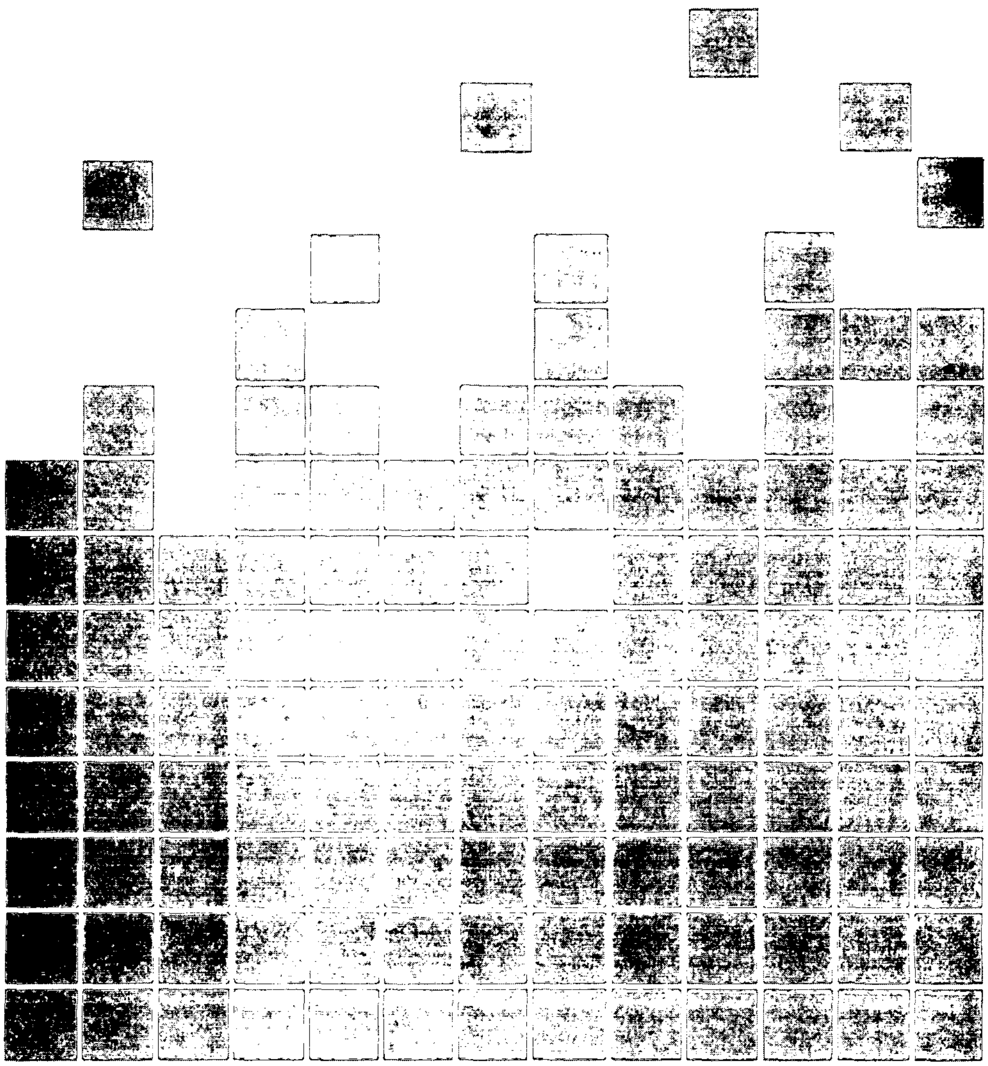
Nutrition Monitoring in the United States

An Update Report on Nutrition Monitoring

Prepared by Life Sciences Research Office
Federation of American Societies for Experimental Biology



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service

U.S. DEPARTMENT OF AGRICULTURE
Food and Consumer Services

Hyattsville, Maryland
September 1989

DHHS Publication No. (PHS) 89-1255

This report, *Nutrition Monitoring in the United States: An Update Report on Nutrition Monitoring*, is the product of an extramural independent effort performed under a contract with the Life Sciences Research Office of the Federation of American Societies for Experimental Biology (LSRO) at the request of the U.S. Department of Agriculture and the U.S. Department of Health and Human Services. The report was prepared by LSRO staff members in consultation with experts from nutrition, health, and related disciplines. The two departments jointly developed the scope of the contract and provided contract funds. They also provided background documents and data tabulations as requested by LSRO and the expert consultants. Although printed and distributed as part of a series of reports from the National Nutrition Monitoring System, the interpretations contained in this report do not necessarily express the views or policies of the United States Government and its constituent agencies.

Suggested Citation

Life Sciences Research Office, Federation of American Societies for Experimental Biology: Nutrition Monitoring in the United States — An Update Report on Nutrition Monitoring. Prepared for the U.S. Department of Agriculture and the U.S. Department of Health and Human Services. DHHS Publication No. (PHS) 89-1255. Public Health Service. Washington. U.S. Government Printing Office. September 1989.

Library of Congress Catalog Card Number
89-14529

For Sale by the Superintendent of Documents
U.S. Government Printing Office
Washington. D.C. 20402

Foreword

This report reviews the dietary and nutritional status of the U.S. population, as well as the factors that determine status, based on the data and information available through the nutrition monitoring activities conducted by the U.S. Departments of Agriculture (USDA) and Health and Human Services (DHHS). This report is the second report on the National Nutrition Monitoring System (NNMS) and builds on the framework of the first report, *Nutrition Monitoring in the United States--A Progress Report from the Joint Nutrition Monitoring Evaluation Committee*, submitted in 1986. Its release follows closely the publication of *The Surgeon General's Report on Diet and Health* and the report of the National Academy of Sciences, *Diet and Health: Implications for Reducing Chronic Disease Risk*, but its focus is on the monitoring of dietary and nutritional status related to health, rather than the broader perspectives on diet, nutrition, and health encompassed in the other reports.

This report was developed at the request of DHHS and USDA in accordance with the provisions of a joint contract, No. DHHS 282-87-0051, with the Federation of American Societies for Experimental Biology (FASEB). The report was prepared by the Federation's Life Sciences Research Office (LSRO). It was edited by Susan M. Pilch, Ph.D., Senior Staff Scientist, LSRO, FASEB, and was based on discussion of, and materials drafted by, the ad hoc Expert Panel on Nutrition Monitoring (EPONM). Scientists selected by FASEB as members of the Panel were chosen for their qualifications, experience, and judgment, with due consideration for balance and breadth in appropriate disciplines. Members of the EPONM and the LSRO staff and consultants who participated in the project are listed below:

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The contractual activities were overseen and assistance was provided to the EPONM and LSRO by the Joint Project Steering Committee (JPSC), which consisted of representatives from each of the Agencies within the departments concerned with nutrition monitoring (see list that follows). The cooperation and the careful, conscientious reviews provided by the JPSC were essential to the successful completion of this project.

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Special appreciation is extended to Marie T. Fanelli-Kuczmarski, Ph.D., R.D., National Center for Health Statistics, and Susan M. Krebs-Smith, Ph.D., R.D., U.S. Department of Agriculture, for their dedicated work in coordinating data analyses and other supporting activities in the Agencies. The EPONM and LSRO would also like to thank the following Agency scientists who provided invaluable assistance in supplying information on NNMS surveys, performing data analyses, generating the data tables included in the appendices, and reviewing sections of draft reports:

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The Expert Panel met eight times between November 1987 and February 1989 to obtain background information on the NNMS, to review analyses of NNMS data published in the literature and prepared especially for this report, and to review drafts of the report. The LSRO and the Expert Panel held an open meeting on January 20, 1988 to hear oral presentations of data, information, and views on the topics related to the NNMS. At that time, one presentation was made by Mary Enig, Ph.D., Research Associate, University of Maryland, College Park, MD. A transcript of the open meeting is available from Ace Federal Reporters, 444 N. Capital St., Washington, D.C. 20001. Written comments were also invited in the *Federal Register* announcement of November 30, 1987 (52 FR 45504) and December 18, 1987 (52 FR 48160), and a tentative outline was made publicly available for comment. Written comments were received from the following persons and organizations: Mary Enig, Ph.D., Joseph Sampugna, Ph.D., Frank E. McLaughlin, J.D., and Mark Keeney, Ph.D. (University of Maryland); Elaine Blume (Center for Science in the Public Interest); George L. Blackburn, M.D., Ph.D. (Harvard Medical School); J. Edward Hunter, Ph.D., and Thomas H. Applewhite, Ph.D. (Institute of Shortening and Edible Oils, Inc); Lawrence J. Machlin, Ph.D. (Roche Vitamin and Fine Chemicals); and Patricia A. O'Malley (Hunger Services Network). The data, information, and views presented at the open meeting and received in writing were considered by the Panel in reaching its final conclusions.

The EPONM reviewed each draft and the final report and provided additional documentation of conclusions and viewpoints for incorporation into the report. Members of the JPSC and the Deputy Assistant Secretaries for Food and Consumer Services, U.S. Department of Agriculture, and for Disease Prevention and Health Promotion, Department of Health and Human Services, also reviewed final drafts of the report for technical accuracy and satisfaction of the scope of work. The EPONM and the LSRO accept responsibility for the study conclusions and the accuracy of the report; however, the listing of these individuals does not imply that individual Panel members specifically endorse all statements in the report.

The final report was reviewed and approved by the LSRO Advisory Committee (which consists of representatives of each constituent Society of FASEB) under authority delegated by the Executive Committee of the Federation Board. Upon completion of these review procedures, the report was approved and transmitted to DHHS and USDA by the Executive Director, FASEB.

Although this is a report of the Federation of American Societies for Experimental Biology, it does not necessarily reflect the opinion of each individual member of the FASEB constituent Societies.

July 31, 1989
(date)

Kenneth D. Fisher

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Executive Summary

The National Nutrition Monitoring System (NNMS) includes all data collection and analysis activities of the Federal government associated with health and nutrition status measurements, food consumption measurements, food composition measurements, dietary knowledge, attitude assessment, and surveillance of the food supply. The ad hoc Expert Panel on Nutrition Monitoring (EPONM) was established by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology (FASEB) to review the dietary and nutritional status of the U.S. population, as well as the factors that determine status based on the NNMS data and information available through the activities of the U.S. Departments of Agriculture (USDA) and Health and Human Services (DHHS). This report requested by USDA and DHHS is the second report on the National Nutrition Monitoring System. It builds on the framework of the report developed by the Joint Nutrition Monitoring Evaluation Committee (JNMEC) in 1986.

Charge to Panel

The charge given to the EPONM for this report directed that two themes dominate:

- An updating of the dietary and nutritional status as presented in the 1986 JNMEC report, and

- An in-depth analysis of the contributions of the NNMS to assessment of the status of the population as determined from two types of data--data on diet and chronic diseases and data on dietary and nutritional problems.

With respect to the first theme, the EPONM was charged to update the first report by comparing data in that report with data from NNMS surveys that became available since it was written. The EPONM was also charged to address methodological issues in comparing data from different sources or times, and to identify the types of analyses necessary to make comparisons meaningful. Trend and baseline data presented in the first report were to be updated. The components as to the completeness of relevant data and the level of monitoring status that should be accorded each food component.

With respect to the second theme, the EPONM was to include in the report in-depth analyses of two topics selected as examples of NNMS data: the first, represented by data on the relationship of diet to a specified chronic disease, was to emphasize dietary and nutritional factors in cardiovascular disease; the second, represented by data on a dietary and nutritional problem, was the assessment of iron nutriture. The objective of this part of the report was to demonstrate how NNMS data could contribute to understanding these public health concerns, as well as to identify the strengths and weaknesses of data and information available primarily from components of the NNMS. The ability to identify the nature and magnitude of nutrition-related problems in the U.S. population was to be addressed, with focus especially on the NNMS capabilities for identifying 1) populations at risk, 2) limits to interpretations of data, 3) gaps in the database, 4) trends, and 5) determining factors.

Response to Charge

The update portion of this report is a followup to the 1986 JNMEC report and is intended to identify new data available from the NNMS and to examine changes and trends in dietary intake, nutritional status, and nutrition-related health conditions. The JNMEC report emphasized a coordinated review of dietary data from the Nationwide Food Consumption Survey (NFCS) 1977-78 and nutritional and health status data from the second National Health and Nutrition Examination Survey (NHANES II). New national survey data on dietary intake and nutritional status of the entire U.S. population have not become available since the JNMEC report; however, data for certain subgroups of the population have become available. Most of the available data are for the three Hispanic groups surveyed in the Hispanic Health and Nutrition Examination Survey (HHANES) and the women and children surveyed in the Continuing Sur-

Data analyses included in the report are intended to be descriptive of dietary and/or nutritional status, trends, and associations rather than to establish causal relationships. The report is not intended to serve the purpose of program evaluation. Summary data from relevant surveys are included, by topic, in appendix II; detailed analyses are provided in the body of the report when a public health issue is identified for some of the food components included in the update (criteria are described in chapter 3) as well as in the chapters on cardiovascular disease and diet and assessment of iron nutriture. Many of the data analyses presented were prepared by the Agencies specifically for inclusion in this report; others were obtained from Agency publications or the peer-reviewed literature.

Chapter 2 (on the appropriate uses of survey data for assessing dietary and nutrition-related health status) is responsive to the charge to address methodological issues in comparing data from different sources or times and to identify the types of analyses necessary to make comparisons meaningful. The discussions of data that comprise the update portion of this report are divided into two chapters, with the first (chapter 3) providing new data on dietary intake, food availability, major food sources of various food components, and nutritional status with respect to various nutrients, and the second (chapter 4) providing new estimates of the prevalence of nutrition-related health conditions and behaviors. Reference is made to baseline data when appropriate.

With respect to the second charge to the EPONM, the two selected topics are discussed separately. The chapter on nutritional and dietary factors in cardiovascular disease (chapter 5) concentrates on the utility of NNMS data in assessing risk factors for cardiovascular disease and dietary and other factors related to these risk factors. The chapter on assessment of iron nutriture (chapter 6) concentrates on the utility of NNMS data in assessing the prevalence of iron deficiency and identifying groups at risk and the factors contributing to iron nutriture. Finally, chapter 7 contains the EPONM's specific recommendations for improvements in the NNMS, based on their experiences in evaluating the data analyses in this report.

Update of Dietary and Nutritional Status

Major Conclusions

The EPONM drew the following conclusions based on their review of new NNMS data:

- In the United States today, the amounts of food available in the food supply and the nutrient content on a per capita basis are generally adequate to prevent undernutrition and deficiency-related diseases. Although some Americans may not have sufficient food for a variety of reasons, the supply of food that is available is abundant.

- The NNMS does not provide sufficient population-based data to permit a full assessment of nutritional status in some groups for whom there are special concerns about nutritional status, such as young infants and pregnant and lactating women. In addition, some other groups whose nutritional status may reasonably be suspected to differ from that of the general population, such as the homeless, institutionalized persons, migrant workers, and Native Americans living on reservations, are not included in most of the current household-based surveys of the NNMS. Finally, very little information on the dietary and nutritional status of the elderly (a group for which standards for nutrient adequacy and normal physiologic status have been questioned) was available in the most recent NNMS data that were the focus of this evaluation.

- Evidence from recent analyses of the U.S. food supply and from surveys of individual food consumption suggests that some changes are occurring in eating patterns consistent with recommended dietary guidelines for Americans to avoid too much fat, saturated fat, and cholesterol and to consume adequate amounts of starch and dietary fiber. Recent data indicate that consumers are increasingly choosing some lower-fat alternatives within the meat and dairy product food groups and are increasing their consumption of grain products.

- Evidence available on dietary and nutritional status with respect to individual food components does not indicate substantial changes since the JNMEC report was completed in 1986. Consequently, the EPONM and JNMEC classifications of food components by public health monitoring priority are very similar.

- The principal nutrition-related health problems experienced by Americans continue to be related to the overconsumption of some nutrients and food components, particularly food energy, fat, saturated fatty acids, cholesterol, sodium, and alcohol.

