number of distinct classes involved (Lansing, 1957, p. 512).

Average age of the children, the homemaker's capacity for child-birth, and presence of the homemaker were used as criteria to develop the discrete stages of the family life cycle with respect to food nutrient consumption by the household. The central idea of this variable was to develop a framework reflecting the sequence of stages through which the family unit passes. Average age of the children was included as one criterion to reflect changes in nutrient consumption patterns as the children grow and develop.⁹ Shifts in consumption patterns may result from changes in the physical, mental, social, or psychological development of the children. The capacity of the female to bear children as represented by her age could reflect a stage in which the family unit has the capacity to change or a stage where change was limited. The class representing households with the homemaker under 40 years of age and with no children represented family units which had the possibility of changing status. These family units were considered to have the capacity for further development. On the other hand, family units which included no children and with the homemaker over 40 years of age represented households which were in the declining phases of the family life cycle. Households with the female head of household absent were also classified as being in the declining phases of the cycle (Lansing, 1957, p. 513).

The presence of a female head of the household could have an important influence on nutrient consumption. Since this individual

⁹Average age was chosen because an average would possibly counteract the effect of wide disparities in the ages of children in a household and would reflect nutrient consumption levels more accurately. The age of the youngest or oldest child could have been used, but this might have over or under estimated nutrient consumption.

generally exercises primary control over the purchase and preparation of food, the quantity of food nutrients consumed by each household member is affected by this individual's decisions. If this individual is not present in the household, some other member of the household must make decisions concerning the types and quantities of food to purchase and prepare. Generally, if the male head of household assumes this responsibility, meals may not be as nutritious. This situation results from the fact that the American society does not promote the training of males to do housework. Also, home economics classes in high schools primarily include and train females to be homemakers. Thus, the male may lack sufficient food and nutrition information and training to provide nutritionally adequate meals for his family in the case of absence of the female.

Also, the presence and average age of children may have relevant implications to consumption of food nutrients by the household. Since the age of children generally reflects their level of activity, average age of the children in the household and presence of a female head of household were coupled and used as one criterion to partition life cycle classes. This criterion resulted in four distinct life cycle classes: (1) the housewife was present and the average age of the children was under six years of age, (2) the housewife was present and the average age of the children ranged from six to less than 12 years, (3) the housewife was present and the average age of the children ranged from 12 to 17 years, and (4) the housewife was present and the average age of the children was over 17 years.

Two additional life cycle classes were developed based on the age of the homemaker and the lack of presence of children. The age of

the homemaker influences child-bearing capacity and thus, the possibility of changing life cycle classifications. These classifications were:

- (1) the housewife was 40 years of age or under and had no children, and
- (2) the housewife was over 40 years of age and had no children. An additional class was included to segregate households which did not meet the above criteria. This class was primarily composed of households with the female head absent.

Households having a female head of household and children from 12 to 17 years old were hypothesized to consume more of each nutrient than households in the other classifications. Nutrient consumption should be greatest for this group because body demand for nutrients for growth, repair, and activity are probably greater than for other stages in life. Households with no children and the housewife over 40 years of age were expected to consume the smallest quantities of each nutrient relative to the other categories. This would result from decreased activity of such consuming units and the lack of pressure to meet the consumption requirements that the presence of children entails. There was little information available to evaluate the relative impact of the other classes.

Family Size

Variations in food nutrient consumption among households could also be explained by differences in family size. Generally, a household should increase consumption of nutrients as family size increases so as to maintain a relative nutrient balance. If nutrient consumption per household did not increase with an increase in family size, the available nutrients would have to be reallocated among all family members.

Total Meals

Total meals consumed by the household as represented by the number of home, guest, skipped, and free meals could influence the quantity of nutrients consumed by the household. An increase in either home or guest meals would result in increased household nutrient consumption. An increase in either skipped or away meals would result in the opposite effect. There was no information available to gauge the incidence of skipping meals, but intuitively household members could not skip a large number of meals and still maintain their health. Thus, the overall impact of this variable was hypothesized, a priori, to be positive.

Employment Status of the Female

The employment status, employed or not, of the female head of household was hypothesized to influence the consumption of food nutrients. In addition to effects which would be reflected through variations in income, her employment outside the home could limit the amount of time available for planning, selecting, and preparing food for consumption by household members. Thus, the purchase and consumption of more convenience foods was expected by households having an employed female head of household. The precise impact of these relationships on the consumption of each food nutrient was indeterminate because little information was available to evaluate relative to the nutritional content of convenience foods or other results of the female being employed outside the home.

CHAPTER III

SPECIFICATION OF THE STATISTICAL MODEL

This chapter involved the specification of the statistical model to be used in evaluating household consumption of food nutrients. The statistical model was presented in the first section of this chapter and a discussion of the statistical criteria utilized to evaluate and test this model was presented in the latter sections.

I. STATISTICAL MODEL

The theoretical model was developed in Chapter II which represented the impact of various economic and sociological factors on the consumption of food nutrients. The following statistical model was developed from the relationships suggested in the economic model.

$$\begin{aligned} Q_{i,j} = & a + B_1I_1 + B_2I_2 + B_3I_3 + B_4I_4 + B_5I_5 + B_6I_6 + \\ & B_7I_7 + B_8I_8 + B_9I_9 + B_{10}I_{10} + B_{11}I_{11} + B_{12}I_{12} + \\ & B_{13}I_{13} + B_{14}U_1 + B_{15}U_2 + B_{16}R_1 + B_{17}R_2 + B_{18}E_1 + \\ & B_{19}E_2 + B_{20}E_3 + B_{21}L_1 + B_{22}L_2 + B_{23}L_3 + B_{24}L_4 + \\ & B_{25}L_5 + B_{26}L_6 + B_{27}S + B_{28}M + B_{29}F + U. \end{aligned} \quad (2)$$

The dependent variables or quantities ($Q_{i,j}$'s) of each respective nutrient ($i=1...13$) consumed by households situated in the various regions ($j=0...4$) were specified as follows:

$Q_{1,0}-Q_{1,4}$ = calories of food energy consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.

$Q_{2,0}-Q_{2,4}$ = grams of protein consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.

- Q3.0-Q3.4 = grams of animal protein consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q4.0-Q4.4 = grams of vegetable protein consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q5.0-Q5.4 = grams of fat consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q6.0-Q6.4 = grams of carbohydrate consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q7.0-Q7.4 = milligrams of calcium consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q8.0-Q8.4 = milligrams of iron consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q9.0-Q9.4 = international units (I.U.) of vitamin A consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q10.0-Q10.4 = milligrams of thiamine (vitamin B₁) consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q11.0-Q11.4 = milligrams of riboflavin (vitamin B₂) consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q12.0-Q12.4 = milligrams of niacin consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.
- Q13.0-Q13.4 = milligrams of ascorbic acid (vitamin C) consumed per household per week for the United States and the South, Northeast, North Central, and West regions, respectively.

The independent variables were defined as follows:

I_0-I_{13} = disposable income per household categorized into one of 14 groups. The groups were coded using the zero-one analysis of covariance (dummy variable) technique as follows:

- I_0 = 1 if income = under \$1,000 and = 0 otherwise;
- I_1 = 1 if income = \$1,000-1,999 and = 0 otherwise;
- I_2 = 1 if income = \$2,000-2,999 and = 0 otherwise;
- I_3 = 1 if income = \$3,000-3,999 and = 0 otherwise;
- I_4 = 1 if income = \$4,000-4,999 and = 0 otherwise;
- I_5 = 1 if income = \$5,000-5,999 and = 0 otherwise;
- I_6 = 1 if income = \$6,000-6,999 and = 0 otherwise;
- I_7 = 1 if income = \$7,000-7,999 and = 0 otherwise;
- I_8 = 1 if income = \$8,000-8,999 and = 0 otherwise;
- I_9 = 1 if income = \$9,000-9,999 and = 0 otherwise;
- I_{10} = 1 if income = \$10,000-11,999 and = 0 otherwise;
- I_{11} = 1 if income = \$12,000-14,999 and = 0 otherwise;
- I_{12} = 1 if income = \$15,000-24,999 and = 0 otherwise;
- I_{13} = 1 if income = \$25,000 or more and = 0 otherwise.

The under \$1,000 disposable income class (I_0) was omitted to avoid singularity.

U_0-U_2 = degree of urbanization which was grouped into three groups. Again, the zero-one analysis of covariance technique was used. Classes of urbanization were represented as follows:

- U_0 = 1 if rural farm and = 0 otherwise;
- U_1 = 1 if urban and = 0 otherwise;
- U_2 = 1 if rural nonfarm and = 0 otherwise.

The rural farm class (U_0) was omitted.

R_0 - R_2 = race of the household members. Race classes were coded using the zero-one format as follows:

R_0 = 1 if Negro and = 0 otherwise;

R_1 = 1 if White and = 0 otherwise;

R_2 = 1 if other races and = 0 otherwise.

The Negro race classification (R_0) was omitted to prevent singularity.

E_0 - E_3 = level of education attained by the homemaker. The zero-one dummy variable scheme was used to represent the data as follows:

E_1 = 1 if grade school and = 0 otherwise;

E_0 = 1 if high school and = 0 otherwise;

E_2 = 1 if some college and = 0 otherwise;

E_3 = 1 if college graduate and = 0 otherwise.

The high school classification (E_0) was omitted to avoid singularity.

L_0 - L_6 = stage of the household in the family life cycle. The seven discrete family life cycle stages were represented using the zero-one dummy variable format as follows:

L_1 = 1 if no children were present and the housewife was 40 years of age or less (stage 1) and = 0 otherwise;

L_2 = 1 if the housewife was present and the average age of the children was under six years (stage 2) and = 0 otherwise;

L_0 = 1 if the housewife was present and the average age of the children ranged from six to less than 12 years (stage 3) and = 0 otherwise;

L_3 = 1 if the housewife was present and the average age of the children ranged from 12 to 17 years (stage 4) and = 0 otherwise;

L_4 = 1 if the housewife was present and the average age of the children was over 17 years (stage 5) and = 0 otherwise;

L_5 = 1 if no children were present and the housewife was over 40 years of age (stage 6) and = 0 otherwise;

L_6 = 1 if the housewife was absent (stage 7) and = 0 otherwise.

The classification including households in which the housewife was present and the average age of the children was from six to less than 12 years (L_0 --stage 3) was omitted to avoid singularity.

S = economic family size. The variable represented the total number of individuals in a household who depended on a common pool of income for their livelihood.

M = meal adjustment. This variable represented the influence of home, guest, skipped, and away meals.¹⁰ Meal adjustment was computed as the difference between the total number of meals each household reported serving and the number of economic family members multiplied by 21. The 21 represented meal equivalents per week for one household member. In equation form, this may be represented as:

$$\text{Meal adjustment} = \text{Total Home Meals} - (21) (\text{Number of Family Members}). \quad (3)$$

The latter portion of equation 3, (21) (Number of Family Members), represented an "ideal" situation based on the assumption that household members consume three meals per day. Thus, family meals from the home food supply, purchased and free meals from outside the home food supply, and skipped meals were represented by this portion of the equation.

F = employment status of the homemaker as represented by:

F = 1 if employed and = 0 if not employed.

With the aid of economic theory, knowledge of sociological relationships, and other information, hypotheses concerning the signs of the coefficients of these independent variables were formulated.

Income

Since income data were collected by classes, zero-one dummy variable analysis was used. This necessitated the exclusion of one

¹⁰Home and guest meals represented the number of meals consumed from the home food supply. Away meals represented the number of meals eaten from other than the home food supply, either purchased meals or free meals.

income class to avoid singularity. The under \$1,000 disposable income class was omitted. Since the magnitude and sign of the coefficients of the other income classes were based upon the omitted class, the coefficients of the other income classes were hypothesized to be positive for all nutrients except carbohydrate, food energy, and vegetable protein. That is, consumption of each respective nutrient was expected to be greater for all households with income of \$1,000 or more as compared to the households with less than \$1,000 income. This relationship was expected to hold for the United States and for the four regions of the United States. The, a priori, signs of the respective coefficients were hypothesized to be positive; i.e., $B_1-B_{13} > 0$.

The specifications of expected signs for the relationships of the quantities of vegetable protein, carbohydrate, and food energy consumed per household were not easily ascertained. The dilemma involved determining the impact of income on consumption relative to the under \$1,000 class which was omitted. At lower income levels consumption was expected to increase, but at middle and high income levels appropriate signs could not be ascertained. Thus, the expected signs for the income coefficients of the carbohydrate and vegetable protein estimates could be specified as $B_1-B_7 > 0$ and $B_8-B_{13} \geq 0$. Based on the discussion in Chapter II, the signs of the income coefficients for the food energy estimate were indeterminate: i.e., $B_1-B_{13} \geq 0$.

Measures of Income Elasticity

Income elasticity may be measured by either point or arc elasticity. Arc elasticity measures the average percentage change over a range of income and point elasticity reflects the percentage change in quantity at a specific income. Since income data for this study were classified

based on income classes, the arc elasticity formulation was used to compute average elasticities between the respective pairs of income levels. Arc elasticity may be defined mathematically as:

$$E_I = \frac{\Delta Q}{Q_1 + Q_2} \frac{I_1 + I_2}{\Delta I} \quad (4)$$

where:

E_I = income elasticity.

ΔQ = change in quantity over the specified income range.

ΔI = change in income over the specified range.

Q_1 = initial quantity of each respective nutrient.

Q_2 = final quantity of each respective nutrient.

I_1 = initial level of income.

I_2 = final level of income.

Therefore, arc income elasticity is affected by the rate of change of income and quantity and the levels of income and quantity (Watson, 1968, pp. 43 and 89).

Urbanization

Degree of urbanization was segmented into urban, rural farm, and rural nonfarm classes. The rural farm class was omitted to avoid singularity. Rural farm households were expected to consume more of each respective nutrient than their urban or rural nonfarm neighbors. Therefore, the coefficients for the urban and rural nonfarm variables were expected to be negative; i.e., B_{14} and $B_{15} < 0$.

Race

Households were classified into one of three race groups: white, Negro, and other. The use of zero-one dummy variables necessitated

deletion of one class to prevent singularity. The Negro race was excluded. Since there was little information available to evaluate the relative impact of race of the household on nutrient consumption, expected signs of the respective race coefficients were not ascertained. Therefore, the coefficients for the white and other races categories could be either positive or negative; i.e., B_{16} and $B_{17} \geq 0$.

Education of the Homemaker

Educational attainment of the female head of household was categorized into one of four classes: (1) grade school, (2) high school, (3) some college, and (4) college graduate. Little evidence was available to make inferences relative to the hypothesized signs of the respective education coefficients in the estimated nutrient consumption relationships. Generally, increased educational levels should increase nutrient consumption through increased exposure to a broad base of knowledge and through increased ability to comprehend available nutritional information.

Signs and magnitudes of the education coefficients were dependent on the class omitted to avoid singularity. Since the high school class was omitted, the grade school coefficient (B_{18}) was expected to be negative and the some college (B_{19}) and college graduate (B_{20}) coefficients were hypothesized to be positive for all nutrients.

Family Life Cycle

Family life cycle was entered in the model to trace changes in food nutrient consumption as the household unit develops, stabilizes, and declines. A class representing households in a more stable development situation, housewife present and average age of the children was

from six to less than 12 years (stage 3), was excluded from the life cycle category to avoid singularity. Little information was available for evaluation relative to the expected signs of the coefficients. Average age of the children was used as the primary criterion to evaluate the signs of the stages in the family life cycle variable because this figure reflected both the presence and the expected level of activity and growth of the children which could affect nutrient consumption. Households included in the classes with no children present (stages 1 and 6) and the class with the housewife absent (stage 7) were hypothesized to have negative coefficients while the classification with the housewife present and the average age of the children from 12 to 17 years (stage 4) was hypothesized to be positive. These relationships reflected the belief that nutrient consumption per household increases because of the presence of children and of increases in their average age. The relative signs of the other coefficients (stages 2 and 5) were indeterminate. Thus, the signs were hypothesized to be negative for B_{21} , B_{25} , and B_{26} , positive for B_{23} , and indeterminate for B_{22} and B_{24} .

Family Size

Family size was hypothesized to have a positive impact on the consumption of each respective food nutrients; that is, as the size of the family increases, household consumption of nutrients should increase. Thus, the coefficient representing the impact of family size (B_{27}) should be positive.

Meal Adjustment

Meal adjustment was the variable used to measure the composite impact of the number of home, guest, away, and skipped meals on nutrient

consumption. A mean of the meal adjustment variable equal to zero would indicate that the family ate no meals away from home, had no guest, and skipped no meals or served as many guest meals at home as the family members ate away from home and skipped. A negative mean value would indicate that consumption of a larger number of meals away from home or skipped meals than guest meals served at home. A positive mean value would indicate more guest meals were served at home than meals eaten away from home or skipped.

Since an increase in either home or guest meals would increase nutrient consumption and these were expected to have a greater impact on nutrient consumption than away or skipped meals, the coefficient of the meal adjustment variable (B_{28}) was hypothesized to be positive. The influence of skipped meals was expected to be minimal because each household member must consume an adequate quantity of food nutrients to maintain the individual's health.

Employment Status of the Female

The expected sign of the employment status of the female head of household was indeterminate. The effects of the housewife maintaining regular work hours outside the home could not be ascertained. An employed female could have less time to plan, purchase, and prepare food. There was little information available to evaluate the impact of these effects on household nutrient consumption. These households could purchase more convenience foods, eat away from home more often, or choose among other alternatives. Thus, the coefficient for the employment status of the female head of household could be either positive or negative; i.e., $B_{29} \geq 0$.

II. FUNCTIONAL FORM OF THE NUTRIENT CONSUMPTION RELATIONSHIP

Multiple regression analysis was used to fit linear models to the available data for the various food nutrients. The linear function form was chosen because of the computational manageability afforded by this form. The primary operational benefits of this form are: (1) results at the extremes of the data may be more meaningful than with other forms, (2) over a certain range of data linear relationships could closely approximate a curved line, and (3) linear relationships allow elasticities to be different at various points on the estimated relationship.

The linear functional form was theoretically satisfactory and consistent with, a priori, expectations concerning the behavior of the household with respect to nutrient consumption. Since the income data for this study were in discrete classes, zero-one dummy variables were used to estimate the income coefficients. Graphical illustrations of the quantities of each nutrient consumed with changes in income, ceteris paribus, could be used to reflect an approximation of a curved relationship. Burk (1961, p. 16) has found considerable evidence in food research studies that income elasticities are lower in the higher income ranges. These findings could be relevant for nutrient consumption relationships. Since the linear form affords the estimation of different elasticities at various income levels, this form was used rather than other forms with continuous income data developed from midpoints of income classes.

III. STATISTICAL CONSIDERATIONS

The primary objective of this study was to isolate and analyze the impact of several economic and sociological variables on the consumption of various food nutrients. As was stated previously, multiple regression analysis was the statistical technique used to accomplish this objective. This technique permitted the disentanglement of the impacts of several factors which may be producing a single result, nutrient consumption in this case.

Dummy Variable Technique

Dummy variables are generally used to reflect qualitative variables, temporal effects, spatial effects, or broad groupings of quantitative variables (Johnston, 1972, pp. 176-177). Dummy variables were included in the models in this study using the zero-one format. This reflected the assumption that within a dummy category each class was mutually exclusive. That is, each observation of the variable for which the dummy system was created must fall into only one class. Also, the assumption that the various dummy variable categories are independent of each other must be in force; that is, there would be no interaction between categories (Tomek, 1963, p. 814).

The latter assumption involves changes in the intercept term of the regression equation without changing slope coefficients. That is, the impact of the various dummy variable categories on the dependent variable are additive rather than interactive. If two dummy variable categories or a dummy variable category and a continuous variable are believed to have a multiplicative effect, interaction terms can be formulated to allow for changes in slope. The primary shortcoming of the use

of interaction terms is that it may be expensive in terms of degrees of freedom.

Statistical significance tests of dummy variables differs slightly from normal significance tests. Use of dummy variables entails the elimination of one class in each category to circumvent the problem of singularity of the $(X'X)$ matrix. Statistical significance of each class is measured relative to the base or omitted class using the t-test. Signs of the respective coefficients are dependent upon which class is omitted.

The relative impact of each dummy class on the dependent variable could be ascertained by comparing the relative magnitudes of the coefficients. The largest relative coefficient within a category indicates the class which has the largest impact on the dependent variable.

Statistical Criteria

The adequacy of statistical models are generally evaluated based on such criteria as: (1) the coefficient of multiple determination (R^2), (2) the number of significant variables, and (3) the number of coefficients with proper signs. The coefficient of multiple determination reflects the percentage of the variability in the dependent variable that can be explained by variations in the independent variables. This measure is generally used to reflect the "goodness of fit" of a model (Kane, 1968, pp. 268-270).

Statistical significance of the various coefficients of the independent variables may be judged by using the t-test. Choice of the level of significance to use as a criterion for rejection of the null hypothesis that the coefficient is not different from zero is based upon the

degree of precision desired. For this study, the null hypothesis was rejected at the .10 level. Probabilities at the .05 and .01 levels were presented in the tables. All references to significance in the text refer to the .10 level.

Analysis of proper signs primarily involves the consideration of relevant economic and sociological theory. The adequacy of the estimated models in reflecting nutrient consumption patterns of households were examined statistically using these three criteria.

Multicollinearity

The utilization of multiple regression analysis entails the assumption that explanatory or independent variables are not associated with each other.¹¹ Multicollinearity is a problem when this assumption is violated. Presence of multicollinearity limits inferences concerning the individual impacts of the explanatory variables on some specific dependent variable (Brennan, 1965, p. 380). In economic analysis, multicollinearity is more a problem of degree than of presence or absence (Kmenta, 1971, p. 380).

The primary consequences of multicollinearity are problems of disentangling the relative influences of the various explanatory variables and dropping variables because coefficients are not significantly different from zero. Multicollinearity may result in large standard errors for the coefficients involved. Since significance tests are based on a

¹¹Kane (1968) discussed on page 355 all the least-squares assumptions. Multicollinearity results from the violation of one of these assumptions; that is, the independent variables are not independent of each other. Kmenta (1971, pp. 380-391), Hu (1973, pp. 73-77), and Thomas (1972, pp. 57-62) discussed the problems related to the incidence of multicollinearity.

comparison of the quotient of the standard error of the coefficient divided into the value of the coefficient with a value at a specified significance level and degrees of freedom, coefficients would be insignificant more often when multicollinearity is present (Johnston, 1972, p. 160).

Economic and sociological factors may be related to each other or to other economic and sociological factors. The problem is one of ascertaining which independent variables are highly related and the degree of relationship. The magnitude of simple correlation coefficients between explanatory variables is one criterion used to detect the presence of multicollinearity. A large simple correlation between two independent variables would indicate that the variables were highly related (Johnston, 1972, pp. 163-168). Another method which could be used is an evaluation of the entry and exit of independent variables when using stepwise regression analysis.

The impact of multicollinearity can be lessened by excluding one of the highly related variables from the model and re-estimating the coefficients or by utilizing proxy variables. Care must be exercised in eliminating variables from the model for fear of eliminating a variable which should be included based on economic theory.

CHAPTER IV

STATISTICAL RESULTS

This chapter included an analysis of the estimated nutrient consumption relationships for the United States and four regions of the United States utilizing the statistical criteria discussed in Chapter III. The four regions of the United States were the South, Northeast, North Central, and West. United States and regional models representing household consumption relationships for food energy, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamine (vitamin B₁), riboflavin (vitamin B₂), niacin, and ascorbic acid (vitamin C) were evaluated in the first section of this chapter, while separate models representing the animal and vegetable components of protein consumption were analyzed in the latter section.

Primary emphasis in each of the two sections was devoted to analyzing the consistency of the estimated relationships between the specified socioeconomic variables and food nutrient consumption and the, a priori, relationships hypothesized in Chapter III. The statistical significance of the various independent variables in the respective models was evaluated using the Student's t distribution. Variables were judged at the .01, .05, and .10 significance levels to determine whether the coefficients were significantly different from zero in the case of continuous variables or to determine whether the coefficients were significantly different from the omitted or base class in the case of dummy variables. More specifically, these tests were conducted to determine which socioeconomic characteristics of the household or of the household members affected household food nutrient consumption.

I. FOOD NUTRIENT CONSUMPTION MODELS

Characteristics of the household hypothesized to affect the consumption of food nutrients were: income, urbanization, race, stage in the family life cycle, family size, and family eating habits (i.e., the meal adjustment variable, page 35). Characteristics of the female head of the household hypothesized to influence the consumption of food nutrients were educational attainment and employment status. These characteristics of the household and female head of household were included as independent variables in the respective food nutrient models for the United States and the four regions of the United States.

Estimated coefficients and standard errors of these respective coefficients were presented in Tables 2 through 12. Also, the percentage of variability in consumption of each respective nutrient explained by variations in these independent variables was represented by the respective R^2 's in Tables 2 through 12.

In all United States and regional food nutrient consumption models, the selected characteristics of the household and homemaker explained a satisfactory amount of the variation in consumption of each respective food nutrient. The explained variation for all nutrients except vitamins A and C for the United States and regional models was greater than 53 percent, Tables 2, 3, 4, 5, 6, 7, 9, 10, and 11. The percentages of variation in household consumption of vitamins A and C explained by variations of the independent variables in these models were not as large, Tables 8 and 12. Coefficients of determination (R^2 's) were .19 and .32 for the United States models representing vitamin A and vitamin C consumption, respectively. Similar results were obtained in the regional models.

Table 2. Estimates of United States and Regional Consumption Relationships for Food Energy in Calories, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-Intercept	26632.19	2432.64 ^d		25059.83	3749.58 ^d		29241.24	6161.55 ^d		26802.67	5073.75 ^d		27013.62	7746.72 ^d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	2325.58	1755.63		4350.25	2457.79 ^b		1663.58	4949.65		-525.17	3612.25		-1393.70	5862.53	
\$2,000-2,999	3618.48	1753.95 ^c		3229.89	2490.63		2674.30	4825.11		6841.44	3612.51 ^b		-1334.06	5811.79	
\$3,000-3,999	7073.10	1755.98 ^d		8303.24	2533.05 ^d		9821.48	4705.96 ^c		2056.47	3643.07		3517.48	5827.73	
\$4,000-4,999	8506.66	1779.82 ^d		12466.54	2663.07 ^d		7489.55	4695.26		4423.53	3612.68		2896.90	5784.67	
\$5,000-5,999	9093.62	1717.50 ^d		11286.26	2672.23 ^d		11107.64	4563.01 ^c		5054.15	3412.35		5560.71	5621.54	
\$6,000-6,999	9595.48	1816.86 ^d		12851.94	2919.39 ^d		9537.32	4679.35 ^c		6144.87	3568.36 ^b		5679.10	5862.22	
\$7,000-7,999	11934.73	1873.22 ^d		11994.92	3104.10 ^d		16210.32	4737.47 ^d		6730.43	3672.11 ^b		11157.63	5860.42 ^b	
\$8,000-8,999	12334.62	1987.12 ^d		12434.67	3362.27 ^d		12676.53	4914.31 ^d		10828.00	3855.77 ^b		9916.99	6052.51 ^b	
\$9,000-9,999	11236.48	2160.40 ^d		19498.02	3973.85 ^d		12923.81	5068.06 ^d		6015.37	4218.04		3760.45	6149.44	
\$10,000-11,999	11228.30	2143.15 ^d		12532.44	3807.55 ^d		12788.26	5140.41 ^c		9086.82	4089.75 ^c		6743.89	6293.16	
\$12,000-14,999	10039.55	2336.08 ^d		16206.05	4523.06 ^d		7235.49	5275.98		8409.24	4464.78 ^b		7058.67	6650.84	
\$15,000-24,999	9832.31	2642.08 ^d		15389.51	4877.61 ^d		12374.31	5856.92 ^c		5025.14	5245.44 ^b		2187.06	6900.18 ^d	
\$25,000 or more	26623.71	3985.41 ^d		29819.54	6925.18 ^d		20484.47	9346.99 ^c		15449.06	8272.14 ^b		34404.23	8816.15 ^d	
Urbanization:															
Rural farm ^a															
Urban	-17065.25	818.22 ^d		-15041.98	1359.66 ^d		-16005.19	2508.02 ^d		-18586.43	1444.62 ^d		-17112.34	2485.24 ^d	
Rural nonfarm	-11037.28	976.48 ^d		-8820.11	1522.48 ^d		-12794.97	2723.39 ^d		-10980.99	1742.36 ^d		-13043.73	3561.89 ^d	
Race:															
Negro ^a															
White	1668.59	1068.65		5806.39	1576.29 ^d		-6364.66	2286.68 ^d		169.88	2650.41		-1764.77	3442.12	
Other	1728.81	2424.19		6039.85	5157.94		1581.72	4263.93		-5654.78	6030.43		-5373.11	5055.05	
Education:															
Grade school	1186.29	815.15		151.03	1399.89		2944.48	1679.34 ^b		2259.79	1489.42		26.35	2514.18	
High school ^a															
Some college	-81.48	1107.93		-1471.14	2138.87		-2172.81	2295.59		3254.78	2081.79		96.71	2393.83	
College graduate	-3298.26	1368.06 ^c		-7736.51	2506.81 ^d		1445.11	3063.23		-2387.36	2563.51		-3509.44	2968.34	
Life Cycle:															
Stage 1	-4888.68	1927.16 ^d		-5289.04	3496.45		-3520.44	3837.91		-1622.22	3657.59		-6180.14	4831.21	
Stage 2	-8585.17	1070.98 ^d		-10209.79	1881.25 ^d		-5564.71	2219.36 ^c		-7322.66	1940.27 ^d		-10279.02	2863.10 ^d	
Stage 3 ^a															
Stage 4	6089.56	1190.00 ^d		2750.57	2012.48		9655.71	2517.85 ^d		9833.26	2218.39 ^d		3556.91	3215.73	
Stage 5	846.18	1949.58		-752.31	3347.57		6283.14	4186.14		1369.53	3574.13		-3918.97	5083.83	
Stage 6	-9310.74	1333.84 ^d		-9753.08	2283.56 ^d		-8365.10	2814.50 ^d		-7720.92	2481.34 ^d		-7710.24	3639.34 ^c	
Stage 7	-11927.01	2416.02 ^d		-10596.86	4335.06 ^c		-8948.25	5224.74 ^b		-15039.92	4357.09 ^d		-7710.99	6220.66	
Family Size	17391.32	246.00 ^d		16979.56	400.87 ^d		17048.43	533.25 ^d		18118.45	472.44 ^d		19324.23	708.71 ^d	
Meal Adjustment	963.62	22.47 ^d		945.73	37.24 ^d		514.92	49.65 ^d		981.61	41.91 ^d		1036.72	61.21 ^d	
Homemaker Employed	1581.02	741.25		1333.36	1287.10		1800.04	1483.57		2278.92	1394.73		1219.45	1974.87	
R ²			.69			.67			.69			.69			.73

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 3. Estimates of United States and Regional Consumption Relationships for Protein in Grams, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variable	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	672.99	79.21 ^d		665.96	117.08 ^d		822.14	207.51 ^d		736.02	164.91 ^d		1035.18	262.75 ^d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	109.33	57.16 ^b		171.91	76.74 ^c		32.43	166.69		45.96	117.41 ^d		-30.18	198.85	
\$2,000-2,999	145.66	57.11 ^c		84.77	77.77		27.14	162.50		309.37	117.41 ^d		101.58	197.13	
\$3,000-3,999	274.03	57.17 ^d		296.57	79.09 ^d		227.32	158.49		164.04	119.41		202.92	197.67	
\$4,000-4,999	372.10	57.95 ^d		476.65	83.15 ^d		280.23	158.12 ^b		238.14	117.42 ^c		153.52	196.21 ^b	
\$5,000-5,999	428.80	55.92 ^d		438.16	83.44 ^d		392.71	153.67 ^c		303.39	110.91 ^d		319.07	190.67 ^b	
\$6,000-6,999	471.30	59.16 ^d		570.10	91.15 ^d		322.43	157.59 ^c		367.57	115.98 ^d		331.21	198.84 ^b	
\$7,000-7,999	551.19	60.99 ^d		510.26	96.92 ^d		553.28	159.55 ^d		423.19	119.35 ^d		464.46	193.77 ^c	
\$8,000-8,999	540.54	64.70 ^d		526.12	104.98 ^d		405.37	165.50 ^c		498.53	125.32 ^d		396.53	205.29 ^b	
\$9,000-9,999	541.03	70.34 ^d		819.83	124.08 ^d		475.37	170.68 ^d		330.98	137.10 ^c		255.70	208.58	
\$10,000-11,999	572.15	69.78 ^d		623.15	118.89 ^d		513.29	173.11 ^d		477.71	132.93 ^d		332.27	213.45 ^c	
\$12,000-14,999	543.07	76.06 ^d		785.92	141.23 ^d		329.97	177.68 ^b		354.90	145.12 ^c		486.96	225.58 ^c	
\$15,000-24,999	542.16	86.03 ^d		776.74	152.30 ^d		427.81	197.25 ^c		403.65	170.49 ^c		248.85	234.04	
\$25,000 or more	1039.66	129.76 ^d		1050.47	216.23 ^d		811.59	314.78 ^d		806.43	288.86 ^d		1255.43	299.03 ^d	
Urbanization:															
Rural farm ^a	-327.56	26.64 ^d		-388.72	42.75 ^d		-331.58	84.46 ^d		-457.93	46.95 ^d		-478.27	84.30 ^d	
Urban	-268.14	31.79 ^d		-177.98	47.54 ^d		-348.62	91.72 ^d		-284.07	56.63 ^d		-408.62	120.81 ^d	
Rural nonfarm															
Race:															
Negro ^a															
White	135.11	34.80 ^d		209.00	49.22 ^d		-122.04	77.00		13.70	86.14		-112.39	116.75	
Other	166.61	78.93 ^c		311.31	161.05 ^b		42.11	143.60		-68.07	196.00		-205.09	171.46	
Education:															
Grade school	-27.68	26.54		-37.51	43.71		38.45	56.56		34.90	48.41		-70.87	85.28	
High school ^a															
Some college	17.01	36.07		-17.64	66.78		-105.32	77.31		125.92	67.66 ^b		52.31	81.16	
College graduate	-51.73	44.54		-209.70	78.27 ^d		118.55	103.16		22.53	83.32		-44.13	100.68	
Life Cycle:															
Stage 1	-249.97	62.75 ^d		-269.45	109.17 ^c		-183.12	129.25		-58.59	118.88		-362.07	163.87 ^c	
Stage 2	-240.52	34.87 ^d		-251.87	58.74 ^d		-87.44	74.74		-256.49	63.06 ^d		-346.07	97.11 ^d	
Stage 3a															
Stage 4	215.38	38.75 ^d		96.36	62.84		367.90	84.79 ^d		326.17	72.10 ^d		221.64	109.07 ^c	
Stage 5	84.09	63.48 ^c		36.00	104.52		237.96	140.98 ^b		125.78	116.17		-41.70	172.43	
Stage 6	-257.81	43.43 ^d		-296.29	71.30 ^d		-148.21	94.79		-210.87	80.65 ^d		-252.28	123.44 ^c	
Stage 7	-298.95	78.66 ^d		-304.17	135.36 ^c		-167.77	175.96		-404.76	141.62 ^d		-263.55	210.99	
Family Size	521.51	8.01 ^d		480.64	12.52 ^d		530.17	17.96 ^d		572.83	15.36 ^d		585.78	24.04 ^d	
Meal Adjustment	31.60	0.73 ^d		30.99	1.16 ^d		28.68	1.67 ^d		32.07	1.36 ^d		34.96	2.08 ^d	
Homemaker Employed	21.76	24.14		23.66	40.19		37.50	49.96		58.79	45.33		-5.65	66.98	
R ²	.65			.63			.65			.68			.70		

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 4. Estimates of United States and Regional Consumption Relationships for Fat in Grams, Spring 1965; Including Regression Coefficients, Standard Errors and R²'s.

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-Intercept	1464.60	128.85 ^d		1362.20	199.16 ^d		1678.41	327.25 ^d		1564.35	261.81 ^d		1804.46	419.22 ^d	
Income:															
Under \$1,000 ^a	147.72	92.99		175.70	130.55		135.28	262.88		81.09	186.40		1.68	317.26	
\$1,000-1,999	256.90	92.90 ^d		233.16	132.29 ^c		157.19	256.27		384.45	186.41 ^c		33.40	314.51	
\$2,000-2,999	438.84	93.01 ^d		485.86	134.54 ^d		527.89	249.94 ^c		173.61	187.99		230.54	315.37	
\$3,000-3,999	601.81	94.27 ^d		808.25	141.45 ^d		560.17	249.37 ^c		284.82	186.42		294.63	313.04	
\$4,000-4,999	699.50	90.97 ^d		793.67	141.94 ^d		758.67	242.35 ^d		512.31	176.08 ^d		361.41	304.22 ^b	
\$5,000-5,999	740.45	96.23 ^d		890.56	155.06 ^d		660.24	248.52 ^d		567.25	184.13 ^d		497.60	317.24	
\$6,000-6,999	874.98	99.22 ^d		837.83	164.88 ^d		1066.17	231.61 ^d		597.63	189.48 ^d		774.38	317.16 ^c	
\$7,000-7,999	964.92	105.25 ^d		959.88	178.59 ^d		807.06	261.00 ^d		940.65	198.93 ^d		824.86	327.54 ^c	
\$8,000-8,999	874.93	114.43 ^d		1294.82	211.07 ^d		938.22	269.17 ^d		632.97	217.65 ^d		368.30	332.78	
\$9,000-9,999	861.11	113.51 ^d		1030.95	202.24 ^d		821.51	273.01 ^d		692.81	211.03 ^d		609.53	340.56 ^b	
\$10,000-11,999	901.51	123.73 ^d		1182.38	240.23 ^d		768.51	280.21 ^d		773.03	230.39 ^d		666.59	359.92 ^b	
\$12,000-14,999	906.82	139.94 ^d		1404.24	259.08 ^d		871.47	311.07 ^d		516.58	270.67 ^d		428.81	373.41	
\$15,000-24,999	1780.26	211.09 ^d		1698.84	367.84 ^d		1477.84	496.43 ^d		1079.16	426.85 ^d		2432.19	477.09 ^b	
Urbanization															
Rural farms	-749.50	43.34 ^d		-601.99	72.22 ^d		-759.23	133.20 ^d		-809.20	74.54 ^d		-1011.50	134.49 ^d	
Urban	-495.83	51.72 ^d		-321.82	80.87 ^d		-723.29	144.64 ^d		-506.17	89.91 ^d		-808.98	192.76 ^d	
Rural nonfarm															
Race:															
Negro ^a	3.46	56.60		232.12	83.73 ^d		-407.96	121.45 ^d		-219.76	136.76		-261.64	186.27	
White	-271.47	128.40 ^c		108.99	273.97		-343.47	226.46		-917.57	311.18 ^d		-691.05	273.56 ^d	
Other															
Education:															
Grade school	-2.11	43.17		-115.80	74.36		169.84	89.19 ^b		117.77	76.86		-78.49	136.06	
High school ^a	-23.07	58.68		-154.84	113.61		-79.97	121.92		157.00	107.42		19.96	129.49	
Some college	-224.90	72.46 ^d		-416.02	133.15 ^d		3.57	162.69		-220.04	132.28 ^b		-245.23	160.63	
College graduate															
Life Cycle:															
Stage 1	-332.21	102.07 ^d		-339.08	185.72 ^b		-301.64	203.84		-106.86	188.73		-349.85	261.45	
Stage 2	-360.11	56.73 ^d		-440.23	99.92 ^d		-133.74	117.87		-353.70	100.20 ^d		-415.90	154.94 ^d	
Stage 3 ^a															
Stage 4	356.48	63.03 ^d		213.72	106.89 ^c		559.94	133.73 ^d		462.60	114.47 ^d		341.69	174.02 ^c	
Stage 5	118.97	103.26		73.76	177.81		422.47	222.33 ^b		89.26	184.43		-143.40	275.12	
Stage 6	-502.74	70.65 ^d		-511.51	121.29 ^d		-458.30	149.48 ^d		-423.76	128.04 ^d		-393.45	196.95 ^c	
Stage 7	-672.38	127.96 ^d		-654.12	230.26 ^d		-562.63	277.49 ^c		-803.14	224.83 ^d		-445.44	336.64	
Family Size	725.44	13.03 ^d		696.67	21.29 ^d		690.93	28.32 ^d		790.85	24.38 ^d		832.82	38.35 ^d	
Meal Adjustment	45.96	1.19 ^d		44.34	1.98 ^d		42.53	2.64 ^d		46.30	2.16 ^d		53.69	3.31 ^d	
Homemaker Employed	87.81	39.26 ^c		110.64	68.37		132.82	78.79 ^b		66.07	71.97		71.88	106.87	
R ²		.61			.58			.60			.64			.67	

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 5. Estimates of United States and Regional Consumption Relationships for Carbohydrate in Grams, Spring 1965; Including Regression Coefficients, Standard Errors, and R^2 's

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	2767.02	311.47 ^d		2603.92	488.22 ^d		2854.59	762.64 ^d		2552.92	661.66 ^d		1713.19	949.59 ^b	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	141.86	224.79		524.29	320.02		83.53	612.64		-360.64	471.07		-331.05	718.62	
\$2,000-2,999	173.39	224.57		194.14	324.29		283.60	597.22		540.14	471.10		-558.87	712.41	
\$3,000-3,999	512.96	224.83 ^c		702.99	329.82 ^c		994.48	582.47 ^b		-25.68	475.09		163.54	714.36	
\$4,000-4,999	402.61	227.88 ^b		845.41	346.75 ^c		269.87	581.15		240.97	471.13		-123.65	709.08	
\$5,000-5,999	254.34	219.90		630.13	347.93 ^b		238.96	564.78		-189.99	445.00		215.78	689.09	
\$6,000-6,999	225.35	232.63		639.75	380.12 ^b		443.05	579.18		-123.78	465.35		-118.34	718.59	
\$7,000-7,999	410.06	239.84 ^b		640.09	404.17		899.33	586.37		-148.30	478.88		551.35	718.37	
\$8,000-8,999	315.50	254.43		395.62	437.79		819.80	608.26		21.90	502.83		163.73	741.91	
\$9,000-9,999	227.78	276.61		1112.09	517.42 ^c		452.60	627.29		-304.04	550.07		-202.52	753.79	
\$10,000-11,999	217.21	274.40		186.11	495.76		579.41	636.25		209.21	533.34		-166.58	771.41	
\$12,000-14,999	-203.67	299.11		581.99	588.93		-487.92	653.03		-178.32	582.25		-394.26	815.26	
\$15,000-24,999	-329.74	338.29		-123.33	635.09		438.57	724.93		-685.77	684.05		-902.57	845.82	
\$25,000 or more	1339.28	510.28 ^d		2623.00	901.70 ^d		601.32	1156.91		585.17	1078.76		1027.47	1080.68	
Urbanization:															
Rural farm ^a															
Urban	-2364.29	104.76 ^d		-2216.13	177.04 ^d		-2141.56	310.43 ^d		-2513.72	188.39 ^d		-1642.66	304.64 ^d	
Rural nonfarm	-1431.31	125.03 ^d		-1338.17	198.24 ^d		-1540.30	337.08 ^d		-1382.29	227.22 ^d		-1132.37	436.61 ^d	
Race:															
Negro ^a															
White	373.41	136.83 ^d		840.47	205.24 ^d		-514.19	283.03 ^b		566.29	345.64		292.71	421.93	
Other	922.92	310.39 ^d		1044.94	671.59		1052.35	527.76 ^b		919.39	786.42		433.50	619.64	
Education:															
Grade school	302.57	104.37 ^d		328.86	182.27 ^b		267.72	207.86		252.40	194.23		260.01	308.19	
High school ^a															
Some college	49.51	141.86		12.92	278.49		-188.51	284.13		382.42	271.48		-87.44	293.31	
College graduate	-257.56	175.16		-838.58	326.40 ^d		301.44	379.15		-137.81	334.31		-213.54	363.86	
Life Cycle:															
Stage 1	-347.25	246.75 ^d		-427.36	455.26 ^d		-69.56	475.03 ^d		-227.04	476.98		-457.76	592.21 ^d	
Stage 2	-1132.53	137.13 ^d		-1325.68	244.95 ^d		-1013.49	274.70 ^d		-808.23	253.03 ^d		-1295.24	350.96 ^d	
Stage 3 ^a															
Stage 4	490.73	152.36 ^d		75.68	262.04		773.43	311.64 ^c		1094.33	289.30 ^d		-21.17	394.18	
Stage 5	-243.12	249.62		-461.06	435.87		132.09	518.13		23.81	466.10		-758.28	623.17	
Stage 6	-978.98	170.78 ^d		-1071.37	297.33 ^d		-892.64	348.59 ^c		-779.56	-323.59 ^c		-770.24	446.11 ^b	
Stage 7	-1366.06	309.34 ^d		-1068.68	564.54 ^b		-983.25	646.68		-1609.14	568.20 ^d		-1040.45	762.52	
Family Size	2217.36	31.50 ^d		2203.78	52.20 ^d		2218.60	66.00 ^d		2210.18	61.61 ^d		2419.37	86.87 ^d	
Meal Adjustment	106.82	2.88 ^d		107.45	4.85 ^d		104.48	6.15 ^d		109.61	5.47 ^d		103.89	7.50 ^d	
Homemaker Employed	190.36	94.91 ^c		83.64	167.59		149.80	183.63		353.77	181.89 ^b		160.57	242.08	
R^2		.67		.66			.69			.65			.72		

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 6. Estimates of United States and Regional Consumption Relationships for Calcium in Milligrams, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	7427.40	1017.64 ^d		5563.41	1675.58 ^d		10438.40	2465.81 ^d		5674.44	2000.12 ^d		5285.01	3142.13 ^b	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	1460.78	734.43 ^b		2875.44	1098.32 ^d		459.22	1960.82		499.19	1423.98		-153.42	2377.89	
\$2,000-2,999	1191.16	733.72		931.45	1112.99		1779.39	1930.98		2812.94	1424.08 ^c		385.69	2557.31	
\$3,000-3,999	1554.14	734.57 ^c		2330.62	1131.95 ^c		1014.97	1883.29		1356.96	1436.13		1628.28	2363.77	
\$4,000-4,999	1591.46	744.55 ^c		2538.14	1190.05 ^c		1663.76	1879.01		1823.89	1424.15		542.58	2346.31	
\$5,000-5,999	2112.60	718.47 ^d		2813.24	1194.17 ^c		2214.77	1826.09		1994.22	1345.18		3044.64	2280.14	
\$6,000-6,999	1703.28	760.04 ^c		2035.91	1304.59		2362.68	1872.65		1571.30	1406.68		1926.12	2377.76	
\$7,000-7,999	3164.06	783.61 ^d		2526.53	1367.13 ^b		4091.99	1895.90 ^c		3353.72	1447.58 ^c		3894.34	2377.03	
\$8,000-8,999	2594.68	831.26 ^d		2366.26	1502.50		2544.63	1966.68		3675.55	1519.98 ^c		3407.69	2454.95	
\$9,000-9,999	3030.49	903.75 ^d		5454.75	1775.80 ^d		3187.87	2028.20		1780.89	1662.79		2957.59	2494.26	
\$10,000-11,999	3263.22	896.53 ^d		4401.82	1701.48 ^d		3844.82	2057.16 ^b		3884.29	1612.22 ^c		899.16	2552.56	
\$12,000-14,999	2916.10	977.24 ^d		3427.81	2021.22 ^b		2586.80	2111.41		3580.34	1760.05 ^c		3241.30	2697.63	
\$15,000-24,999	1967.95	1105.25 ^b		2329.96	2179.66		2630.69	2343.90		1584.08	2067.80		3115.34	2798.77	
\$25,000 or more	6673.72	1667.20 ^d		7818.83	3094.66 ^d		6504.92	3740.61 ^b		6489.21	3260.95 ^c		6732.19	3575.90 ^b	
Urbanization:															
Rural farm ^a															
Urban	-4700.41	342.28 ^d		-5126.49	607.59 ^d		-4461.89	1003.69 ^d		-4079.79	569.48 ^d		-3231.96	1008.03 ^d	
Rural nonfarm	-2895.19	408.49 ^d		-3044.56	680.35 ^d		-3328.58	1089.88 ^d		-1955.47	686.85 ^d		-3382.17	1444.73 ^c	
Race:															
Negro ^a															
White	4110.29	447.05 ^d		5670.43	704.40 ^d		334.22	915.11		5731.92	1044.81 ^d		4413.35	1396.15 ^d	
Other	3269.96	1014.10 ^d		2947.61	2304.93		2144.00	1706.40		5154.94	2377.25 ^c		1961.55	2050.37	
Education:															
Grade school	279.20	341.00		860.14	625.57		-172.18	672.06		-57.17	587.14		-732.03	1019.77	
High school															
Some college	757.85	463.48		-454.58	955.80		-334.02	918.68		3295.22	820.66 ^d		381.82	970.55	
College graduate	1049.12	572.29 ^b		-1051.45	1120.22		2514.79	1225.89 ^c		2495.35	1010.56 ^c		670.82	1203.98	
Life Cycle:															
Stage 1	-4295.37	806.18 ^d		-2610.22	1562.46 ^b		-4595.73	1535.91 ^d		-4789.98	1441.85 ^d		-6257.76	1959.58 ^d	
Stage 2	-1393.41	448.02 ^d		-1398.49	840.68 ^b		-271.54	888.17		-1488.95	764.87 ^b		-2549.24	1161.29 ^c	
Stage 3a															
Stage 4	1402.70	497.81 ^d		1331.60	899.32		1991.53	1007.63 ^c		1936.36	874.51 ^c		-202.94	1304.32	
Stage 5	-1591.55	815.56 ^b		-234.41	1495.92		-1825.44	1675.27		-3385.00	1408.95 ^c		-1489.25	2062.04	
Stage 6	-4254.28	557.98 ^d		-2708.10	1020.46 ^d		-4570.35	1126.35 ^d		-5149.00	973.17 ^d		-4873.07	1476.14 ^d	
Stage 7	-5361.93	1010.68 ^d		-4259.86	1937.21 ^c		-4713.33	2090.91 ^c		-6025.64	1717.60 ^d		-4717.61	2523.15 ^b	
Family Size	5600.17	102.91 ^d		5686.28	179.14 ^d		5487.92	213.40 ^d		5377.57	186.24 ^d		6179.15	287.46 ^d	
Meal Adjustment	289.18	9.40 ^d		301.89	16.64 ^d		304.56	19.87 ^d		268.43	16.52 ^d		254.42	24.83 ^d	
Homemaker Employed	387.74	310.08		393.63	575.17		1079.51	593.72		197.11	549.81		-275.26	801.02	
R ²	.57			.53			.62			.60			.65		

aOmitted to avoid singularity. bSignificant at .10 level. cSignificant at .05 level. dSignificant at .01 level.

Table 7. Estimates of United States and Regional Consumption Relationships for Iron in Milligrams, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-Intercept	128.70	16.59d		98.58	24.99d		121.04	42.64d		182.73	35.37d		176.52	52.68d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	17.45	11.97		37.54	16.38 ^c		12.85	34.25		-21.58	25.19		-2.07	39.87	
\$2,000-2,999	18.26	11.96		15.16	16.60		1.77	33.39		29.45	25.19		17.51	39.52	
\$3,000-3,999	40.72	11.98d		47.19	16.88d		50.06	32.56		-3.32	25.40		55.09	39.63	
\$4,000-4,999	51.78	12.14d		76.23	17.75d		40.47	32.49		18.08	25.19		34.34	39.34	
\$5,000-5,999	49.40	11.71d		59.93	17.81d		64.67	31.58 ^c		10.91	23.79		54.78	38.23	
\$6,000-6,999	57.15	12.39d		84.15	19.46d		43.82	32.38		30.04	24.88		44.15	39.87	
\$7,000-7,999	56.82	12.77d		65.11	20.69d		76.96	32.78 ^c		10.57	25.60		73.56	39.85b	
\$8,000-8,999	59.66	13.55d		67.55	22.41d		52.31	34.01		38.33	26.88		50.39	41.16	
\$9,000-9,999	55.90	14.73d		121.84	25.48d		59.10	35.07b		3.21	29.41		29.25	41.82	
\$10,000-11,999	68.14	14.62d		71.19	25.37d		90.98	35.57d		43.20	28.51		34.11	42.80	
\$12,000-14,999	51.81	15.93d		113.96	30.14d		31.80	36.51		11.88	31.13		48.14	45.26	
\$15,000-24,999	50.96	18.02d		92.14	32.51d		67.92	40.53b		22.15	36.57		-9.02	46.92	
\$25,000 or more	150.61	27.18d		155.88	46.15d		117.60	64.68b		115.69	57.67 ^c		192.17	59.95d	
Urbanization:															
Rural farm ^a	-81.43	5.58d		-67.61	9.06d		-72.86	17.36d		-97.80	10.07d		-94.64	16.90d	
Urban	-59.18	6.66d		-43.93	10.15d		-69.77	16.85d		-59.98	12.15d		-68.14	24.22d	
Rural nonfarm															
Race:															
Negro ^a	-4.02	7.29		18.97	10.51b		-26.36	15.82b		-41.50	18.48 ^c		-41.61	23.41b	
White	33.03	16.53 ^c		50.06	34.37		87.48	29.51d		-68.19	42.04		-37.03	34.38	
Other															
Education:															
Grade school	7.07	5.56		7.36	9.33		21.68	11.62b		7.74	10.38		-4.00	17.10	
High school ^a															
Some college	0.82	7.56		0.08	14.25		-19.77	15.89		6.46	14.51		13.03	16.27	
College graduate	-15.36	9.33b		-50.42	16.71d		28.03	21.20		-8.72	17.87		-11.44	20.19	
Life Cycle:															
Stage 1	-8.19	13.14		-6.52	23.30		-5.74	26.56		18.94	25.50		-35.18	32.85	
Stage 2	-33.25	7.30d		-34.34	12.54d		0.92	15.36		-41.40	13.53d		-58.19	19.47d	
Stage 3a															
Stage 4	37.02	8.12d		18.03	13.41		53.26	17.42d		64.34	15.47d		23.72	21.87	
Stage 5	19.14	13.30		15.28	22.31		37.50	28.97		28.61	24.92		-19.84	34.57	
Stage 6	-21.36	9.10 ^c		-24.64	15.22		-9.93	19.48		-11.05	17.30		-25.28	24.75	
Stage 7	-38.48	16.48 ^c		-14.82	28.89		-30.48	36.15		-66.14	30.38 ^c		-27.06	42.30	
Family Size	109.57	1.68d		108.86	2.67d		106.56	3.69d		113.53	3.29d		116.77	4.82d	
Meal Adjustment	5.97	0.15d		6.05	0.25d		5.24	0.34d		6.02	0.29d		6.44	0.42d	
Homemaker Employed	6.11	5.06		8.80	8.58		1.92	10.27		14.76	9.72		-6.50	13.43	
R ²		.62		.63	.62		.62	.62		.62	.62		.62	.68	

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 8. Estimates of United States and Regional Consumption Relationships for Vitamin A in International Units, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	73635.61	12510.07 ^d		52379.62	14257.84 ^d		151906.18	44248.61 ^d		84613.67	25646.19 ^d		155427.37	39504.90 ^d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	18916.07	9028.49 ^c		20846.04	9345.78 ^c		4502.61	35545.46		8718.41	18258.75		23359.86	29896.33	
\$2,000-2,999	17415.98	9019.83 ^b		9721.70	9470.66		9754.33	34651.13		25423.73	18260.11		17894.65	29637.58	
\$3,000-3,999	35078.93	9030.30 ^d		35857.05	9631.97 ^d		22077.22	33795.42		22012.15	18414.57 ^b		15547.28	29718.86	
\$4,000-4,999	51537.96	9152.90 ^d		45757.29	10126.37 ^d		59393.94	33718.62 ^b		40480.38	18260.93 ^c		9510.71	29499.28	
\$5,000-5,999	52139.94	8832.39 ^d		46240.13	10161.39 ^d		34491.12	32768.85		17248.36 ^c	52443.88		28667.42 ^b		
\$6,000-6,999	54699.01	9343.35 ^d		60694.85	11101.03 ^d		24306.73	33604.37		48668.95	18036.92 ^d		38706.05	29894.75	
\$7,000-7,999	55848.18	9633.17 ^d		46019.80	11803.40 ^d		51684.72	34021.70		43826.30	18561.33 ^c		41663.63	29885.57	
\$8,000-8,999	57462.14	10218.91 ^d		54082.50	12785.11 ^d		30505.93	35291.68		53197.39	19489.67 ^d		35326.70	30865.17	
\$9,000-9,999	57922.19	11110.02 ^d		64441.92	15110.64 ^d		52002.75	36395.82		41832.16	21320.83 ^c		25353.82	31359.45	
\$10,000-11,999	62057.66	11021.32 ^d		71159.18	14478.26 ^d		47191.79	36915.38		56734.46	20672.40 ^d		13582.69	32092.39	
\$12,000-14,999	66416.85	12013.51 ^d		87269.22	17199.00 ^d		37681.12	37888.97		48046.87	22368.03		61743.45	33916.37 ^b	
\$15,000-24,999	76961.47	13587.14 ^d		91847.95	18547.19 ^d		53220.74	42060.97		64279.71	26514.01 ^c		48692.35	35187.92	
\$25,000 or more	161665.75	20495.31 ^d		105140.05	26333.12 ^d		78377.76	67126.61 ^b		41251.40	41813.01 ^d		33681.94	44958.52	
Urbanization:															
Rural farms ^a															
Urban	2694.77	4207.77		11011.43	5170.14 ^c		-16542.29	18011.09		-23606.74	7302.11 ^d		-15872.67	12673.65	
Rural nonfarm	-12922.23	5021.64 ^d		-345.33	5789.26		-47830.33	19557.75 ^d		-10569.83	8807.07		-50894.01	18164.09 ^d	
Race:															
Negro															
White	-23343.42	5495.64 ^d		-7731.05	5993.87		-51329.97	16421.58 ^d		-51453.69	13396.97 ^d		-75278.13	17553.31 ^d	
Other	224.86	12466.60		39070.02	19613.15 ^c		-34635.86	30621.02		-27802.65	30481.92		-71408.22	25778.53 ^d	
Education:															
Grade school	-3616.25	4191.95		-11040.43	5323.09 ^c		23444.32	12060.01 ^b		291.65	7528.52		-3869.92	12821.22	
High school															
Some college	4330.71	5697.62		13514.33	8133.10 ^b		-3800.73	16485.61		5269.84	10522.79		1899.08	12202.38	
College graduate	2216.31	7035.36		-7904.86	9332.17		30731.16	21998.36		-102.58	12937.75		16477.13	15137.25	
Life Cycle:															
Stage 1	-32862.27	9910.57 ^d		-24161.04	13295.32 ^b		-61325.72	27561.65 ^c		2851.70	18487.95		-45262.16	24637.07 ^b	
Stage 2	-17087.30	5507.60 ^d		-8220.15	7153.48		-23409.00	19398.14		-12841.26	9807.44		-28115.87	14600.54 ^b	
Stage 3a															
Stage 4	-2642.68	6119.66		-396.87	7652.47		-14358.60	18081.70		23181.15	11213.25 ^c		-24184.33	16398.80	
Stage 5	-1512.56	10025.86		3329.64	12729.10		-11553.47	30062.39		10311.21	18066.11		-12843.48	25925.31	
Stage 6	-16348.27	6859.40 ^c		-13799.09	8683.27		-44250.52	20212.08 ^c		15085.25	12542.37		-37750.66	18559.02 ^b	
Stage 7	-35132.54	12424.59 ^d		-24110.79	16484.13		-95933.65	37521.00 ^d		-15990.72	22023.69		-25552.17	31722.64	
Family Size	26437.22	1265.10 ^d		23606.93	1524.33 ^d		26432.13	3829.47 ^d		30923.21	2388.03 ^d		34341.67	3614.11 ^d	
Meal Adjustment	1763.43	115.55 ^d		2090.04	141.61 ^d		1061.92	356.57 ^d		1505.30	211.82 ^d		2194.47	312.16 ^d	
Homemaker Employed	-3073.44	3811.93		9286.30	4894.21		-5914.12	10654.12		-1856.96	7049.91		-13153.74	10070.98	
R ²		.19		.26			.14			.22			.31		