  - The high prevalence of overweight among adults in the United States is evidence that energy intakes exceed energy expenditures (probably because of low energy expenditures, although this possibility cannot be assessed currently in the NNMS); however, reported intakes of food energy do not exceed standards (Recommended Energy Intakes). The JNMEC noted that more than one-quarter of the adult U.S. population was overweight, based on data collected in NHANES II. Data collected since then in the HHANES (1982-84) also indicate a high prevalence of overweight in three Hispanic groups not previously studied (26-42 percent), especially in Mexican-American and Puerto Rican women (40 and 42 percent, respectively). Overweight is a controllable risk factor for cardiovascular disease, high blood pressure, and diabetes.

- Intakes of total fat and saturated fat continue to be higher than the levels recommended by many authoritative groups; cholesterol intakes are high for adult men. These high intakes are reflected in the high prevalence (11-22 percent) of elevated levels of total serum cholesterol, as defined by the 1984 NIH Consensus Development Conference, found in nearly all adult groups aged 20-74 years in the United States. Elevated serum cholesterol levels constitute an important controllable risk factor for coronary heart disease.

- Sodium intakes also exceed recommended levels in almost every group in the United States. Such intakes are of concern because of the sensitivity of blood pressure in some persons to sodium intake. Hypertension is prevalent (14-44 percent) in adult groups aged 20-74 years in the U.S. population. Hypertension is a controllable risk factor for cardiovascular disease and stroke.

- Although consumption of excessive alcohol does not appear to be prevalent in a large proportion of the population, reported intakes are high in a large number of Americans and the serious nature of the health and social consequences of such intakes justifies public health concern.

• In spite of the general adequacy of the supply of nutrients, there is evidence of inadequate individual dietary intake and/or impaired nutritional status in some subgroups in the population with respect to a few vitamins and minerals.

  - Iron deficiency continues to be the most common single nutrient deficiency, even though some recent hematological and biochemical evidence from the NNMS suggests that its prevalence has declined in children aged 1-5 years. Among groups that are assessed adequately in the NNMS, women of childbearing years and young children are at greatest risk for iron deficiency.

  - Although less evidence is available, the calcium status of women is a concern. The high prevalence of osteoporosis in later life is suggestive that the calcium intake of many women may be inadequate to permit the accretion of maximal bone mass in early adulthood and/or to maintain bone mass later in life.

  - Limited evidence from biochemical assessments suggests that the vitamin A, vitamin C, and folacin nutritional status of some subgroups of the population might be improved.

  - Intakes of zinc and vitamin B6 are also low, and poor status has been reported in some population groups in the clinical literature, but further study is needed to assess the health consequences of the reported intakes in U.S. population groups.

• The risk of nutrition-related disorders is generally greater in low-income groups than in groups with higher incomes.

  - The prevalences of both overweight and iron deficiency are greater in women below poverty than in women above poverty.

  - The intakes of several vitamins and minerals are lower in persons below poverty than in persons above poverty. This finding is also highlighted in the low-income component of the CSFII 1985-86. Women in the low-income survey had lower intakes of food energy than women in the all-income survey. Intakes of vitamin E, vitamin B6, folacin, calcium, magnesium, iron, and zinc were low in women in both surveys, but lower in the low-income survey than in the all-income survey. Low-income women and children who lived in households that participated in the Food Stamp Program had nutrient intakes that were generally the same or higher than those of low-income women and children living in households that did not participate in the program.

• The ability of the EPONM to examine excessive intakes of vitamins and minerals, and possibly to assess consequences of nutrient toxicity, was limited because none of the available NNMS surveys that assess nutrient intake from food included quantitative estimates of nutrient intake from vitamin/mineral supplements.

• Although the data available to the EPONM for their update on dietary and nutritional status of the U.S. population were not equivalent to the data reviewed by the JNMEC, in terms of the populations surveyed, the conclusions of the EPONM are very consistent with those of the JNMEC. The results of recently completed and ongoing national surveys of dietary and nutritional status by USDA and DHHS will provide a more extensive database for further evaluation of the nutritional status of the U.S. population and various subgroups in future reports on the NNMS.

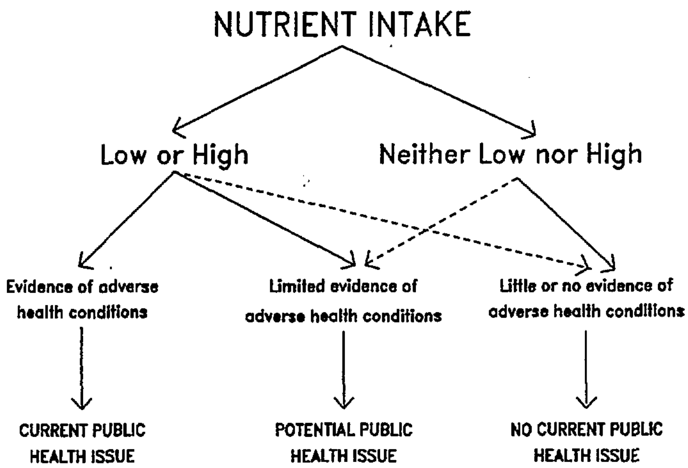
Monitoring Priority Status for Individual Food Components

The availability of relevant update data on dietary, nutritional, and health status from the various surveys of the NNMS for each food component varies. The data elements from the NNMS common to most of the food components considered are per capita amounts in the food supply and individual dietary intakes. The quality and quantity of data, as well as the availability of appropriate assessment criteria, differ for different components and influence the confidence with which evaluations of status may be made.

The JNMEC classification and the classification used in this update report by the EPONM are similar philosophically (see table below). In the JNMEC report, nutrients and other food components were prioritized in three categories to contrast those components having high and moderate priority status for continued monitoring with the third group identified as those requiring further investigation. In this report, the EPONM labeled the categories somewhat differently to place emphasis on their evaluation in regard to public health significance. The category of food components considered to be current public health issues by the EPONM can be equated to the JNMEC category of food components warranting public health monitoring priority status. The category of food components considered by the EPONM to be potential public health issues and requiring further study is most similar to the JNMEC category of components requiring further investigation. The type of additional study required for each component differs; basic research on the health consequences of high or low intake, additional data on food composition and dietary intake, and/or the development of methods for assessing status together with interpretative criteria may be needed. The EPONM category of food components that are not considered current public health issues is most similar to the JNMEC category of components warranting continued monitoring consideration. Assigning food components to this category does not necessarily indicate that there are no known health problems associated with these components, but that the prevalence of such problems on a national basis is known or expected to be so low that a lower level of monitoring effort than for food components in the other categories is appropriate.

A schematic diagram that illustrates the decision-making process used by the EPONM for categorizing food components is shown in the figure on the opposite page. This process differs from the one used by the JNMEC in that the evaluation of each food component begins with the dietary intake data. This choice to begin the evaluation of each food component with consideration of the dietary intake data was made recognizing that such data are available for most of the components included; the same is not true of related health data. However, as illustrated in the figure, the resulting evaluations by both the EPONM and JNMEC are similar in that the evidence for adverse health consequences ultimately determines the categorization of food components.

EPONM classification of food components	JNMEC classification of food components
Current public health issues	Warranting public health monitoring priority
Potential public health issues for which further study is required	Requiring further investigation
Not current public health issues	Warranting continued public health monitoring consideration



In the discussions of each of the categories that follow, the criteria for assigning food components to the category are described, update data available related to the components are tabulated, and brief conclusions about each food component are presented. A "plus" in the table indicates data were available; a "minus" indicates they were not. The notation "limited" indicates that food composition data were available for less than 75 percent of important sources of the nutrient.

- **Food components were considered to be current public health issues**
  - if dietary intakes were low or high for a substantial proportion of the population, and if evidence from NNMS surveys of health and nutritional status indicated related health problems in the population or in subgroups of the population, or
  - if dietary intakes were low or high for a substantial proportion of the population, and if evidence from epidemiological or clinical studies in the literature indicated related health problems in the population or in subgroups of the population.

Food components in this category are recommended for high priority monitoring status; that is, multiple assessments, when possible, should continue to be employed. A high priority should be given to development of assessment tools when these are lacking.

The food components listed in the following table were considered to be current public health issues.

Food component	Food composition data	Dietary data	Health data
Food Energy	+	Food supply Individual intake	Overweight and associated conditions
Fat	+	Food supply Individual intake	Serum cholesterol level
Saturated fat	+	Food supply Individual intake	Serum cholesterol level
Cholesterol	+	Food supply Individual intake	Serum cholesterol level
Alcohol	+	Disappearance/sales Individual intake (limited)	–
Iron	+	Food supply Individual intake	Mean corpuscular volume, transferrin saturation, erythrocyte protoporphyrin, hemoglobin/hematocrit
Calcium	+	Food supply Individual intake	–
Sodium	+	Individual intake (limited)	Blood pressure

Reported dietary intakes of food energy by adults are lower than Recommended Energy Intakes, but the data available from the NNMS on the high prevalence of overweight (approximately one-fourth of adults) in many groups in the United States suggest a continuing public health problem in regard to energy balance. Food energy should be accorded high priority for monitoring status. Additional information on both energy intake and energy expenditure (physical activity) is required to evaluate the relative impact of these factors on the occurrence of obesity.

The intakes of total fat, saturated fat, and cholesterol by many persons in the U.S. population exceed levels recommended by many authoritative groups. Serum cholesterol levels are affected by dietary intake of these components (and other factors); elevated levels of serum cholesterol are prevalent in the United States (11-22 percent) in men and women of all racial and ethnic groups examined and represent a risk factor for the development of coronary heart disease. Continued priority for the monitoring of serum cholesterol levels and the dietary intake of fat, fatty acids, and cholesterol is warranted.

Self-reported alcohol intakes are high (an average of 1 ounce or more of ethanol per day) in a large number of persons (9 percent of adults). The public health and social consequences of excessive alcohol intake are sufficiently grave that continued efforts to improve monitoring of alcohol intake are warranted.

Iron intakes are low for many in the population. Although the prevalence of iron deficiency has apparently declined in recent years, it is still relatively high in vulnerable groups (up to 14 percent) such as women of childbearing years. Continued monitoring is warranted and is likely to yield useful information on iron nutritional status because of the wealth of indicators available for inclusion in the NNMS.

The low intakes of calcium in vulnerable groups, especially women, suggest a reason for concern. The high prevalence and severity of osteoporosis, which is possibly related, in part, to calcium intake of adolescents and young women, provide sufficient evidence for a public health concern. Calcium should be considered a nutrient about which there is public health concern even if there is some question about its exact role in health disorders. Monitoring the intake of calcium and including assessments of bone status in NNMS surveys is warranted, as is investigating the possible overuse of calcium supplements by adults.

Reported dietary intakes of sodium are high in many persons relative to estimates of safe and adequate levels of intake; reported intakes do not account for all sources of sodium. The prevalence of hypertension, which is related in some persons to sodium intake as well as other factors, is high in all adult groups examined (14-44 percent). Because of the serious, and largely preventable, deleterious effects of elevated blood pressure, a high level of monitoring effort is warranted. Blood pressure measurements should continue to be included in surveys and efforts to improve and validate the assessment of total sodium intake should be pursued.

- **Food components were considered to be potential public health issues, for which further study is needed,**

  - if dietary intakes were low or high for a substantial proportion of the population, and if limited evidence from either NNMS nutrition and health surveys or studies in the literature suggested related health problems in at least some subgroups in the population, or

  - if dietary intakes were adequate for the majority of the population, but limited evidence from either NNMS nutrition and health surveys or studies in the literature suggested related health problems in at least some subgroups in the population, or

  - if dietary intakes were low or high for a substantial proportion of the population, and if evidence was not available from either NNMS nutrition and health surveys or studies in the literature that permitted evaluation of the public health significance of the observed dietary intakes.

  Food components in this category are recommended for moderate monitoring priority status, with continued assessment at the least in subgroups suspected to be at risk, and moderate priority for the development of improved assessment techniques.

The food components listed in the following table were considered potential public health issues, for which further study is needed.

Food component	Food composition data	Dietary data	Health data
Dietary fiber	+ (limited)*	Individual intake	–
Vitamin A	+	Food supply Individual intake	Serum retinol level
Carotenes	+	Food supply Individual intake	–
Folacin	+	Food supply Individual intake	Serum and red blood cell folate levels
Vitamin B6	+ (limited)*	Food supply Individual intake	–
Vitamin C	+	Food supply Individual intake	–
Potassium	+	Food supply Individual intake	–
Zinc	+	Food supply Individual intake	–
Fluoride	–	–	Dental caries

* Less than 75 percent analytical data for important sources of the food component.

Intakes of dietary fiber are low in relation to suggested levels of intake, but the impact of these low intakes cannot be judged on the basis of available data. More information is required on the health effects of dietary fiber, the content in foods of various components of fiber (which have different physiological effects) as well as total dietary fiber, and recommendations for intake. Monitoring is recommended as this information is developed.

The content of vitamin A in the food supply and individual intakes suggest general adequacy. Intake and status may, however, warrant continued monitoring efforts in certain groups. HHANES data on low serum vitamin A levels suggest that poor young children, particularly Mexican Americans, may be such a group. Greater attention needs to be given to studying the relationships of biochemical assessments of status to functional impairments. Carotenes are also considered a potential public health issue for which further study is required. Data on intake of carotenes are available from the CSFII 1985–86 and will be available from HHANES to provide a baseline for assessing future changes in intake. Future surveys should continue to collect and report intake separately for carotenes and total vitamin A. Additional research is needed on the health effects of consumption of specified levels of total carotenes, as well as individual carotenes.

Vitamin B6 intakes are lower than recommended levels for a substantial number of persons, especially women. In order to interpret the consequences of these intakes, further study is needed on the content and bioavailability of vitamin B6 in foods, vitamin B6 requirements, and biochemical or other techniques for assessing vitamin B6 nutritional status. Increased monitoring activity may be warranted as progress is made in these areas.

Recent dietary intakes of vitamin C appear to be adequate in most of the population, even without consideration of the substantial contribution of vitamin C supplements. Older data for serum vitamin C (from NHANES II) indicate that the prevalence of low serum vitamin C levels is generally higher in groups with low socioeconomic status, especially older men, but do not provide strong evidence for vitamin C deficiency. Although these data suggest the need for some continued surveillance, changes in vitamin C fortification practices may affect intake among many segments of the population. Continued monitoring is warranted to assess the impact of these changes, but the apparently adequate intakes do not provide support for priority monitoring status.

Folacin intakes are much lower than recommended in some groups, especially women. Biochemical and other evidence for deficiency is limited, but suggests a risk of deficiency in women. Further study is required to evaluate folacin requirements, to develop methods and interpretative criteria for folacin nutritional status, and to examine the status of groups at risk.

Potassium intakes are lower than recommended levels in a substantial number of persons in the population. Further research on the role of potassium intake in the regulation of blood pressure and on the assessment of potassium status is needed to elucidate the public health significance of the low intakes observed.

Zinc intakes are lower than recommended levels in some groups, particularly women. The possibility of impaired zinc status is not supported by available biochemical or clinical data from the NNMS. However, findings from the clinical literature suggest zinc deficiency in some groups in the United States. The significance of the observed low dietary intakes of zinc cannot be evaluated until additional research to determine zinc requirements and to develop better measures of zinc status is conducted. Further monitoring is warranted.

The EPONM agrees with the JNMEC's concern that fluoride intake may be too low in some groups to provide maximal benefit, but NNMS data are not currently available that permit evaluation of this possibility. Assessments of fluoride intake that take all sources into account are warranted.

- **Food components were not considered to be current public health issues**

  - if dietary intakes were adequate for the majority of the population, and evidence from either NNMS nutrition and health surveys or studies in the literature did not suggest related health problems in the population, or

  - if dietary intakes were low or high for a substantial proportion of the population, but evidence from either NNMS nutrition and health surveys or studies in the literature did not suggest related health problems in the population.

  Food components in this category are recommended for lower monitoring priority status; continued assessment should include, at a minimum, estimation of dietary intake.