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 9. Estimates of United States and Regional Consumption Relationships for Thiamine (Vitamin B₁) in Milligrams, Spring 1965;
Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	10.62	1.35 ^d		9.95	2.10 ^d		7.50	3.42 ^c		10.17	2.86 ^d		13.43	4.12 ^d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	1.19	0.97		2.75	1.37 ^c		0.66	2.74		-0.80	2.04		-1.24	3.12	
\$2,000-2,999	0.91	0.97		0.76	1.39		-0.28	2.67		2.54	2.04		0.11	3.09	
\$3,000-3,999	2.93	0.97 ^d		4.14	1.42 ^d		4.01	2.61		0.30	2.06		1.41	3.10	
\$4,000-4,999	2.98	0.99 ^d		4.85	1.49 ^d		2.66	2.60		1.55	2.04		0.59	3.08	
\$5,000-5,999	2.39	0.95 ^c		3.12	1.49 ^c		3.33	2.53		1.15	1.92		1.33	2.99	
\$6,000-6,999	2.90	1.01 ^d		5.05	1.63 ^d		2.40	2.59		1.98	2.01		0.25	3.12	
\$7,000-7,999	3.69	1.04 ^d		3.79	1.73 ^c		5.34	2.63 ^c		2.10	2.07		3.13	3.12	
\$8,000-8,999	3.11	1.10 ^d		4.17	1.88 ^c		3.53	2.72		2.19	2.18		1.11	3.22	
\$9,000-9,999	3.28	1.20 ^d		7.65	2.22 ^d		3.18	2.81		0.70	2.38		0.89	3.27	
\$10,000-11,999	3.22	1.19 ^d		4.42	2.13 ^c		3.57	2.85		3.48	2.31		-1.52	3.35	
\$12,000-14,999	2.30	1.30 ^b		6.08	2.53 ^c		-0.01	2.92		1.74	2.52		0.44	3.54	
\$15,000-24,999	2.73	1.47 ^b		4.48	2.73 ^b		2.55	3.25		5.32	2.96 ^b		-3.81	3.67	
\$25,000 or more	7.63	2.21 ^d		10.83	3.87 ^d		3.04	5.18		5.47	4.67		7.87	4.69 ^b	
Urbanization:															
Rural farm ^a	-7.18	0.45 ^d		-7.94	0.76 ^d		-4.46	1.39 ^d		-7.04	0.82 ^d		-6.10	1.32 ^d	
Urban	-5.04	0.54 ^d		-5.31	0.85 ^d		-4.11	1.39 ^d		-3.95	0.98 ^d		-4.52	1.90 ^c	
Rural nonfarm															
Race:															
Negro ^a	-1.62	0.59 ^d		-0.54	0.88		-3.25	1.27 ^d		-1.39	1.50		-3.31	1.83 ^b	
White	0.64	1.34		0.15	2.88		2.60	2.36		-2.63	3.40		-1.91	2.69	
Other															
Education:															
Grade school	1.40	0.45 ^d		1.48	0.78 ^b		1.67	0.93 ^b		1.60	0.84 ^b		-0.22	1.34	
High school ^a															
Some college	-0.24	0.61		-0.28	1.20		-1.66	1.27		0.74	1.17		0.33	1.27	
College graduate	-0.65	0.76		-3.02	1.40 ^c		2.59	1.70		-0.58	1.45		0.16	1.58	
Life Cycle:															
Stage 1	-0.63	1.07		0.22	1.95		0.48	2.13		0.32	2.06		-4.31	2.57 ^b	
Stage 2	-2.52	0.59 ^d		-2.41	1.05 ^c		-0.62	1.23		-2.64	1.09 ^c		-5.06	1.52 ^d	
Stage 3 ^a															
Stage 4	3.39	0.66 ^d		2.45	1.12 ^c		4.10	1.40 ^d		5.37	1.25 ^d		1.30	1.71	
Stage 5	1.02	1.08		1.55	1.87		3.10	2.32		1.14	2.02		-4.05	2.71	
Stage 6	-2.40	0.74 ^d		-1.66	1.28		-2.19	1.56		-2.32	1.40 ^b		-3.90	1.94 ^c	
Stage 7	-3.57	1.34 ^d		-0.74	2.42		-1.49	2.90		-6.01	2.46 ^c		-3.02	3.31	
Family Size	9.60	0.14 ^d		9.52	0.22 ^d		9.68	0.30 ^d		9.67	0.24 ^d		10.10	0.38 ^d	
Meal Adjustment	0.48	0.01 ^d		0.49	0.02 ^d		0.45	0.03 ^d		0.47	0.02 ^d		0.45	0.03 ^d	
Homemaker Employed	0.60	0.41		0.56	0.72		0.92	0.82		0.87	0.79		-0.14	1.05	
R ²		.66			.65			.66			.65			.71	

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 10. Estimates of United States and Regional Consumption Relationships for Riboflavin (Vitamin B₂) in Milligrams, Spring 1965, Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	16.49	1.98 ^d		14.24	2.84 ^d		23.41	5.93 ^d		17.10	3.95 ^d		24.71	6.40 ^d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	3.17	1.43 ^c		5.20	1.86 ^d		0.45	4.76		1.23	2.81		0.37	4.84	
\$2,000-2,999	3.14	1.43 ^c		2.49	1.89		1.34	4.64		7.02	2.81 ^c		-0.38	4.80	
\$3,000-3,999	5.99	1.43 ^d		6.84	1.92 ^d		4.48	4.53		4.25	2.84		2.95	4.81	
\$4,000-4,999	7.32	1.45 ^d		8.03	2.02 ^d		7.59	4.52 ^b		5.92	2.81 ^c		1.02	4.78	
\$5,000-5,999	8.71	1.40 ^d		8.92	2.03 ^d		6.81	4.39		6.96	2.66 ^d		6.97	4.64	
\$6,000-6,999	8.52	1.48 ^d		10.51	2.21 ^d		4.99	4.50		7.03	2.78 ^d		4.80	4.84	
\$7,000-7,999	10.43	1.53 ^d		9.30	2.35 ^d		9.34	4.56 ^c		9.27	2.86 ^d		7.53	4.84	
\$8,000-8,999	10.02	1.62 ^d		10.27	2.55 ^d		5.46	4.73		10.76	3.00 ^d		5.88	5.00	
\$9,000-9,999	10.34	1.76 ^d		16.19	3.01 ^d		7.49	4.88		6.58	3.28		4.60	5.08	
\$10,000-11,999	11.23	1.75 ^d		13.71	2.89 ^d		7.38	4.95		12.13	3.18 ^d		2.47	5.20	
\$12,000-14,999	10.78	1.91 ^d		14.38	3.43 ^d		5.52	5.08		8.75	3.48 ^c		8.60	5.49	
\$15,000-24,999	10.91	2.16 ^d		13.84	3.70 ^d		7.74	5.63		8.48	4.08 ^c		7.54	5.70	
\$25,000 or more	17.49	3.25 ^d		21.37	5.25 ^d		11.41	8.99		16.18	6.44 ^c		13.81	7.28 ^b	
Urbanization:															
Rural farm ^a	-7.93	0.68 ^d		-7.10	1.03 ^d		-8.03	2.41 ^d		-10.20	1.12 ^d		-10.60	2.05 ^d	
Urban	-6.76	0.80 ^d		-5.79	1.15 ^d		-9.14	2.62 ^d		-5.60	1.36 ^d		-11.80	2.94 ^d	
Rural nonfarm															
Race:															
Negro ^a	4.44	0.87 ^d		6.47	1.20 ^d		-1.16	2.20		2.93	2.06		-2.42	2.84	
White	6.57	1.98		9.05	3.91 ^c		4.03	4.10		4.19	4.69		-3.92	4.17	
Other															
Education:															
Grade school	0.67	0.67		0.62	1.06		2.41	1.62		1.83	1.16		-1.72	2.08	
High school ^a															
Some college	0.38	0.90		-1.15	1.62		-1.90	2.21		4.04	1.62 ^c		0.98	1.98	
College graduate	-0.01	1.12		-3.50	1.90 ^b		4.39	2.95		1.56	2.00		0.79	2.45	
Life Cycle:															
Stage 1	-7.53	1.57 ^d		-4.56	2.65 ^b		-9.74	3.69 ^d		-5.37	2.85 ^b		-9.62	3.99 ^c	
Stage 2	-3.95	0.87 ^d		-2.64	1.43 ^b		-3.30	2.14		-4.61	1.51 ^d		-5.73	2.36 ^c	
Stage 3 ^a															
Stage 4	2.96	0.97 ^d		3.01	1.53 ^c		3.08	2.42		4.92	1.73 ^d		0.78	2.66	
Stage 5	-1.79	1.59		0.69	2.54		-1.81	4.03		-3.73	2.78		-3.38	4.20	
Stage 6	-7.70	1.09 ^d		-5.60	1.73 ^d		-9.78	2.71 ^d		-7.54	1.93 ^d		-7.37	3.01 ^c	
Stage 7	-10.42	1.97 ^d		-8.59	3.29 ^d		-11.90	5.03 ^c		-13.21	3.39 ^d		-5.43	5.14	
Family Size	11.55	0.20 ^d		10.77	0.30 ^d		11.93	0.51 ^d		12.17	0.37 ^d		13.36	0.59 ^d	
Meal Adjustment	0.64	0.02 ^d		0.67	0.03 ^d		0.55	0.05 ^d		0.63	0.03 ^d		0.65	0.50 ^d	
Homemaker Employed	0.32	0.60		0.93	0.98		1.30	1.43		0.68	1.09		-1.18	1.63	
R ²	.60			.59			.55			.64			.67		

^aOmitted to avoid singularity ^bSignificant at .10 level. ^cSignificant at .05 level. ^dSignificant at .01 level.

Table 11. Estimates of United States and Regional Consumption Relationships for Niacin in Milligrams, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	115.67	20.11 ^d		142.28	27.99 ^d		93.14	55.90 ^b		121.32	42.98 ^d		173.62	68.14 ^d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	24.51	14.51 ^b		33.78	18.34 ^b		55.19	44.91		-4.76	30.60		25.08	51.57	
\$2,000-2,999	35.21	14.50 ^c		18.90	18.59		24.31	43.78		59.91	30.60 ^b		76.12	51.12	
\$3,000-3,999	69.78	14.52 ^d		62.93	18.91 ^d		85.87	42.70 ^c		37.56	30.86		117.77	51.26 ^c	
\$4,000-4,999	98.00	14.71 ^d		116.00	19.88 ^d		96.01	42.60 ^c		63.56	30.60 ^c		95.44	50.88 ^b	
\$5,000-5,999	107.01	14.20 ^d		97.12	19.94 ^d		128.77	41.40 ^d		74.02	28.91 ^d		113.93	49.45 ^c	
\$6,000-6,999	119.37	15.02 ^d		143.05	21.79 ^d		108.12	42.46 ^d		84.33	30.23 ^d		123.69	51.57	
\$7,000-7,999	138.34	15.49 ^d		125.98	23.17 ^d		152.43	42.98 ^d		102.77	31.11 ^d		168.49	51.55 ^d	
\$8,000-8,999	137.20	16.43 ^d		130.55	25.09 ^d		114.30	44.59 ^d		121.37	32.66 ^d		153.29	53.24 ^d	
\$9,000-9,999	140.76	17.86 ^d		204.54	29.66 ^d		142.48	45.98 ^d		86.10	35.73 ^c		152.99	54.09 ^c	
\$10,000-11,999	144.78	17.72 ^d		144.48	28.42 ^d		146.14	46.64 ^d		127.68	34.65 ^d		121.12	55.36 ^c	
\$12,000-14,999	132.59	19.31 ^d		189.21	33.76 ^d		100.84	47.87 ^c		93.21	37.82 ^c		139.10	58.50 ^c	
\$15,000-24,999	136.15	21.84 ^d		205.95	36.40 ^d		113.61	53.14 ^c		117.39	44.44 ^d		76.23	60.70	
\$25,000 or more	246.86	32.95 ^d		228.50	51.69 ^d		152.29	84.80 ^b		218.50	70.08 ^d		381.03	77.55 ^d	
Urbanization:															
Rural farm ^a	-61.31	6.76 ^d		-53.95	27.99 ^d		-64.00	22.75 ^d		-77.98	12.38 ^d		-99.80	21.86 ^d	
Rural nonfarm	-45.92	8.07 ^d		-40.78	11.36 ^d		-69.30	24.71 ^d		-33.76	14.76 ^c		-74.38	31.33 ^c	
Race:															
Negro ^a															
White	39.19	8.83 ^d		228.50	51.69 ^d		15.80	20.75		15.35	22.45		-19.82	30.28	
Other	43.28	20.04 ^c		43.24	11.76 ^d		46.03	38.69 ^b		-9.20	51.09		-62.67	44.47	
Education:															
Grade school	0.98	6.74		80.55	38.50		15.04	15.24		4.88	12.62		-6.35	22.12	
High school ^a															
Some college	-13.41	9.16		0.15	10.45		-53.87	20.83 ^d		-2.59	17.64		6.59	21.05	
College graduate	-30.05	11.31 ^d		-3.20	15.96		32.05	27.79		-28.47	21.72		-27.29	26.11	
Life Cycle:															
Stage 1	-23.09	15.93		-32.14	26.09		-15.59	34.82		31.47	30.98		-49.40	42.50 ^d	
Stage 2	-61.23	8.85 ^d		-64.74	14.04 ^d		-26.13	20.14		-64.85	16.44 ^d		-83.37	25.19 ^d	
Stage 3 ^a															
Stage 4	56.29	9.84 ^d		22.63	15.02		87.73	22.84 ^d		98.80	18.79 ^d		44.84	28.29	
Stage 5	46.18	16.12 ^d		28.59	24.98		67.00	37.98 ^b		72.24	30.28 ^c		17.19	44.72	
Stage 6	-32.02	11.03 ^d		-46.82	17.04 ^d		-11.47	25.54		-8.35	21.02		-40.82	32.01	
Stage 7	-49.13	19.97 ^c		-39.97	32.36 ^d		-53.51	47.40		-62.86	36.91 ^b		-34.93	54.72	
Family Size	123.37	2.03 ^d		112.83	2.99 ^d		128.92	4.84 ^d		134.57	4.00 ^d		134.59	6.23 ^d	
Meal Adjustment	7.36	0.18 ^d		6.94	0.28 ^d		6.70	4.84 ^d		7.87	-35 ^d		7.82	0.54 ^d	
Homemaker Employed	5.63	6.13		3.89	9.61		19.51	13.46		16.99	11.82		-10.38	17.37	
R ²		.60			.61			.58			.61			.64	

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Table 12. Estimates of United States and Regional Consumption Relationships for Ascorbic Acid (Vitamin C) in Milligrams, Spring 1965; Including Regression Coefficients, Standard Errors and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-Intercept	684.59	128.11 ^d		785.86	177.67 ^d		689.92	354.76 ^b		634.21	276.61 ^c		1065.26	416.06 ^d	
Income:															
Under \$1,000 ^a	150.85	92.45		99.34	116.46		416.37	284.98		63.13	196.93		381.77	314.87	
\$1,000-1,999	127.72	92.37		-35.50	118.02		307.72	277.81		251.82	196.95		446.17	312.14	
\$2,000-2,999	345.10	92.47 ^d		338.02	120.03 ^d		609.15	270.95 ^c		143.31	198.61		259.57	313.00	
\$3,000-3,999	511.50	93.73 ^d		402.94	126.19 ^d		850.73	270.34 ^d		495.13	196.96 ^c		187.59	310.68	
\$4,000-4,999	679.32	90.45 ^d		696.78	126.62 ^d		867.14	262.73 ^d		509.45	186.03 ^d		577.62	301.93 ^b	
\$5,000-5,999	761.15	95.68 ^d		746.54	138.33 ^d		754.63	269.42 ^d		759.85	194.54 ^d		641.28	314.85 ^c	
\$6,000-6,999	821.88	98.65 ^d		676.77	147.09 ^d		915.76	272.77 ^d		845.45	200.20 ^d		779.89	314.75 ^c	
\$7,000-7,999	952.23	104.65 ^d		1051.84	159.32 ^d		1113.74	282.95 ^d		866.70	210.21 ^d		502.53	325.07	
\$8,000-8,999	1107.66	113.77 ^d		1299.35	188.30 ^d		1256.91	291.80 ^d		975.28	229.96 ^d		658.83	330.27 ^c	
\$9,000-9,999	1206.62	112.86 ^d		1197.25	180.42 ^d		1395.66	295.97 ^d		1347.55	222.97 ^d		683.57	337.99	
\$10,000-11,999	1218.05	123.02 ^d		1427.04	214.32 ^d		1075.63	303.77 ^d		1142.06	243.41 ^d		1043.79	337.20 ^d	
\$12,000-14,999	1529.17	139.14 ^d		1890.50	231.12 ^d		1707.91	337.22 ^d		1474.97	285.97 ^d		751.76	370.60 ^c	
\$15,000-24,999	1808.56	209.88 ^d		2265.18	328.15 ^d		1666.59	538.17 ^d		1701.55	450.98 ^d		1380.50	473.50 ^d	
\$25,000 or more															
Urbanization:															
Rural farm ^a	22.22	43.09		40.00	64.43		-59.19	144.40		-222.86	78.76 ^d		-169.77	133.48	
Urban	-4.37	51.42		-9.49	72.14		-253.01	156.80		51.82	94.99		-304.72	191.30	
Rural nonfarm															
Race:															
Negro ^a	98.61	56.28 ^b		78.43	74.69		-233.57	131.66 ^b		157.23	144.49		1380.50	473.50 ^d	
White	435.62	127.66 ^d		281.37	244.41		337.04	245.50		62.31	328.77		19.97	184.87	
Other															
Education:															
Grade school	-165.13	42.93 ^d		-216.38	66.33 ^d		5.11	96.69		-114.84	81.20		-116.57	135.03	
High school ^a	188.97	58.35 ^d		164.57	101.35		77.40	132.17		346.35	113.49 ^d		273.77	128.51 ^c	
Some college	107.72	72.04		-82.58	118.78		468.18	176.37 ^d		148.06	139.76		256.46	159.42	
College graduate															
Life Cycle:															
Stage 1	-440.21	101.49 ^d		-483.72	165.58 ^d		-349.54	220.97		-284.00	199.40		-529.14	259.48 ^b	
Stage 2	-277.77	56.40 ^d		-191.93	89.14 ^b		-240.66	127.78 ^b		-332.01	105.78 ^d		-418.98	153.77 ^d	
Stage 3 ^a															
Stage 4	211.94	62.67 ^d		22.46	95.36		480.64	144.97 ^d		378.81	120.94 ^d		166.80	172.71	
Stage 5	75.32	102.67		18.06	158.62		412.78	241.02 ^b		16.65	194.85		61.11	273.04 ^d	
Stage 6	-233.48	70.24 ^d		-130.59	108.21		-184.61	162.05		-212.13	135.28		-499.06	195.46 ^d	
Stage 7	-562.83	127.23 ^d		-597.83	205.41 ^d		-621.97	300.82 ^c		-523.50	237.56 ^c		-562.29	334.10 ^b	
Family Size	340.65	12.96 ^d		291.51	19.00 ^d		423.62	30.70 ^d		372.45	25.76 ^d		376.47	38.06 ^d	
Meal Adjustment	27.59	1.18 ^d		28.29	1.76 ^d		24.93	2.86 ^d		29.68	2.28 ^d		22.20	3.29 ^d	
Homemaker Employed	-7.72	39.04		90.01	60.99		38.73	85.42		-36.00	76.04		-91.25	106.07	
R ²		.32		.31	.35		.35	.35		.34	.35		.35	.35	

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

Income

Annual household disposable income was represented in the various nutrient consumption models by 14 discrete classes.¹² The under \$1,000 disposable income class was omitted. Thus, tests for significant differences in nutrient consumption by income levels were relative to this class.

An analysis of the United States estimates indicated that relative to the base income class, families with \$1,000 or more disposable income consumed significantly more protein, vitamin A, riboflavin, and niacin, Tables 3, 8, 10, and 11. Similarly, families with more than \$2,000 disposable income consumed significantly more food energy and fat than did families with under \$1,000 disposable income, Tables 2 and 4. Households with more than \$3,000 income consumed significantly more calcium, iron, thiamine, and ascorbic acid (vitamin C) than did households in the base income group, Tables 6, 7, 9, and 12. Consumption of calcium by households with from \$1,000 to \$1,999 disposable income was also significantly greater than consumption of calcium by households with under \$1,000 income. These relationships closely approximated hypothesized relationships.

Few significant differences in carbohydrate consumption in the United States model were ascertained between the various income classes

¹²Several alternative models with different income specifications were evaluated. Income was represented alternatively in various models as continuous based on midpoints of the income classes, past annual income based on 1964 income, and as first differences from differences in 1964 and 1965 household disposable income. None of these specifications proved superior to the dummy variable scheme in explaining variations in food nutrient consumption.

and the base class, Table 5. Exceptions were noted for households having \$3,000 to \$4,999, \$7,000 to \$7,999, and more than \$25,000 income.¹³

Households in these income classes consumed significantly more carbohydrate than did households with under \$1,000 income.

The pattern of significant differences in nutrient consumption with respect to income noted in the United States models were not consistently reflected in any of the four regional models. In the Southern region of the United States, households with disposable income between \$1,000 and \$1,999 and over \$3,000 consumed significantly more food energy, protein, iron, vitamin A, thiamine, riboflavin, and niacin than did households with less than \$1,000 disposable income, Tables 2, 3, 7, 8, 9, 10, and 11. Relative to households in the base income class, households with over \$2,000 and over \$3,000 disposable income consumed significantly more fat and ascorbic acid, respectively, Tables 4 and 12. Households having \$3,000 to \$6,999, \$9,000 to \$9,999, and \$25,000 or more disposable income consumed significantly more carbohydrate than did households having under \$1,000 disposable income (base class), Table 5. Households in the South having \$1,000 to \$1,999, \$3,000 to \$5,999, \$7,000 to \$7,999, \$9,000 to \$14,999, and \$25,000 or more disposable income consumed significantly more calcium than did households having under \$1,000 disposable income, Table 6.

In the Northeast region of the United States, few significant differences in the consumption of carbohydrate, calcium, iron, vitamin A, thiamine, and riboflavin were noted between households in the under

¹³Caution should be used in making inferences from the \$25,000 or more income coefficients because of the small number of observations in this class relative to other income classes.

\$1,000 income class and households in other income classes, Tables 5, 6, 7, 8, 9, and 10. When compared to households having under \$1,000 disposable income, significantly more food energy was consumed by households having \$3,000 to \$3,999, \$5,000 to \$11,999, and above \$15,000 disposable income, Table 2. Families with more than \$3,000 disposable income consumed significantly more fat, niacin, and vitamin C than did families included in the base income class, Tables 4, 11, and 12. A similar relationship existed for protein consumption by families having more than \$4,000 disposable income, Table 3.

In the North Central region of the United States, few significant differences in the consumption of food energy, carbohydrate, calcium, iron, or thiamine were noted between households with under \$1,000 and over \$1,000 disposable income, Tables 2, 5, 6, 7, and 9. Significantly more vitamin A and vitamin C were consumed by households with more than \$3,000 and \$4,000 disposable income, respectively, than were consumed by households with less than \$1,000 disposable income, Tables 8 and 12. Households having \$2,000 to \$2,999 and over \$4,000 disposable income consumed significantly more protein, riboflavin, and niacin than did households in the base income class, Tables 3, 10, and 11. Relative to households with under \$1,000 disposable income, households having \$2,000 to \$2,999 and over \$5,000 disposable income consumed significantly more fat, Table 4.

In the Western region of the United States, few significant differences in the consumption of food energy, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamine, or riboflavin were noted between households in the under \$1,000 income class and households in other income classes, Tables 2, 3, 4, 5, 6, 7, 8, 9, and 10. Consumption of

niacin by households having from \$3,000 to \$14,999 and over \$25,000 disposable income was significantly greater than was consumption of niacin by households with under \$1,000 disposable income, Table 11. Families having disposable income from \$5,000 to \$7,999, \$9,000 to \$9,999, and over \$12,000 consumed significantly more vitamin C than did families in the base income class, Table 12.

The effect of income upon food nutrient consumption was considerably different in the four regions. All the regional nutrient consumption models diverged from the United States models to some degree. However, the models representing food nutrient consumption in the South more closely approximated relationships depicted by United States nutrient consumption models. The regional estimates most radically different from the overall United States estimates for practically all food nutrient consumption models were for the West.

Urbanization

Households were classified as being located in one of three urbanization classes: rural farm, urban, or rural nonfarm. The rural farm class was utilized as the base class.

Households classified as being rural farm in the United States and regional models consumed significantly more of all food nutrients except vitamin A and vitamin C than did rural nonfarm or urban households, Tables 2 through 12.¹⁴ Rural farm households in the United States and

¹⁴Income and urbanization were suspected of being interrelated. A model was estimated including interaction terms between income and urbanization to examine the possibility of a multiplicative relationship. None of the interaction terms were significantly different from zero and inclusive of these terms did not improve R^2 greatly. In fact, R^2 would have been less if an adjustment for the loss of degrees of freedom had been made.

the Northeast and West regions of the United States consumed significantly more vitamin A than did rural nonfarm households, but consumed about the same quantities of vitamin A as did urban households, Table 8. In the South, rural farm families consumed significantly less vitamin A than did urban families. No significant difference in the consumption of vitamin A was noted between rural farm and rural nonfarm households in the South. In the North Central region of the United States, rural farm households consumed significantly more vitamin A than did urban households. No significant difference in the consumption of this nutrient was noted between rural farm and rural nonfarm households.

Consumption of vitamin C by urban households in the North Central region was significantly less than consumption by rural farm families, Table 12. Consumption of vitamin C by households in urban and rural nonfarm areas of the United States and the South, Northeast, and West regions of the United States was not significantly different from vitamin C consumption by rural farm households.

Race

Race of the household members was categorized into one of three classes: Negro, white, and other. The Negro class was utilized as the base race class. Nutrient consumption by white and other race households was compared with nutrient consumption by Negro households.

In the United States models, Negro households consumed significantly less protein, carbohydrate, calcium, riboflavin, niacin, and vitamin C than did either white or other race households, Tables 3, 5, 6, 10, 11, and 12. They also consumed significantly less iron than the other race category, but there was no significant difference in white and Negro household iron consumption, Table 7.

Negro households consumed significantly more vitamin A and thiamine than did white households, but there was no significant difference in the consumption of these two nutrients between Negro and other race households, Tables 8 and 9. Also, Negro households consumed significantly more fat than did other race households, but there was no significant difference in fat consumption between Negro and white households, Table 4. Race had no significant impact on the consumption of food energy by households, Table 2.

The patterns of food nutrient consumption by households of different races varied among the different regions of the United States. Also, none of the regional models were totally consistent with the United States models.

In the South, Negro households consumed significantly less of all nutrients except vitamin A, thiamine, and vitamin C than did white households, Tables 2 through 12. There were no significant differences in the consumption of these three nutrients noted between black and white households, Tables 8, 9, and 12. Households included in the other races category consumed more of all nutrients than did Negro households, but only significantly more protein, vitamin A, riboflavin, and niacin, Tables 3, 8, 10, and 11.

In the Northeast region of the United States, nutrient consumption patterns by households of different races varied greatly from the patterns noted for the United States or the South. Negro households consumed significantly more of all nutrients except protein, calcium, riboflavin, and niacin, Tables 2 through 12. No significant differences in consumption of these four nutrients was found to exist between black and white households in the Northeast region, Tables 3, 6, 10, and 11. However, Negro

households consumed less of all nutrients except fat and vitamin A than did households of other races, but only significantly less carbohydrate, iron, and niacin, Tables 2 through 12.

An analysis of race coefficients for the North Central and West regions indicated fewer significant differences in nutrient consumption than were noted in the South or Northeast regions. In the North Central region, only the consumption of calcium, iron, and vitamin A was significantly different between Negro and white households, Tables 2 through 12. Negro households consumed significantly less calcium and significantly more iron and vitamin A than did white households in this region, Tables 6, 7, and 8. Also, the only significant differences between Negro and other races households was in the consumption of fat and calcium, Tables 2 through 12. Negro households consumed significantly more fat and less calcium than did households of other races, Tables 4 and 6.

In the Western region of the United States, Negro households consumed more of all nutrients except carbohydrates, calcium, and vitamin C than did white households, Tables 2 through 12. However, they consumed only significantly more iron, vitamin A, and thiamine, Tables 7, 8, and 9. Negro households consumed significantly less calcium and vitamin C than did white households, but no significant difference in carbohydrate consumption was found between households of these two race classes, Tables 5, 6, and 12. The only significant differences in nutrient consumption between Negro and other races households in the West region were that Negro households consumed significantly more fat and vitamin A, Tables 4 and 8.

In summary, the effect of race of the household on food nutrient

consumption varied considerably among the four regions. Fewer significant differences in nutrient consumption were noted between Negro households and white and other races households, respectively, in the North Central and West regions than were noted in the United States, South, or Northeast locations.

Education of the Homemaker

Educational attainment of the homemaker was classified into one of four discrete classes: completed grade school, completed high school, completed some college, and completed a college education. The high school class was utilized as the base class; that is, measurement of consumption of food nutrients by households in other education classes was relative to nutrient consumption by households with the homemaker having a high school education.

In the United States, households with the homemaker having a high school education consumed significantly less carbohydrate and thiamine and significantly more vitamin C than did households having a homemaker with a grade school education, Tables 5, 9, and 12. Households in the high school class consumed less of all nutrients except food energy, fat, thiamine, and niacin than did households with the homemaker having completed some college, Tables 2 through 12. However, the only significant difference in consumption between households in these two education classes was for vitamin C; that is, households where the housewife completed high school consumed significantly less vitamin C, Table 12. Households with the housewife having a high school education consumed significantly more food energy, fat, iron, and niacin and significantly less calcium than did households with the housewife having a

college degree, Tables 2, 4, 6, 7, and 11. Educational attainment of the homemaker did not significantly influence household consumption of protein, vitamin A, or riboflavin in the United States model, Tables 3, 8, and 10.

The impact of educational attainment of the homemaker on household food nutrient consumption varied considerably among the four regions. Also, there was little similarity in the impact of education on nutrient consumption in the United States model and the regional model.

In the Southern region of the United States, signs of significant coefficients for education classes corresponded to those noted for United States estimates for only food energy, fat, and iron, Tables 2, 4, and 7. Households in the South with the homemaker having a high school education consumed significantly less carbohydrates and thiamine and significantly more vitamin A and vitamin C than did households with the homemaker having a grade school education, Tables 5, 8, 9, and 12. There were no significant differences in the consumption of any of the other nutrients between households in these two education classes, Tables 2, 3, 4, 6, 7, 10, and 11.

Households in Southern states with the female head having completed some college consumed significantly more vitamin A than did households in the base education class, Table 8. No significant differences in the consumption of other nutrients were noted between households in these two education classes, Tables 2, 3, 4, 5, 6, 7, 9, 10, 11, and 12.

Southern households with the homemaker having a high school education consumed more of all nutrients than did households in which the housewife was a college graduate, Tables 2 through 12. However, the

greater consumption of calcium, vitamin A, niacin, and vitamin C by households in the high school class was not significantly greater than consumption by households with the homemaker having a college degree, Tables 6, 8, 11, and 12.

In the Northeast region of the United States, households with the homemaker having a high school education consumed less of all food nutrients except calcium than did households with the homemaker having a grade school education, but only the consumption of food energy, fat, iron, vitamin A, and thiamine was significantly different between households included in these two education classes, Tables 2 through 12. Consumption of calcium was greater for households included in the high school education class, but not significantly greater, Table 6.

Comparing nutrient consumption between households in the Northeast having a housewife with a high school education and households with the housewife having completed some college indicated that households in the latter group consumed less of all food nutrients except vitamin C, Tables 2 through 12. However, only the consumption of niacin was significantly less between these two groups, Table 11. Vitamin C consumption was greater for households in the some college education class, but it was not significantly greater, Table 12.

In the Northeast, households with the housewife having a high school diploma consumed less of all nutrients than did households with the housewife having a college degree, Tables 2 through 12. However, only the consumption of calcium and vitamin C was significantly less for households in the high school class as compared to households in the college graduate class, Tables 6 and 12.

In the North Central region of the United States, households with

the homemaker having a high school education consumed less of all nutrients except calcium and vitamin C than did households with the homemaker having a grade school education, but only significantly less thiamine, Tables 2 through 12. Similarly, households in the high school class consumed less of all nutrients except niacin than did households with the homemaker having completed some college, but only significantly less protein, calcium, riboflavin, and vitamin C, Tables 2 through 12. Households with the homemaker having completed high school consumed significantly more fat and significantly less calcium than did households with the homemaker having a college degree, Tables 4 and 6.

In the Western region of the United States, only the protein and vitamin A consumption patterns were the same as the patterns evidenced for the United States models, Tables 3 and 8. In the West, no significant differences in consumption of any of the nutrients were noted among households in any of the educational classes except for vitamin C, Tables 2 through 12. Households in the high school education class consumed significantly less vitamin C than did households in the some college class, Table 12.

Educational attainment of the female head of household seemed to exert few consistent relationships among the different regions of the United States. An exception was noted in the South, Northeast and North Central regions for households with the homemaker having a grade school education. Generally, these households consumed larger quantities of most nutrients than did households with the homemaker having a high school education, but these differences in consumption were not always significant.

Other patterns noted were that Northeastern households with the

homemaker having completed some college consumed less of most nutrients than did households with the housewife having completed high school. However, North Central and Western households in the former education class generally consumed more of most nutrients than did households in the latter class. Again, these differences were not always significant.

Final patterns noted relative to education of the homemaker and nutrient consumption were in the South and Northeast regions. Households in the South with the homemaker having a college degree consumed less of all nutrients than did households with the homemaker having a high school degree. Most of these differences in consumption were significant. Conversely, households in the Northeast region with the homemaker having completed college consumed more of all nutrients than did households having a high school education.

Family Life Cycle

The family life cycle variable was developed to reflect the impact of the stage of development of the family unit on food nutrient consumption.¹⁵ Stages in the life cycle were represented by seven discrete stages or classes as follows: (1) no children were present and the housewife was 40 years of age or less (stage 1), (2) the housewife was present and the average age of the children was under six years (stage 2), (3) the housewife was present and the average age of the children ranged from six to less than 12 years (stage 3), (4) the housewife was present and the average age of the children ranged from 12 to 17 years (stage 4), (5) the housewife was present and the average age of the

¹⁵Also, the family life cycle variable was developed to alleviate the problem of multicollinearity between the presence of children and the wife and their ages.

children was over 17 years (stage 5), (6) no children were present and the housewife was over 40 years of age (stage 6), and (7) the housewife was absent from the household (stage 7). Stage 3 was the base class for comparisons.

The impact of the stages in the family life cycle variable generally approximated, a priori, expectations although stage coefficients for some nutrients were not significantly different from the omitted class, stage 3. In the United States models, households in stage 3 consumed significantly more of all nutrients than did households in stages 2, 6, and 7, Tables 2 through 12. They also consumed more of all nutrients than did households in stage 1, but the higher consumption of carbohydrate, iron, thiamine, and niacin was not significant, Tables 5, 7, 9, and 11. However, households in stage 3 consumed significantly less of all nutrients except vitamin A than did households in stage 4. There appeared to be little difference in nutrient consumption between households in stages 3 and 5; however, households in stage 3 did consume significantly more calcium and less niacin than did households in stage 5, Tables 6 and 11.

The impact of stage of the household in the family life cycle varied among the four regions and between the United States estimates and the respective regional estimates. Signs of the coefficients changed from region to region in some cases. Also, fewer significant differences in consumption of nutrients between the base stage and other life cycle stages were noted in the regional models than in the United States models. In the South, households in stage 3 consumed more of all nutrients except thiamine than did households in stage 1, Tables 2 through 12. However, only the consumption of protein, fat,

calcium, vitamin A, riboflavin, and vitamin C was significantly greater, Tables 3, 4, 6, 8, 10, and 12. Also, households in stage 3 consumed more of all nutrients than did households in stages 2, 6, and 7, Tables 2 through 12. Households in stage 3 consumed significantly more of all nutrients except vitamin A than did households in stage 2. They also consumed significantly more of all nutrients except iron, vitamin A, thiamine, and vitamin C than did households in stage 6. Households in stage 3 also consumed significantly more of all nutrients except iron, vitamin A, thiamine, and niacin than did households in stage 7.

Southern households in stage 3 consumed less of all nutrients except vitamin A than did households in stage 4, Tables 2 through 12. However, only the consumption of fat, thiamine, and riboflavin was significantly less, Tables 4, 9, and 10. Also, Southern households in stage 3 consumed less of all nutrients except food energy, carbohydrate, and calcium than did households in stage 5, but none of these differences in consumption were significant.

Households in the Northeast region of the United States included in stage 3 consumed more of all nutrients except thiamine than did households in stage 1, but only the consumption of calcium, vitamin A, and riboflavin was significantly greater, Tables 2 through 12. Relative to households in stage 2, households in stage 3 consumed more of all nutrients except iron, but only significantly more food energy, carbohydrate, and vitamin C, Tables 2 through 12. Also, households in stage 3 consumed more of all nutrients than did households in stages 6 and 7, Tables 2 through 12. A comparison of consumption levels between households in stages 3 and 6 indicated that households in stage 3 consumed significantly more food energy, fat, carbohydrate, calcium, vitamin A,

and riboflavin, Tables 2, 4, 5, 6, 8, and 10. A similar comparison between households in stages 3 and 7 indicated that households in stage 3 consumed significantly more food energy, fat, calcium, vitamin A, riboflavin, and vitamin C, Tables 2, 4, 6, 8, 10, and 12.

In the Northeast region, households in stage 3 consumed significantly less of all nutrients except vitamin A and riboflavin than did households in stage 4, Tables 2 through 12. A comparison of households in stages 3 and 5 revealed that households in stage 3 consumed significantly less protein, fat, niacin, and vitamin C than did households in stage 5, Tables 3, 4, 11, and 12.

In the North Central region of the United States, households in stage 3 consumed significantly more calcium and riboflavin than did households in stage 1, Tables 6 and 10. Households in stages 2 and 7 consumed significantly less of all nutrients except vitamin A than did households in stage 3, Tables 2 through 12. Families in stage 3 consumed significantly more of all nutrients except iron, vitamin A, niacin, and vitamin C than did families in stage 6.

Households in the North Central region included in stage 3 consumed significantly less of all nutrients than did households in stage 4, Tables 2 through 12. Few significant differences in the consumption of food nutrients were noted between households in stages 3 and 5. Exceptions were that households in stage 3 consumed significantly more calcium and less niacin than did households in stage 5, Tables 6 and 11.

In the Western region of the United States, households in stage 3 consumed more of all nutrients than did households in stages 1, 2, 6, and 7, Tables 2 through 12. Relative to households in stage 3, households in

stage 1 consumed significantly less protein, calcium, vitamin A, thiamine, riboflavin, and vitamin C. Further, households in stage 3 consumed significantly more of all nutrients than did households in stage 2. Households in stage 3 consumed significantly more of all nutrients except iron and niacin than did households in stage 6. Finally, households in stage 3 consumed significantly more calcium and vitamin C than did households in stage 7, Tables 6 and 12.

Western households in stage 4 consumed more of all nutrients except carbohydrates, calcium, and vitamin A than did households in stage 3, Tables 2 through 12. However, only the consumption of protein and fat was significantly greater for stage 4 than for stage 3, Tables 3 and 4. No significant differences in the consumption of any of the nutrients was noted between households in stages 3 and 5.

In summary, stage in the family life cycle tended to influence nutrient consumption in a fairly consistent fashion although there were deviations among regions. Generally, households in stages 1, 2, 6, and 7 tended to consume less of most nutrients than did households in stage 3 in all regions. Households in stage 4 tended to consume larger quantities of most nutrients than did households in stage 3 in all regions. Households in stage 5 tended to consume larger quantities of most nutrients than did households in stage 3 in the South, Northeast, and North Central regions, but significant differences in consumption between households in these stages were few.

Family Size

Family size was a highly significant ($P \geq .01$) factor affecting the consumption of all nutrients in the United States and in each of the

four regions of the United States, Tables 2 through 12. As hypothesized, the signs of the family size coefficients were positive; that is, as family size increased, household consumption of each respective nutrient increased.

The impact of family size varied among the four regions of the United States. For example, an increase in family size by one member would increase household food energy consumption by 16,974, 17,048, 18,118, and 19,324 calories in the South, Northeast, North Central, and West regions, respectively, Table 2. The impact of increased family size on the consumption of most nutrients was generally lowest in the South region and highest in the West region, Tables 2 through 12.

Meal Adjustment

The meal adjustment variable was developed to incorporate differences in eating habits among all households by combining all family meals consumed in the home with guest meals and subtracting meals eaten away from home or skipped by members of the household, Tables 2 through 12. This variable had a highly significant ($P \geq .01$) impact on the consumption of all nutrients in the United States models and also in all four regional models. Thus, an increase in total or guest meals increased household consumption of each respective nutrient and an increase in skipped or away meals decreased household consumption of each respective nutrient.¹⁶ The influence of meal adjustment on the consumption of the respective nutrients was similar among the four regions.

¹⁶Several alternative models were developed with total, guest, and away meals included as separate explanatory variables. A high degree of multicollinearity was noted between these variables and also between total household meals, income, and family size. Thus, the meal adjustment variable was developed to alleviate these problems.

Employment Status of the Female

Whether the female head of household was employed outside the home was entered as an explanatory variable in each of the nutrient consumption models. The impact of the homemaker being employed outside the home was reflected by the appropriate coefficient in each of the models.

In the United States models, the employment status of the female head of household had a positive impact on the consumption of all nutrients except vitamins A and C, Tables 2 through 12. However, the employment status of the female was found to have a significant positive impact on only household consumption of food energy, fat, and carbohydrate, Tables 2, 4, and 5.

In the Southern region of the United States, households in which the female head of household was employed consumed more of all nutrients than did households in which the housewife was not employed, Tables 2 through 12. However, only the consumption of vitamin A was affected significantly by the female head of household being employed, Table 8.

In the Northeast region, households with the housewife being employed consumed more of all nutrients except vitamin A than did households with the housewife not being employed outside the home, Tables 2 through 12. The consumption of fat and calcium was significantly greater for households with the housewife employed, Tables 4 and 6.

In the North Central region of the United States, households having an employed housewife consumed more of all nutrients except vitamins A and C than did households in which the housewife was not employed, Tables 2 through 12. Households with an employed housewife consumed significantly more carbohydrate than did households with the housewife not employed, Table 5.

In the Western states, employment of the homemaker tended to have a reverse effect from that evidenced in the other three regions. Although employment of the homemaker was not significantly related to consumption of any of the nutrients by households in the West, households in which the homemaker worked consumed less of all nutrients except food energy, fat, and carbohydrate, Tables 2, 4, and 5.

II. ANIMAL AND VEGETABLE PROTEIN CONSUMPTION MODELS

The total quantity of protein consumed by the household was divided into two components by the source of the protein, vegetable or animal. Consumption relationship models were estimated for these two sources of protein. The characteristics of the household and household members which were hypothesized to influence the consumption of animal and vegetable protein were the same as those utilized in the food nutrient models in the previous section of this chapter.

The total quantity of protein consumed by the average household in the United States was comprised of two-thirds animal protein and one-third vegetable protein, Appendix Table 35. The composition of total protein as originating from either vegetable or animal sources deviated slightly from these percentages for households in the respective regions of the United States. Southern households consumed larger quantities of vegetable protein and smaller quantities of animal protein than did the average United States household. However, households in the Northeast, North Central, and West regions consumed more animal protein and less vegetable protein than did the average United States household. Sixty-four percent of the total protein consumed by Southern households was from animal sources and 36 percent was from vegetable

sources, Appendix Table 35. Sixty-nine percent of the total protein consumed by households in the Northeast, North Central, and West regions was from animal sources and 31 percent was from vegetable sources, Appendix Table 35. Since the major portion of the total protein consumed originated from animal sources, the animal protein and total protein relationships as expected were very similar.

The percentages of variability in the consumption of animal and vegetable protein explained by the independent variables were presented as R^2 's in Tables 13 and 14. Coefficients of determination (R^2 's) for animal protein models for the United States and the South, Northeast, North Central, and West regions of the United States were .54, .51, .55, .60, and .61, respectively, Table 13. Variability in the quantity of vegetable protein consumed explained by the independent variables was .63, .63, .65, .62, and .70 for the United States and the South, Northeast, North Central, and West regional models, respectively, Table 14.

Income

Annual disposable income of the household was represented by 14 classes with the under \$1,000 income class used as the base. For the United States models, households having more than \$1,000 disposable income consumed significantly more animal protein than did households with less than \$1,000 disposable income, Table 13. A similar relationship was noted for households having more than \$4,000 and more than \$2,000 in the Northeast and North Central regions, respectively. In the Southern region of the United States, households with disposable income from \$1,000 to \$1,999 and above \$3,000 consumed significantly more animal protein than did households with under \$1,000 income. In

Table 13. Estimates of United States and Regional Consumption Relationships for Animal Protein in Grams, Spring 1965; Including Regression Coefficients, Standard Errors, and R²'s

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-intercept	557.83	61.19d		577.60	88.04d		745.81	159.57d		636.45	126.02d		982.49	209.61d	
Income:															
Under \$1,000 ^a															
\$1,000-1,999	91.20	44.16c		99.86	57.51b		1.59	128.18		116.29	89.72		-5.34	158.62	
\$2,000-2,999	129.27	44.12d		63.47	58.48		-10.46	124.96		276.69	89.73d		127.90	157.25	
\$3,000-3,999	238.13	44.17d		240.08	59.47d		107.08	121.87		197.41	90.48c		182.80	157.68	
\$4,000-4,999	345.39	44.77d		382.92	62.53d		259.73	121.60c		252.91	89.73d		149.96	156.52	
\$5,000-5,999	440.81	43.20d		432.85	62.74d		327.20	118.17d		361.28	84.75d		309.30	152.10c	
\$6,000-6,999	486.50	45.70d		536.61	68.54d		274.12	121.19c		429.11	88.63d		380.82	158.62c	
\$7,000-7,999	563.48	47.12d		513.21	72.88d		463.29	122.69d		508.36	91.21d		431.37	158.57d	
\$8,000-8,999	555.69	49.98d		530.17	78.94d		320.13	127.27c		574.91	95.77d		383.03	163.77c	
\$9,000-9,999	553.88	54.34d		717.76	93.30d		431.44	131.25d		442.32	104.77d		265.08	166.39	
\$10,000-11,999	608.67	53.91d		673.93	89.40d		454.02	133.15d		545.76	101.58d		349.73	170.28c	
\$12,000-14,999	637.14	58.76d		832.54	106.20d		394.13	136.64d		460.37	110.89d		562.54	179.95d	
\$15,000-24,999	636.92	66.46d		840.06	114.52d		396.42	151.68d		532.49	130.28d		425.97	186.70c	
\$25,000 or more	993.34	100.25d		921.80	162.60d		750.07	242.07d		804.81	205.46d		1248.77	238.54d	
Urbanization:															
Rural farm ^a															
Urban	-168.03	20.58d		-78.62	31.92c		-206.89	64.95d		-297.96	35.88d		-385.50	67.24d	
Rural nonfarm	-184.90	24.56d		-99.15	35.75d		-257.98	70.53d		-219.41	43.28d		-346.62	96.37d	
Race:															
Negro ^a															
White	103.32	26.88d		124.28	37.01d		-88.71	59.22		-33.92	65.83		-123.39	93.14b	
Other	62.35	60.98		134.98	121.10		-35.11	110.43		-146.56	149.78		-265.91	136.78b	
Education:															
Grade school	-78.40	20.50d		134.98	121.10		-12.99	43.49		1.31	36.99		-113.17	68.03b	
High school															
Some college	21.28	27.87		-98.00	32.87d		-53.46	59.45		83.71	51.71		89.86	64.74	
College graduate	-43.64	34.41		-13.59	50.22		92.93	79.33		13.34	63.67		-50.92	80.32	
Life Cycle:															
Stage 1	-275.25	48.48d		-285.78	82.09d		-227.94	99.39c		-112.22	90.85		-353.22	130.72d	
Stage 2	-139.54	26.94d		-140.64	44.17d		-1.33	57.48		-181.75	48.15d		-207.03	77.47d	
Stage 3a															
Stage 4	146.91	29.93d		66.22	47.25		284.91	65.21d		205.90	55.10d		178.20	87.01c	
Stage 5	50.80	49.04		24.79	78.60		192.65	108.41b		67.14	88.77		-40.69	137.56	
Stage 6	-215.67	33.55d		-240.16	53.62d		-120.47	72.89b		-191.96	61.63d		-215.37	98.47c	
Stage 7	-256.11	60.77d		-279.47	101.78d		-145.79	135.31		-378.50	108.22d		-215.83	169.32	
Family Size	284.77	6.19d		242.18	9.41d		298.85	13.81d		339.09	11.73d		331.55	19.18d	
Meal Adjustment	21.27	0.57d		20.48	0.87d		18.68	1.29d		21.61	1.04d		24.74	1.66d	
Homemaker Employed	-0.14	18.64		13.51	30.22		27.71	38.42		18.14	34.64		-8.39	53.43	
R ²	.54			.51			.55			.60			.61		

^aOmitted to avoid singularity. bSignificant at .10 level. cSignificant at .05 level. dSignificant at .01 level.

Table 14. Estimates of United States and Regional Consumption Relationships for Vegetable Protein in Grams, Spring 1965; Including Regression Coefficients, Standard Errors, and R^2 's

Variables	United States			South			Northeast			North Central			West		
	Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors		Regression Coefficients	Standard Errors	
a-Intercept	115.17	33.26 ^d		88.36	53.30 ^b		76.33	81.39		99.57	68.51		52.69	100.64	
Income:															
Under \$1,000 ^a	18.14	24.00		72.05	34.94 ^c		30.84	65.38		-70.33	48.77		-24.84	76.17	
\$1,000-1,999	16.40	23.98		21.30	35.41		37.60	63.73		32.68	48.78		-26.31	75.51	
\$2,000-2,999	35.90	24.01		56.49	36.01		120.24	62.16 ^b		-33.37	49.19		20.12	75.52	
\$3,000-3,999	26.71	24.33		91.73	37.86 ^c		20.50	62.02		-14.78	48.78		3.57	75.16	
\$4,000-4,999	-12.01	23.48		5.31	37.99		65.51	60.27		-57.89	46.08		9.76	73.04	
\$5,000-5,999	-15.20	24.84		23.48	41.50		46.32	61.81		-61.53	48.18		-49.61	76.17	
\$6,000-6,999	-12.30	25.61		-2.94	49.13		89.99	62.58		-85.17	49.58 ^b		33.09	76.14	
\$7,000-7,999	-15.16	27.17		-4.05	47.80		85.24	64.91		-76.37	52.06		13.50	78.64	
\$8,000-8,999	-12.85	29.54		102.07	56.49 ^b		43.93	66.94		-111.34	56.95 ^b		-9.37	79.90	
\$9,000-9,999	-36.52	29.30		-50.77	54.13		59.27	67.90		-68.04	55.22		-17.47	81.77	
\$10,000-11,999	-94.07	31.94 ^d		-46.62	64.30		-64.16	69.69		-105.47	60.29 ^b		-75.58	86.41	
\$12,000-14,999	-94.76	36.12 ^d		-63.32	69.34		31.40	77.36		-128.84	70.83 ^b		-177.12	89.65 ^c	
\$15,000-24,999	46.12	54.49		130.66	98.45		61.51	123.46		1.62	111.69		6.66	114.54	
\$25,000 or more															
Urbanization:															
Rural farm ^a	-159.54	11.19 ^d		-160.10	19.33 ^d		-124.13	33.13 ^d		-159.97	19.51 ^d		-92.77	32.29 ^d	
Urban	-83.24	13.35 ^d		-78.83	21.64 ^d		-90.64	35.97 ^d		-64.66	23.53 ^d		-62.61	46.28	
Rural nonfarm															
Race:															
Negro ^a	31.79	14.61 ^c		84.72	22.41 ^d		-33.33	30.20		47.62	35.79		10.99	44.72	
White	104.25	33.15 ^d		176.33	73.32 ^c		77.21	56.32		78.49	81.43		60.82	65.69	
Other															
Education:															
Grade school	50.73	11.15 ^d		60.48	19.90 ^d		51.44	22.18 ^c		33.59	20.11 ^b		42.31	32.67	
High school ^a	-4.27	15.15		-4.05	30.41		-51.85	30.32 ^b		42.22	28.11		-37.55	31.09	
Some college	-8.09	18.71		-75.49	35.64 ^c		25.62	40.46		9.19	34.61		6.79	38.57	
College graduate															
Life Cycle:															
Stage 1	25.27	26.35		16.33	49.70		44.82	50.69		53.64	49.39		-8.85	62.77	
Stage 2	-100.97	14.64 ^d		-111.22	26.74 ^d		-86.10	29.32 ^d		-74.74	26.20 ^d		-139.03	37.20 ^d	
Stage 3 ^a															
Stage 4	68.47	16.27 ^d		30.14	28.61		82.99	33.26 ^c		120.27	29.95 ^d		43.44	41.78	
Stage 5	33.28	26.66		11.21	47.59		45.31	55.29		58.64	48.26		-1.01	66.05	
Stage 6	-42.15	18.24 ^c		-56.13	32.46 ^b		-27.74	37.18		-18.91	33.50		-36.91	47.29	
Stage 7	-42.84	33.03		-24.70	61.63		-21.98	69.01		-26.26	58.83		-47.72	80.82	
Family Size	236.74	3.36 ^d		238.47	5.70 ^d		231.31	7.04 ^d		233.73	6.38 ^d		254.23	9.21 ^d	
Meal Adjustment	10.33	0.31 ^d		10.51	0.53 ^d		10.00	0.66 ^d		10.45	0.57 ^d		10.22	0.80 ^d	
Homemaker Employed	21.91	10.14 ^c		16.15	18.30		9.80	19.60		40.65	18.83 ^c		2.74	25.66	
R^2		.63			.63			.65			.62			.70	

^aOmitted to avoid singularity.

^bSignificant at .10 level.

^cSignificant at .05 level.

^dSignificant at .01 level.

the West, households having from \$5,000 to \$8,999 and above \$10,000 income consumed significantly more animal protein than did households in the base income class.

Few significant differences in the consumption of vegetable protein were noted between the base income class and other income classes in the United States or regional models, Table 14. In the United States model, only households with income between \$12,000 and \$24,999 consumed significantly less vegetable protein than did households having less than \$1,000 income. In the South, households having from \$1,000 to \$1,999, \$4,000 to \$4,999, \$9,000 to \$9,999, and \$12,000 to \$24,999 disposable income consumed significantly less vegetable protein than did households with under \$1,000 income. The only significant difference in the consumption of vegetable protein by income class in the West region was that households having \$15,000 to \$24,000 disposable income consumed significantly less than did households in the under \$1,000 income class.

A comparison of the vegetable and animal protein models with the total protein model by location revealed that the animal protein and total protein models were very similar with respect to income and the vegetable protein and total protein models were very different. Generally, households consumed more animal and total protein as income increased, but less vegetable protein as income increased.

Urbanization

Rural farm households in the United States and regions of the United States consumed significantly more of both animal and vegetable protein than did urban or rural nonfarm families with the exception that

there was no difference between rural nonfarm and rural farm household consumption of plant protein in the West, Tables 13 and 14.

Except for the discrepancy in the West for vegetable protein, the animal and vegetable protein consumption models were the same as the total protein model with respect to degree of urbanization of the household. In all of these cases, the rural farm households consumed significantly more animal, vegetable, and total protein than did households in urban or rural nonfarm areas.

Race

In the United States and the Southern region of the United States, white households consumed significantly more animal protein than did Negro households, but there was no significant difference in consumption of animal protein between Negro and other races households, Table 13. In the West region of the United States, Negro households consumed significantly more animal protein than did households in the other races class. However, there was no significant difference in animal protein consumption between Negro and white households. Also, there were no significant differences noted in animal protein consumption in the Northeast or North Central regions.

In the United States and the Southern region of the United States, Negro households consumed significantly less vegetable protein than did white or other races households, Table 14. In the North Central and West regions, Negro households consumed less vegetable protein than did white or other race households, but not significantly less. Also, no significant difference in vegetable protein consumption was noted in the Northeast region by race of the households.

Statistical significance and signs of the race coefficients for animal protein did not correspond to the statistical significance and signs of the respective race coefficients for total protein in the United States or regional models, Tables 3 and 13. However, the signs and statistical significance of race coefficients for vegetable protein model corresponded to the signs and statistical significance of race coefficients for the United States, South, and Northeast models, Tables 3 and 14. Therefore, the impact of race of the household on vegetable and total protein consumption was similar for these models.

Education of the Homemaker

Households in the United States and the West region of the United States with the homemaker having a high school education consumed significantly more animal protein than did households with the homemaker having a grade school education, Table 13. The only other significant difference in the consumption of animal protein noted in any of the models indicated that Southern households with the homemaker having completed some college consumed significantly less animal protein than did households with the homemaker having a high school education.

In the United States and the North Central region of the United States, households with the homemaker having a high school education consumed significantly less vegetable protein than did households with the homemaker having a grade school education, Table 14. In the South region, households in the high school education class consumed significantly less vegetable protein than did households with the homemaker having a grade school education and significantly more vegetable protein than did households in the college graduate class. In the Northeast

region, a similar relationship held for households in the grade school and some college classes, respectively. No significant differences in consumption of vegetable protein were noted in the West region.

None of the estimates for vegetable or animal protein models corresponded to estimates detected for total protein in the respective locations. The only patterns noted for vegetable and animal protein consumption were that households with the housewife having a grade school education tended to consume more vegetable protein and less animal protein than did households with the homemaker having a high school education.

Family Life Cycle

Households in the United States in which the housewife was present and the average age of the children ranged from six to less than 12 years (stage 3) consumed significantly more animal protein than did households in stages where no children were present and the housewife was 40 years of age or less (stage 1), the housewife was present and the average age of the children was under six years (stage 2), no children were present and the housewife was over 40 years of age (stage 6), and the housewife was absent (stage 7), Table 13. Households in stage 3 consumed less animal protein than did households in which the housewife was present and the average age of the children ranged from 12 to 17 years (stage 4) and households in which the housewife was present and the average age of the children was over 17 years (stage 5), but only significantly less than households in stage 4. Similar relationships were noted for the life cycle coefficients in all of the regional models except in the West. In the South, Northeast, and North Central regions, signs of

the coefficients were consistent with the United States models, but coefficients were not always significant.

In the United States models, households in stage 3 consumed significantly more vegetable protein than did households in stages 2, 6, or 7, Table 14. Households in stage 4 consumed significantly more vegetable protein than did households in stage 3. No significant differences in consumption of vegetable protein were noted between households in stages 1 and 5 and stage 3, respectively. Again, regional estimates for the South, Northeast, and North Central households approximated estimates found for households in the United States, but these regional estimates were not always significant.

The life cycle estimates for the South, North Central, and West regions for animal protein consumption corresponded to total protein consumption estimates in these regions. None of the vegetable protein estimates corresponded to the total protein estimates for any of the locations.

Family Size

Family size was a highly significant ($P \geq .01$) factor affecting the consumption of animal and vegetable protein in the United States and in each region of the United States, Tables 13 and 14. As hypothesized, the signs of the family size coefficients were positive; that is, as family size increased, household consumption of both animal and vegetable protein increased.

The impact of family size varied among the four regions of the United States. An increase in family size by one member increased household animal protein consumption by 242, 299, 339, and 332 grams in the

South, Northeast, North Central, and West regions, respectively, Table 13. Therefore, a change in family size would have the greatest impact on animal protein consumption in the North Central region with households in the West, Northeast, and South regions ranked next, respectively. Similarly, an increase in family size by one member increased household vegetable protein consumption by 238, 231, 234, and 254 grams in the South, Northeast, North Central, and West regions, respectively, Table 14. Therefore, a change in family size would have the greatest impact on vegetable protein consumption in the West region with households in the South, North Central, and Northeast regions ranked next, respectively.

Meal Adjustment

The meal adjustment variable had a highly significant ($P \geq .01$) impact on the consumption of both animal and vegetable protein in all models, Tables 13 and 14. Generally, households in all regions evidenced a similar impact of family eating habits on animal and vegetable protein consumption.

Employment Status of the Female

The housewife working outside the home was not a significant factor affecting the consumption of animal protein in the United States or regional models, Table 13. However, the housewife being employed outside the home had a significant positive impact on vegetable protein consumption in the United States and the North Central region of the United States, Table 14.

CHAPTER V

SOCIOECONOMIC IMPLICATIONS

Chapter IV included an analysis of the statistical impact of income and other socioeconomic characteristics of the household and of the female head of household on the consumption of food energy, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. Also, the quantity of protein consumed by the household was dissected into animal and vegetable components and the impact of income and other socioeconomic characteristics of the household and of the female head of household on the consumption of these quantities was specified. These consumption relationships were specified for the United States and for four regions of the United States.

In this chapter, the statistically estimated household nutrient consumption relationships were utilized to accomplish two primary goals. First, the nutrient consumption relationships were utilized to evaluate the implications of the impact of income and other selected socioeconomic factors on household nutrient consumption by isolating consumption trends which could be used in understanding the impact of future changes in the characteristics of United States households on nutrient consumption. Ultimately, the attainment of this goal would result in a functional classification relating household nutrient consumption to spacial, economic, sociological, and demographic characteristics of United States households and their members. These estimations were made for households in the United States and in the South, Northeast, North

Central, and West regions of the United States. Second, the estimated nutrient consumption relationships were utilized to evaluate the adequacy of food nutrient consumption by selected households in the United States. This analysis was undertaken to foster the development of implications relative to the impact of income and other selected socioeconomic factors on the adequacy of diets of United States households.