The food components listed in the following table were not considered to be current public health issues:

Food component	Food composition data	Dietary data	Health data
Protein	+	Food supply Individual intake	–
Carbohydrate	+	Food supply Individual intake	–
Vitamin E	+ (limited)*	Food supply Individual intake	Serum α–tocopherol level
Thiamin	+	Food supply Individual intake	–
Riboflavin	+	Food supply Individual intake	–

* Less than 75 percent analytical data for important sources of the food component.

Food component	Food composition data	Dietary data	Health data
Niacin	+	Food supply Individual intake	–
Vitamin B12	+ (limited)*	Food supply Individual intake	–
Phosphorus	+	Food supply Individual intake	–
Magnesium	+ (limited)*	Food supply Individual intake	–
Copper	+	Food supply Individual intake	–

* Less than 75 percent analytical data for important sources of the food component.

Protein intakes appear to be adequate for almost all persons and there is no evidence of health problems associated with deficiency or excess. Monitoring should continue at a low level, especially for the elderly.

Carbohydrate intakes are lower than may be desirable, based on the dietary pattern recommended in the U.S. dietary guidelines (USDA/DHHS, 1985), but evidence does not suggest that current intakes pose a specific public health problem. Monitoring of intake should continue; if recommended decreases in the percent of energy from fats occur, concomitant increases in the proportion of energy from carbohydrates are expected.

Although some vitamin E intakes are lower than recommended levels (especially in women), data on serum α-tocopherol levels and clinical data on the rarity of vitamin E deficiency suggest little reason for a public health focus. Interpretation of serum α-tocopherol levels is confounded by other factors such as serum lipid concentrations, and clear interpretative guidelines to assess marginal vitamin E status do not yet exist.

Intakes of thiamin appear to be adequate, and no other evidence suggests a public health problem with respect to thiamin status.

Intakes of riboflavin appear to be adequate, and no other evidence suggests a public health problem with regard to riboflavin status.

Individual intakes of preformed niacin appear to be adequate (and additional niacin may be obtained from the conversion of dietary tryptophan in the body). No other evidence suggests a public health problem in relation to niacin status.

Intakes of vitamin B12 appear to be adequate for the majority of the population. Clinical or biochemical evidence for a public health problem with respect to vitamin B12 deficiency is not available. Further monitoring, at a low level, is warranted.

Phosphorus intakes appear to be adequate, and no other evidence exists to suggest a public health problem. Monitoring should continue at a relatively low level.

Magnesium intakes appear to be low, but there are no other data on magnesium status available and magnesium deficiency is very unlikely to result from low dietary intake alone. Further research on magnesium requirements and assessment of magnesium status would be desirable. Current information supports continued monitoring at a low level.

Copper intakes appear to be low in a large number of persons in the population. Despite some unanswered questions about the estimation of intake and the assessment of status, the likelihood of a public health problem associated with copper is very low. Monitoring should continue at a low level, unless further research suggests more compelling reasons for concern.

Use of NNMS Data to Examine Dietary and Nutritional Factors in Cardiovascular Disease

The EPONM identified the following limits to interpretation of the data and gaps in the database, based on their review of the data available from the NNMS with respect to dietary and nutrition factors in cardiovascular diseases:

- The most recent dietary survey, the CSFII 1985-86, provides estimates of dietary intake of several food components associated with cardiovascular diseases: food energy, fat, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, dietary fiber, calcium, and potassium. Estimates of sodium intake from food are also available, but these exclude sodium from salt added at the table; thus, total sodium intake is underestimated. Estimates of alcohol intake from self reports are also less certain, because of methodological difficulties such as underreporting. Because the properties of individual fatty acids differ, estimates of their intake would also be desirable; the nutrient composition databases available during the EPONM's review do not contain composition information with respect to individual fatty acids.

- With respect to implications for cardiovascular disease, the most recent data on the distribution of usual dietary intakes are limited because they are for women and children, groups not thought to be at high risk of cardiovascular disease. The earlier NFCS 1977-78 obtained dietary intake data for multiple days for both sexes and all ages, but the nutrient composition database was more limited with respect to information on fatty acids and cholesterol at the time.

- The ability to assess the distribution of usual dietary intakes from the data obtained in the Health and Nutrition Examination Surveys (HANES) is more limited because only 1 day of dietary data is collected.

- Trends in dietary intake of individuals with respect to fat and cholesterol, as assessed by the dietary and health surveys of the NNMS, must be interpreted with caution because of differences in survey methodology and improvements in the nutrient composition databases over time. The ability to interpret changes in intake over time could be improved by the conduct of methodological studies designed to assess the consequences of changes in survey procedures on the estimates generated.

- Cross-sectional associations of dietary influences and risk factors for cardiovascular diseases may be examined using data from the HANES, but the power of such analyses is severely restricted because of the large day-to-day differences in the food and nutrient intake of any individual. The results of analyses of 1-day food intakes of individuals do not represent the average usual intake of any individual over a longer period of time. In studying diet and disease relationships, it is generally recognized that an estimate of average, or "usual," nutrient intakes is needed. With respect to studying relationships between diet and cardiovascular disease risk factors in the NNMS, measurements of "usual" dietary intake are not obtained for the same individuals in whom measurements of risk factors are performed. Other limitations in interpretation of such associations exist because of the nature of cross-sectional data; an "association" between a postulated risk factor and a disease may be identified, not because it is causally related to the disease, but because it is related to another factor which is really one of the causes of the disease.

- Because a single 24-hour recall was used to obtain dietary intake information, there are also limitations in the interpretation of relationships between dietary intake and subsequent morbidity and mortality in the longitudinal NHANES I Epidemiologic Followup Study.

- Surveys have not assessed directly the impact of knowledge and attitudes about cardiovascular disease risk factors and diet on patterns of food consumption or nutrient intake.

The EPONM drew the following conclusions, based on the analyses reviewed, about the major contributions of the NNMS to the understanding of dietary and nutritional factors as they relate to cardiovascular diseases:

Populations at Risk

- Measurements of body weight, blood pressure, serum lipids, and glucose tolerance and questionnaires in the HANES permit the assessment of the prevalence of several major diet- and nutrition-related risk factors for cardiovascular diseases--obesity (overweight), hypertension, elevated serum cholesterol level, and diabetes--in nationally representative samples. By comparing the prevalence estimates of different population groups, some characteristics of groups most affected by each risk factor can be identified. Characteristics of the groups at risk differ depending on the risk factor considered. For example, blacks are at greater risk of hypertension than whites; women of low socioeconomic status are at greater risk of obesity than women of high socioeconomic status, and persons above poverty are at greater risk of hypercholesterolemia than persons below poverty. The characteristics of individuals with multiple risk factors can also be examined: black males have a higher prevalence of multiple risk factors than white males and black or white females. However, a model that quantitates the relative contribution of all risk factors, including genetic predisposition, has not been developed that can be applied to NNMS data to assess overall risk of cardiovascular diseases.

- High intakes of fat, especially saturated fat, and cholesterol constitute risk factors for hypercholesterolemia, and characteristics of populations with high intakes can be assessed in the NNMS. For example, in women, high fat intake is associated with being white, having more than a high school education, and smoking.

Trends

- Data from the U.S. Food Supply Series provide information on trends in the foods and amounts of food components in the food supply over time. Although the inferences about food consumption and food component intake that may be drawn from these data are limited, they are nonetheless useful to demonstrate shifts over time within food supply sources of various food components related to cardiovascular diseases (notably, total fat and fatty acid groups) in the national diet. These data indicate recent shifts from animal sources of fat to vegetable sources of fat, consistent with dietary guidance to avoid too much saturated fat.

- Data from the surveys that collect information on food consumption indicate a decline in the consumption of some high-fat foods and foods containing saturated fat. Some changes observed in the past 20 years include a shift from whole milk to low-fat milks, an increased consumption of leaner types and cuts of meat, and an increase in the use of margarine with a concomitant decrease in the use of butter.

- However, as noted earlier, interpretation of trends in nutrient intake is problematic because of changes in survey methods over time.

- Biochemical and clinical measurements that permit assessment of the prevalence of overweight, hypertension, and elevated serum cholesterol levels have been made repeatedly over time (with limited changes in methodology). Thus, trends in the prevalence of these risk factors can be assessed. Data from the NNMS indicate a recent decline in the prevalence of hypertension and elevated serum cholesterol levels, but no decline in the prevalence of overweight. Associations between risk factors (for example, body weight and serum cholesterol level) and the occurrence of multiple risk factors in population groups can also be examined.

- The NNMS trend data are useful for examining concurrent changes in group intakes or status over time. For example, changes in food availability in the food supply contributing to a decrease in the content of saturated fat have been observed to precede the decline in coronary heart disease mortality. Changes in mean serum cholesterol levels consistent with changes in mean dietary intake of fats and cholesterol can also be detected between the first and second NHANES.

Determining Factors

- Sex and age are important determining factors for the risk of coronary heart disease and cerebrovascular diseases. Men are at higher risk than women for coronary heart disease and hypertension. Although serum cholesterol levels do not vary dramatically with sex, elevated levels constitute a greater risk for men than for premenopausal women. The dietary intakes of fat, saturated fat, and cholesterol are higher in males than in females.

- Race also has an important impact on relative risk of cardiovascular disease. NNMS and related data indicate that blacks are at greater risk than whites for coronary heart disease, cerebrovascular disease, hypertension, and hypercholesterolemia. More black women are significantly overweight than white women or men of either race.

- The effects of socioeconomic factors such as poverty status and education do not seem consistent for all risk factors related to cardiovascular diseases. Indicators of high socioecomic status tend to be associated with hypercholesterolemia and higher intakes of fat, but with lower prevalences of hypertension and, for women, overweight.

- Several surveys of the NNMS permit the assessment of knowledge and attitudes about diet- and nutrition-related risk factors for cardiovascular disease. Such surveys have been repeated over time and show a trend for increasing knowledge and changing diet-related practices.

Use of NNMS Data for the Assessment of Iron Nutriture

The EPONM identified the following limits to interpretation of the data and gaps in the database, based on their review of the data available from the NNMS with respect to the assessment of iron nutriture:

- Information about selected groups at risk of iron deficiency, pregnant women and infants under age 1 year, is inadequate. In pregnant women, anemia is associated with increased neonatal mortality and a higher prevalence of low birthweight. Iron deficiency during the brief period of infancy is believed to lead to long-term harmful consequences in regard to subsequent development. In both groups, dietary practices differ from other age and sex groups. In both of these groups, dietary intake and use of supplements over a period of 6 to 9 months determine the risk of iron deficiency. These groups require longitudinal assessment over at least 6 months for an adequate assessment of their nutritional status because iron status changes rapidly over a period of a few months.

- The combination of foods eaten at each meal is the most important determinant of iron absorption. Such information is even more important than the amount of iron consumed and has only been analyzed on a very limited scale. Improvements in the ability to provide such analyses should be incorporated into the NNMS.

- Distinguishing iron deficiency from mild inflammatory conditions is difficult because laboratory measurements in mild inflammatory conditions or following infections may mimic iron deficiency, thereby suggesting a higher than actual prevalence. This problem, which is greatest among the elderly, may be alleviated by using a recently developed four-variable model to assess iron nutriture and laboratory tests that reflect the presence of inflammation.

- Criteria for anemia in blacks are uncertain. Blacks have lower hemoglobin concentrations than whites irrespective of iron status. These lower concentrations lead to misleadingly higher prevalences of anemia among blacks if uniform criteria for low hemoglobin values are used for all races. This problem can be circumvented by using the three- or four-variable models for iron deficiency (that do not include hemoglobin as a variable) and by using laboratory tests that reflect the presence of inflammatory disease (C-reactive protein).

- No information on blood donation has been collected in the NNMS.

- More detailed information is needed on the type and amount of supplement intake. Total iron intake could not be determined because quantitative estimates of iron intake from supplements were not available from any of the surveys in which estimates of intake from food were made.

The EPONM drew the following conclusions, based on the analyses reviewed, about the assessment of iron nutriture in the United States using NNMS data:

Populations at Risk

- The variety of biochemical and hematological measures of iron nutritional status collected in the NNMS permits an estimation of the prevalence of iron deficiency and iron deficiency anemia in the U.S. population and some characterization of population groups at risk of iron deficiency.

- The prevalence of iron deficiency anemia (based on findings of low hemoglobin levels plus evidence of iron deficiency) in NHANES II and HHANES is low (less than 5 percent); however, the prevalence of iron deficiency without anemia is still appreciable (up to 14 percent) in several groups.

- Groups at greatest risk of iron deficiency, as indicated by the biochemical data from the NNMS, are young children, adolescents, and women of childbearing age.

- Pregnant women and infants under 1 year of age are risk groups not well covered in current nationally representative surveys. Surveillance data for the Centers for Disease Control indicate that low-income pregnant women are at high risk of anemia.

- Dietary iron intake, assessed in the CSFII 1985-86, is very low in women of childbearing years relative to recommended levels. Available iron intake, determined by using data from the NFCS 1977-78, is also low for women relative to apparent requirements. The intake estimates do not include the contribution from iron supplements.

- In contrast to iron deficiency, iron overload cannot be assessed adequately with current NNMS data to identify groups at risk. The prevalence of hemochromatosis is too low to be estimated reliably by available NNMS surveys.

Trends

- The best trend data available are those on the nutrient content of the U.S. food supply, which indicate an increase in the level of iron in recent years.

- Assessing trends in individual intakes of iron by various population groups is more difficult because of methodological differences in the surveys over time, including revised nutrient composition data. The available NNMS data indicate little change during the last 20 years.

- Assessing trends in iron nutritional status is also difficult, because the measures used to estimate the prevalence of iron deficiency have not been used in many surveys. Limited data from the Pediatric Nutrition Surveillance System suggest recent improvements in iron status among the low-income children monitored.

Determining Factors

- Sex and age are powerful determining factors relative to iron nutritional status. Evidence of iron deficiency is rare in males, in the elderly of both sexes, and in school children.

- Univariate analyses of NNMS data indicate that the prevalence of iron deficiency is influenced by race and socioeconomic factors such as poverty status and education. Iron intake also differs with these variables, but not as consistently as iron status, suggesting differences in bioavailable iron.

- Parity is also observed in NNMS data to be an influence on iron status in women during child-bearing years; women who have given birth to many children are at greater risk of deficiency.

- Other determining factors, such as iron supplement use, blood donation, use of medications, and growth, could not be assessed with current data from the NNMS.

Recommendations

The EPONM offered recommendations, based on their experiences in analyzing NNMS data for this report, for improvements in the NNMS in several areas:

- Improved comparability of nutrient composition data and coding used in different dietary surveys.

- Testing the impact of methodological differences on survey results.

- Use of a common core of sociodemographic descriptors in all NNMS surveys.

- Greater similarities in NNMS data reporting.

- Investigation of methods for assessing population groups currently excluded from the NNMS.

- Improved coverage of some groups at nutritional risk: infants, pregnant women, lactating women, the elderly, preschool children, and adolescents.

- Improved measures of usual dietary intake in the HANES.

- Collection of information for assessing the impact of knowledge and attitudes on patterns of food consumption and nutrient intake.

- Obtaining quantitative information on vitamin and mineral supplement use to better estimate total nutrient intake.

- Improving estimates of alcohol consumption.

- Improving response rates and analyzing non-response.

- Educating data users in the proper use of data from complex surveys.

- Being responsive to the needs of State and local data users.

The EPONM also suggested that, in future reports on the NNMS, the updates of nutritional status of the U.S. population be prepared separately from reports of detailed analyses of special topics. Updates might take the form of comprehensive reviews such as this report or might consist of tabulations of new data with more limited interpretation.

Chapter 1
Introduction

Charge to Expert Panel on Nutrition Monitoring

The ad hoc Expert Panel on Nutrition Monitoring (EPONM) was established to review the dietary and nutritional status of the U.S. population, as well as the factors that determine status, based on the data and information available through the nutrition monitoring activities conducted by the U.S. Departments of Agriculture (USDA) and Health and Human Services (DHHS). This report requested by USDA and DHHS is the second report on the National Nutrition Monitoring System (NNMS). It builds on the framework of the first report submitted in 1986.

The first report was an overview of the dietary and nutritional status of the U.S. population. It was developed by the Joint Nutrition Monitoring Evaluation Committee (JNMEC) to serve as a reference or baseline report for subsequent reports. The Joint Committee, as part of its analysis of data and information, partitioned food components into categories according to whether the component warranted public health monitoring priority status, public health monitoring consideration, or further investigation. Findings for the entire range of food components were presented for a variety of age and sex groupings. The JNMEC reported conclusions about the nutritional status of the U.S. population and made recommendations for improvements of the monitoring system. It also recommended that the focus of the second report be on factors that influence nutritional status.

The charge given to the EPONM for this report directed that two themes dominate:

- An updating of the dietary and nutritional status of the population as presented in the 1986 report.

- An in-depth analysis of the contributions of the NNMS to assessment of the status of the population as determined from two types of data—data on diet and chronic diseases and data on dietary and nutritional problems.

With respect to the first theme, the EPONM was charged to update the first report by comparing data in it with NNMS data on food and nutrient intake and nutritional status produced or released since publication of the first report. The EPONM was also charged to address methodological issues in comparing data from different sources or times, and to identify the types of analyses necessary to make comparisons meaningful. Trend and baseline data presented in the first report were to be updated. The EPONM was to reevaluate the categorization of food components as to the completeness of relevant data and the level of monitoring status that should be accorded each food component. Food components that were not included in the first report were to be considered if appropriate. The rationale for recategorization of previously reported food components and for the inclusion of new food components was to be stated as well as the rationale for any new assessment criteria.

With respect to the second theme, the EPONM was to include in the report in-depth integrated analyses of two topics selected as examples of NNMS health and dietary data: the first, represented by data on the relationship of diet to a specified chronic disease, was to emphasize dietary and nutritional factors in cardiovascular disease; the second, represented by data on a dietary and nutritional problem, was the assessment of iron nutriture. These two topics were selected because of their public health significance and because of the breadth of data regarding them that was available from the NNMS. The JNMEC classified iron and several dietary components related to cardiovascular disease among the food components warranting public health monitoring priority status. The objective of this part of the report was to demonstrate how NNMS data could contribute to understanding these public health concerns as well as to identify the strengths and weaknesses of data and information available primarily from components of the NNMS. The ability to identify the nature and magnitude of nutrition–related problems in the U.S. population was to be addressed, with focus especially on the NNMS capabilities for identifying (1) populations at risk, (2) limits to interpretations of data, (3) gaps in the database, (4) trends, and (5) determining factors. These factors include the following:

- Personal factors, such as age, race, ethnicity, education, height, and weight.

- Demographic and other factors, such as region, urbanization, and season.

- Household factors, such as income, work status, food assistance program participation, household size, tenancy status, usual food cost, perceived sufficiency of household food supply, and household composition.

- Health–related factors, such as health status, smoking, activity level, and use of medications.

- Vitamin and mineral supplement use.

- Eating pattern factors, such as food choices, source of food, food avoidance, and meal patterns.

- Knowledge and attitudes.

Finally, based on experiences involved in reviewing data analyses for this report, the EPONM was to recommend ways to strengthen the NNMS.

Background

Brief History of the NNMS

As noted in the JNMEC report (DHHS/USDA, 1986), the Food and Agriculture Act of 1977 (Public Law 95–113) instructed the Secretary of Agriculture and the Secretary of Health, Education, and Welfare (now Health and Human Services) to submit to Congress a proposal for a comprehensive nutritional status monitoring system to integrate the ongoing nutrition survey activities of both Departments. The Departments' proposal was submitted to Congress in May 1978 and, at the request of the Committee on Science and Technology, was reviewed by the General Accounting Office, which recommended the development of a comprehensive implementation plan. This plan, the *Joint Implementation Plan for a Comprehensive National Nutrition Monitoring System*, was submitted to Congress in September 1981 and described ongoing nutrition monitoring activities as well as specifying goals and implementation activities.

The NNMS includes all existing and proposed Federal survey and research activities with the purpose of monitoring nutritional status in the United States. The five component parts of the system are as follows:

- Nutritional and health status measurements.
- Food consumption measurements.
- Food composition measurements.
- Assessments of dietary knowledge and attitudes.
- Food supply determinations.

The *Joint Implementation Plan for a Comprehensive National Nutrition Monitoring System* set two major objectives:

- Achievement of the best possible coordination of the two largest components of the system, the National Health and Nutrition Examination Survey (of the DHHS) and the Nationwide Food Consumption Survey (of the USDA), and

- Development of a reporting system to translate findings from the two national surveys and other monitoring activities into periodic reports to Congress on the nutritional status of the American population.

The first report of the JNMEC in 1986 and the current report of the EPONM represent activities designed to fulfill the second objective.

Goals and Purposes of the NNMS

The overall goals of the NNMS are as follows (DHHS/USDA, 1986):

- To provide the scientific foundation for the maintenance and improvement of the nutritional status of the U.S. population and the nutritional quality and healthfulness of the national food supply.

- To collect, analyze, and disseminate timely data on the nutritional and dietary status of the U.S. population, the nutritional quality of the food supply, food consumption patterns, and consumer knowledge and attitudes concerning nutrition.

- To identify high–risk groups and geographic areas, as well as nutrition–related problems and trends, in order to facilitate prompt implementation of nutritional intervention activities.

- To establish national baseline data and to develop and improve uniform standards, methods, criteria, policies, and procedures for nutrition monitoring.

- To provide data for evaluating the implications of changes in agricultural policy related to food production, processing, and distribution which may affect the nutritional quality and healthfulness of the U.S. food supply.

Specific goals for the current operational phase of NNMS activities (1987–96) are stated in the *Operational Plan for the National Nutrition Monitoring System* (DHHS/USDA, 1987) as follows:

- Achieve a comprehensive system through coordination among NNMS components by
  - including all appropriate nutrition monitoring activities;
  - improving coverage of major population groups at risk, including low-income groups, nursing home residents, native Americans living on reservations, and the homeless;
  - improving temporal coverage; and
  - improving comparability among surveys by increasing similarities of dietary methodologies, increasing uniformity of sociodemographic descriptors, sharing a common nutrient database, and using compatible survey designs.

- Improve information dissemination and exchange by
  - continuing the reporting system to Congress (with this report);
  - continuing timely reporting and interpretation of data;
  - developing comparable reports and tape documentation;
  - increasing policy relevance of data collected; and
  - improving information exchange between data users and generators.

- Improve the research base for nutrition monitoring including
  - methodological research specific to the conduct of surveys and surveillance activities; and
  - research conducted by the broader nutrition community for its own purposes which also has application to nutrition monitoring.

Components of the NNMS

The components of the NNMS which represent sources of data included in the present report are summarized in table 1–1. This table contains the following information: survey or study name, sponsoring Agency, date, population studied, and data collected. For detailed descriptions of the surveys to be discussed, see appendix I. New cycles of several of the surveys listed have been undertaken; data collection for the Nationwide Food Consumption Survey (NFCS) 1987–88 was recently completed and data collections for the third National Health and Nutrition Examination Survey (NHANES III) and the Continuing Survey of Food Intakes by Individuals (CSFII) 1989 were begun. In addition, the USDA 1988 Bridging Survey has been undertaken to compare the dietary methodologies used in the NFCS 1977–78 and the NFCS 1987–88. Data from these surveys were not available for inclusion in the current report.

These components of the NNMS are augmented and supplemented by other Federal research and data collection activities. For example, the Agricultural Research Service of USDA and the National Institutes of Health, the Centers for Disease Control, and the Food and Drug Administration of DHHS provide much of the research base underlying the efforts of the NNMS in determining human nutritional requirements, methods for assessing nutritional status, and methods to measure food composition. The U.S. Vital Statistics Series of the National Center for Health Statistics and the Alcohol Epidemiologic Data System also supply data useful for national nutrition monitoring. Data from such additional sources of information are included, as appropriate, in this report.

Uses of NNMS Data

The many types of data from the components of the NNMS have been put to a variety of uses (National Research Council, 1984; Yetley and Johnson, 1987). A partial list of these uses includes the following:

- Determining food consumption patterns and nutrient intake of populations and subgroups.

- Demonstrating historical and secular trends in food consumption and nutritional status.

- Assessing the nutritional quality of diets of the population.

- Examining impacts of food programs and food guidance.

- Assessing the prevalence of nutrition-related health conditions.

- Developing educational materials for dietary guidance based on food intake patterns.

Table 1-1. Sources of data from the National Nutrition Monitoring System considered in the EPONM[1] report

Survey or study	Sponsoring agency	Date	Population	Data collected
Nationwide Food Consumption Survey (NFCS)	USDA	1977-78	Private households in the 48 conterminous States and the individuals in those households (all income and low income)	Household characteristics; foods used from home supplies (7 days); household income; name and description, quantity, form, source, and eating occasion for all food and beverages consumed by individuals (1-day recall, 2-days food records, 3 consecutive days); information on diet and health
Continuing Survey of Food Intakes by Individuals (CSFII)	USDA	1985	Women 19-50 years, children 1-5 years, men 19-50 years (all income and low income)	Household and individual characteristics, individual food intake (one to six 24-hour recalls, nonconsecutive days; 1 day only for men)
		1986	Women 19-50 years, children 1-5 years (all income and low income)	Household and individual characteristics, individual food intake (one to six 24-hour recalls, nonconsecutive days)
U.S. Food Supply Series	USDA	Each year since 1909	U.S. civilian population	Per capita disappearance of foods (levels of nutrients in food supply calculated)
National Nutrient Data Bank	USDA	Continuous	NA	Nutrient content of foods; basis of nutrient composition databases for other surveys
First National Health and Nutrition Examination Survey (NHANES I)	NCHS	1971-75	Civilian, noninstitutionalized population of the United States; 1-74 years	Dietary intake (one 24-hour recall), socioeconomic and demographic information, biochemical analyses of blood and urine, physical examination, body measurements
Second National Health and Nutrition Examination Survey (NHANES II)	NCHS	1976-80	Civilian, noninstitutionalized population of the United States; 6 months-74 years	Dietary intake (one 24-hour recall), socioeconomic and demographic information, biochemical analyses of blood and urine, physical examination, body measurements
Hispanic Health and Nutrition Examination Survey (HHANES)	NCHS	1982-84	Civilian, noninstitutionalized Mexican Americans in five Southwestern States, Cuban Americans in Dade County, Florida, and Puerto Ricans in metropolitan New York City; 6 months-74 years	Dietary intake (one 24-hour recall), socioeconomic and demographic information, biochemical analyses of blood and urine, physical examination, body measurements
NHANES I Epidemiological Follow-up Study (NHEFS)	NCHS	1982-84, 1986	Persons examined in NHANES I; 25-74 years old at baseline	Interviews of survivors and proxies for decedents; death certificate, hospitalization history, health status, food frequency

See footnote at end of table for definitions of acronyms.

Table 1-1. Sources of data from the National Nutrition Monitoring System considered in the EPONM[1] report--continued

Survey or study	Sponsoring agency	Date	Population	Data collected
National Health Interview Survey (NHIS)	NCHS	1984	Civilian noninstitutionalized population; 55 years and over	Health and living conditions of elderly
		1985	Civilian, noninstitutionalized population of the United States; 18 years and over	Health promotion and disease prevention habits and knowledge
		1986	Civilian, noninstitutionalized children (2–6 years) and adults (18 years and over) in the United States	Use of vitamin and mineral supplements
Food Label and Package Survey (FLAPS)	FDA	1978, 1980 1982, 1983, 1984, 1986	NA	Prevalence of nutrition labeling and declarations of selected nutrients and ingredients
Total Diet Study (TDS)	FDA	Annually since 1961	NA	Mineral and contaminant content of representative diets for various age–sex groups
Vitamin/Mineral Supplement Intake Survey	FDA	1980	Civilian, noninstitutionalized adults; 16 years and over	Supplement intake, attitudes, and behaviors (telephone interview)
Health and Diet Survey	FDA NHLBI	1982, 1984	Civilian, noninstitutionalized population; 18 years and over	Awareness, attitudes, knowledge, and behaviors regarding food and nutrition; health status and history (telephone interview)
	FDA NHLBI NCI	1986	Civilian, noninstitutionalized population; 18 years and over	Awareness, attitudes, knowledge, and behaviors regarding food and nutrition; health status and history (telephone interview)
Pediatric Nutrition Surveillance System (PedNSS)	CDC	Continuous	Low–income, high–risk children (especially 1–5 years) in 36 States	Anthropometry, birthweight, hematological measures
Pregnancy Nutrition Surveillance System (PNSS)	CDC	Continuous	Low–income, high–risk, pregnant women in 12 States	Weight, health status, behavioral risk factors
Behavioral Risk Factor Surveillance System (BRFSS)	CDC	Continuous	Adults (18 years and over) in 35 States in households with telephones	Height, weight; diet practices; salt, alcohol, and tobacco use; cholesterol screening practices, awareness, and treatment

[1] EPONM = Expert Panel on Nutrition Monitoring; NA = not applicable; USDA = U.S. Department of Agriculture; NCHS = National Center for Health Statistics; FDA = Food and Drug Administration; NHLBI = National Heart, Lung and Blood Institute; NCI = National Cancer Institute; CDC = Centers for Disease Control.

- Examining the relationship of food consumption patterns and nutrient intakes to physical and physiological indicators of health status.

- Assessing the prevalence of specific knowledge of nutrition and certain health practices.

- Determining the economics of food consumption.

- Establishing the distribution of values for indicators of health and nutritional status in the population.

- Identifying food safety considerations.

Major Conclusions and Uses of the JNMEC Report

The major conclusions of the JNMEC report (DHHS/USDA, 1986) were stated as follows:

- In the United States today, the food supply is safe and adequate, indeed, abundant.

- The principal nutrition-related health problems experienced by Americans arise from the overconsumption of certain food components: fat, saturated fatty acids, cholesterol, and sodium.

- Twenty-eight percent of the American population ages 25–74 years, approximately 32 million people, are overweight.

- Available monitoring data suggest that, overall, Americans maintain low levels of physical activity.

- Dietary and biochemical data indicate that intakes of iron and vitamin C are low in certain subgroups of the population.

- Because calcium deficiency has been implicated as a contributor to the prevalence of osteoporosis among postmenopausal white women, the relatively low intake of calcium among women is a cause of concern.

- Prevalences of health conditions directly or indirectly related to poor nutritional status are generally highest among the low-income population.

As the first comprehensive review of data from the NNMS, the 1986 JNMEC report has been used in various ways. The report has been widely disseminated to information offices and professionals in the Government, academic scientists, the general public, and the international community. It has served as a reference for many other reports including *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) and activities such as evaluating progress in achieving the 1990 Nutrition Objectives (DHHS, 1986). Conclusions and recommendations of the report have been used for the following purposes:

- Guiding policy decisions of various Agencies.

- Justifying additional efforts to measure the dietary and nutritional status of low-income populations.

- Establishing priorities for Agency research and education activities including research on food composition and factors affecting dietary status.

Principles and Definitions Used

The update portion of this report is a followup to the 1986 JNMEC report and is intended to identify new data available from the NNMS and to examine changes and trends in dietary intake, nutritional status, and nutrition-related health conditions. The JNMEC report emphasized a coordinated review of dietary data from the NFCS 1977–78 and nutritional and health status data from the second National Health and Nutrition Examination Survey (NHANES II). <u>New national survey data on dietary intake and nutritional status of the entire U.S. population have not become available since the JNMEC report</u>; however, data for certain subgroups of the population have become available. Most of the available data are for the three Hispanic groups surveyed in the Hispanic Health and Nutrition Examination Survey (HHANES) and the women and children surveyed in the CSFII 1985–86. The current report will describe the information available since the 1986 report with respect to the following three types of data:

- Cross-sectional data that may stand alone or serve as a new baseline against which data collected in the future may be compared.

- Trend data (measurements repeated over time using similar techniques).

- Longitudinal data on cohorts of individuals identified at a specific point in time (re-examination of same individuals).