I. IMPACT OF INCOME AND OTHER SELECTED SOCIOECONOMIC FACTORS ON HOUSEHOLD FOOD NUTRIENT CONSUMPTION

In this section of Chapter V, the relative impact of each of the socioeconomic variables in the respective models were analyzed to ascertain implications relative to possible trends in household food nutrient consumption. The characteristics of the household discussed in this section were: income, location, race, stage of the household in the family life cycle, family size, and family nutrient eating habits (meal adjustment). The characteristics of the homemaker which were also discussed in more detail in this section were her education and employment status.

Household disposable income was determined to be a primary factor influencing the allocation of food and nutrients among households. Also, income was a characteristic which was susceptible to manipulation by the government for the purpose of improving household diets. More specifically, household disposable income affords a mechanism tied directly to the household food and nutrient consumption decision-making process. Thus, specification of the relationship of income to the intake of nutrients by the household could provide information which could be evaluated relative to income redistribution programs. Income redistribu-

tion policy decisions coupled with overt action on the part of the government could result in relatively fast remedies to nutritional problems of low income households. Other characteristics such as degree of urbanization, education of the homemaker, family size, and employment status of the homemaker could not be manipulated by government policy decisions to improve household diets as easily as income, but certain actions could possibly be undertaken in an indirect manner.

Income

The impact of disposable income on household nutrient consumption was evaluated using income elasticities.¹⁷ Income elasticities were computed from the statistical relationships estimated in Chapter IV. Average income elasticities were first estimated for the 14 income dummy variable classes estimated in the previously presented nutrient consumption models for the United States and the South, Northeast, North Central, and West regions, respectively. These elasticities reflected the responsiveness of household nutrient consumption to changes in income over a range of income, ceteris paribus. Each income class except the open-ended class was represented by the midpoint of that income class. The open-ended upper income class was represented by the initial value of that class, \$25,000. All other factors in the respective nutrient consumption models were held at their mean values and the quantity of the respective nutrient consumed by the household was

¹⁷The use of cross-sectional data requires an additional assumption when calculating income elasticities. The basic assumption in analyzing income elasticities derived from cross-sectional data is that a household at one income level would consume as much of a certain nutrient as did a household at a different income level if its income were increased to the new level.

allowed to vary only in response to changes in disposable income. The respective average income elasticities were estimated using these respective quantities consumed by households and disposable income of households as was indicated by the elasticity equation presented in Chapter III.

These estimated arc elasticities for the 14 income classes for the United States and regional models were presented in Appendix Tables 22 through 34. The income elasticities calculated using this approach were difficult to fully evaluate. The magnitudes of the coefficients reflecting the impact of income on the consumption of each respective nutrient evidenced erratic responses for the income classes considered, Tables 2 through 12 (pp. 43-53) and Tables 13 and 14 (pp. 74 and 75). An example of the influence of these erratic changes in income was reflected by the computed arc income elasticities for food energy consumption by households in the United States. These income elasticities were .03 up to the \$2,999 income level, jumped to .13 for the \$3,000 to \$3,999 income level, but dropped to .07, .04, and .04 for the next three income ranges, respectively. The income elasticities increased to .20 for the \$7,000 to \$7,999 income range, decreased to .04 for the \$8,000 to \$8,999 income range, and became negative for income levels between \$9,000 and \$24,999. Households in the above \$25,000 income class evidenced a large positive income response, .84, Appendix Table 22. This erratic variation was extremely difficult to logically rationalize. Thus, this statistical technique and mathematical approach for calculating arc elasticities appeared suspect. Therefore, an alternative method was devised to identify the functional relationship between income and nutrient consumption which would give more consistent

elasticities throughout the range of incomes considered in this study.

This alternative approach involved use of the same models which were presented previously except the income variable was specified as a continuous variable rather than as 14 discrete income classes (dummy variables). Continuous income data were developed for each household from the income classes by representing each class, except the upper-income class, by the mid-point of that class. The upper-income class, \$25,000 or more, was represented by the initial income of that class, \$25,000. Several alternative functional forms were used to determine the functional relationship between income and household consumption of all 13 nutrients. The function forms evaluated were: linear, semilogarithmic, double-logarithmic, cubic, quadratic, and transcendental. Based on the coefficients of determination (R^2 's) and statistical significance of income coefficients for these functional forms, the quadratic form was the most appropriate for all 13 nutrient consumption relationships. The point elasticities estimated for selected income levels were presented in Tables 15 through 19.

Point income elasticities were computed at the \$2,000, \$4,000, \$8,000, \$12,000, \$16,000, and \$20,000 income levels. These income levels were selected for scrutiny because the previous analysis using income dummy variables indicated possible changes in income responsiveness at these income levels. Evaluation of other income levels would only increase the number of computations without providing additional information. On the other hand, evaluation of income responsiveness at fewer income levels would possibly mask important changes in responsiveness. Therefore, these income levels were selected to reflect relevant changes in nutrient consumption with changes in disposable income, ceteris paribus.

Table 15. Income Elasticities Estimated from Quadratic Functions for Selected Income Levels Representing Household Food Nutrient Consumption, the United States, Spring 1965

Food Nutrient	Selected Income Levels					
	\$2,000	\$4,000	\$8,000	\$12,000	\$16,000	\$20,000
Food energy ^a	.036	.065	.083	.072	.033	-.037
Protein ^a	.060	.099	.129	.106	.037	-.080
Animal protein ^a	.107	.170	.211	.173	.071	-.102
Vegetable protein ^b	-.020	-.036	-.058	-.064	-.052	-.022
Fat ^a	.067	.110	.144	.123	.055	-.063
Carbohydrate	-.000	-.001	-.004	-.010	-.019	-.031
Calcium ^a	.021	.037	.054	.054	.038	.006
Iron ^a	.028	.049	.068	.063	.035	-.017
Vitamin A ^a	.082	.141	.206	.224	.206	.159
Thiamine ^a	.017	.029	.040	.036	.016	-.020
Riboflavin ^a	.047	.079	.103	.084	.026	-.074
Niacin ^a	.064	.104	.132	.104	.024	-.110
Ascorbic acid ^a	.139	.221	.290	.280	.215	.100

^aThe income elasticities were computed from an income coefficient significant at the .01 level.

^bThe income elasticities were computed for an income coefficient significant at the .05 level.

Table 16. Income Elasticities Estimated from Quadratic Functions for Selected Income Levels Representing Household Food Nutrient Consumption, the South Region of the United States, Spring 1965

Food Nutrient	Selected Income Levels					
	\$2,000	\$4,000	\$8,000	\$12,000	\$16,000	\$20,000
Food energy ^a	.046	.077	.108	.100	.061	-.012
Protein ^a	.073	.121	.161	.146	.084	-.025
Animal protein ^a	.130	.205	.257	.225	.128	.036
Vegetable protein	-.013	-.053	-.036	-.036	-.024	.001
Fat ^a	.085	.133	.175	.156	.085	-.038
Carbohydrate	.008	.015	.023	.026	.024	.016
Calcium	.019	.035	.054	.061	.055	.038
Iron ^a	.043	.073	.102	.096	.059	-.009
Vitamin A ^a	.115	.186	.245	.232	.164	.045
Thiamine ^a	.027	.047	.067	.064	.039	-.007
Riboflavin ^a	.054	.092	.127	.121	.078	.000
Niacin ^a	.080	.132	.173	.153	.083	-.039
Ascorbic acid ^a	.158	.256	.356	.588	.371	.327

^aThe income elasticities were computed from an income coefficient significant at the .01 level.

Table 17. Income Elasticities Estimated from Quadratic Functions for Selected Income Levels Representing Household Food Nutrient Consumption, the Northeast Region of the United States, Spring 1965

Food Nutrient	Selected Income Levels					
	\$2,000	\$4,000	\$8,000	\$12,000	\$16,000	\$20,000
Food energy ^a	.043	.070	.083	.047	-.035	-.168
Protein ^a	.057	.091	.109	.070	-.023	-.177
Animal protein ^a	.086	.136	.164	.117	.005	-.184
Vegetable protein	.000	-.003	-.019	-.050	-.096	-.159
Fat ^a	.071	.114	.135	.090	-.017	-.195
Carbohydrate	.007	.009	.000	-.027	-.072	-.138
Calcium ^b	.032	.054	.068	.050	.001	-.082
Iron ^b	.035	.058	.072	.049	-.010	-.106
Vitamin A	.057	.095	.125	.106	.043	-.065
Thiamine ^c	.022	.034	.029	-.010	-.087	-.206
Riboflavin ^b	.032	.052	.063	.040	-.018	-.113
Niacin ^a	.059	.092	.099	.039	-.089	-.299
Ascorbic acid ^a	.111	.181	.242	.235	.176	.069

^aThe income elasticities were computed from an income coefficient significant at the .01 level.

^bThe income elasticities were computed from an income coefficient significant at the .05 level.

^cThe income elasticities were computed from an income coefficient significant at the .10 level.

Table 18. Income Elasticities Estimated from Quadratic Functions for Selected Income Levels Representing Household Food Nutrient Consumption, the North Central Region of the United States, Spring 1965

Food Nutrient	Selected Income Levels					
	\$2,000	\$4,000	\$8,000	\$12,000	\$16,000	\$20,000
Food energy ^a	.027	.045	.059	.044	.033	-.067
Protein ^a	.040	.067	.087	.070	.019	-.070
Animal protein ^a	.076	.123	.154	.120	.028	-.126
Vegetable protein ^b	-.029	-.052	-.070	-.059	-.006	.082
Fat ^a	.056	.091	.110	.074	-.014	-.160
Carbohydrate	-.005	-.010	-.016	-.018	-.017	-.012
Calcium ^b	.024	.041	.056	.047	.016	-.037
Iron	.013	.024	.041	.052	.056	.054
Vitamin A	.018	.063	.219	.428	.647	.851
Thiamine	.011	.022	.043	.062	.080	.096
Riboflavin ^a	.039	.066	.085	.066	.012	-.080
Niacin ^a	.049	.082	.110	.098	.048	-.040
Ascorbic acid ^a	.152	.240	.309	.294	.221	.095

^aThe income elasticities were computed from an income coefficient significant at the .01 level.

^bThe income elasticities were computed from an income coefficient significant at the .05 level.

Table 19. Income Elasticities Estimated from Quadratic Functions for Selected Income Levels Representing Household Food Nutrient Consumption, the West Region of the United States, Spring 1965

Food Nutrient	Selected Income Levels					
	\$2,000	\$4,000	\$8,000	\$12,000	\$16,000	\$20,000
Food energy	.025	.047	.080	.103	.115	.119
Protein ^b	.036	.064	.103	.187	.120	.103
Animal protein ^c	.054	.097	.161	.200	.220	.226
Vegetable protein	.001	-.005	-.032	-.083	-.162	-.275
Fat ^d	.042	.077	.131	.167	.190	.200
Carbohydrate	.007	.011	.008	-.008	-.034	-.082
Calcium ^a	.032	.055	.080	.081	.060	.017
Iron	.014	.026	.042	.050	.049	.040
Vitamin A	.046	.077	.099	.078	.016	-.088
Thiamine	.002	.004	.005	.003	-.002	-.010
Riboflavin ^a	.030	.054	.081	.087	.074	.042
Niacin ^b	.040	.070	.106	.115	.102	.068
Ascorbic acid ^a	.048	.087	.139	.166	.173	.162

^aThe income elasticities were computed from an income coefficient significant at the .01 level.

^bThe income elasticities were computed from an income coefficient significant at the .05 level.

^cThe income elasticities were computed from an income coefficient significant at the .10 level.

Income elasticities estimated for these levels of disposable income were less than one for the consumption of all nutrients by United States and regional households. Therefore, an increase in household disposable income would result in a less than proportional increase in consumption of each respective nutrient, Tables 15 through 19.

Vitamin C was the only nutrient which had positive income elasticities over all income levels in all models, Tables 15 through 19. However, animal protein, calcium, and vitamin A income elasticities were positive at all selected income levels except the \$20,000 income level for United States and regional models. Income elasticities for vegetable protein and carbohydrate were negative over all income levels in the United States models. However, only vegetable protein had negative income elasticities over all income levels in all regional models. In the Southern region, income elasticities for carbohydrate consumption were positive at all income levels. Negative income elasticities were evident in the United States and regional models for a majority of the nutrients at the \$16,000 and \$20,000 income levels.

In the United States models, the largest income elasticity noted for these selected income levels was .29 for vitamin C consumption by households having \$8,000 disposable income, Tables 15 through 19. The largest negative income elasticity was -.11 for niacin consumption by households having \$20,000 disposable income. In the regional models, the largest income elasticity was .85 for vitamin A consumption at the \$20,000 income level in the North Central model. Similarly, the most negative income elasticity was -.30 for niacin consumption at the \$20,000 income level in the Northeast model.

Animal protein, fat, vitamin A, and vitamin C consumption evidenced the highest income elasticities at most income levels in both the United States and regional models, Tables 15 through 19. Calcium, iron, and thiamine consumption was generally the least responsive to income changes (i.e., lowest income elasticities) over most income levels in both the United States and regional models. Vegetable protein and carbohydrate consumption was often negatively responsive to income changes in the United States and regional models.

The highest income responsiveness were hypothesized to occur at the low income levels. However, the income elasticities which were estimated from the United States and regional models indicated that the highest income responses generally occurred at the \$8,000 disposable income level. Larger income elasticities were evident at even higher income levels for some nutrients in certain regions of the United States.

Similarities in the maximum income responsiveness (largest income elasticities) at the various income levels between the United States and the four regional estimates, respectively, were not extensive, Tables 15 through 19. In no case did maximum elasticities for all of the four regions correspond to the maximum elasticities noted for United States households at the respective selected income levels. However, in many cases the selected income levels where maximum elasticities occurred for the South, Northeast, and North Central regions corresponded to the pattern noted for the United States. Generally, households in the West region of the United States were inclined to have income elasticities which were maximum at higher income levels than were noted for the United States or other regions.

Several implications relative to the impact of household disposable

income on household nutrient consumption were developed from the previous analyses. The high degree of positive income responsiveness noted for animal protein, fat, vitamin A, and vitamin C implied a future positive trend in the consumption of these nutrients with increases in household disposable income. This implied that consumption of such commodities as meats and fruits (especially citrus fruits) may increase in response to income increases in the future. Calcium consumption was only slightly responsive to increases in disposable income. Therefore, increases in household disposable income would have little impact on the consumption of milk and milk products. Vegetable protein and carbohydrate consumption by households declined slightly with increases in income. This implied that consumption of such commodities as wheat, rice, corn, and potatoes may decline with future increases in disposable income.

The magnitude of the income elasticities were generally larger for households having \$8,000 disposable income than the elasticities were at other income levels. Therefore, income redistribution programs aimed at extremely low income households which have inadequate nutrient consumption levels could be inappropriate if food expenditure controls are not included in the proposition. That is, the expenditure of the redistributed income must be limited to food because there seemed to be a tendency for low income households to spend a small proportion of income increases on food. This implied that there was a trade-off among different household necessities; i.e., food versus other necessities such as shelter, clothing, and transportation.

The large number of negative income elasticities noted at the higher income levels (\$16,000 and \$20,000) implied that consumption of most nutrients tended to decline with income increases for households

having these levels of income. Whether this phenomenon was a function of the consumption capacity of the human or some economic, sociological, or psychological factor not included in the analysis was not ascertained. If real disposable income per United States household increases in the future, then consumption of nutrients and food will tend to level-off at some income level. For the data analyzed in this study, consumption of most nutrients leveled-off in the vicinity of the \$16,000 income level. However, extrapolation from this figure to future income levels and consumption should be approached carefully because the set of other factors may have changed and inflation may have eroded the value of household income. Nevertheless, American agriculture must depend upon increases in population or foreign demand for additional sales if household consumption of nutrients stabilizes. Since population growth of the United States has tended to stabilize, foreign markets seemed to offer the most potential.

Urbanization

Rural households generally consumed the largest quantities of all nutrients except vitamin A and vitamin C in the United States and regional models. Urban households consumed the most vitamin A and vitamin C in the United States and South region, but rural households consumed the largest quantities of these nutrients in the Northeast, North Central and West regions. This implied that smaller quantities of all nutrients except possibly vitamin A and vitamin C would be consumed as our society becomes more urban. This implied that food consumption as a whole would decrease if the trend toward greater urbanization continues. With respect to nutrition, this implied that urban

households have the poorest diets from a quantity of nutrients consumed standpoint.

Race

There were significant differences in nutrient consumption among households of different races, Tables 2 through 12 (pp. 43-53) and Tables 13 and 14 (pp. 79-80). White households analyzed for the United States models consumed significantly more protein, carbohydrate, calcium, riboflavin, niacin, vitamin C, animal protein, and vegetable protein than did Negro households. However, Negro households consumed significantly more vitamin A and thiamine. In the South region, white households consumed significantly more food energy, protein, fat, carbohydrate, calcium, iron, riboflavin, niacin, animal protein, and vegetable protein than did Negro households. Negroes in other regions of the United States had diets which were equivalent or superior to the diets of white households. In the Northeast region, Negro households consumed significantly more food energy, fat, carbohydrate, iron, vitamin A, thiamine, and vitamin C than did white households. In the North Central region, Negro households consumed significantly more iron and vitamin A than did white households. In the West region, Negro households consumed significantly more iron, vitamin A, thiamine, and vitamin C than did white households. In both the North Central and West regions, white households consumed significantly more calcium than did Negro households.

The levels of consumption of all nutrients except fat by other race households were comparable or greater than the levels consumed by Negro households. Other race households consumed significantly less fat than did Negro households in the United States and the North Central and West regions.

This implied that diets of Negro households were comparable or superior to the diets of white households in all regions except the South. Diets of Negro households seemed to be weakest in the consumption of calcium which indicated low levels of consumption of milk and milk products. Diets of other race (other than white or Negro) households seemed to be weakest in the consumption of fat.

Education of the Homemaker

An analysis of the United States estimates with respect to the magnitude of the coefficients representing the impact of educational attainment of the homemaker revealed that household consumption of food energy, fat, carbohydrate, iron, thiamine, niacin, and vegetable protein declined significantly with increases in the level of education attained by the female head of household, Tables 2, 4, 5, 7, 9, 11, and 14 (pp. 43, 45, 46, 48, 50, 52, and 75). However, an increase in educational attainment of the homemaker increased household calcium, vitamin C, and animal protein consumption, Tables 6, 12, and 14 (pp. 47, 53, and 75).

The impact of educational attainment of the homemaker differed among regions of the United States, Tables 2 through 12 (pp. 43-53) and Tables 13 and 14 (pp. 74-75). In the South, consumption of food energy, protein, fat, carbohydrate, iron, thiamine, riboflavin, and vegetable protein declined significantly with increases in the education of the homemaker. Consumption of vitamin A and vitamin C increased significantly with increases in the education of the homemaker for Southern households. In the Northeast region, consumption of food energy, fat, iron, vitamin A, thiamine, and vegetable protein declined significantly with increases in the level of education attained by the housewife.

Consumption of calcium and vitamin C increased significantly with increases in the education of the homemaker in the Northeast region. Significant trends in consumption of most nutrients with increases in educational attainment were not evident in the North Central and West regions.

These analyses implied that a continued trend toward higher levels of formal education would result in a decline in the consumption of food energy, fat, carbohydrate, iron, thiamine, and vegetable protein and an increase in the consumption of calcium, vitamin C, and animal protein by households. Therefore, consumption of cereals, legume seeds, and potatoes may decline in response to increased formal education of the homemaker. Conversely, consumption of milk, meats, and citrus fruits may increase in response to increased formal education of the homemaker. These relationships held for all regions except the North Central and West regions where education of the homemaker had little impact on nutrient consumption.

Stage in the Family Life Cycle

The family life cycle variable was developed to reflect the impact of the presence of the household in one of seven distinct life cycle stages on nutrient consumption. Three periods of change in the family unit were characterized by these seven stages: (1) the development period (stages 1 and 2), (2) the stable period (stages 3, 4, and 5), and (3) the decline period (stages 6 and 7).

Generally, households in the developing and declining periods of the family life cycle consumed less of all food nutrients than did households in the stable period, Tables 2 through 12 (pp. 43-53) and Tables 13 and 14 (pp. 74-75). Systematic differences in nutrient

consumption between households in the developing and declining periods were not evident. These relationships held for the United States and regional models.

The stable period of development of the household was depicted by three life cycle stages: (1) the housewife was present and the average age of the children ranged from six to less than 12 years (stage 3), (2) the housewife was present and the average age of the children ranged from 12 to 17 years (stage 4), and (3) the housewife was present and the average age of the children was over 17 years (stage 5). The larger levels of consumption of nutrients by these households implied that families with the housewife absent, no children, or young children consumed smaller relative quantities of the food nutrients than did households with middle or old aged children.

Family Size

Family size of the household had a positive impact on the consumption of all nutrients in all regions of the United States and for the nation as a whole, Table 2 through 12 (pp. 43-53) and Table 13 and 14 (pp. 74-75). Therefore, an increase in family size resulted in an increase in the quantity of all nutrients consumed by the household. The magnitudes of the family size coefficients differed among regions, but a large difference was not found for most nutrients. Generally, the impact of family size on the consumption of most nutrients was highest for households in the Western region of the United States and was lowest for households in the Southern region of the United States. Notable exceptions were that households in the North Central region consumed the smallest quantities of calcium and households in the North-

east region consumed the least amounts of vegetable protein with respect to family size.

These results coupled with the trend toward smaller family units could result in declines in nutrient consumption in the United States in the future. This implied that per household and total food consumption may decline in the future.

Meal Adjustment

Meal adjustment also had a positive impact on household food nutrient consumption, Tables 2 through 12 (pp. 43-53) and Tables 13 and 14 (pp. 74-75). Therefore, an increase in either home or guest meals would increase household nutrient consumption and an increase in either skipped or away from home meals would have the opposite effect. The impact of the meal adjustment variable on household nutrient consumption was not systematic among regions; that is, the relative magnitudes of the meal adjustment coefficients were not the same for any one region for a majority of the nutrients.

These analyses implied that shifts from the traditional three meals per day to fewer meals per day would result in smaller quantities of nutrients and food being consumed. Also, a greater incidence of skipped meals would have the same effect. Implications relative to the impact of an increase in away from home meals could not be made.

Employment Status of the Female

The female head of household being employed outside the home had a significant positive impact on the consumption of food energy, fat, carbohydrate, and vegetable protein for the United States households, Tables 2 through 12 (pp. 43-53) and Tables 13 and 14 (pp. 74-75).

Furthermore, the female head of household being employed outside the home had a significant positive impact on vitamin A consumption in the South region, fat and calcium consumption in the Northeast region, and carbohydrate and vegetable protein consumption in the North Central region. Employment status of the female head of household did not have a significant impact on food nutrient consumption in the West region.

Households with the female head employed consumed larger quantities of food energy, fat, carbohydrate, and vegetable protein than did households with the female not employed. This implied that these households generally consumed larger quantities of quick service foods and snacks than did households with the female not employed.

II. ADEQUACY OF FOOD NUTRIENT CONSUMPTION BY HOUSEHOLDS IN THE UNITED STATES

In this section, the adequacy of household consumption of each respective food nutrient was evaluated at different levels of disposable income by comparing estimated levels of consumption with recommended levels of consumption. This evaluation was accomplished by comparing two nutrient consumption estimates derived from the food nutrient consumption relationships which were developed and estimated earlier with established Recommended Dietary Allowances for each respective nutrient.

One of the nutrient consumption estimates reflected the quantities of the respective nutrients consumed by average United States households at different levels of disposable income, ceteris paribus. This estimate was developed from the respective food nutrient consumption relationships by shifting income from level to level and noting the resulting changes

in quantity of the nutrient consumed. In this case, the impact of the socioeconomic variables other than income were entered at their means.

The other nutrient consumption estimates reflected the various quantities of the respective nutrients consumed by households having certain selected characteristics. These characteristics were selected to evaluate the nutritional adequacy of low nutrient consuming households. The selection process involved scrutiny of the discrete independent variables for the class in each respective category consuming the smallest quantities which were significantly different for a given nutrient. In cases where a significant difference in consumption was not ascertained within a discrete independent variable category, the average impact of these categories were entered. Discrete variables analyzed in this manner were urbanization, race, education of the homemaker, stage in the family life cycle, and employment status of the female. Continuous variables, family size and meal adjustment, were entered at their means. Also, the impact of regional location was included in the evaluation based on the magnitudes of the respective means of household nutrient consumption which were presented in Appendix Table 35. The region where households consumed the smallest average quantities of a given nutrient was selected for the evaluation process. Income-consumption estimates for lowest nutrient consuming households were then developed from the respective estimated nutrient consumption relationships by shifting income from level to level and noting the resulting changes in quantity of the nutrient consumed, ceteris paribus.

Therefore, nutrient consumption estimates were developed for average households in the United States and lowest nutrient consuming households in selected regions of the United States. These relationships

were developed for food energy, protein (animal, vegetable, and total), fat, carbohydrate, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid at the 14 income (dummy variable) levels discussed in Chapter III.

Estimates reflecting Recommended Dietary Allowances for food energy, total protein, calcium, iron, vitamin A, thiamine, riboflavin, and ascorbic acid were also developed.¹⁸ Estimates reflecting Recommended Dietary Allowances for fat, carbohydrate, and niacin were not developed because absolute Recommended Dietary Allowances did not exist. Also, estimates reflecting Recommended Dietary Allowances for vegetable and animal protein were not presented because there were no individual standards for these two constituent parts of total protein.

The estimates representing Recommended Dietary Allowances were developed from the quantity of each nutrient needed by the adult-male to meet the Recommended Dietary Allowance and equivalent nutrition units as were computed by the United States Department of Agriculture for the 14 income classes utilized in this study.¹⁹ The product of the

¹⁸Recommended Dietary Allowances reflect daily calorie and nutrient consumption levels judged by scientists of the Food and Nutrition Board as being sufficient for the maintenance of good nutrition in practically all healthy individuals in the United States given current living conditions. A margin of sufficiency above the average physiological requirements of each nutrient except food energy is provided by these allowances. Thus, food practices should not necessarily be judged as poor or malnutrition assumed to exist when the recommended allowance is not met. However, the allowances could provide guidelines for detecting possible nutrition problems (U.S. Department of Agriculture, 1969, p. 3).

¹⁹Equivalent nutrition units for each respective nutrient were computed using the 1963 Recommended Dietary Allowances to relate the needs of persons of different age and sex to those of the 20-35 year-old man (U.S. Department of Agriculture, 1969, pp. 14 and 107). This approach provided for variations in household nutrient needs due to variations in household size and sex composition at the different income levels.

Recommended Dietary Allowance for a nutrient and the respective equivalent nutrition units per income class for that nutrient times seven (days per week) represented the Recommended Dietary Allowances per household per week by income classifications.

A comparison of the nutrient consumption estimates and Recommended Dietary Allowances were made to determine the nutritional adequacy of diets of United States households at different levels of disposable income. In addition to these comparisons, each of the following subdivisions included a brief discussion of the major body functions of each nutrient and the primary food sources of each nutrient.

Food Energy

Food energy is utilized by the body for physical activity, the functional activities of the various organs and tissue, growth, repair, and maintenance of the body temperature. Thus, this nutrient is very important for the sustenance of life. Energy-yielding foods (high in fat, carbohydrate, and protein content) are eaten and oxidized to provide substances which can be stored in the body for variable periods of time. When this potential energy is converted to kinetic energy and is released in the body, it may occur as either chemical, electrical, mechanical, or thermal energy. Since all forms of energy released in the body can be converted into heat energy, the production of energy by the body is measured in calories, units of heat energy (Arnow, 1972, pp. 24-26).

The nutrient consumption estimate representing food energy consumption by average households in the United States (FE) was above the Recommended Dietary Allowance (RDA) estimate at all levels of disposable income, Figure 2. At income levels below \$2,000, these households

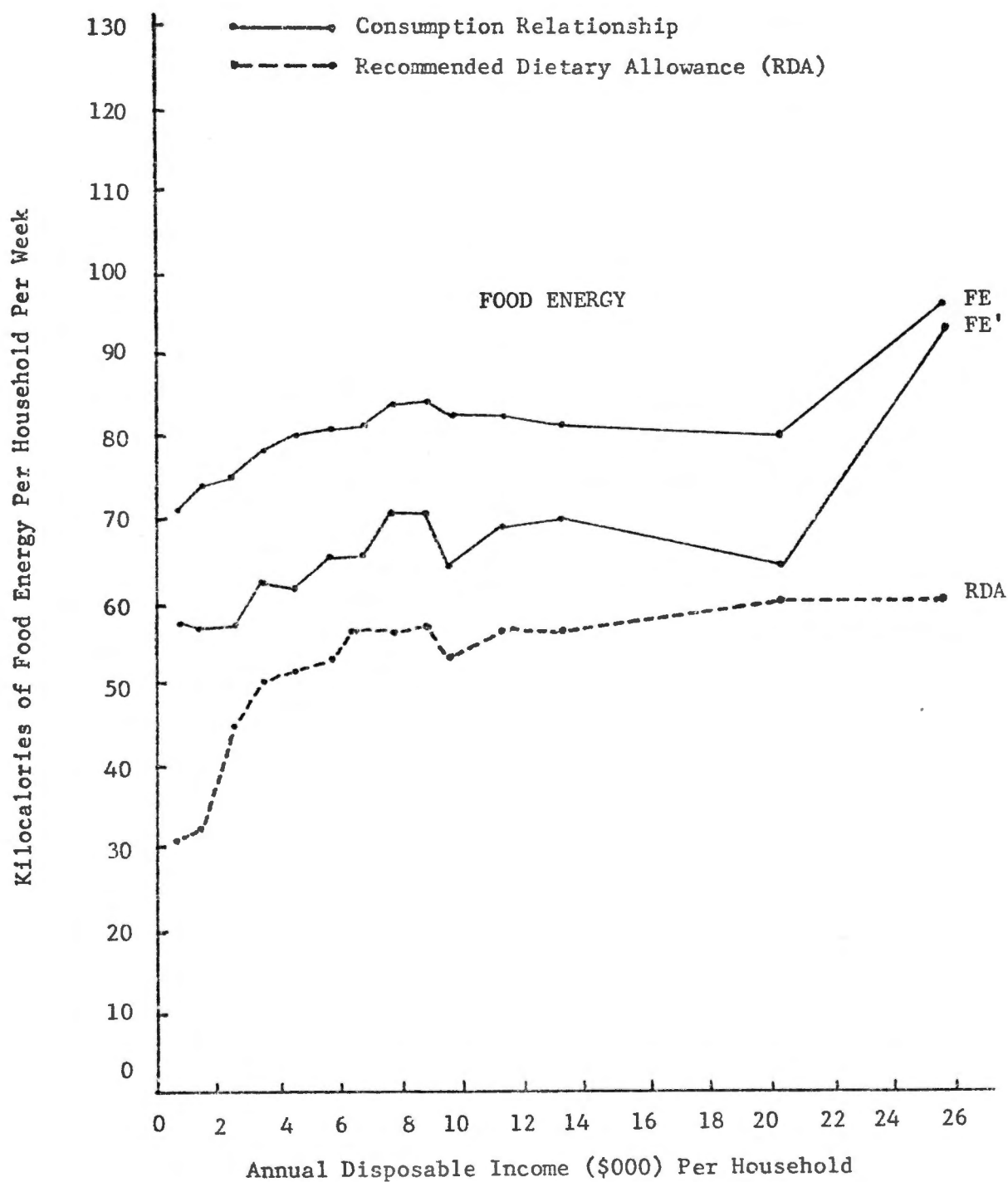


Figure 2. Household Food Energy Consumption Relationships and the Recommended Dietary Allowance, the United States, Spring 1965.

consumed approximately 40 more kilocalories of energy than were recommended. Approximately 25 kilocalories over the recommended levels were consumed by households in the \$4,000 to \$20,000 income range. At the \$25,000 income level, the difference increased to approximately 35 kilocalories.

Lowest levels of food energy consumption were noted for urban households located in the West region of the United States. These households included children whose average age was less than six years. A comparison of the level of consumption of food energy by households having these characteristics (FE') and the Recommended Dietary Allowance (RDA) revealed no apparent food energy consumption deficiencies. At income levels below \$2,000, household consumption of food energy exceeded the recommended levels by approximately 25 kilocalories. The consumption estimate (FE') was approximately 10 kilocalories above the RDA over the \$3,000 to \$15,000 income range. The estimates differed by approximately 5 kilocalories at the \$20,000 income level and 35 kilocalories at the \$25,000 income level.

These point estimates for food energy consumption at all income levels did not isolate food energy deficiencies in the diets of average United States households. However, some urban households located in the West region of the United States appeared to be consuming quantities of food energy below the RDA since the standard error of the estimate was 25 kilocalories per household.²⁰ The income-consumption estimates for

²⁰The standard error of the estimate reflects the degree of dispersion of observations on the dependent variable in the vicinity of the estimated regression line.

these households were only five to 10 kilocalories above the RDA at income levels from \$3,000 to \$20,000. Care must be exercised when evaluating the adequacy of food energy consumption because requirements may vary greatly depending on the level of activity of the members of the household.

Protein

As a class, proteins are one of the basic and essential nutrients consumed by man. All animal life is dependent on an adequate quantity of protein-building material because body tissues, the living protoplasm of the cell, and the components of the blood are primarily protein in nature (Arnow, 1972, p. 23).

The proteins in the human diet are provided by both animal and vegetable sources. Many of the proteins derived from animal sources are nutritionally adequate because all of the essential amino acids are present. However, proteins from vegetable sources are often deficient in one or more of the essential amino acids. Therefore, vegetable protein must generally be supplemented with other proteins in the diet to supply the missing amino acids in order to provide good nutrition. However, vegetable proteins can provide a satisfactory diet if the individual is careful in selecting the food mixture. The most important sources of protein of animal origin are milk, milk products, meats, fish, seafoods, poultry, and eggs. Cereals (wheat, rice, corn, barley, and rye), legume seeds (beans, peas, and soybeans), and nuts are primary sources of vegetable protein (Burton, 1965, pp. 41-53).

The quantities of total protein consumed by average United States households from these and other food sources (TP) were greater than the

consumption levels recommended (RDA) at all income levels, Figure 3. In fact, the animal protein consumption estimates for average households in the United States (AP) were above the RDA for total protein at all income levels. Thus, an average United States household met protein nutritional allowances from only animal sources. The difference between the total protein consumption (TP) and the allowance (RDA) estimates remained fairly constant at approximately 1,400 grams at all income levels.

The characteristics of the household selected to represent the lowest consumption levels of animal, vegetable, and total protein differed. The lowest level of total protein consumption was noted for Western, urban households with no children and housewives who were 40 years of age or younger. The lowest level of animal protein consumption was noted for Negro, rural nonfarm households located in the South region of the United States. In this case, no children were present in the households and the housewives were 40 years of age or younger and had completed some college. The lowest level of vegetable protein consumption was noted for urban households located in the West. These households had a housewife present and children whose average age was under six years. The levels of total, animal and vegetable protein consumption by households bearing these characteristics were represented in Figure 3 by consumption estimates TP', AP', and VP', respectively.

Total protein consumption by the lowest nutrient consuming households (TP') was greater than the RDA at all income levels, Figure 3. This consumption estimate was approximately 900 grams above the RDA at all income levels except the \$25,000 income level where the difference was approximately 1,500 grams. Animal protein consumption by low

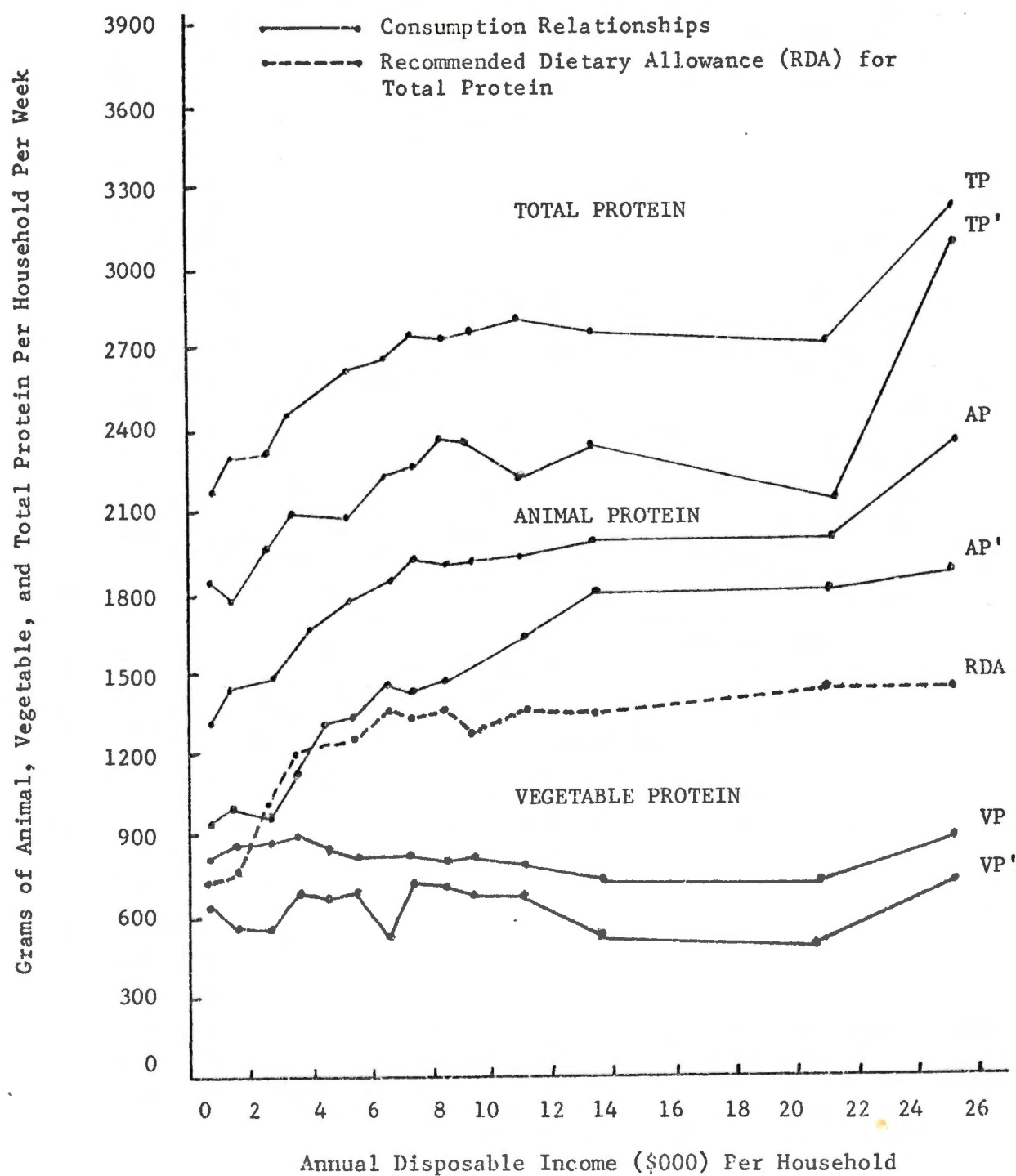


Figure 3. Household Animal, Vegetable, and Total Protein Consumption Relationships and the Recommended Dietary Allowance for Total Protein, the United States, Spring 1965.

consuming households (AP') was above the total protein RDA at all income levels except the \$2,000 to \$4,000 income range.

Average United States households and low protein consuming households consumed quantities of total protein which were above the RDA at all income levels. The standard error of estimate for total protein consumption was 850 grams per household. Therefore, evaluation of the dispersion of household protein consumption in the vicinity of these income-consumption estimates revealed no obvious protein deficiencies for average United States households or low protein consuming households.

Fat and Carbohydrate

Fat is a necessary component of living tissues and is essential in human nutrition. Fat provides the body with a prime reserve fuel source, energy. Generally, food from animal sources contain primarily saturated or monosaturated fats; vegetable foods have a larger proportion of polyunsaturated fats, while butter is rich in saturated fats (Arnow, 1972, pp. 21-22).

The bulk of man's energy supply is provided by carbohydrate. The principle carbohydrates are sugars and starches which are produced in plants by photosynthesis. These starches are converted to sugars in the human digestive tract. The primary sugars of animal origin are lactose in milk and fructose in honey (Arnow, 1972, p. 21).

Fat and carbohydrate consumption estimates were presented in Figure 4. Recommended Dietary Allowances (RDA) were not presented for these two nutrients because absolute standards did not exist. Thus, no evaluation of fat and carbohydrate consumption adequacy was made. However, the difference between the consumption estimates for carbohydrate

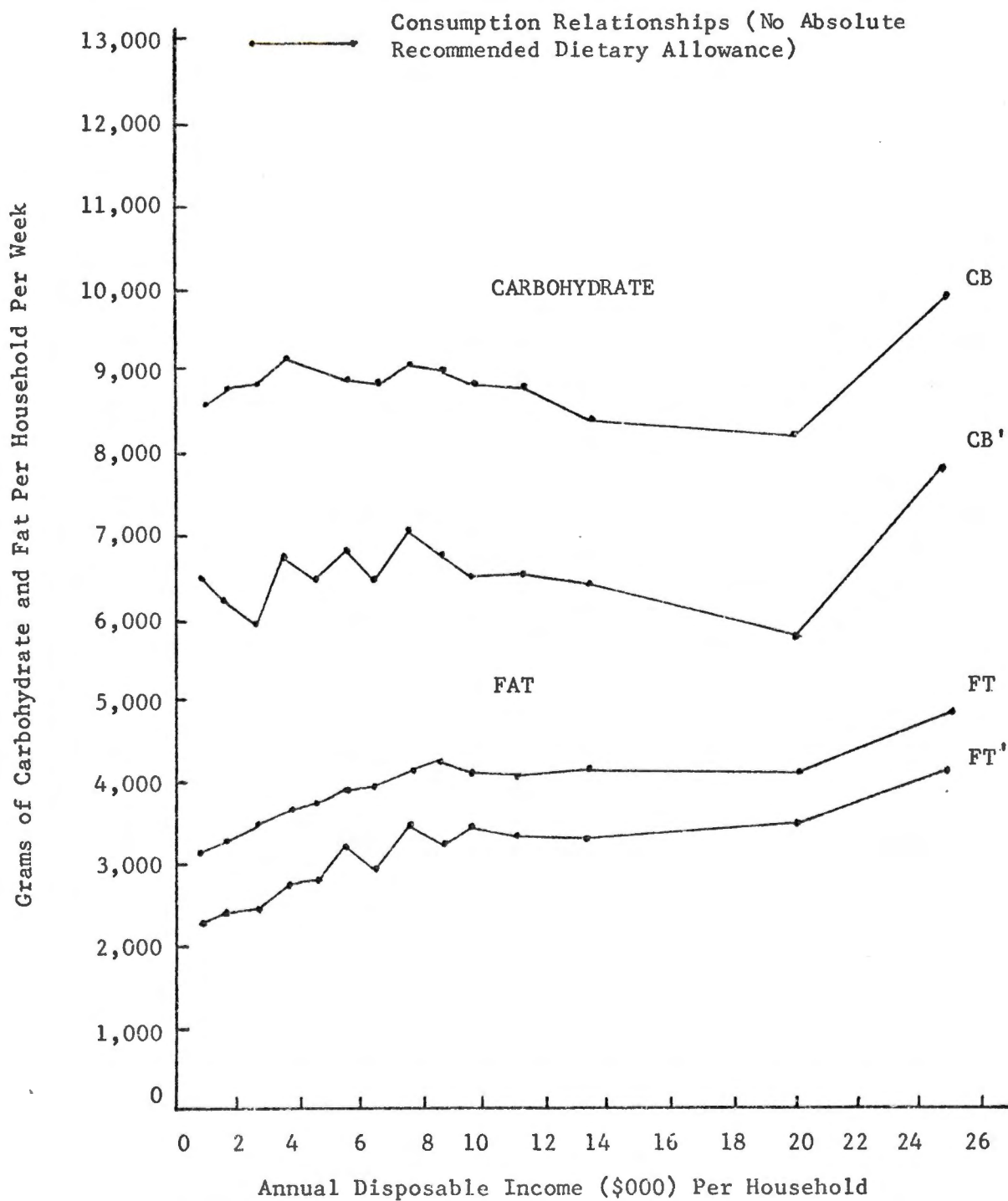


Figure 4. Household Carbohydrate and Fat Consumption Relationships, the United States, Spring 1965.

and fat by average United States households (CB and FT) and low carbohydrate and fat consuming households (CB' and FT') was analyzed, respectively. Urban households located in the West with the housewife present and the average age of the children being less than six years represented low carbohydrate consumption (CB'). The lowest levels of fat consumption (FT') were noted for urban, white households located in the Northeast region of the United States. In these households, no children were present and the housewives were over 40 years of age, had completed high school, and were not employed outside the home. Differences in carbohydrate consumption between average United States households (CB) and low consuming households (CB') varied from approximately 2,000 to 3,000 grams over the entire income range, ceteris paribus. Differences in fat consumption by households in these two classifications (FT and FT') remained fairly constant over the income spectrum at 900 grams. Therefore, carbohydrate consumption among households varied much more than did fat consumption among households over the income spectrum.

Calcium

Calcium is the fifth most abundant element in the body. Ninety-nine percent of the body calcium is present in bones and teeth. In addition to the body structural role, calcium is necessary for growth and reproduction, maintenance and permeability of cell membranes, nerve impulse conduction, muscle contraction, proper rhythm of the heartbeat, and blood clotting. Milk and most dairy products, egg yolk, meat, whole grains, legumes, and nuts are good sources of calcium (Burton, 1965, pp. 115-119).

Consumption of calcium by average United States households (CL)

was above the RDA at all income levels except the \$19,000 to \$21,000 income range, ceteris paribus, Figure 5. These estimates differed by an average of seven grams at income levels below \$4,000, three grams for income levels between \$4,000 and \$22,000, and four grams at the \$25,000 income level. Negro, rural nonfarm households located in the Western United States with no children and the housewife over 40 years of age consumed the smallest quantities of calcium. These quantities (CL') were less than the recommended quantities at all income levels above \$2,500.

The standard error of the estimate for calcium consumption was 10 grams per household. Therefore, one standard error from the nutrient consumption estimates for average United States households and low calcium consuming households overlapped the RDA at all income levels. Thus, many average United States households and lowest calcium consuming households had diets deficient in calcium.

Iron

Iron is a component of hemoglobin, the protein of red blood cells that transports oxygen from the lungs to the tissue. Usually, 80 percent of more of the body iron is a constituent of hemoglobin. Iron is also present in myoglobin, a protein that is responsible for much of the red color of muscle. Liver, lean meats, egg yolk, whole wheat, green leafy vegetables, nuts, dried fruits, and legumes are good sources of iron (Arnow, 1972, pp. 151-152).

The iron income-consumption estimates for average United States households (IR) were above the RDA by an average of 200 milligrams at income levels below \$8,000 and were above the RDA by approximately 150

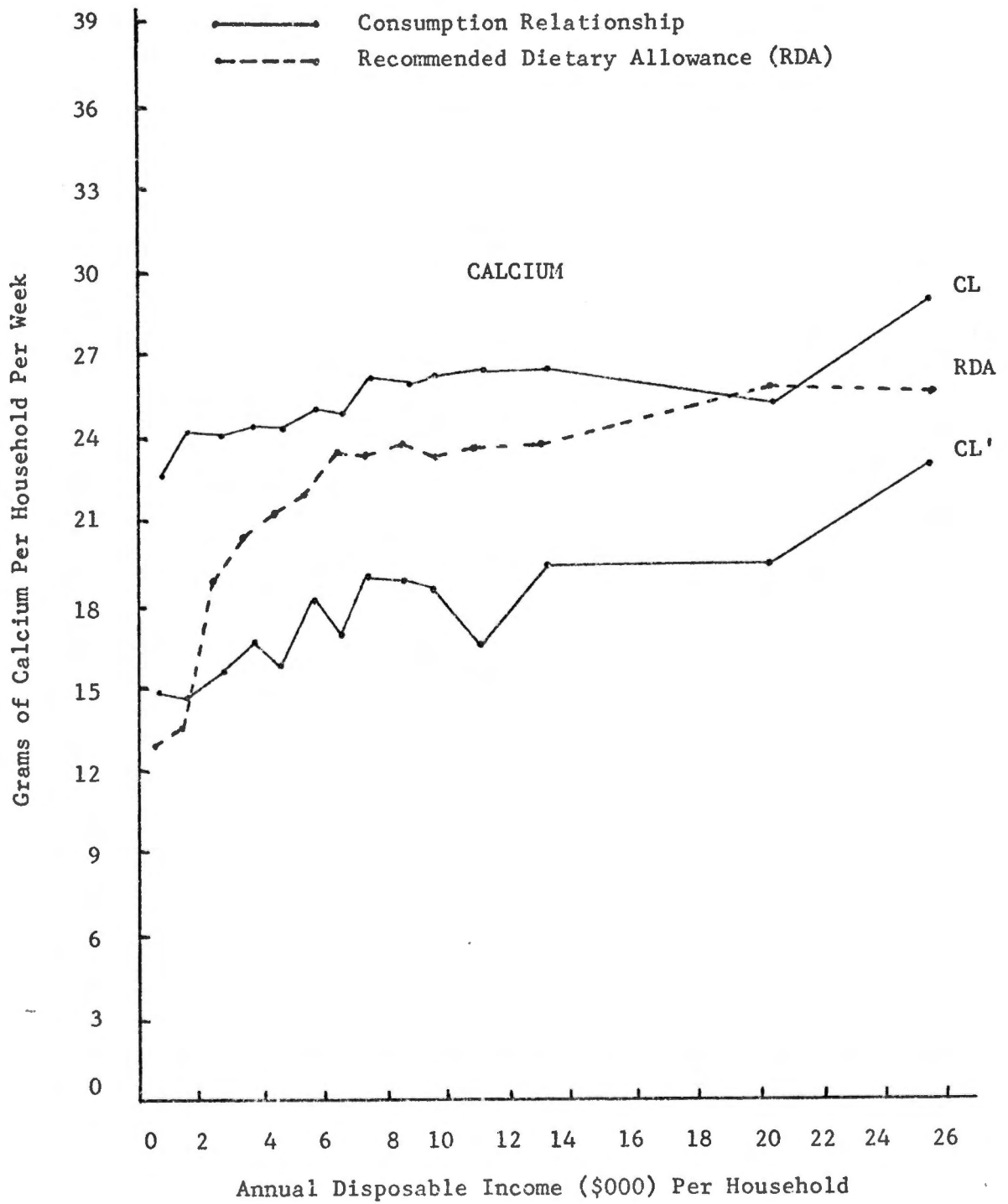


Figure 5. Household Calcium Consumption Relationships and the Recommended Dietary Allowance, the United States, Spring 1965.

milligrams at income levels above \$8,000, Figure 6. Urban, white households located in the Northeast region of the United States were the households which were estimated to have the lowest levels of iron consumption. These households were composed of children whose average age ranged from six to less than 12 years and housewives who had completed high school. The iron income-consumption estimates for these households (IR') were above the RDA by approximately 150 milligrams at \$5,000 income level, 75 milligrams at the \$8,000 income level, and 30 milligrams at the \$20,000 income level.

The standard error of the estimate for iron consumption was 170 milligrams per household. Therefore, consumption of iron by some average United States households was deficient at income levels above \$8,000 and consumption of iron by many of the lowest iron consuming households was deficient at all income levels.

Vitamin A

Vitamin A is necessary in the body for the integrity and normal growth of membraneous cellular tissue. Normal vision and growth of developing body structures and teeth are also dependent on adequate quantities of vitamin A. Primary sources of vitamin A in the diet are liver, egg yolk, dark green leafy vegetables, deep yellow vegetables, tomatoes and tomato products, and butter (Burton, 1965, pp. 79-83).

The income-consumption estimates for vitamin A consumption by average United States households (VA) were above the RDA by approximately 90,000 international units at income levels below \$20,000, Figure 7. At income levels between \$20,000 and \$25,000, the average difference increased to 150,000 international units. Rural farm, Negro households

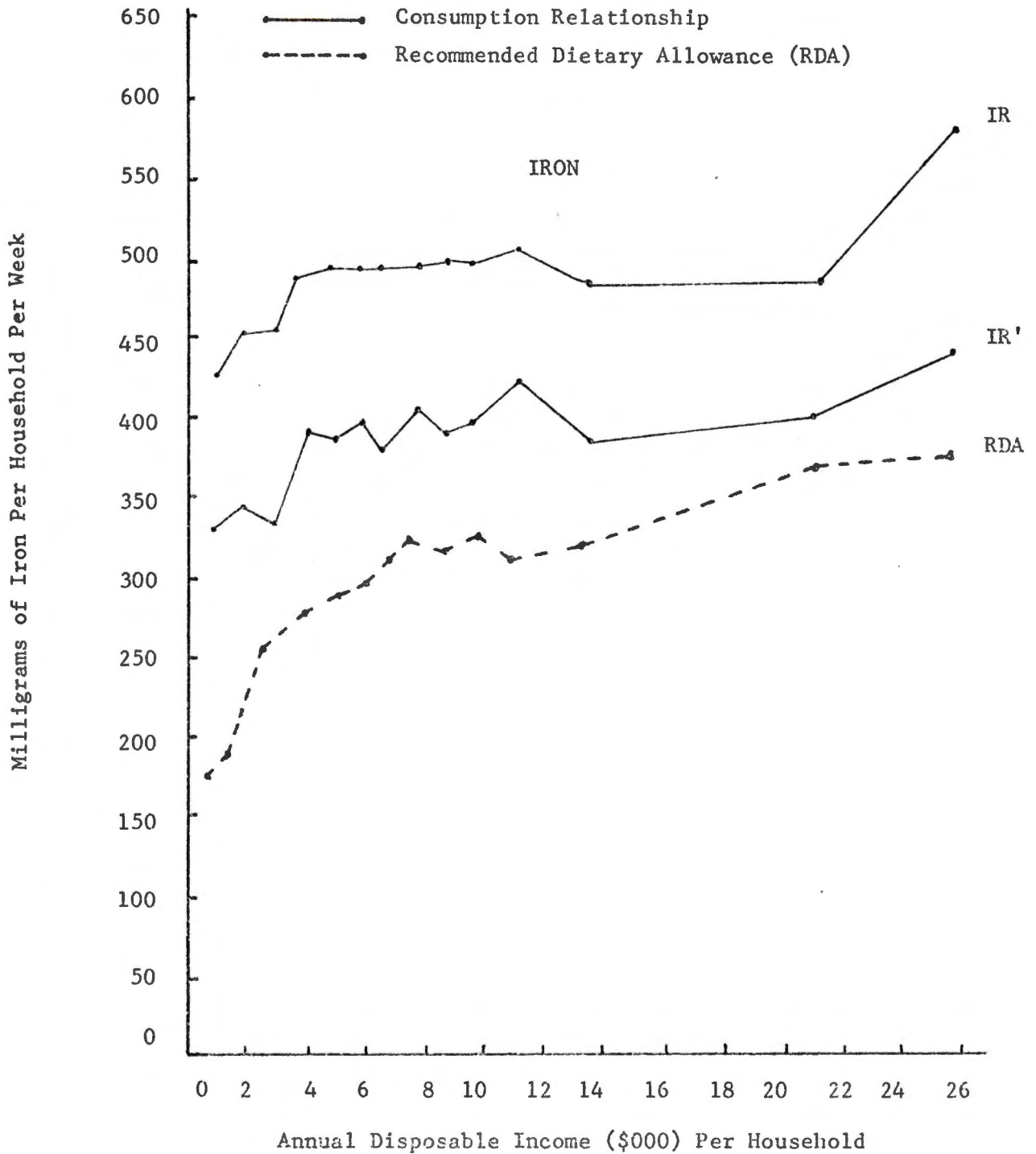


Figure 6. Household Iron Consumption Relationships and the Recommended Dietary Allowance, the United States, Spring 1965.

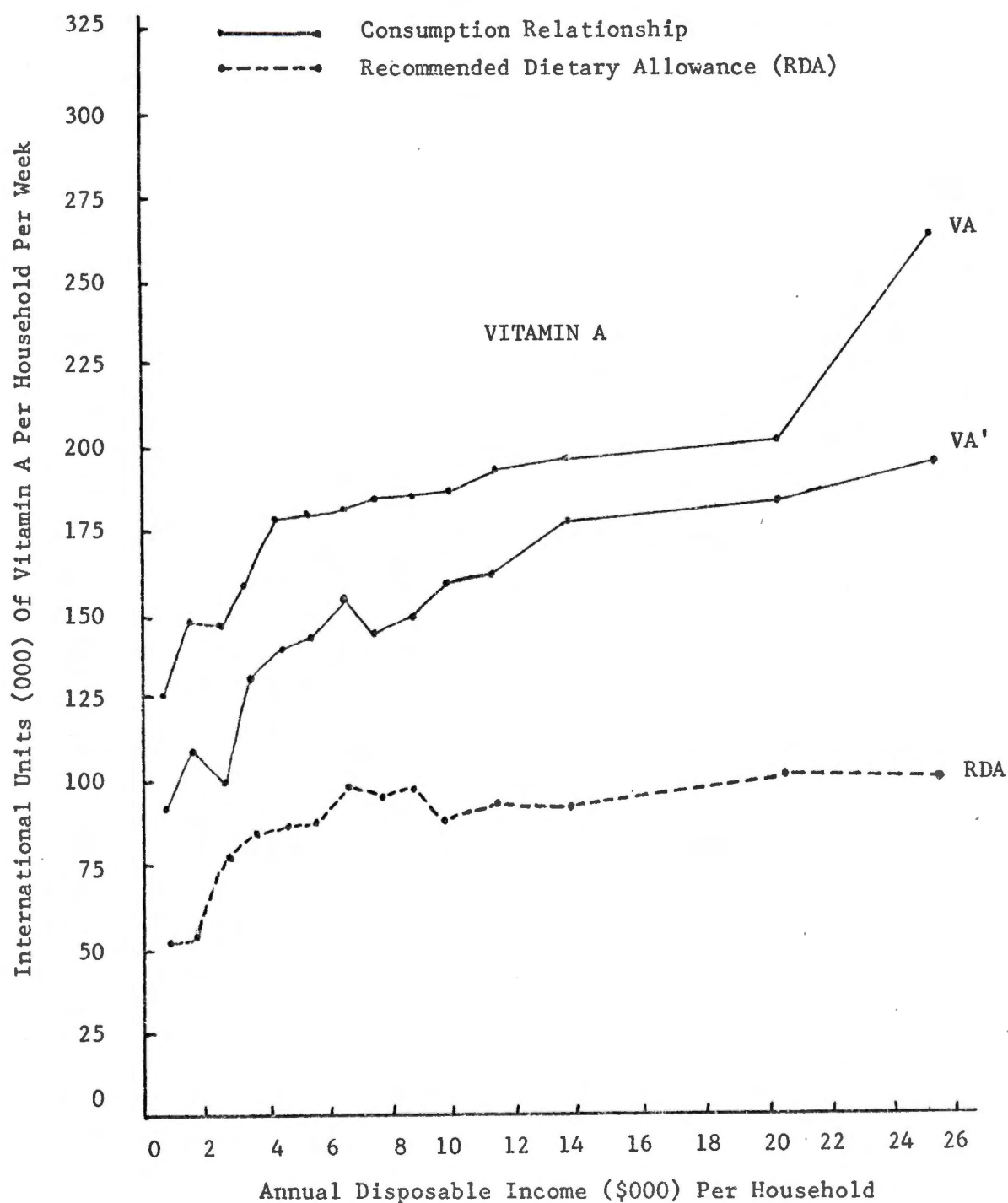


Figure 7. Household Vitamin A Consumption Relationships and the Recommended Dietary Allowance, the United States, Spring 1965.

located in the Southern United States consumed the smallest quantities of vitamin A. These households were further characterized by having no children and housewives who were under 40 years of age, had a grade school education, and were not employed outside the home. Despite the low levels of consumption of vitamin A by these households, the estimated average quantities of vitamin A consumed (VA') were above the RDA by approximately 40,000 international units at the \$1,000 income level, 65,000 international units at the \$10,000 income level, and 100,000 international units at the \$25,000 income level.

The standard error of the estimate for vitamin A consumption was 105,000 international units per household. Evaluation of vitamin A consumption by average United States households and especially by rural farm, Negro households located in the Southern region revealed that their estimated average consumption of vitamin A was not above the RDA by one standard error. In fact, one standard error of the estimate overlapped the RDA by approximately 15,000 international units for average United States households having less than \$20,000. For lowest vitamin A consuming households, one standard error of the estimate overlapped the RDA by approximately 65,000 international units at the \$1,000 income level, 40,000 international units at the \$10,000 income level, and 5,000 international units at the \$25,000 income level. Therefore, some households consumed inadequate quantities of vitamin A.

Thiamine

Thiamine (vitamin B₁) functions in the metabolism of carbohydrates. Deficiency of thiamine results in the disease beriberi. Food sources of thiamine are many, but lean pork, beef, yeast, whole cereals,

peas, nuts, legumes, green leafy vegetables, and berries are primary sources (Arnow, 1972, pp. 163-165).

The thiamine consumption estimates for average United States households (TH) were above the RDA by approximately 18 to 26 milligrams at all income levels, Figure 8. Urban, white households located in the West region of the United States consumed the smallest quantities of thiamine. No children were present in these households and the housewives were 40 years of age or less. Thiamine income-consumption estimates for these households (TH') were greater than the recommended quantities (RDA) by approximately 16 milligrams for income levels from \$500 to \$4,000 and \$22,000 to \$25,000, 11 milligrams for income levels between \$4,000 and \$16,000, and only four milligrams at the \$20,000 income level.