Data analyses included in the report are intended to be descriptive of dietary and/or nutritional status, trends, and associations rather than to establish causal relationships. The report is not intended to serve the purpose of program evaluation. Summary data from relevant surveys are included in appendix II, by topic; detailed analyses are provided in the body of the report when a public health issue is identified for some of the food components included in the update (criteria are described in chapter 3) as well as in the chapters on cardiovascular disease and diet and assessment of iron nutriture. Many of the data analyses presented were prepared by the Agencies specifically for inclusion in this report; others were obtained from Agency publications or the peer-reviewed literature.

The chapters on dietary and nutritional aspects of cardiovascular disease and on iron nutriture are intended to illustrate the utility of NNMS data in examining these public health problems, not to provide a comprehensive review of the literature concerning these topics. The EPONM relied upon sources such as *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) and *Diet and Health: Implications for Reducing Chronic Disease Risk* (National Research Council, 1989) for summaries of the scientific evidence concerning nutritional status, health, and diseases.

The EPONM determined that it would be useful to highlight the definition of some terms used in this report as well as in the JNMEC report (see also Glossary, appendix III). Discussions of these terms, used to describe nutrition monitoring activities, status assessment, and related factors, are provided in the following sections.

Nutrition assessment refers to the measurement of indicators of dietary status and nutrition-related health status to identify the possible occurrence, nature, and extent of impaired nutritional status (ranging from deficiency to toxicity). Nutrition monitoring refers to the assessment of dietary or nutritional status at intermittent times with the aim of detecting changes in the dietary or nutritional status of a population. Nutrition surveillance refers to a continuous assessment of nutritional status for the purpose of detecting changes in trend or distribution in order to initiate corrective measures.

Dietary status is defined as the condition of a population's or an individual's intake of foods and food components, especially nutrients. Food components discussed in this report include nutrients (macronutrients, vitamins, and minerals) and non-nutrients that may affect health (such as dietary fiber), obtained from food or other sources (such as vitamin/mineral supplements). Nutritional status is defined as the condition of a population's or an individual's health as influenced by the intake and utilization of nutrients and non-nutrients. Measures of nutritional status reflect, directly or inferentially, the processes of food ingestion and digestion; absorption, transport, and metabolism of food components; and excretion of food components and their metabolic products. As noted in the JNMEC report (DHHS/USDA, 1986), indicators of nutritional status include (1) levels of specific food components in diets; (2) clinical, anthropometric, hematological, and biochemical measurements related to specific food components; and (3) health conditions or diseases that may be associated with inadequate or excessive intakes of several food components. Health status, as used in this report, refers to a population's or an individual's status with respect to physical state or disease condition.

Various terms are used to describe nutritional status. Overnutrition refers to the condition resulting from the excessive intake of foods in general or particular food components; undernutrition refers to the converse situation resulting from the inadequate intake of foods in general or particular food components. Nutrient deficiency is defined as a condition associated with adverse health consequences arising from inadequate intake or utilization of a nutrient. Marginal nutritional status is defined as a condition in which nutrient stores may be low, but impairment of performance, health, or survival may not be evident. Persons with marginal nutritional status are considered at risk of nutritional deficiency, especially when subjected to stress. Nutritional imbalance is defined as a condition associated with adverse health consequences arising from insufficient or excessive intake of one nutrient or food component relative to another. Nutrient excess and/or toxicity is defined as a condition associated with adverse health consequences arising from excessive intake or utilization of a nutrient. Terms used to describe the occurrence of conditions or diseases include prevalence and incidence. Prevalence is the number of instances of a given disease or other condition in a given population at a designated time. Incidence refers generally to the number of new events (for example, new cases of disease) in a defined population, within a specified time period.

Because of the JNMEC observation that health conditions related to poor nutritional status were most prevalent in the low-income population, poverty status is an important variable to examine in assessing dietary and nutritional status. The statistical measurement of poverty was developed by the Social Security Administration in 1964. The poverty index consists of a set of cash income cutoffs that vary by the size and number of children in a family (President's Task Force on Food Assistance, 1984). Since 1964, various cutoffs for the definition of poverty index have been used for a variety of analytical and policy applications. For example, 130 percent of the poverty index has been used to establish eligibility for several Federal nutrition and food assistance programs. (See appendices I and II for details on the calculations of poverty indices in specific NNMS surveys.)

The JNMEC (DHHS/USDA, 1986) noted that poverty may result in the inability to obtain a sufficient quantity or variety of food to prevent hunger or to maintain good nutritional status. Hunger (unassuaged) is considered the perceived need to eat. It may be the result of poverty and may or may not be associated with poor nutritional status, inadequate dietary intake, or measurable nutrient deficiencies. Hunger represents a social problem regardless of its nutritional implications. The JNMEC (DHHS/USDA, 1986) also noted the paucity of data from the NNMS available at that time to assess the occurrence and impact of hunger. Although information on perceived household food sufficiency was collected in the NFCS 1977–78 and CSFII 1985–86, the more recent data were not available for consideration in the current report.

Dietary guidelines considered in this report are the qualitative recommendations from *Nutrition and Your Health: Dietary Guidelines for Americans* (USDA/DHHS, 1985) which are also included in *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988). Discussion of the specific dietary guidelines and recommendations promulgated by other groups is included for illustrative purposes and should not be construed as endorsement by the EPONM.

General Conceptual Model

A general conceptual model representing the relationships among food choice, food and nutrient intake, and nutritional and health status developed by the EPONM in formulating discussions of the nutritional status of the U.S. population is presented in figure 1–1. The EPONM developed the model based on their collective knowledge of the principles of nutrition, economics, and behavior and on a review of several similar models (Hautvast and Klaver, 1982; Mason et al., 1984; Mayer and Dwyer, 1979; McLaren, 1981; National Research Council, 1984; Sanjur, 1982; World Health Organization, 1976). The model identifies the major stages at which the effects of food and nutrient intake on nutrition-related health status may be assessed as well as the factors that influence each stage. The model represents a starting point rather than an exhaustive description of all possible factors and interrelationships; it is designed to allow for expansion or elaboration of detail (see chapters 3, 4, 5, and 6 for expanded models appropriate for the discussions contained in these chapters). The components of the model shown in solid-line boxes represent the primary steps in the sequence from the food supply to health outcome(s). Components shown in broken-line boxes represent those factors that may influence each primary stage. The model does not distinguish between direct and indirect influencing factors.

The relationships illustrated in the model have been interpreted from independent experimental or observational studies. The NNMS measures the prevalence and distribution of various outcomes and influencing factors in the U.S. population, thus permitting the evaluation of the nature and extent of public health issues. Data from the NNMS are available for many, but not all, components of the model; when data are available, however, they do not necessarily address all relevant questions adequately. The following paragraphs describe the components of the general conceptual model and sources of NNMS data related to these components.

Cross-sectional and trend data on the quantities of foods that enter the domestic food supply are provided by the U.S. Food Supply Series. The division of foods into two categories, "away-from-home" and "household" food, is often desirable for characterizing acquisition and consumption patterns, but the separation between the two categories is not always clear in the current distribution system. Away-from-home foods may be obtained from restaurants, fast-food establishments, cafeterias, vending machines, and other foodservices as well as from food programs such as school lunch and breakfast and congregate meal programs for the elderly. Foods consumed away from home may have been prepared at home. Household food includes food products purchased in the market, food donations (food as gift or in-kind payment), and food grown or produced at home as well as prepared foods obtained from foodservice establishments. Factors that influence the choices to acquire and consume foods (measured in many NNMS surveys) include household income; the price of food; personal factors such as age, sex, ethnic group, education, and physiological status (such as pregnancy); environmental factors such as advertising; and characteristics of food such as label information or convenience. These factors determine food preferences, cognitions, and attitudes. In turn, food preferences, cognitions, and attitudes may be affected by exposure to foods in the marketplace. Consumer demand for various products also influences the availability of foods in the food supply.

Household food consumption (or money value of food consumed or used) is measured in the household

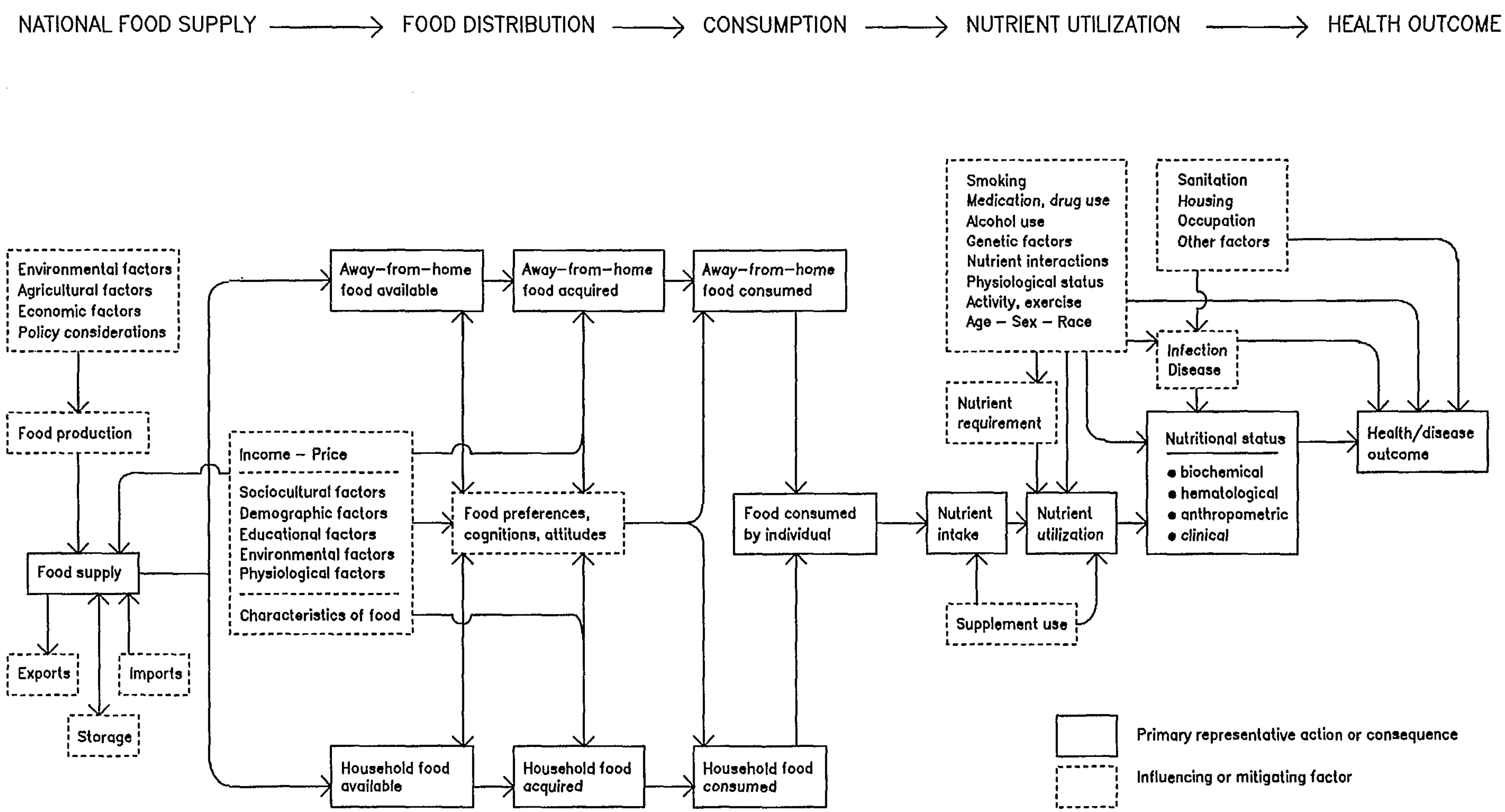


Figure 1–1. General conceptual model for food choice, food and nutrient intake, and nutritional and health status (see text for explanation)

component of the NFCS. Individual food consumption is measured in the individual component of the NFCS, the CSFII, and the Health and Nutrition Examination Surveys (HANES). Combining information in the nutrient composition databases developed by the USDA with food supply or individual food consumption data permits the estimation of per capita nutrient content of the food supply and individual nutrient intake, respectively. The mineral content of typical diets in the United States is determined in the Total Diet Study. The use of supplements also contributes to nutrient intake. Supplement use has been assessed, but not quantified, in the NFCS 1977-78, CSFII 1985-86, and HANES; use was measured in the 1980 Vitamin/Mineral Supplement Intake Survey and in the 1986 National Health Interview Survey (NHIS). Monitoring of the information on nutrition labels is conducted in the Food Label and Package Survey (FLAPS).

Nutritional status indicators are measured in the HANES and the Pediatric and Pregnancy Nutrition Surveillance Systems (PedNSS and PNSS, respectively). Although nutrient utilization is not measured directly, factors that may influence nutrient utilization and nutritional status are assessed in a variety of NNMS surveys. The prevalence of various diseases and nutrition-related health conditions is estimated in the HANES, PedNSS, and PNSS. The NHANES I Epidemiological Followup Study (NHEFS) contains cohort data that permit exploration of relationships of dietary and nutritional status and subsequent morbidity and mortality. The U.S. Vital Statistics Series also provides mortality data for some conditions related to diet and nutrition. Finally, knowledge, attitudes, and practices that influence nutritional and health status are assessed in selected years by the NHIS, the Health and Diet Survey, and the Behavioral Risk Factors Surveillance System (BRFSS).

Organization of the Report

With respect to the requested update of the information contained in the JNMEC report, chapter 2 (on the appropriate uses of survey data for assessing dietary and nutrition-related health status) is responsive to the charge to address methodological issues in comparing data from different sources or times and to identify the types of analyses necessary to make comparisons meaningful. The discussions of data that comprise the update portion of this report are divided into two chapters, with the first (chapter 3) providing new data on dietary intake, food availability, major food sources of various food components, and nutritional status with respect to various nutrients, and the second (chapter 4) providing new estimates of the prevalence of nutrition-related health conditions and behaviors. Reference is made to baseline data when appropriate.

With respect to the second charge to the EPONM, the two selected topics are discussed separately. The chapter on nutritional and dietary factors in cardiovascular disease (chapter 5) concentrates on the utility of NNMS data in assessing risk factors for cardiovascular disease and dietary and other factors related to these risk factors. The chapter on assessment of iron nutriture (chapter 6) concentrates on the utility of NNMS data in assessing the prevalence of iron deficiency and identifying groups at risk and the factors contributing to iron nutriture.

Finally, chapter 7 contains recommendations from the EPONM for improvements in the NNMS, based on their experiences in evaluating the data included in this report.

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Chapter 2

Appropriate Uses of Survey Data in the Assessment of Dietary and Nutrition-Related Health Status

Assessment of Dietary Status

Assessment of dietary status includes consideration of the types and amounts of foods consumed as well as intake of the nutrients and other components contained in foods. Information on diets may be collected at several levels--national food supply, household food use, individual food intake--and by a variety of methods. When data on food consumption are combined with information on the composition of food, estimates may be made of the intake of particular nutrients and other food components.

Available Methodologies

Nutrient composition

The nutrient composition databases used for dietary assessment are based on pooling of data from many sources. Methods for the characterization of the nutrient composition of foods require a variety of complex steps: selection of foods to be analyzed; appropriate sampling of foods to be analyzed; homogenization and subsampling, extraction, separation, detection, and identification of nutrients; calculation of results and report generation; use of standards, standard reference materials, and control samples; and validation of results (Beecher and Vanderslice, 1984). In view of the variety of the chemical forms of nutrients in foods and the complexity of foods, it is not surprising that a wide variety of analytical methods of variable quality exists for the determination of nutrients. Nutrient content data are lacking for some nutrients because accurate, precise, and affordable analytical methodologies are not available. Beecher and Vanderslice (1984) have summarized the state of development of methods for the analysis of nutrients in foods.