The standard error of the estimate for thiamine consumption was 15 milligrams per household. Therefore, one standard error from the thiamine income-consumption estimates for average United States households did not overlap the RDA at any income level. However, one standard error from the thiamine income-consumption estimates for the lowest thiamine consuming households overlapped the RDA by approximately four milligrams over the \$4,000 to \$16,000 income range and by 11 milligrams at the \$20,000 income level. Therefore, no apparent thiamine deficiency existed for average United States households, but deficiencies were evident in the diets of some white, urban households in the West region of the United States.

Riboflavin

A riboflavin (vitamin B₂) deficiency does not endanger life or cause a disease. Milk is the most important source of riboflavin, but

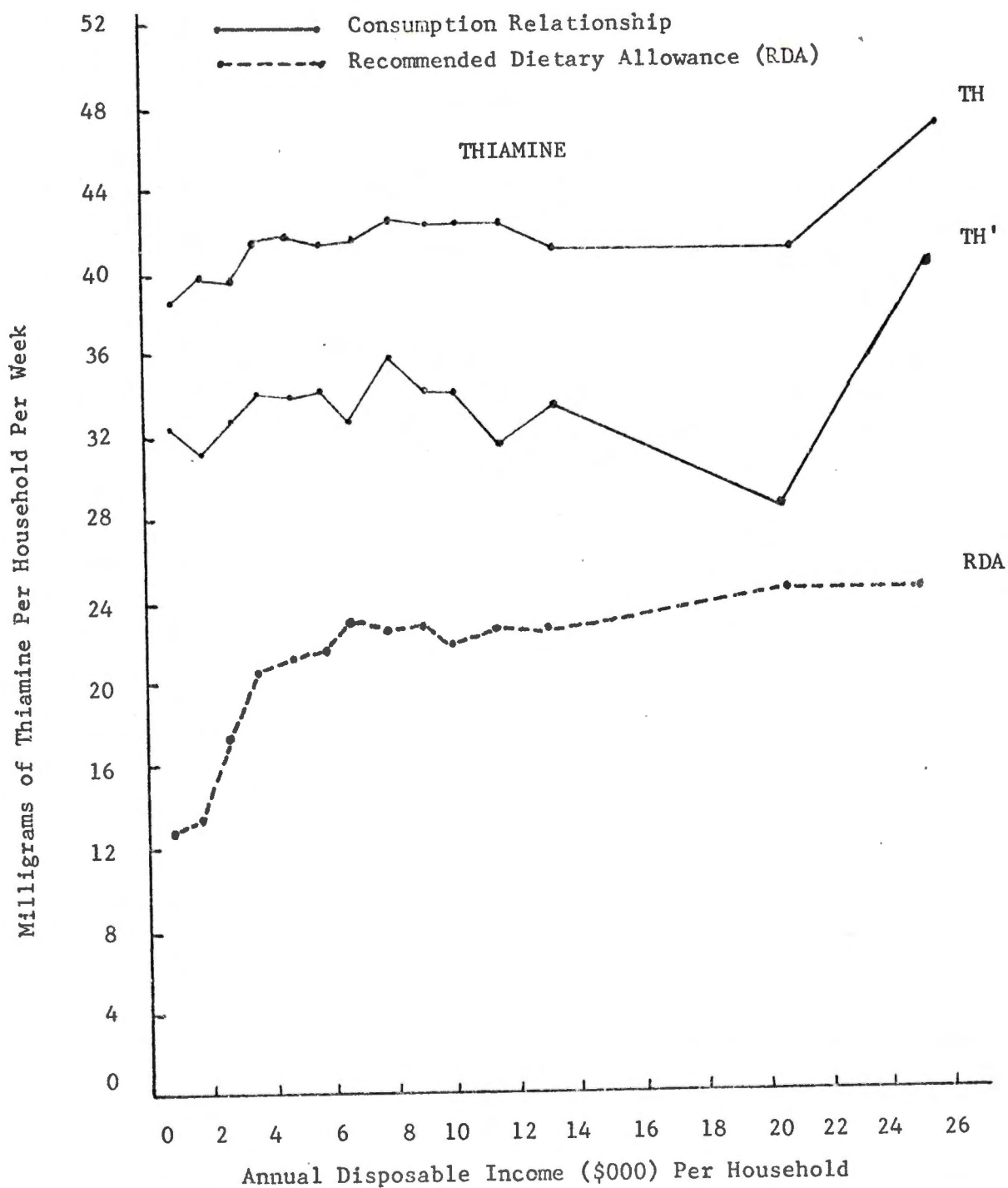


Figure 8. Household Thiamine Consumption Relationships and the Recommended Dietary Allowance, the United States, Spring 1965.

liver, eggs, and green leafy vegetables can supply adequate quantities (Arnow, 1972, pp. 165-167).

The riboflavin income-consumption estimates for average United States households (RB) were above the RDA by approximately 30 milligrams over the entire income spectrum, Figure 9. A rural nonfarm household located in the West region consumed the smallest quantities of riboflavin. No children were present in these households and the housewives were 40 years of age or younger. Consumption of riboflavin by these households (RB') was greater than the recommended consumption levels (RDA) by approximately 15 milligrams at all levels of disposable income.

The standard error of estimate for riboflavin consumption was 21 milligrams per household. Therefore, one standard error from the riboflavin income-consumption estimates for average United States households did not overlap the RDA at any income level. However, one standard error from the riboflavin income-consumption estimates for the lowest riboflavin consuming households overlapped the RDA by approximately six milligrams at all levels of disposable income. Therefore, some rural nonfarm households located in the West have riboflavin deficient diets.

Niacin

A deficiency of niacin in the diet results in a condition known as pellagra. Foods which are good sources of niacin are liver, meats, fish, whole grain, dried peas and beans, nuts, and peanut butter (Burton, 1965, pp. 96-98).

The niacin income-consumption estimates for average United States households (NC) were presented in Figure 10. An absolute RDA for niacin

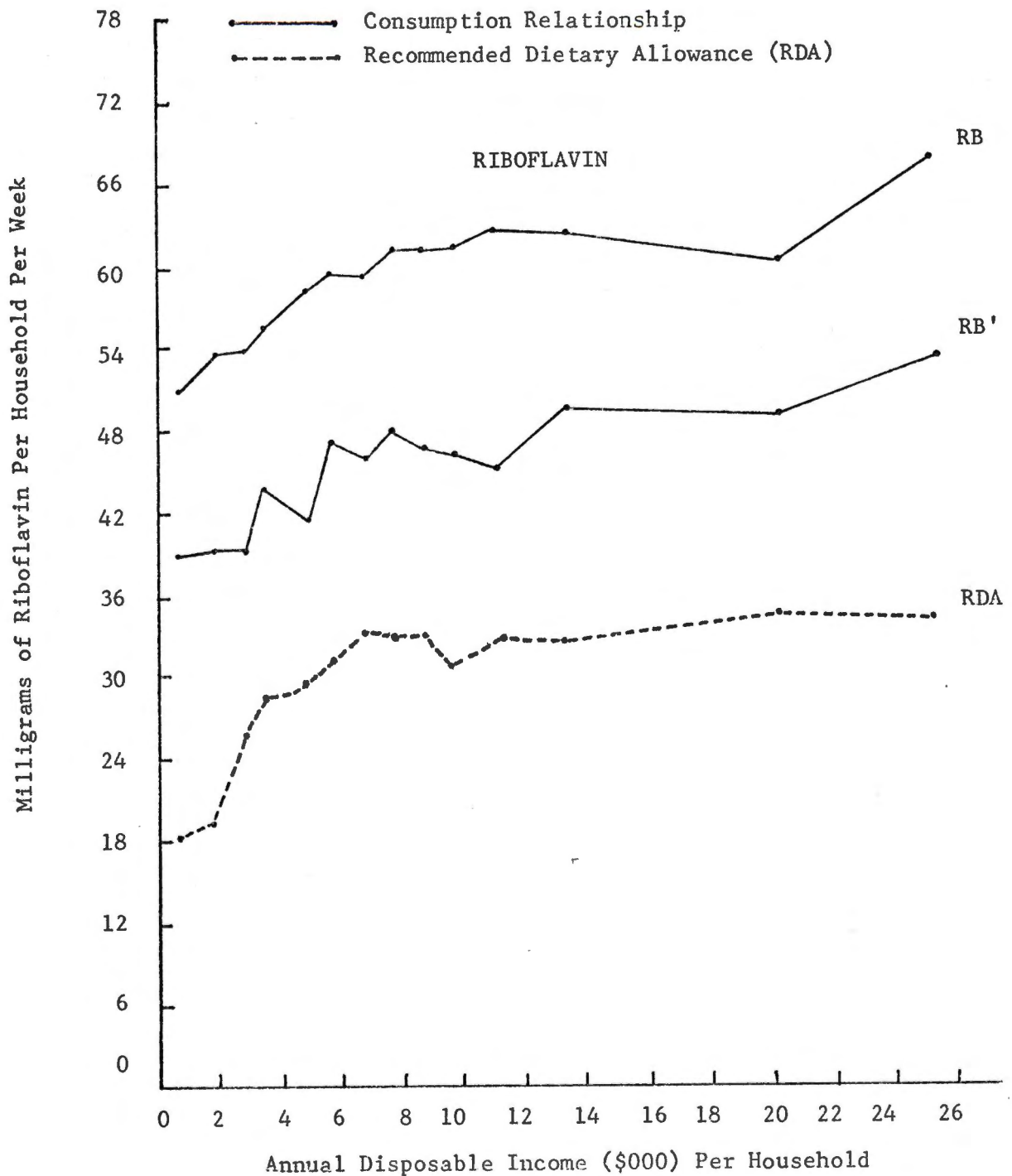


Figure 9. Household Riboflavin Consumption Relationships and Recommended Dietary Allowance, the United States, Spring 1965.

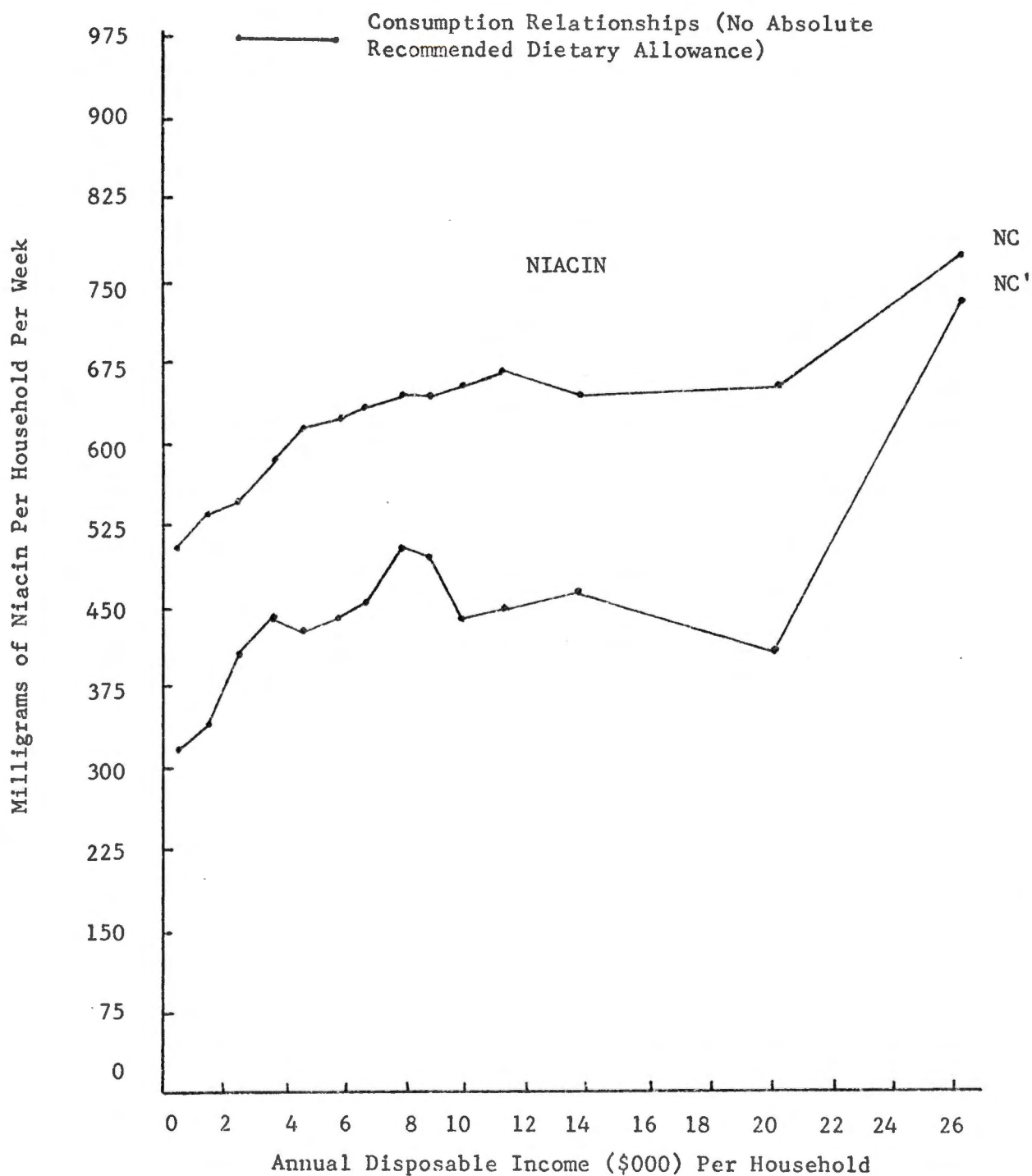


Figure 10. Household Niacin Consumption Relationships, the United States, Spring 1965.

did not exist. Thus, a household RDA was not developed and an evaluation of the adequacy of niacin consumption by households was not undertaken. However, the level of niacin consumption by average United States households was compared with the level of consumption of niacin by the lowest niacin consuming households.

Urban households located in the West region of the United States consumed the smallest quantities of niacin. These households had a housewife present and children whose average age was less than six years. Consumption of niacin by average United States households (NC) and lowest niacin consuming households (NC') differed by approximately 240 grams at the \$20,000 income level, 60 milligrams at the \$25,000 income level, and 180 milligrams at other income levels, Figure 10. This implied that there was little difference in the quantity of niacin consumed by average United States households or the lowest niacin consuming households at the \$25,000 income level.

Ascorbic Acid

Ascorbic acid (vitamin C) enhances the metabolism of amino acids, plays an important role in tooth and bone formation, promotes the capacity of the organism to withstand injury from burns and bacterial toxins, and is necessary for the formation of the intercellular substances of collangeneous and fibrous tissues in the animal organism. Also, large quantities of vitamin C promotes the absorption of iron from the intestines in normal as well as iron deficient human beings. The common foods which provide the richest supplies of vitamin C are citrus fruits and their juices, strawberries, cantaloupes, tomatoes, potatoes, cabbages, and green and yellow vegetables (Arnow, 1972, pp. 171-173).

The vitamin C income-consumption estimates for average United States households (AA) were above the RDA by approximately 1,000 milligrams at the lowest income levels and 2,100 milligrams at the highest income levels, Figure 11. Southern households with no children and the housewife having a grade school education and being under 40 years of age consumed the smallest quantities of vitamin C per household. Consumption of vitamin C by these households (AA') was greater than the RDA by approximately 30 milligrams at the \$2,500 income level, 900 milligrams at the \$11,000 income level, and 1,800 milligrams at the \$25,000 income level.

The standard error of the estimate for vitamin C consumption was 1,300 milligrams per household. Therefore, one standard error from the vitamin C income-consumption estimates for average United States households overlapped the RDA at income levels below \$8,000. The estimated range of consumption for the lowest consuming households overlapped the RDA at all income levels below \$18,000. This implied that many of the households in the Southern region of the United States did not have adequate quantities of vitamin C in their diets.

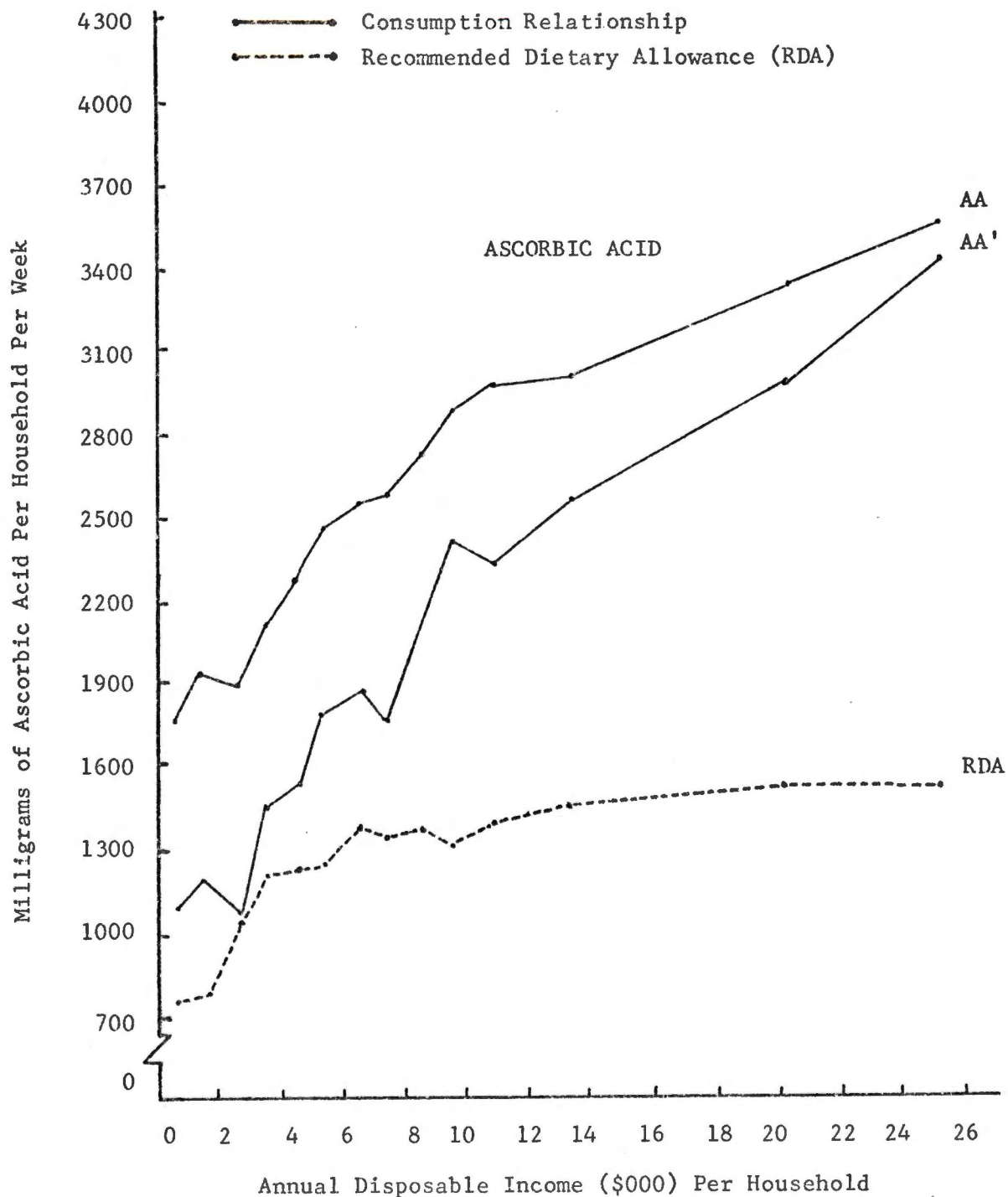


Figure 11. Household Ascorbic Acid Consumption Relationships and the Recommended Dietary Allowance, the United States, Spring 1965.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The emphasis of this study focused on specifying the impact of income and other selected socioeconomic characteristics of the household and of the female head of household on food nutrient consumption. Also, the adequacy of food nutrient consumption by households was evaluated. This chapter included a brief summary of the statistical and economic findings of the previous chapters, conclusions and implications of these findings, and suggestions for future research. Conclusions and implications of the findings were drawn relative to income distribution and nutritional adequacy, nutrition education programs, and future production and marketing decisions.

I. SUMMARY

Data from approximately 7,150 households located in the contiguous states of the United States were utilized to specify household nutrient consumption relationships. Also, these data were separated by geographic location of the household to facilitate the estimation of nutrient consumption relationships for households in the South, Northeast, North Central, and West regions of the United States. United States and regional household consumption relationships were estimated for food energy, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamine (vitamin B₁), riboflavin (vitamin B₂), niacin, and ascorbic acid (vitamin C) using multiple regression analysis. Also, the quantity of protein consumed by the household was separated into quantities

reflecting animal and vegetable sources of protein. Then, household animal and vegetable protein consumption relationships were estimated for each region and for the United States.

These estimated nutrient consumption relationships were utilized to analyze the impact of income and other selected socioeconomic factors on household consumption of the respective food nutrients. Also, income-consumption estimates derived from these relationships were compared with established household Recommended Dietary Allowances (RDA) for the respective food nutrients to evaluate the adequacy of nutrient consumption by average United States households and households having characteristics which would result in low levels of food nutrient consumption.

Impact of Socioeconomic Factors

Characteristics of the household and of the female head of household hypothesized to influence household consumption of food nutrients were: income, location, race, education of the homemaker, stage in the family life cycle, family size, eating habits, and employment status of the homemaker.

Household consumption of food energy, protein, animal protein, fat, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid were positively related to increases in household disposable income, ceteris paribus, for the United States and regional models.

Household consumption of all of these nutrients except iron, vitamin A, and vitamin C generally increased from the \$500 income level to the \$8,000 to \$10,000 income levels, leveled-off to the \$20,000 income level, and increased again to the \$25,000 income level. Consumption of vitamin A and vitamin C increased throughout the income spectrum.

Iron consumption increased from the \$500 income level to the \$4,000 income level, leveled-off to the \$20,000 income level, and increased again to the \$25,000 income level.

Carbohydrate consumption by households in the United States and North Central region models was negatively related to changes in household disposable income. However, carbohydrate consumption by households in the Southern model was positively related to changes in income. A perceptible relationship between consumption of carbohydrate and disposable income was not ascertained for households in the Northeast and West models. Consumption of carbohydrate by households in the United States increased slightly from the \$500 income level to the \$4,000 income level, decreased to the \$20,000 income level, and increased to the \$25,000 income level.

Household vegetable protein consumption was negatively related to changes in income for the United States and all regions of the United States. Vegetable protein consumption increased slightly from the \$500 income level to the \$4,000 income level, declined to the \$20,000 income level, and increased slightly to the \$25,000 income level.

Income elasticities for the respective food nutrients proved to be less than one for all of the selected income levels for households in the United States and regions of the United States. Therefore, an increase in household disposable income would result in a less than proportional increase in consumption of each respective nutrient. These income elasticities revealed income-response patterns similar to the relationships noted above.

Generally, income elasticities for the consumption of all

nutrients except vegetable protein and carbohydrate by United States and regional households except Western households were largest at the \$8,000 income level. Income elasticities for food nutrient consumption by households in the West region of the United States differed from other regions. Western households tended to be more responsive to income changes at higher income levels. For example, the largest income elasticities for consumption of protein, riboflavin, and niacin were noted at the \$8,000 income level for households in the South, Northeast, and North Central regions and at the \$12,000 income level for households in the West region.

Household consumption of animal protein, fat, vitamin A, and vitamin C was the most responsive to changes in disposable income in the United States and regional models at all income levels. Calcium, iron, and thiamine consumption was generally the least responsive to income changes in the United States and regional models at all income levels.

Vitamin C was the only nutrient which had positive income elasticities over all income levels in all models. However, animal protein, calcium, and vitamin A income elasticities were positive at all selected income levels except the \$20,000 income level for the United States and regional models. Income elasticities for vegetable protein and carbohydrate were negative over all income levels in the United States models. However, only vegetable protein had negative income elasticities over all income levels in all regional models. Income elasticities for carbohydrate were positive at all income levels for Southern households and negative at all income levels for households in the North Central region.

Nutrient income elasticities estimated in this study were compared with agricultural commodity income elasticities estimated in two previous studies, Table 20. The average income elasticity for animal protein was .23 while the average income elasticities for beef, pork, and chicken were .47, .32, and .37 in Brandow's (1961, p. 17) study, respectively. George and King's (1971, p. 70) research on the 1965 Household Food Consumption data which was used in this study isolated income elasticities for beef, pork, and chicken at .27, .01, and -.03, respectively. The calcium income elasticity (.12) was considerably lower than the milk income elasticity (.37) estimated by George and King, but was about the same as the milk income elasticity (.16) estimated by Brandow. Thus, there were some differences in income elasticities estimated by the food nutrient approach and the commodity approach.

The impact of degree of urbanization of the household on nutrient consumption was relatively consistent among households in the United States and regions of the United States. Rural farm households generally consumed the largest quantities of all nutrients except vitamin A and vitamin C. Urban households consumed the most vitamin A and vitamin C in the United States and South region, but rural households consumed the largest quantities of these nutrients in the Northeast, North Central, and West regions.

There were significant differences in nutrient consumption among different race households. White households in the United States consumed significantly more of all nutrients except food energy, fat, iron, vitamin A, and thiamine than did Negro households. Negro households consumed significantly more vitamin A and thiamine. In the South, white households consumed significantly more of all nutrients except

Table 20. Comparison of Nutrient Income Elasticities Computed for United States Households in this Study and Commodity Income Elasticities Computed for Two Other Studies

Nutrient or Commodity	United States Household Study ¹	Brandow's Study ²	George and King's Study ²
- - - - - Income Elasticities - - - - -			
Animal protein	.23		
Beef		.47	.27
Pork		.32	.01
Chicken		.37	-.03
Fish		.42	-.06
Eggs		.16	-.07
Vegetable protein	.08		
Dry beans		.12	-.82
Cereals		.00	
Fat	.19		
Margarine		.00	-.06
Shortening		.12	.03
Calcium	.12		
Milk		.16	.37
Cheese		.45	.23
Carbohydrates	.09		
Potatoes		.08	.02
Sugar		.18	-.17
Vitamin C	.30		
Tomatoes			.16
Fruit		.40	
Oranges			.23

¹Nutrient income elasticities for United States households were computed from doublelogrithmic functions to facilitate a comparison with income elasticities from the other studies.

²Commodity income elasticities for Brandow's (1961, p. 17) and George and King's (1971, p. 70) studies were computed from doublelogrithmic functions. Therefore, these elasticities represented income responsiveness over the entire income spectrum.

vitamin A, thiamine, and vitamin C than did Negro households. Negro households in other regions had diets which were equivalent or superior to the diets of white households. The levels of consumption of all nutrients except fat by other race households were comparable or greater than the levels consumed by Negro households. Other race households consumed significantly less fat than did Negro households in the United States and the North Central and West regions.

In the United States, consumption of food energy, fat, carbohydrate, iron, thiamine, niacin, and vegetable protein declined significantly with increases in the level of education attained by the homemaker. Conversely, an increase in educational attainment increased household calcium, vitamin C, and animal protein consumption. In all regional models, vitamin C consumption increased with increases in the level of education attained by the housewife. Consumption of fat, thiamine, and vegetable protein declined with increases in the level of education of the homemaker for households in the South, Northeast, and North Central regions. Generally, the level of education attained by the homemaker was not a significant factor influencing consumption of other nutrients.

The impact of stage of the household in the family life cycle was relatively consistent for households in the United States and regions of the United States. Three periods of change in the family unit were characterized by seven stages: (1) the development period (stages 1 and 2), (2) the stable period (stages 3, 4, and 5), and (3) the decline period (stages 6 and 7). Generally, households in the developing and declining periods of the family life cycle consumed less of all food nutrients than did households in the stable period. Systema-

tic differences in nutrient consumption among households in the stages depicting the developing and declining periods were not evident.

Household size had a significant positive impact on the consumption of all nutrients in all regions of the United States and for the United States as a whole. Therefore, an increase in family size would result in an increase in household nutrient consumption. Generally, the impact of family size on the consumption of most nutrients was highest for households in the West region of the United States and was lowest for households located in the South region of the United States.

Meal adjustment also had a significant positive impact on household food nutrient consumption in the United States and regions of the United States. Therefore, an increase in either home or guest meals would increase household nutrient consumption and an increase in either skipped or away from home meals would have the opposite effect.

In the United States, the female head of household being employed outside the home had a significant positive impact upon household consumption of food energy, fat, and carbohydrate. Also, the employment status of the housewife had a significant positive impact on the consumption of: vitamin A in the South region, fat and calcium in the Northeast region, and carbohydrate in the North Central region. The employment status of the female head of household was not a significant factor affecting the consumption of any food nutrient in the West region.

Household Nutrient Consumption Adequacy

The adequacy of household food nutrient consumption was evaluated by comparing nutrient consumption estimates derived from the respective

food nutrient consumption relationships with Recommended Dietary Allowances (RDA) at the various levels of household disposable income. Two nutrient consumption estimates were utilized for this evaluation. One compared nutrient consumption by average United States households with the RDA and the other compared nutrient consumption by the lowest nutrient consuming households with the RDA. These comparisons were made for household consumption of food energy, total protein, calcium, iron, vitamin A, thiamine, riboflavin, and ascorbic acid. Comparisons for household consumption of fat, carbohydrate, niacin, vegetable protein, and animal protein were not made because RDA's were not available.

Characteristics of households which consumed the smallest quantities of the respective food nutrients were summarized in Table 21. Nonfarm (urban and rural nonfarm), developing and declining period (stages 1, 2, 6, 7) households located in the West consumed the smallest quantities of most nutrients. Race and homemaker education and employment did not significantly affect low levels of consumption of the majority of the nutrients in the respective locations.

The average nutrient consumption estimates for average United States and lowest nutrient consuming households were above the Recommended Dietary Allowances at all levels of household disposable income for all of the food nutrients. However, an evaluation of the dispersion of household nutrient consumption in the vicinity of these income-consumption estimates revealed some overlapping of the RDA at certain income levels.

One standard error from the average United States and the lowest nutrient consuming income-consumption estimates overlapped the RDA's

Table 21. A Summary of Characteristics of Lowest Nutrient Consuming Households in the United States, Spring 1965

Food Nutrient	Urbanization	Race	Homemaker Education	Stage in Life Cycle	Homemaker Employed	Region
Food energy	U,RNF	*	*	2,6	*	W
Protein	U,RNF	*	*	1,2,6	*	W
Animal protein	U,RNF	N,O	SC	1,2,6,7	*	S
Vegetable protein	U	*	*	2	*	W
Fat	U,RNF	W	HS,SC,CG	6,7	No	NE
Carbohydrate	U,RNF	*	*	2,6	*	W
Calcium	U,RNF	N,O	*	1,2,6,7	*	W
Iron	U,RNF	W	HS,SC,CG	1-3,5-7	*	NE
Vitamin A	RF	N,W	GS	1	No	S
Thiamine	U,RNF	W	*	1,2,6	*	W
Riboflavin	U,RNF	*	*	1,2,6	*	W
Niacin	U,RNF	*	*	2	*	W
Vitamin C	*	*	GS	1,2,7	*	S

* -- There were no significant differences in consumption among categories.

Urbanization -- Urbanization was represented by urban (U), rural nonfarm (RNF), and rural farm (RF).

Race -- Race was represented by Negro (N), white (W), and other (O).

Homemaker Education -- Homemaker education was represented by grade school (GS), high school (HS), some college (SC), and college graduate (CG).

Stage in Life Cycle -- Family life cycle was represented by stages 1,2,3,4,5,6, and 7.

Homemaker Employed -- The homemaker was either employed outside the home (Yes) or not (No).

Region -- Households were located in the South (S), Northeast (NE), North Central (NC), or West (W) regions. The region with the smallest average level of consumption was selected for the analysis. Other characteristics were selected based on significant differences in the levels of consumption.

for calcium, iron, vitamin A, and vitamin C at several income levels. More specifically, one standard error from the average United States nutrient consumption estimates overlapped the RDA at all income levels below \$20,000 for vitamin A, all income levels below \$8,000 for iron and vitamin C, and at all income levels for calcium. Similarly, one standard error from the lowest nutrient consumption estimates overlapped the RDA at all income levels for calcium, iron, vitamin A, and at all income levels below \$18,000 for vitamin C.

Food energy, protein, thiamine, and riboflavin income-consumption estimates for average United States households were more than one standard error above the RDA at all levels of income. However, one standard error from the lowest income-consumption household estimates overlapped the RDA at the \$3,000 to \$20,000 income levels for food energy, the \$4,000 to \$24,000 income levels for thiamine, and at all income levels for riboflavin. Income-consumption estimates for protein were more than one standard error above the RDA at all income levels.

II. CONCLUSIONS

As was indicated in Chapter I, one of the objectives of this study was to examine the policy implications of the findings relative to income distribution and nutritional adequacy, nutrition education programs, and future commodity production and marketing decisions. Further, some effort was also to be made in developing projected trends in nutrient consumption which could have direct bearing on future food consumption patterns.

Inferences relative to future commodity production and marketing

decisions and trends in nutrient consumption were derived from the relative impact of the characteristics of the household and of the female head of household. These inferences were tempered by the lack of knowledge concerning the relative contribution that each food makes in supplying a specific nutrient in the diet. However, some trends in consumption were noted. Increases in household disposable income in the United States should result in increases in household consumption of food energy, protein, animal protein, fat, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid up to some level. This increase in consumption should be especially true for animal protein, fat, vitamin A, and vitamin C. Therefore, consumption of such commodities as meats and fruits (especially citrus fruits) may increase in the future in response to increases in income. Calcium consumption was only slightly responsive to changes in income. Thus, increases in household disposable income may have little impact on the consumption of milk and milk products. Vegetable protein and carbohydrate consumption by households declined slightly with increases in income. Therefore, the consumption of such commodities as wheat, rice, corn, and potatoes may decline with future increases in income.

A leveling-off of consumption with increases in income was reflected by the income elasticities and the income-consumption estimates above \$8,000 (excluding the \$25,000 category for the dummy variable analysis). If real disposable income per United States household increases in the future, then consumption of nutrients and food will tend to level-off at some income level. For the data analyzed in this study, consumption of most nutrients leveled-off in the vicinity of the \$16,000 income level. However, extrapolation from this figure

to future income levels and consumption should be approached carefully because the set of other factors may have changed and inflation may have eroded the value of household income. Nevertheless, American agriculture must depend upon increases in population or foreign demand for additional sales if household consumption of nutrients stabilizes. Since population growth in the United States has tended to stabilize, foreign markets may have to be cultivated to utilize expanding production of American agriculture in the future.

An analysis of the impact of other socioeconomic factors on food nutrient consumption revealed some inferences relative to future consumption of food nutrients by households. A trend toward a more urban society in the United States would result in a possible decline in consumption of all food nutrients. This occurrence would probably result from declines in home food production by families and decreased food consumption because of more sedentary work habits.

Diets of Negro households were comparable or superior to the diets of white households in all regions except the South. Diets of Negro households were weakest in the consumption of calcium which indicated a possible need for larger levels of consumption of milk and milk products.

Increases in the level of education attained by the homemaker resulted in declines in the consumption of food energy, fat, carbohydrate, iron, thiamine, and vegetable protein and increases in the consumption of calcium, vitamin C, and animal protein by the household. Therefore, consumption of such commodities as cereals, legume seeds, and potatoes may decline in the future and consumption of milk, meats, and citrus fruits may increase. On this basis, the more educated

housewives seemed to serve their families better meals; that is, fewer carbohydrates and fat foods and more meat, fruits, and milk.

A trend toward smaller families would result in smaller quantities of most nutrients being consumed by households. Also, a trend away from the traditional three meals per day pattern to fewer meals per day would result in declines in household nutrient consumption. Increased employment of housewives outside the home would have little impact on the consumption of most nutrients. However, household consumption of food energy, fat, and carbohydrate may increase in these cases. This implies that larger quantities of quick service foods and snacks may be consumed in the future.

An analysis of the nutritional adequacy of household diets in the United States revealed that on the average, the distribution of income among households in the United States and regions of the United States appeared to be sufficient to generate adequate levels of consumption of all nutrients, ceteris paribus. However, special cases existed where household consumption of all of the nutrients evaluated for adequacy except protein were deficient. The greatest possibility of a deficiency existed for calcium, iron, vitamin A, and vitamin C consumption. These deficiencies were not limited to the lowest income households or to any particular income level.

Since widespread nutritional deficiencies were not isolated at any given income level, the initiation of income redistribution programs for United States households did not seem expedient from a nutrition standpoint. Also, income redistribution programs aimed at only the low income segments of society would be inappropriate because in many cases their diets were superior to other higher income segments.

Furthermore, consumption of food nutrients by low income households (less than \$4,000) was less responsive to income increases than was consumption by higher income households (\$8,000 to \$12,000). Therefore, a large proportion of the income re-allocated to these households would probably be expended for non-food items and thus, would help nutritional adequacy little.

The primary conclusion drawn from these analyses was that the problem of excesses rather than deficiencies in household nutrient consumption should be a major nutritional concern in the United States. In most cases, estimated levels of household consumption were much greater than recommended levels of consumption. Since consumption represented availability rather than actual intake of nutrients, it can be concluded that adequate quantities of nutrients were available in the majority of households in the United States. Therefore, nutritional education programs should provide information relative to the food sources of specific nutrients and means of balancing the diet of the household.

However, nutritional education programs should also continue to be directed toward the elimination of nutritional deficiencies in the United States. Several nutritional problem areas were identified in this study. These areas could be used in planning and organizing programs to eliminate nutritional deficiencies. Since many of the lowest nutrient consuming units were nonfarm households composed of relatively young or old couples, more effort may need to be directed in these areas. Also, some effort may need to be directed at alleviating the deficiencies of calcium in the diets of Negroes.

III. SUGGESTIONS FOR FUTURE RESEARCH

The two primary objectives of this study were to specify the impact of characteristics of the household and of the female head of household on food nutrient consumption and to evaluate the adequacy of household diets in the United States and regions of the United States. The data utilized in this study were collected by the United States Department of Agriculture; therefore, it was not possible to assist in developing the questionnaire used to collect the data. Thus, some of the data used in this study were not in the desired form. Therefore, data forms needed for future analyses were discussed in the remaining paragraphs.

Since the data analyzed in this study were on a household basis, conclusions and implications were made relative to the household unit. After analyzing food nutrient consumption on a household basis, an individual nutrient consumption analysis would seem to be a relevant future research endeavor. Isolation and specification of the characteristics of the individual and of his environment which affects his consumption of specific food nutrients could increase the ability of policymakers to deal with suspected nutritional problems in the United States.

This analysis could be improved by the availability of continuous income data rather than levels of income represented by an income range. Also, specific data relative to the quantities of nutrients provided by non-income sources such as welfare and home production could improve the analysis. Furthermore, specification of the quantities of food consumed outside the home food supply could improve the evaluation of the adequacy of diets.

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APPENDIX

Table 22. Income Elasticities for Food Energy by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.032	.080	.199	-.007	-.021
\$2,000-2,999	.035	-.040	.209	.185	.002
\$3,000-3,999	.135	.261	1.557	-.178	.209
\$4,000-4,999	.072	.265	-.577	.119	-.035
\$5,000-5,999	.037	-.092	1.076	.039	.183
\$6,000-6,999	.037	.146	-.528	.080	.010
\$7,000-7,999	.199	-.093	2.290	.049	.499
\$8,000-8,999	.038	.054	-1.287	.385	-.126
\$9,000-9,999	-.119	.930	.110	-.511	-.736
\$10,000-11,999	-.001	-.696	-.045	.250	.277
\$12,000-14,999	-.071	.270	-1.552	-.039	.020
\$15,000-24,999	-.077	-.031	.764	-.105	-.172
\$25,000 or more	.842	.866	1.524	.541	1.672

^aOmitted to avoid singularity.

Table 23. Income Elasticities for Protein by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.048	.071	.015	.019	-.014
\$2,000-2,999	.031	-.071	-.005	.205	.116
\$3,000-3,999	.160	.053	.261	-.165	.127
\$4,000-4,999	.155	.263	.087	.114	-.082
\$5,000-5,999	.109	-.066	.224	.122	.335
\$6,000-6,999	.096	.280	-.166	.141	.028
\$7,000-7,999	.206	-.146	.618	.139	.354
\$8,000-8,999	-.031	.045	-.445	.211	-.204
\$9,000-9,999	.002	.882	.241	-.536	-.494
\$10,000-11,999	.077	-.441	.097	.358	.207
\$12,000-14,999	.052	.263	-.346	.214	.286
\$15,000-24,999	.001	-.008	.099	.045	-.235
\$25,000 or more	.748	.380	.617	.604	1.515

^aOmitted to avoid singularity.

Table 24. Income Elasticities for Animal Protein by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.065	.068	.001	.078	-.006
\$2,000-2,999	.052	-.048	-.017	.188	.267
\$3,000-3,999	.002	.337	.234	-.136	.151
\$4,000-4,999	.261	.330	.372	.128	-.119
\$5,000-5,999	.273	.137	.193	.299	.682
\$6,000-6,999	.151	.327	-.181	.214	.334
\$7,000-7,999	.287	-.084	.725	.281	.263
\$8,000-8,999	-.033	.070	-.620	.260	-.287
\$9,000-9,999	-.009	.826	.547	-.592	-.841
\$10,000-11,999	.193	-.142	.081	.353	.464
\$12,000-14,999	.071	.358	-.156	-.208	.748
\$15,000-24,999	.000	.009	.003	.093	-.246
\$25,000 or more	.740	.169	.784	.564	2.086

^aOmitted to avoid singularity.

Table 25. Income Elasticities for Vegetable Protein by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.021	.076	.040	.082	-.032
\$2,000-2,999	-.004	-.106	.017	.236	-.004
\$3,000-3,999	.067	.111	.300	-.222	.179
\$4,000-4,999	-.042	.143	-.487	.086	-.083
\$5,000-5,999	-.226	-.450	.303	-.252	.039
\$6,000-6,999	-.023	.182	-.128	-.026	-.467
\$7,000-7,999	.024	-.275	.357	.202	.747
\$8,000-8,999	-.027	-.010	-.046	.087	-.194
\$9,000-9,999	.025	.994	-.457	-.394	-.262
\$10,000-11,999	-.196	1.144	.131	.369	-.072
\$12,000-14,999	-.360	.024	-.810	-.228	-.386
\$15,000-24,999	-.112	-.050	.336	-.078	-.398
\$25,000 or more	.769	.923	.170	.708	1.185

^aOmitted to avoid singularity.

Table 26. Income Elasticities for Fat by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.045	.050	.046	.022	.001
\$2,000-2,999	.064	.000	.014	.157	.020
\$3,000-3,999	.154	.202	.344	-.162	.181
\$4,000-4,999	.176	.319	.038	.115	.075
\$5,000-5,999	.127	-.017	.280	.282	.096
\$6,000-6,999	.063	.137	-.164	.079	.229
\$7,000-7,999	.236	-.087	.757	.050	.513
\$8,000-8,999	.175	.227	-.542	.623	.102
\$9,000-9,999	-.197	.666	.314	-.627	-1.100
\$10,000-11,999	.023	-.396	.212	.095	.454
\$12,000-14,999	.049	.165	-.071	.090	.074
\$15,000-24,999	.003	.122	.072	-.154	-.166
\$25,000 or more	.868	.268	.671	.571	1.972

^aOmitted to avoid singularity.

Table 27. Income Elasticities for Carbohydrate by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.016	.054	.011	-.040	-.043
\$2,000-2,999	.000	-.067	.040	.196	-.061
\$3,000-3,999	.114	.154	.060	-.182	.280
\$4,000-4,999	-.049	.056	-.348	.116	-.144
\$5,000-5,999	-.083	-.106	.166	-.236	.212
\$6,000-6,999	-.020	.006	-.070	.044	-.251
\$7,000-7,999	.145	.000	.382	.000	.574
\$8,000-8,999	-.084	-.196	-.074	.151	-.373
\$9,000-9,999	-.089	.632	-.397	-.328	-.416
\$10,000-11,999	-.008	-.627	.106	.388	.032
\$12,000-14,999	-.239	.197	-.676	-.208	-.146
\$15,000-24,999	-.039	-.188	.311	-.151	-.179
\$25,000 or more	.823	1.156	.089	.632	1.084

^aOmitted to avoid singularity.

Table 28. Income Elasticities for Calcium by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.062	.104	.019	.019	-.006
\$2,000-2,999	-.022	-.138	.106	.170	.045
\$3,000-3,999	.045	.150	-.091	-.158	.150
\$4,000-4,999	.006	.029	.103	.069	-.175
\$5,000-5,999	.106	.047	.107	.031	.489
\$6,000-6,999	-.100	-.162	.034	-.093	-.255
\$7,000-7,999	.406	.118	.446	.445	.516
\$8,000-8,999	-.178	-.045	-.455	.089	-.142
\$9,000-9,999	.153	.920	.216	-.602	-.150
\$10,000-11,999	.092	-.230	.164	.506	.547
\$12,000-14,999	-.066	-.158	-.227	-.051	.444
\$15,000-24,999	-.990	-.097	.004	-.183	-.012
\$25,000 or more	.782	.787	.612	.745	.567

^aOmitted to avoid singularity.

Table 29. Income Elasticities for Iron by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.043	.080	.031	-.046	-.005
\$2,000-2,999	.004	-.094	-.054	.211	.093
\$3,000-3,999	.145	.200	.337	-.199	.251
\$4,000-4,999	.190	.227	-.085	.176	-.181
\$5,000-5,999	-.024	-.207	.265	-.073	.223
\$6,000-6,999	.095	.338	-.273	.229	-.138
\$7,000-7,999	-.005	-.254	.500	-.273	.436
\$8,000-8,999	.046	.038	-.421	.440	-.390
\$9,000-9,999	-.068	.898	.133	-.631	-.420
\$10,000-11,999	.168	-.634	.455	.543	.075
\$12,000-14,999	-.161	.386	-.623	-.302	.151
\$15,000-24,999	-.004	-.102	.205	.053	-.340
\$25,000 or more	.855	.500	.450	.767	1.792

^aOmitted to avoid singularity.

Table 30. Income Elasticities for Vitamin A by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.137	.154	.030	.062	.148
\$2,000-2,999	-.020	-.159	.067	.219	-.066
\$3,000-3,999	.343	.530	.223	-.642	-.043
\$4,000-4,999	.384	.238	.783	.442	-.152
\$5,000-5,999	.016	.014	-.633	.008	1.211
\$6,000-6,999	.085	.486	-.341	.263	-.430
\$7,000-7,999	.044	-.576	1.020	-.186	.111
\$8,000-8,999	.070	.368	-.887	.407	-.275
\$9,000-9,999	.022	.506	1.013	-.558	-.509
\$10,000-11,999	.150	.238	-.165	.550	-.486
\$12,000-14,999	.111	.386	.242	-.226	1.284
\$15,000-24,999	.136	.055	.205	.218	-.167
\$25,000 or more	1.559	.267	.525	4.187	-.362

^aOmitted to avoid singularity.

Table 31. Income Elasticities for Thiamine (Vitamin B₁) by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.030	.069	.019	-.021	-.036
\$2,000-2,999	.014	.099	-.055	.171	.077
\$3,000-3,999	.149	.248	.357	-.169	.108
\$4,000-4,999	.005	.066	-.144	.127	-.090
\$5,000-5,999	-.071	-.204	.090	-.050	.102
\$6,000-6,999	.074	.273	.151	.125	-.179
\$7,000-7,999	.131	-.206	.541	.021	.005
\$8,000-8,999	-.110	.072	-.375	.018	-.430
\$9,000-9,999	.036	.707	.084	-.337	-.054
\$10,000-11,999	-.010	-.497	.071	.470	.468
\$12,000-14,999	-.108	.186	-.488	-.208	.275
\$15,000-24,999	.027	-.094	.186	.221	-.324
\$25,000 or more	.501	.621	.060	.105	1.402

^aOmitted to avoid singularity.

Table 32. Income Elasticities for Riboflavin (Vitamin B₂) by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.061	.097	.009	.023	.007
\$2,000-2,999	-.001	-.099	.034	.201	-.029
\$3,000-3,999	.155	.235	.173	-.140	.189
\$4,000-4,999	.093	.082	.216	.114	-.144
\$5,000-5,999	.118	.075	-.066	.087	.534
\$6,000-6,999	-.019	.158	.190	.007	-.226
\$7,000-7,999	.222	-.137	.518	.254	.330
\$8,000-8,999	-.054	.128	-.526	.188	-.226
\$9,000-9,999	.047	.832	.315	-.605	-.202
\$10,000-11,999	.104	-.258	-.013	.603	-.264
\$12,000-14,999	-.040	.051	-.158	-.259	.525
\$15,000-24,999	.005	-.021	.098	-.011	-.046
\$25,000 or more	.456	.496	.270	.526	.453

^aOmitted to avoid singularity.

Table 33. Income Elasticities for Niacin by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.047	.047	.280	-.009	.052
\$2,000-2,999	.040	-.041	-.295	.220	.197
\$3,000-3,999	.185	.178	.822	-.110	.221
\$4,000-4,999	.190	.268	.156	.170	-.155
\$5,000-5,999	.074	-.117	.581	.083	.161
\$6,000-6,999	.119	.336	-.430	.097	.100
\$7,000-7,999	.208	-.143	1.034	.192	.510
\$8,000-8,999	-.014	.044	-1.007	.234	-.193
\$9,000-9,999	.049	.766	.851	-.478	-.604
\$10,000-11,999	.039	-.469	.080	.426	.096
\$12,000-14,999	-.090	.252	-.371	-.252	.147
\$15,000-24,999	.014	.048	.119	.094	-.281
\$25,000 or more	.711	.110	.575	.625	1.967

^aOmitted to avoid singularity.

Table 34. Income Elasticities for Ascorbic Acid (Vitamin C) by Income Classes, the United States and Regions of the United States, Spring 1965

Income Classes	United States	South	Northeast	North Central	West
Under \$1,000 ^a	--	--	--	--	--
\$1,000-1,999	.082	.056	.209	.033	.185
\$2,000-2,999	-.024	-.153	-.101	.184	.056
\$3,000-3,999	.327	.597	.403	-.155	-.252
\$4,000-4,999	.302	.124	.385	.635	-.138
\$5,000-5,999	.355	.645	.031	.030	.866
\$6,000-6,999	.198	.122	-.260	.593	.154
\$7,000-7,999	.166	-.200	.431	.222	.377
\$8,000-8,999	.393	1.158	.566	.062	-.885
\$9,000-9,999	.500	.767	.428	.347	.574
\$10,000-11,999	.231	-.234	.309	.832	-1.746
\$12,000-14,999	.019	.370	-.519	-.320	1.253
\$15,000-24,999	.255	.353	.513	.680	-.272
\$25,000 or more	.366	.443	.006	.293	.964

^aOmitted to avoid singularity.

Table 35. Means of Dependent and Independent Variables, United States and Regions of the United States, Spring 1965

Variables	United States	South	Northeast	North Central	West
Dependent Variables					
Food Energy ^a	79674.85	83266.88	74692.16	81826.51	73394.35
Protein ^b	2577.62	2538.81	2512.06	2703.65	2511.03
Animal Protein ^b	1732.29	1618.11	1737.12	1864.59	1739.92
Vegetable Protein ^b	845.33	920.70	774.94	839.06	771.11
Fat ^b	3793.17	3910.63	3562.10	3924.87	3563.23
Carbohydrate ^b	8903.78	9593.41	8183.47	9050.25	7901.07
Calcium ^c	27385.28	28401.87	26192.35	27733.76	25828.09
Iron ^c	481.04	495.76	454.00	495.19	454.28
Vitamin A ^d	173230.48	161472.99	184451.57	175545.77	181496.40
Thiamine ^c	39.20	41.25	36.87	39.83	36.12
Riboflavin ^c	58.14	57.65	57.34	60.36	55.89
Niacin ^c	603.33	590.79	597.26	633.31	580.97
Ascorbic Acid ^c	2388.44	2191.20	2642.73	2436.29	2400.99
Independent Variables					
Income					
Under \$1,000	.04	.07	.01	.03	.01
\$1,000-1,999	.09	.13	.05	.08	.08
\$2,000-2,999	.10	.13	.07	.08	.09
\$3,000-3,999	.10	.13	.10	.08	.09
\$4,000-4,999	.10	.11	.10	.09	.10
\$5,000-5,999	.15	.12	.16	.18	.14
\$6,000-6,999	.11	.08	.12	.12	.10
\$7,000-7,999	.09	.07	.11	.10	.10
\$8,000-8,999	.06	.05	.07	.07	.07
\$9,000-9,999	.05	.03	.06	.05	.07
\$10,000-11,999	.05	.03	.06	.05	.06
\$12,000-14,999	.03	.02	.05	.04	.04
\$15,000-24,999	.02	.02	.03	.02	.04
\$25,000 or more	.01	.01	.01	.01	.01
Urbanization					
Rural farm	.24	.32	.08	.29	.15
Urban	.57	.45	.72	.53	.76
Rural nonfarm	.19	.23	.20	.18	.09
Race					
Negro	.11	.19	.09	.06	.06
White	.87	.80	.88	.93	.89
Other	.02	.01	.03	.01	.05
Education					
Grade school	.31	.39	.27	.29	.19
High school	.53	.47	.59	.56	.55
Some college	.10	.08	.09	.09	.16
College graduate	.06	.06	.05	.06	.10

Table 35 (continued)

Variables	United States	South	Northeast	North Central	West
Life Cycle					
Stage 1	.04	.04	.05	.04	.06
Stage 2	.25	.23	.27	.26	.25
Stage 3	.14	.14	.12	.14	.14
Stage 4	.16	.17	.15	.14	.14
Stage 5	.03	.04	.03	.04	.04
Stage 6	.35	.36	.36	.35	.34
Stage 7	.03	.02	.02	.03	.03
Family Size	3.54	3.59	3.50	3.60	3.37
Meal Adjustment	-1.94	-1.73	-2.65	-1.61	-2.02
Homemaker Employed	.30	.31	.31	.28	.31

^aThese quantities were measured in calories.

^bThese quantities were measured in grams.

^cThese quantities were measured in milligrams.

^dThese quantities were measured in international units.

Table 36. Simple Correlation Coefficients of the Independent Variables, United States, Spring 1965

Variables	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆	X ₁₇	X ₁₈	X ₁₉	X ₂₀	X ₂₁	X ₂₂	X ₂₃	X ₂₄	X ₂₅	X ₂₆	X ₂₇	X ₂₈	X ₂₉												
X ₁	1.00	-0.10	-0.11	-0.11	-0.13	-0.11	-0.10	-0.08	-0.07	-0.07	-0.06	-0.05	-0.03	-0.06	-0.01	-0.07	0.03	0.26	-0.06	-0.07	0.06	-0.16	-0.04	-0.10	-0.04	-0.04	0.01	0.18	0.09	0.09											
X ₂		1.00	-0.11	-0.11	-0.14	-0.11	-0.10	-0.09	-0.07	-0.07	-0.06	-0.05	-0.03	-0.10	0.03	-0.06	0.01	0.14	0.07	-0.04	-0.06	-0.04	-0.03	-0.04	-0.03	-0.02	-0.01	0.03	0.06	0.02											
X ₃			1.00	-0.11	-0.14	-0.12	-0.11	-0.09	-0.07	-0.08	-0.06	-0.05	-0.03	-0.07	0.03	-0.05	-0.00	0.07	-0.04	-0.06	-0.04	-0.01	0.01	0.00	-0.02	-0.01	0.00	-0.02	0.01	-0.02											
X ₄				1.00	-0.14	-0.11	-0.10	-0.09	-0.07	-0.07	-0.06	-0.05	-0.03	0.04	-0.02	0.04	0.01	0.02	-0.03	-0.04	-0.02	0.01	0.01	0.07	-0.01	-0.01	0.01	0.01	-0.06	0.00	-0.02										
X ₅					1.00	-0.14	-0.13	-0.11	-0.09	-0.08	-0.08	-0.06	-0.04	0.05	0.00	0.04	0.00	-0.10	0.01	-0.05	0.02	0.06	0.04	0.06	0.04	0.03	0.01	-0.00	-0.00	-0.04	-0.03										
X ₆						1.00	-0.11	-0.09	-0.08	-0.08	-0.06	-0.05	-0.03	0.06	0.02	0.05	0.01	-0.11	0.04	0.04	0.04	0.04	0.04	0.01	0.05	0.03	0.03	0.01	-0.06	-0.03	-0.03										
X ₇							1.00	-0.08	-0.07	-0.07	-0.06	-0.04	-0.02	0.04	0.00	0.03	0.00	-0.10	0.05	0.08	0.06	0.03	-0.00	-0.00	0.04	0.04	0.02	0.02	-0.04	-0.06	-0.02										
X ₈								1.00	-0.06	-0.06	-0.05	-0.03	-0.02	0.06	-0.02	0.07	-0.03	-0.11	0.05	0.04	0.07	0.09	0.04	0.05	0.03	0.04	0.02	0.04	0.02	-0.06	-0.03										
X ₉									1.00	-0.05	-0.04	-0.03	-0.02	0.05	-0.01	0.05	-0.02	-0.11	0.07	0.09	0.06	0.10	0.04	0.05	0.01	0.01	0.02	0.04	-0.05	-0.07	-0.01										
X ₁₀										1.00	-0.04	-0.03	-0.02	0.06	-0.02	0.06	-0.04	-0.08	0.06	0.15	-0.01	0.06	-0.00	-0.02	-0.02	-0.02	0.02	0.01	0.00	-0.04	-0.01										
X ₁₁											1.00	-0.03	-0.02	0.05	-0.02	0.06	0.00	-0.04	0.05	0.04	0.05	-0.08	-0.13	-0.03	0.06	0.00	-0.01	0.03	0.10	0.01	-0.03										
X ₁₂												1.00	-0.01	0.02	-0.00	0.00	0.00	-0.14	0.03	0.05	0.04	-0.03	0.05	0.03	0.04	-0.01	-0.01	-0.05	-0.01	-0.01	-0.01										
X ₁₃													1.00	0.03	-0.00	0.00	-0.12	0.09	-0.14	0.04	0.05	0.10	-0.12	0.09	0.03	-0.07	-0.00	0.03	-0.01	-0.01	-0.01										
X ₁₄															1.00	0.04	-0.02	-0.10	0.04	0.05	0.10	-0.12	0.09	0.03	0.04	-0.07	-0.00	0.03	-0.01	-0.01	-0.01										
X ₁₅																	1.00	0.02	0.02	-0.02	-0.01	-0.01	-0.04	0.03	0.01	-0.02	-0.02	0.03	-0.01	-0.02	-0.02										
X ₁₆																		1.00	0.02	-0.02	-0.02	-0.05	-0.14	-0.08	-0.21	-0.04	0.00	-0.04	-0.05	-0.05	-0.05										
X ₁₇																			1.00	-0.09	-0.09	-0.05	0.06	0.06	0.05	-0.01	0.00	-0.02	-0.02	-0.04	-0.05										
X ₁₈																				1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05										
X ₁₉																					1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05									
X ₂₀																						1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05								
X ₂₁																							1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05							
X ₂₂																								1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05						
X ₂₃																									1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05					
X ₂₄																										1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05				
X ₂₅																											1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05			
X ₂₆																												1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05		
X ₂₇																													1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05	
X ₂₈																														1.00	1.00	0.09	0.01	0.06	0.05	-0.01	0.00	-0.02	-0.08	-0.10	-0.05
X ₂₉																																									

X₉ = \$9,000-9,999 income.
 X₁₀ = \$10,000-11,999 income.
 X₁₁ = \$12,000-14,999 income.
 X₁₂ = \$15,000-24,999 income.
 X₁₃ = more than \$25,000 income.
 X₁₄ = white race.
 X₁₅ = other races.
 X₁₆ = urban.
 X₁₇ = rural nonfarm.
 X₁₈ = grade school.
 X₁₉ = sort college.
 X₂₀ = college graduate.
 X₂₁ = female worked outside home.
 X₂₂ = family size.
 X₂₃ = life cycle stage 1.
 X₂₄ = life cycle stage 2.
 X₂₅ = life cycle stage 3.
 X₂₆ = life cycle stage 4.
 X₂₇ = life cycle stage 5.
 X₂₈ = life cycle stage 6.
 X₂₉ = meal adjustment.

VITA

John Louie Adrian, Jr. was born in Centre, Alabama, on October 14, 1947. He attended elementary and junior high schools in that city and was graduated from Cherokee County High School in 1965. In June 1965, he entered Auburn University, Auburn, Alabama, and in December 1969, he received a Bachelor of Aeronautical Administration degree. In January 1970, he accepted a research assistantship in the Department of Agricultural Economics and Rural Sociology at Auburn. He received a Master of Science degree in June 1971. In August 1971, he accepted a research assistantship in the Department of Agricultural Economics and Rural Sociology at the University of Tennessee in Knoxville. He received the Doctor of Philosophy degree in August 1974.

The author is a member of Phi Kappa Phi, Sigma Xi, and Gamma Sigma Delta honor societies.

He is married to the former Wanda Kaye Young of Centre, Alabama. He and his wife have a son, John L. Adrian, III.