The quality and quantity of available nutrient content data may also vary for other reasons. Providing data on all nutrients in all types of food consumed in the United States is an overwhelming task; data from NNMS surveys of food consumption aid in the determination of foods to be included in the database. Information is not as complete for less studied nutrients as for those nutrients for which a requirement or disease relationship has long been recognized. Information also is less comprehensive for the wide variety and increasing numbers of commercially prepared foods than for traditional food commodities (Beecher and Vanderslice, 1984). Efforts to improve existing nutrient databases, in terms of the number of nutrients and foods and the amount of analytical data included, are in progress. Hepburn (1987) has summarized the percentage of analytical values (determined by chemical analysis) and imputed values for nutrients included in the Primary Nutrient Data Set used for the CSFII 1985-86. For all foods in the database, the proportion of analytical values, as opposed to imputed values, equaled or exceeded 90 percent for the more familiar nutrients that have been assessed for many years, whereas the proportion of analytical data for components newly added to the survey, such as dietary fiber and α-tocopherol, was less than 30 percent. However, the proportion of analytical values from foods that represent the major sources of each food component was relatively higher (greater than 70 percent for most nutrients).

The variability of nutrient content cannot practically be reflected in the nutrient databases. For example, the content of some nutrients in foods may vary with the cultivar of plant, breed of animal, geographic region, season, and growing conditions. Brand differences, changes in formulations, introduction of new products, and alterations due to processing, packaging, storage, or cooking also introduce variability into nutrient content data.

In practice, the variability of nutrient composition data does not often contribute greatly to variability in the estimate of usual nutrient intake; however, the adequacy of the database for any particular nutrient or other food component of concern should be assessed. As noted by the National Research Council (1981), "the ideal nutrient database would:

1. be current, reliable, and valid;

2. be responsive to changes in the food supply;

3. contain information on all the nutrients of interest;

4. have complete data (unavailable data should be extrapolated until analytical values are obtained);

5. be expandable as new data become available;

6. reflect differences associated with brands; and

7. be in a physical form that facilitates coding and analysis."

The Human Nutrition Information Service (HNIS) of the USDA continuously maintains the National Nutrient Data Bank, the ultimate source from which data are drawn for a variety of published and machine-readable databases, including the nutrient databases for assessing diets reported in national food consumption surveys. The same Nutrient Database for Individual Food Intake Surveys was used in both the CSFII 1985-86 and the HHANES. A similar database was developed and used in the NFCS 1977-78. In NHANES II, the nutrient composition database was primarily compiled by DHHS based on data from USDA's *Handbook 8* (sections 1-6) and *Handbook No. 456* and data from manufacturers (if available) for commercial food items reported 20 or more times.

Food availability and intake

The estimation of food available for consumption and of dietary intake is an essential component of the evaluation of dietary and nutritional status. Data on both food availability and individual food consumption from national surveys are included in the current report.

Food availability. Food availability data may be assessed at the national, retail, warehouse, or household level. The only data on food availability considered in this report are the national disappearance data (U.S. Food Supply Series) collected by the Economic Research Service (ERS) of the USDA.

The U.S. Food Supply Series estimates the amounts of approximately 300-400 foods that "disappear" into the U.S. food distribution system. Disappearance is estimated by subtracting utilization (exports, military use, year-end inventories, and nonfood use) from supplies (annual production, imports, and beginning-of-the-year inventories) (see appendix I for a more detailed discussion of these procedures). Estimates of per capita availability of food are derived by dividing the total food disappearance during the year by the civilian population of the 50 States and the District of Columbia. The HNIS of USDA calculates the nutrient content of the U.S. food supply by multiplying the weight of food consumed per capita per year by the nutritive value of the edible portion per pound, summing the results for all foods, and expressing the total on a per day basis.

Disappearance is measured at different points in the distribution system for different foods. No deductions are made in the estimates for loss or waste that occurs after the food is measured, such as in further processing, marketing, or home use. Some sources of nutrients, such as alcoholic beverages and vitamin/mineral supplements in tablet, capsule, or liquid form, are excluded from the data, but vitamins and minerals added for the fortification or enrichment of food products are included. Although per capita availability is likely to overestimate actual ingestion of food, these overestimates are probably consistent over time because of efforts to keep methodology constant (Welsh and Marston, 1982).

Because different categories of consumers (for example, children and adults) consume different amounts and types of foods, and because the per capita availability is calculated per person without adjustment for age and sex, comparisons of per capita data across time, or comparisons of U.S. per capita data with per capita data from other countries will also reflect any differences in the demographic structure of the populations in addition to that of actual food availability. All these considerations must be taken into account in interpreting the U.S. Food Supply Series data, and care must be taken in linking any trends in disappearance data to trends in disease or mortality. Nonetheless, the data provide a rapid and inexpensive indicator of the overall sufficiency of the foods available to the U.S. civilian population. In addition, these data are especially valuable for use in studies of the effects of technological, economic, and social changes on the U.S. diet and future food production as well as for examining trends in food use, nutrient levels, and food sources of nutrients.

Food intake. The other type of dietary data considered in this report is individual intake data. Such data may be divided into two categories based upon the methods by which they are collected: quantitative daily consumption and semi-quantitative food frequency methods (LSRO, 1986). Quantitative daily consumption methods attempt to measure the nature and quantity of individual foods consumed in a defined period of time, in contrast to food frequency methods which attempt to measure patterns of food use and implied nutrient intake across longer and often less precisely defined periods of time.

The instruments used most frequently to collect dietary data by quantitative daily consumption methods are recalls or records of actual food intake over a specified period of time (usually one or more days). All foods eaten in the specified time period are reported or recorded together with an estimate of the amount ingested (aided by the use of household measures, standard serving sizes, food models, or weighing). The reliability of records and recalls has been found to be comparable for group estimates (Fanelli and Stevenhagen, 1986; Krantzler et al., 1982; Pao, Mickle, and Burk, 1985). The use of both types of instruments is represented in the national surveys considered in this report: the HANES (NHANES I and II and HHANES) each employed a single 24-hour recall, the NFCS 1977-78 employed a 24-hour recall followed by two consecutive days of food records, and the CSFII 1985-86 employed an initial 24-hour recall conducted in person followed on non-consecutive days by up to five additional 24-hour recalls administered by telephone (or in person, when necessary) over the period of one year.

Quantitative daily consumption methods can, depending on subject memory and interviewer skill, provide reasonably accurate information on actual intakes of foods or food components; moreover, if an adequate number of replicates are included, such methods can also provide an estimate of usual intake. The major difficulty in the interpretation of data derived by these methods is the large variation in day-to-day intake of food and nutrients within individuals, referred to as intraindividual variation. Intraindividual variation is often greater than inter-individual variation. Ratios of the two may differ among foods and food components; among age, sex, and socioeconomic groups; and within and between dietary intake instruments (LSRO, 1986; National Research Council, 1986). When the intraindividual variation is large and the number of recalls or records is small, the ability to detect statistically significant differences in the mean dietary intakes of groups of individuals is reduced.

The number of days for which dietary recalls or records are obtained also affects the appropriate use of the data, with greater restrictions placed on the interpretation of data obtained for a single day than on data obtained over multiple days (LSRO, 1986; National Research Council, 1986). Single-day intake data usually result in a distribution that is flatter and wider than the true distribution of usual intakes of individuals in the population. Thus, the prevalence of high or low intakes is overestimated. The large intraindividual variation associated with single-day data may also mask associations between dietary intake and health outcomes because of misclassification of individuals by level of intake on the basis of single-day dietary intake. Although multiple-day data may be subject to bias, use of data obtained from multiple days may provide a means of reducing the effects of intraindividual variation on estimates of usual intakes, thereby increasing the accuracy of estimates of mean intake. In the CSFII 1985-86, a statistically significant decline in reported intake has been detected after the first day (wave) of data collection (Ritenbaugh et al., 1988). Additional analyses of these data indicated that nutrient densities did not vary much by wave (USDA, 1987, 1988), suggesting that the reported quantity of foods consumed decreased but that the overall nutrient composition of the foods consumed remained similar among waves of data collection.

The other category of methods for assessing individual dietary intake, semi-quantitative food frequency methods, includes all questionnaires (general and focused food frequencies as well as diet histories) in which subjects recall their usual dietary intake during a time period in the past. These methods are used most often to estimate usual intake of foods and of food components by rank or category according to frequency of consumption rather than to provide a quantitative measure of actual intake. Data collected by food frequency methods are regarded as more representative of the usual intakes of subjects than quantitative intake data collected for a single day or for only a few days and are less affected by intraindividual variation (LSRO, 1986). However, the accuracy of estimates of actual intake obtained with these methods is not as great as the accuracy of those obtained with quantitative daily methods. A combination of food frequency and quantitative daily consumption data may provide a more comprehensive assessment of food consumption and nutrient intake than either method alone (Krantzler et al., 1982). Food frequency methods have been used less often in the national surveys considered in this report, but a food frequency questionnaire was included in the HANES.

<u>Estimates of population and individual intakes of foods and food components</u>

Single-day dietary intake data collected by recall or record may provide a reasonable estimate of the mean intake for a population if the sample size is sufficiently large to minimize random errors (LSRO, 1986). However, single-day data are not adequate for evaluating the usual dietary intake of individuals.

The number of days of data collection required depends on the purpose of making an estimate, the precision desired, the food component(s) of interest, and the amount of intra- and interindividual variation. Basiotis et al. (1987) have examined this question in a group of 29 adults who kept daily food records for one year. Each individual's average intake of nutrients and associated standard deviation over the year were considered to represent the "usual" intake and variation; the number of days of records needed to estimate individual and group intake within 10 percent of usual intake was calculated. Results indicated that the number of days of records required for an individual estimate varied among individuals for the same nutrient and within individuals for different nutrients. On average, food energy required the fewest days for individuals (31 days) and vitamin A the most (433 days). In contrast, the number of days required to estimate mean intake for the group was considerably less (3 days for food energy and 41 days for vitamin A). Estimating the mean intake of larger groups, such as those reported in NNMS surveys, would require fewer days.

Freudenheim, Johnson, and Wardrop (1987) have also examined the misclassification of nutrient intake of individuals based on food records of varying length. In 106 adult women, 1-, 2-, 3-, and 7-day records were compared with usual intake (based on 37-72 records per subject) of food energy, calcium, vitamin A, and vitamin C. For the 1-day record, 43-67 percent of subjects were correctly classified to the extreme quintiles of intake; for the 7-day record, 52-76 percent were correctly classified. These results indicate the need for caution in interpreting dietary intake data collected for a single day or a few days as representative of an individual's usual intake.

Criteria for Assessment of Dietary Intake of Nutrients (and Other Food Components)

Recommended Dietary Allowances

As defined by the Committee on Dietary Allowances of the Food and Nutrition Board, the Recommended Dietary Allowances (RDA) are the levels of essential nutrients considered, on the basis of available scientific knowledge, to meet the known nutritional needs of practically all healthy persons (National Research Council, 1980). (The allowance for energy is set to meet the average needs of most of the population; for vitamins and minerals that are less well studied, estimated ranges of Safe and Adequate Daily Dietary Intakes have been recommended.) The RDA represent the average daily amounts of nutrients population groups should consume over time (expressed as amount per person per day) and are not intended to represent individual requirements. However, the RDA frequently have been used as standards to evaluate the adequacy of nutrient intake. Because the RDA include a margin of safety, intakes below the RDA are often not inadequate, but the risk of inadequate intake increases as the mean intake of a population falls to lower percentages of the RDA. To overcome these difficulties, proportions (three-fourths, two-thirds, one-half) of the RDA have been used in analyses of food consumption data. However, no clear rationale for the selection of any particular cutoff has been advanced. In addition, because of the differences in data available for determining nutrient requirements, the RDA for different nutrients have different margins of safety, and interpretation of the meaning of levels of intake at any proportion of the RDA cannot be considered to be the same for all nutrients (see discussion of individual nutrients in chapter 3).

Considering the problems and misinterpretations occasioned by the use of the RDA as a standard for dietary adequacy, the EPONM has chosen not to express dietary intake data in this report as a percent of the RDA or to apply the RDA or any proportion of the RDA as a sole criterion for assessing whether a nutrient constitutes a public health problem because of inadequacy. However, mean intakes of population groups falling well below the RDA can be taken as rough indicators that further examination of the status of that population group is needed. This approach is elaborated in chapter 3, in the consideration of the public health concern with individual food components.

Nutrient density

Nutrient density, the unit measurement of each nutrient per 1,000 kilocalories, is another way to measure the nutritive quality of the diet. At first consideration, nutrient density seems to offer a simple and straightforward means of assessing dietary quality, but the definition of appropriate nutrient-to-energy ratios has proven difficult (Beaton, 1988). Although specific standards have not been suggested to evaluate the adequacy of nutrient density in the United States, expressing nutrient intake in this fashion can help evaluate dietary quality in some situations. For example, nutrient densities have been used to assess the nutrient contributions of convenience foods consumed in households (Havlicek, Axelson, and Capps, 1983). Data for intake on a kilocalorie basis are presented for several of the nutrients discussed in chapter 3.

Probability approach

The use of any fixed cutoff point for the assessment of the adequacy of nutrient intake fails to take into account the variability of requirements among individuals. This weakness led the Subcommittee on Criteria for Dietary Evaluation (National Research Council, 1986) to describe and test a "probability approach" to the assessment of nutrient adequacy that is based on the probability that a specific intake is inadequate to meet an individual's requirement. Application of this approach requires the following: (1) estimates of average requirements and variability (standard deviation) for each nutrient, (2) information on the shape of the distribution curve of requirements, and (3) information on the distribution of usual intakes of the nutrient. The latter may be estimated from multiple days of dietary intake data, with appropriate statistical adjustments to account for the contribution of intraindividual variation. The probability approach can yield estimates of the prevalence of inadequacy in a population group but cannot assess the occurrence of inadequate intake by any given individual.

Limitations on the application of this approach include the lack of information on the mean and shape of the requirement distributions for many nutrients, although different values can be assumed. The accuracy of estimates of inadequacy derived by the probability approach may also be constrained by the same systematic errors that affect other evaluations of nutrient adequacy, such as the underreporting or overreporting of food intake. In addition, a statistical assumption of low correlation between requirement and intake or assimilation is necessary for the application of the probability approach. For example, the assumption is violated for food energy (the level of dietary intake and requirement are highly correlated) and for iron (absorption increases as requirement increases).

In theory, the probability approach may also be applied to the estimation of the prevalence of excessive intakes of dietary components. This application would require information on the distribution of intakes judged to be detrimental to individuals in the population. The lack of such information severely constrains the current utility of the probability approach for this application.

The EPONM considers the probability approach to be an attractive one that overcomes many of the difficulties involved in assessing population dietary intake data by use of fixed cutoff points. However, because the basic information on requirement distributions is lacking for most nutrients at this time, the EPONM has chosen not to include estimates of nutrient inadequacy derived by the probability approach in this report. Another consideration in the application of this approach is that requirement must be defined. For any given nutrient, a family of requirement distributions may be generated, ranging from intakes required to prevent the clinical signs of nutrient deficiency to intakes required to provide ample body reserves of the nutrient. When the necessary supporting information is generated, the probability approach can be used more extensively and its utility established. Johnson et al. (1988) have suggested several guidelines for the use of dietary assessment methods and made recommendations for improving approaches to national nutrition assessment.

Other approaches to assessment

In many cases, useful information may be obtained by classification methods that do not require the use of an arbitrary standard to evaluate dietary intake data. For example, subjects can be classified by some health variable and intakes of the groups identified as different can be compared. Alternatively, a population can be stratified by percentiles of intake and health, demographic, or other variables can be examined within these groups for differences and/or similarities. However, the large intraindividual variations in dietary intake result in a large proportion of individuals being misclassified when individuals are classified into different groups by a dietary variable (LSRO, 1986). There is a continuing need to explore other approaches to assessment.

Contributions of Supplement Use and Other Sources of Food Components to Dietary Intake

The evaluation of the total intake of nutrients requires the consideration of sources of intake other than foods. Current data indicate that approximately 40 percent of American adults consume one or more vitamin/mineral supplements, and that substantial amounts may be consumed from these sources (Stewart et al., 1985). Although information about supplement use is collected in several of the NNMS surveys, quantitative estimates of the contribution of supplement use to the intake of nutrients cannot be made based on any of the surveys of food consumption included in this report. Thus, all estimates of dietary intake are derived from foods only, and the total intake of some nutrients may be underestimated for many individuals.

In addition to dietary supplements, other nonfood sources of nutrients also (ideally) should be included in estimating <u>total</u> nutrient intake. These include drinking water (which may supply substantial amounts of minerals and electrolytes) and over-the-counter and prescription medications (such as calcium-containing antacids).

Consistency in Data Sources to Assess Changes Over Time

Comparability of information across databases should be taken into account in the interpretation of survey results. With respect to data on dietary intake of foods and food components, two areas of comparability are of importance: the nutrient composition databases and the methods to assess food intake.

Systematic bias in nutrient composition data may result from inadequate analytical methods or imputation of incorrect values in the database. If an existing bias in a nutrient database is corrected, a false impression of change in nutrient intake over time may be created (Yetley, Beloian, and Lewis, 1986). This difficulty cannot be overcome by using the same nutrient composition database for surveys conducted at different times because adjustments must be made for changes in foods and the composition of foods in the marketplace that occur over time. Another consideration in examining changes over time is consistency in the food descriptors and degree of detail (brands) included in the databases (Yetley, Beloian, and Lewis, 1986).

Other sources of variability over time or across surveys are differences in the methods for collecting food intake information from individual subjects. Use of different degrees of probing and food models or other measurement aids for estimating portion size can elicit different responses. Similarly, differences in the completeness of reporting may occur when a subject is interviewed in the presence of other family members rather than in private, or if a proxy report is given for a subject. Different surveys also include varying coverage of seasons as well as weekdays and weekend days when food patterns are expected to differ. Differences in estimated intake leading to systematic bias may also arise if different assumptions about foods items not described in detail by respondents (such as recipes for mixed dishes or the addition of salt or fats in cooking or at the table) are used in data coding and analysis.

If differences over time or among surveys are observed, efforts should be made to assess whether the differences are the result of actual changes in foods consumed or in the composition of foods rather than the results of such methodological changes as those described above. For example, Perloff (1988a,b) has performed such an assessment of the changes in total fat and iron in the diets of women from 1977 to 1985. The objective of this study was to determine the average change in the intake of an individual reporting food intake data in 1985 because of changes in food composition data between 1977 and 1985. Food items that accounted for 80 percent of the total intake of the respective nutrients (fat or iron) in 1985 were identified and matched to comparable items in the 1977 database. For each item within the 80 percent cutoff, the average change per individual per day was calculated. Results indicated a net change for total fat of −0.6 grams per individual per day, with an estimated change of −0.5 grams due to product changes (mainly changes in the fat content of meats) and −0.1 grams due to data changes. For iron, the estimated net change was +0.2 grams per individual per day, with an estimated change of +0.6 grams due to product changes (increased fortification of grain products) and an estimated change of −0.4 grams due to data changes (corrections of erroneously high values for some meats) (Moss et al., 1983; Wolf, 1987). This analysis addresses one source of variation in estimated dietary intake over time.

Assessment of Nutrition-Related Health Status

The assessment of nutritional status includes, in addition to the measurement of dietary intakes, measurement of indicators of nutrition-related health status such as hematological and biochemical tests, body measurements, clinical signs of nutritional deficiency, tests for diseases or conditions associated with diet, and assessments of nutrition knowledge and attitudes. All of these measures are included in the surveys of the NNMS.

Available Methodologies

In various surveys included in this report, data have been collected for the following indicators of nutrition-related health status:

- Hematological tests (hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, red blood cell counts, white blood cell counts).

- Biochemical tests (serum iron, total iron-binding capacity, erythrocyte protoporphyrin, serum ferritin; serum and red blood cell folate; serum vitamin A or retinol; serum vitamin C; serum α-tocopherol; serum total and HDL cholesterol).

- Body measurements (height, weight, skinfold thicknesses, circumferences, breadths).

- Clinical signs of nutritional deficiency (physical evidence of wasting, edema, classical signs of vitamin deficiencies).

- Tests for conditions associated with diet (high blood pressure, overweight).

- Assessments of nutrition knowledge and attitudes (for example, understanding of the relationship of diet and nutrition to disease).

Important concerns for all the assessment techniques outlined above are that methods be standardized, have a predictable relation to nutritional status, and be applicable in large-scale surveys. Compounds that interfere with biochemical measurements (that is, compounds that react like the compound of interest) should be recognized. Factors other than nutrition or diet that may lead to changes in the indicators should be identified and measured. Ignoring these factors or failing to maintain quality control in the measurements may compromise the reliability of the assessments of nutritional status.

Criteria for Assessment of Biochemical, Hematological, and Clinical Measurements

<u>Establishment of cutoff values</u>

A major concern in estimating the prevalence of impaired nutritional or health status from biochemical, hematological, and clinical measurements is in defining values for the various indicators that are related to the occurrence of impaired nutritional status (either deficiency or excess). Such cutoffs for indicators of nutritional status may be derived in several ways; some of these have been reviewed by Habicht (1980) and Habicht, Meyers, and Brownie (1982). Cutoffs may be related to some consequence of malnutrition or functional outcome and the indicator may precede, be concurrent with, or follow the functional outcome. For example, cutoffs of desirable weight-for-height have been selected based on subsequent mortality experience. Cutoffs may be based on nutritional determinants examined in studies in which changes in the indicator are detected following increases or decreases in intake of the nutrient. An example would be the detection of a decrease in hemoglobin concentration in response to iron depletion. Finally, cutoffs may be derived by statistical means from the normal distribution of values for the indicator in an ostensibly healthy population. Frequently such cutoffs are set to the 95 percent confidence interval, with 2.5 percent of the population at each tail of the distribution described as having potentially abnormal high or low values. If only values that are too low are of interest, a one-sided confidence interval that has all 5 percent in one tail can be constructed. This procedure statistically defines some healthy persons as having abnormal status.

<u>Use of cutoff values</u>

As discussed by Habicht, Meyers, and Brownie (1982), no diagnostic test (consisting of an indicator and a cutoff for that indicator) can reflect the true underlying distribution of normal and abnormal status; some misclassification inevitably occurs. With any cutoff applied to survey data, some individuals with abnormal status are incorrectly classified as normal (false negatives) and some persons with normal status are misclassified as abnormal (false positives) (see figure 2-1). The proportion of those with truly abnormal

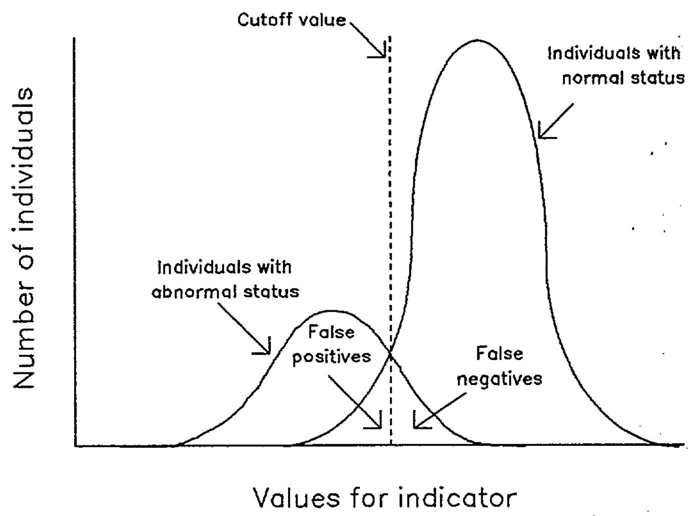

Figure 2-1. Effect of applying a cutoff value for an indicator of nutritional status to the distributions of values for individuals with normal status and individuals with abnormal status

status who are classified as abnormal is a measure of sensitivity, and the proportion of those with truly normal status who are classified as normal is a measure of specificity. Sensitivity and specificity tend to be more stable across populations than within populations, but they are inversely related for any indicator. The predictive value of an abnormal test result (the proportion of abnormal results that are true abnormals when the test is applied to a population containing both healthy and diseased individuals) varies directly with the prevalence of the condition. As illustrated in table 2–1, prevalence becomes more important than sensitivity and specificity in determining predictive value when the prevalence of a condition such as a nutrient deficiency is low (Galen and Gambino, 1975).

Table 2–1. Effect of prevalence on predictive value when sensitivity and specificity equal 95 percent (modified from Galen and Gambino, 1975)

Prevalence (percent)	Predictive value of an abnormal test (percent)
0.1	1.9
1.0	16.1
2.0	27.9
5.0	50.0
50.0	95.0

In interpreting the prevalence data for impaired nutritional or health status generated by the application of a specific cutoff, an understanding of the source and meaning of the cutoff is needed. Care must be taken to assure that cutoffs derived for one population are applicable to other populations (for example, criteria for normal hemoglobin values in whites are not appropriately applied to blacks). Measurement error in the indicator values, diurnal variation, and the possible influence of variables other than the nutrient of concern (such as infection) on the values obtained for the indicator also need to be considered. These issues are discussed, as appropriate, in the consideration of individual nutrients in this report, together with definitions of any cutoffs used for evaluation of indicators of nutritional and health status.

<u>Other approaches to assessment</u>

As was the case with dietary data, distributional analyses of biochemical, hematological, and clinical values are often useful for comparing the relative status of various population groups without defining normal and abnormal status.

Consistency in Data Sources to Assess Changes Over Time

A chief concern relating to consistency in data sources over time is the methodology by which values for biochemical, hematological, and clinical indicators of nutritional and health status are obtained. Improved biochemical methods, new instrumentation, and changes in protocols or standardization procedures are introduced (appropriately) into surveys as they become available and feasible. These changes may, however, introduce systematic changes in the values obtained that might be interpreted erroneously as secular trends (Yetley and Johnson, 1987). Ideally, when new methodology is introduced, extensive comparisons with the earlier methodology should be conducted.

Other Considerations in Interpretation of Data

Linking Dietary Intake Data With Nutritional Status and Health Outcome

The EPONM noted the importance of obtaining dietary and health data on the same sample of individuals representative of the population to achieve greater reliability and more validity. Extensive data on health and nutritional status indicators in individuals have been collected in the HANES, but these surveys have included only a single 24-hour recall (which is inadequate to estimate usual intake for individuals) to obtain quantitative dietary data. (Trade-offs such as these are necessary for decreasing respondent burden while maximizing the amount and quality of information obtained from each survey participant.) Thus, limitations are imposed on examining the cross-sectional relationships of dietary intake and nutritional status in the same survey; for example, the use of regression techniques using individual data is constrained. In the past, methodological differences have limited the ability to link data from the HANES and the USDA surveys that collect more extensive dietary data. Increased coordination between the Agencies in establishing the core content of both sets of surveys, as recommended by the National Research Council (1984) and the JNMEC (DHHS/USDA, 1986), would result in the possibility of greater linkages between the surveys in the future.

Noncoverage of Certain Population Groups

The subjects in the national surveys discussed in this report were selected to be representative of the civilian noninstitutionalized population of the United States (or the 48 contiguous States) living in households. Surveys of the NNMS do not consistently cover population groups such as persons without fixed addresses (migrants and homeless persons), military personnel (living on base in the United States and in total), persons living in institutions (long-term care facilities, college dormitories, and prisons), and Native Americans living on reservations. (Estimates of the sizes of some of these population groups are given in table 2-2.) The nutritional status of some of these groups may be hypothesized to differ from that of the general population. Limited assessments of some of these groups have been made in small-scale studies but have not been attempted on a national basis (Cohen, 1987). Plans for sampling some of these groups in established surveys or in new, special-purpose surveys of the NNMS are under development.

Changing Characteristics of the Population

In interpreting the results of surveys, especially the changes in dietary and nutritional status over time, and in the planning of future surveys, attention should be given to the changing characteristics of the U.S. population. The effectiveness of public policies directed toward consumers is likely to increase with improvements in the understanding of changes in the economic, social, and demographic environments. Knowledge of the changes in characteristics of the U.S. population will also help in resolving comparability issues across time periods. Key characteristics of the population include (1) the distribution of households of various sizes; (2) the age structure of the population; (3) women in the labor force; (4) the racial or ethnic composition of the population; (5) the distribution of income; and (6) other demographic shifts. Perhaps the most apparent demographic change is the aging of the U.S. population (U.S. Bureau of the Census, 1984). For example, in 1978, 16 percent of all Americans were over the age of 55

Table 2-2. Recent estimates of population groups in the United States (Woteki and Fanelli-Kuczmarski, 1989, in press)

Population group	Year	Number (in thousands)
Civilian noninstitutionalized[1]	1986	235,661
Institutionalized[1,2]	1980	2,492
College dormitories[1]	1980	1,994
Military (in United States)[1]	1986	1,836
Homeless[3]	1984	250-350
White[1]	1986	204,301
Black[1]	1986	29,306
Hispanic[1]	1986	18,091
Asian[4]	1980	3,726
Native Americans[5]	1980	1,418

1 From U.S. Bureau of the Census (1987).
2 Excludes dormitories, military quarters, and boarding houses.
3 From U.S. Department of Housing and Urban Development (1984).
4 From U.S. Bureau of the Census (1983).
5 From Bureau of Indian Affairs (1988).

years; now, 20 percent are in this age group. As well, over half of all women over 18 years of age now work outside the home, a figure that is projected to reach about 70 percent by 1995. More single-person households are evident today than ever before. More than half of all households now have two wage earners. The growth of certain ethnic populations is notable, and the population center continues to move to the South and to the West.

The population is reconfiguring into smaller and more varied household units. Increasingly, households consist of childless couples, children living with only one parent, unmarried parents, lone individuals, and unmarried people living together. Currently, the average household has 2.7 members; the average household size is smaller than previously recorded and the trend toward decreased size is continuing. Nearly one-quarter of all households consist of persons living alone. "Nonfamily" households are a burgeoning segment.

The following paragraphs elaborate on the major changes in these characteristics in recent years and expected changes in the near future (U.S. Bureau of the Census, 1977, 1986, 1987).

Single-person households have increased dramatically in the past thirty years. The percentage of single-person households has more than doubled from 10.9 percent in 1950 to 22.5 percent in 1980. The growth in the share of two-person households was much more modest, from 28.8 percent to 31.3 percent over the same period. During the past thirty years there has been a decline in the proportion of more-than-two-person households from 60.3 percent in 1950 to 46.2 percent in 1980. The number of single-person households and two-person households is expected to rise 8.0 percent and 1.7 percent, respectively, over the period 1980 to 2000.

Since 1970, there has been an overall aging of the U.S. population, the median age increasing from 27.9 in 1970 to 30.6 in 1982. This trend is expected to continue in the future with the median age projected to reach 36.3 by the year 2000. In addition, the number of persons in specific age groups should undergo major changes in the coming years. From 1985 to 2000, the number of persons aged 18-24 years will decrease by about 4 million; persons aged 25-34 years will decrease by about 5 million; persons aged 35-44 years will increase by about 12 million; persons aged 45-64 years will increase by roughly 16 million; and persons aged 65 years and over will increase by about 6 million. Most notably, the number of Americans aged 65 and over has doubled in the last three decades, and by the turn of the century, the total of elderly Americans will be approximately 35 million. In 1950, the Census Bureau counted 12.4 million elderly persons, a segment of the population that grew to 25.7 million in 1980.

Over the past several decades, more and more women have entered the labor force, as indicated by the steady increase in the female labor force as a percent of the female population. Female labor force participation has risen in monotonic fashion from 31.4 percent in 1950 to 52.1 percent in 1982. This upward trend is expected to continue in the future. The momentum of this trend towards more dual-career families foreshadows expansion in the segment of "time-sensitive" working couples who favor convenience foods (Capps et al., 1985; Redman, 1980).

Currently, Hispanic persons constitute roughly 7 percent of the U.S. population, but this proportion is expected to rise to nearly 10 percent by the year 2000 and almost 20 percent by the year 2080. By comparison, blacks currently constitute about 12 percent of the U.S. population; this percentage is expected to rise to 13 percent by the turn of the century and to 18 percent by the year 2080. In short, over the period 1980 to 2000, growth of the Hispanic population is expected to be roughly 6 percent, compared with 1.8 percent for blacks and 0.6 percent for whites.

The distribution of income has undergone recent shifts. Annual real income in the United States is expected to grow 2.5 percent between 1980 and 2000. Prior to the 1980s, the trend was toward the relative enhancement of lower income groups with a shift in income to improve their purchasing power. However, this trend reversed in the 1980s with a shift in the income distribution toward higher income groups. The primary impact of this shift in the income distribution on food purchases lies with the emphasis placed on the value of time and the willingness to pay for convenience, value added, quality, and variety. The shift in the income distribution and the increase in real income levels in part account for the decline in the average budget for prepared-at-home food and the rise in the average budget share for away-from-home food over the past decade (Capps, 1986).

Demographic shifts can be expected in the near future. The number of households located in the Northeast and the Midwest is projected to decline by 2.7 and 2.3 percent, respectively, from 1980 to 2000, while the number of households located in the West is projected to increase by 3.6 percent. Further, the number of households located in central cities is expected to fall by almost 6 percent, the number of households located in metropolitan areas is expected to rise by almost 9 percent, and the number of households located in nonmetropolitan areas is expected to rise by almost 2 percent from 1980 to 2000.

Restricted Age Groups in Some Surveys

Some of the surveys considered in this report were limited in their coverage of some age groups. For example, the CSFII 1985–86 was designed to provide information on groups considered to be at relatively high nutritional risk between cycles of the more comprehensive NFCS. Thus, only women aged 19–50 years and their children aged 1–5 years were included in both 1985 and 1986; men aged 19–50 years were included in 1985. In NHANES II and HHANES, persons aged 6 months–74 years were included, but not all measurements were performed for all age groups.

Sample Size Restrictions for Subgroup Analyses

Examining data for subgroups with specified characteristics such as age, race, and sex is often desirable. However, considering several of these characteristics at once may yield sample sizes too small to permit reliable estimates for means, distributions, or prevalences for the subgroup. The criteria for adequate sample sizes for subgroups in the major surveys are described later in this chapter. Groups that may be considered to be at risk (for example, pregnant women, lactating women, and infants under 6 months of age) are frequently represented in numbers too small for analysis in national sample surveys.

Nonresponse and Adjustments for Nonresponse

In the surveys considered, nonresponse may occur at various levels and give rise to concern about the representativeness of the data collected. For example, in the HANES, persons in households selected for inclusion in the survey may not be interviewed, interviewed subjects may not be examined (types of unit nonresponse), and subjects who are interviewed and examined may not complete all items (item nonresponse). Similar types of nonresponse occur in other surveys. In addition, definitional difficulties, differences in interpretation of questions, and coding or recoding errors may also contribute to nonsampling errors.

There are several ways of attempting to deal with nonresponse. No method is perfect, and all are based on some assumptions which may or may not be correct. An adjustment for unit nonresponse is often done by increasing the sample weights for respondents with similar characteristics (those living in the same neighborhood, those of the same demographic subgroup if known, etc.). For item nonresponse, if a relation between the missing item and other data collected is suspected, other types of adjustment to weighting are possible. For example, if the diastolic blood pressure value is missing, but weight, age, gender, race, and smoking history are known, then a regression equation of diastolic blood pressure on these other variables could be performed and used to predict the missing blood pressure value. This imputation would only be done if the regression equation was reasonably accurate. This approach should be better than simply adjusting the weights because it includes more information in the imputation of the missing observation.

Another alternative is to use the sample mean for persons with similar characteristics. This procedure is comparable to weighting, but it allows the observation to be retained in the analysis. The regression equation approach is generally preferred to this approach because it again typically uses more information in the imputation than in the formation of the subgroup with similar characteristics to the missing person.

Still another type of imputation is used extensively by the Census Bureau. It is the replacement of the missing value by the value of another person with the same characteristics. One form of this procedure is the "cold deck" method in which one person's value is used to replace the missing values for all people with these same characteristics. The other form is the "hot deck" method in which the value from the last encountered person with the similar characteristics is used to replace the missing value. The hot deck method allows some variation in the estimation process which is missing in most of the other approaches. The regression and hot/cold deck approaches may require extensive computer time to perform.

The types of imputation used in the surveys considered in this report are described below in the discussion of nonresponse adjustment and imputation in specific surveys.

Sample Weights, Variances, and Design Effects

Much of the data used in this report came from complex surveys such as the HANES, NFCS, and

CSFII. These surveys employed stratified, multistage designs that provided for the selection of samples at each stage with a known probability. Because of the need to obtain a sufficient number of members of certain subgroups (for example, blacks in NHANES II), individuals had different probabilities of being selected into the sample. Nonsampling and other considerations also led to surveyed individuals having different sample weights. For deriving national estimates, the use of statistical analyses that fail to account for variations in sample weights and for the complex sample design is inappropriate. Conclusions based on analyses that are conducted with sample weights and that take the design effect into account can be quite different than conclusions based on analyses conducted without these factors (NCHS, 1982).

The analyses reported here were conducted using each person's unique sample weight, where the weight reflects the individual's probabilities of selection, as well as adjustments for nonresponse and poststratification. In these analyses, the effect of using a sampling design other than a simple random sample is reflected in the calculation of the variance or standard error of an estimate. The design effect is defined as the ratio of the estimate of variance that takes the design into account to the estimate of variance that assumes a simple random sample of the same sample size. A design effect greater than one is often encountered in complex surveys because of pragmatic concerns; for example, the cost of a simple random sample would be far greater then that of a complex sample which may involve many fewer sampling locations. However, the trade-off for the smaller cost of the complex sample is often a greater variance of the estimates.

Statistical Criteria and Data Reporting

Types of Data Presented

The data analyses prepared for inclusion in this report and presented in appendix II are intended to provide descriptive information rather than to provide a basis for statistical tests of hypotheses. Statistical terms used in the tables include the following:

- The mean is a measure of central tendency of a distribution of values calculated by adding all individual values and dividing by the number of values.
- Percentiles constitute divisions of a distribution of values into equal, ordered subgroups of hundredths.
- The 50th percentile or median is a measure of central tendency that divides a distribution of values into two equal parts, with 50 percent of the values above and 50 percent of the values below this point.
- The standard error is the standard deviation (measure of dispersion or variation) of a statistic (mean or percent).
- The standard deviation is equal to the square root of the sum of the squares of deviations divided by n−1.
- The coefficient of variation or the relative standard error (not shown in the tables) can be determined by taking the ratio of the standard error to the mean and multiplying by 100 percent.

Criteria for Reporting and Evaluating Data

The statistical guidelines outlined below were used in the presentation of estimated means, medians, and percentiles in this report.

Reporting Criteria in the HANES

Minimum sample size requirements for presentation of estimated means, percentiles, and variances (standard errors) for NHANES II, assuming an average design effect of 1.5, have been determined (Casady, 1982) and are shown below. This approach was also used in the initial analyses of the HHANES data. These criteria are used for the presentation of data in the tables presented in appendix II.

Criteria for Means and Prevalences

1. If the sample size is less than 25, the mean or percent (prevalence estimate) is not presented. An asterisk is placed in the cell.
2. If the sample size is 25–44, the mean or percent is presented but with an asterisk.
3. If the sample size is 45 or more, the estimated mean or percent is presented without caveat.

Criteria for Percentiles

Percentiles	Sample size
5th and 95th	100
10th and 90th	5
15th and 85th	35
25th and 75th	20
50th	10

If the sample sizes do not meet these minimum values, an asterisk is placed in the cell.

Analyses conducted to date with NHANES and HHANES data sets indicate that it is possible to have very large relative standard errors (greater than 50 percent) and also have large sample sizes. This situation occurs frequently when estimating the prevalence of a rare condition. When situations occur in which the relative standard errors for entries in a table exceed 30 percent, analysts should use judgment in the interpretation of the data. Even with very large standard errors, depending on the condition and the objective of the analysis, it may still be worthwhile to present prevalence estimates and standard errors with strong caveats about the interpretation of the data.

Reporting Criteria in the USDA Surveys

The criteria for the reporting of means and medians employed by the USDA are based on the coefficient of variation rather than a minimum sample size. In the tables presented in appendix II of this report, all estimated means are displayed, but a caveat is supplied in the form of an asterisk for those with estimated coefficients of variation over 20 percent. Medians or 50th percentiles, by assumption, are presented (without comment) whenever means are displayed. However, rules were developed following Woodruff (1952) for the minimum sample sizes required to present reasonably accurate values at the various percentiles. Assuming an average design effect of 2, the minimum subgroup sample size rules are as follows:

Criteria for percentiles

Percentiles	Minimum subgroup sample sizes
5th and 95th	140
10th and 90th	80
25th and 75th	40

Criteria for the EPONM's Evaluation of Data

The EPONM believes that a descriptive report best serves the needs of this report's intended audience. Thus, formal statistical procedures, such as t-tests and analysis of variance, have not been used extensively in the comparison of dietary or health-related mean values from the many different subgroups. Instead, a difference between subgroups is considered to be large if it is approximately twice the value of its standard error. This rule, although an approximate procedure, should provide reasonable guidance to the reader. For a variable with several levels, the existence of a consistent pattern across its levels also provides support for the existence of a difference. If the existence of a large difference is not consistent with the literature, this finding would need to be replicated in another study before one concludes that it is important. However, if the literature supports the existence of a difference associated with a variable, for example, poverty level, then the existence of a large difference here is probably meaningful.

More formal statistical methods such as the analysis of variance and multiple comparison procedures could be used to adjust for the number of comparisons that are implicitly being done when only one difference (usually the largest) is selected for discussion. However, the use of multiple comparison procedures often makes it difficult to find real differences because it emphasizes the type I error (falsely concluding there is a difference) at the expense of the type II error (wrongly concluding there is no difference). The EPONM is more concerned about failing to find real differences than about falsely finding differences, and the procedure described in the above paragraph is consistent with this philosophy.

Imputation in Specific Surveys

Imputation for missing analytical values occurs in several data sets from surveys discussed in this report. Some values for nutrient composition are imputed in the nutrient composition database. Hepburn (1987) provided data on the percentage of analytical and imputed values for nutrients in the most recent Primary Nutrient Data Set used for CSFII 1985-86 and HHANES. No imputed values were included in the dietary intake data from NFCS 1977-78, CSFII 1985-86, or HHANES. For NHANES II, some dietary intake measurements were imputed for subjects who had unsatisfactory 24-hour recalls by randomly assigning a value from the same item of information for examined persons of the same age, sex, and race. In the same survey, imputations of missing body measurements were made by substituting for the missing measurements those of an individual of the same age, sex, and race who had other dimensions similar to those available for the person with missing values.

Age-Adjustment Procedures in Specific Surveys

Identical age-adjustment procedures were used in the calculation of estimates from the NFCS 1977-78, CSFII 1985-86, NHANES II, and HHANES data prepared for inclusion in this report. As an illustration, in the CSFII 1985-86, the mean nutrient intake estimates reported in appendix II were adjusted to reflect the 1980 U.S. Census distribution of individuals in the 10-year age groups 20-29, 30-39, and 40-49. Thus, both males and females were adjusted to the same standard. The adjustment was done to the means for all women aged 20-49 years and the means for each category of race, poverty status, education, region, and urbanization. The associated standard errors were also computed for these adjusted means. These 1980 Census counts are:

Age (years)	1980 Census count	Percent of persons aged 20-49 years
20-29	40,839,623	42.93
30-39	31,526,222	33.14
40-49	22,759,163	23.93
20-49	95,125,008	100.00

Nonresponse in Specific Surveys

One of the concerns of the EPONM was whether the data from the sample surveys (NFCS 1977-78, CSFII 1985-86, NHANES II, and HHANES) could be generalized to the U.S. population. Because the surveys were household based, it was clear that they excluded certain components of the U.S. population by design, for example, people living on reservations and in institutions as well as the homeless. Although these groups represent a small proportion of the total U.S. population, their nutrient intake and health status may have been so different from the rest of the population as to have called into question the findings based on the households or individuals surveyed.

An additional concern was whether the surveys adequately represented the population of U.S. households. One way the surveys may have failed to have been representative of the target population was if there was substantial nonresponse. Ideally, there would be none or very little nonresponse; however, over time there has been a decrease in the response rates to national surveys. Based on the EPONM's experience, carefully designed and conducted surveys that require a substantial investment of the respondent's time will often have nonresponse rates ranging from 20 to 40 percent. As the nonresponse rate increases, the greater the possibility for bias in the results.

It is appropriate to examine the nonresponse issue in all surveys, not just in those with substantial nonresponse. The examination for potential bias depends on the available information. The surveys used in this report varied in their rates of nonresponse from greater than 60 percent over the 4 waves of the 1985 CSFII basic group to 25 percent in the HHANES in the Mexican-American and Puerto Rican subgroups. Within these surveys, there were demographic subgroups with even higher rates of nonresponse. The EPONM appreciates the problems that the Agencies face in attempting to collect such vast amounts of data. For example, the USDA attempts to collect multiple days of data and the NCHS data collection involves a physical examination. These efforts impose unusually heavy demands on the survey participants, and a high nonresponse rate is understandable. However, the EPONM was still reluctant to use data with nonresponse rates as large as these, particularly those from the USDA, without an investigation of the nonrespondents. Because of the EPONM's concern as well as that of the Agencies themselves, additional analyses were performed to examine this issue. Analyses of nonresponse for NFCS 1977-78, CSFII 1985-86, NHANES II, and HHANES are discussed in detail in appendix I; some of the findings are summarized here.

The analysis of the CSFII 1985 1-day and 4-day subgroups showed that demographic and socioeconomic differences between these subgroups existed, but that these differences did not appear to translate into differences in nutrient intake. Although the analysis did not demonstrate any major differences in nutrient intake, caution must still be used in the interpretation of the data with such large nonresponse rates because of the potential for bias. The analysis of the HHANES showed that there were some differences between the Cuban respondents and nonrespondents, and as a result of these differences coupled with the 40 percent nonresponse rate, the EPONM has some concern about the use of the Cuban data from HHANES. The respondents and nonrespondents from the Mexican-American and Puerto Rican groups did not appear to differ on the variables examined.

Variance Calculation and Design Effects in Specific Surveys

The program SESUDAAN (SAS Institute, Inc., 1979) was used with the design effect option (DEFT) to obtain design effects for the HANES. For variables from NHANES II, the average design effect was calculated separately for non-Hispanic white males and white females. (The value for non-Hispanic whites was also used for non-Hispanic blacks and for each poverty subgroup.) The design effect represented an average across the several age-sex specific cells for a selected variable. When a design effect was less than 1.0, the value of 1.0 was used. Then the design effects for men and women were averaged and the square root of this value was used in the following formula to obtain a new estimate of the standard error:

$$\text{Standard Error (complex)} = \sqrt{\text{Design Effect}} \times \text{Standard Error (simple)}.$$

The calculation of standard errors for the NHANES II and HHANES data in this report was performed using an average design effects approach based on SESUDAAN calculations of variances (Kovar and Johnson, 1986). The HHANES (and some of the NHANES II) variances calculated directly by SESUDAAN were found to be unstable; therefore, the average design effects approach was developed. For comparability in the methods used in this report, the average design effects approach was applied to both the NHANES II and HHANES data. To check the reasonableness of the approach, the standard errors calculated by both methods were compared for a subset of the NHANES II data and found to be nearly identical.

Design effects were calculated separately for each portion of HHANES: Mexican American, Cuban, and Puerto Rican. The approach was the same as described above. The NCHS has indicated that wide variability exists in the design effects associated with HHANES. Because of the instabilities found in the design effects, NCHS has recommended that an average design effect be calculated for classes of similar variables. This procedure was used for the HHANES data presented in this report.

The USDA used the program SESUDAAN to calculate directly point estimates and their corresponding standard errors. These standard error estimates were used in computing design effects for each sex and age cell. The average design effect in the USDA survey data reported herein is roughly 2. Mean intake standard error estimates from the CSFII 1985-86 have been determined to be reasonably stable for sex and age cells. However, the stability of standard error estimates for lower levels of aggregation (for example, sex and age and region) is more variable and caution is urged in their use for determining confidence intervals.

Use of Système International (SI) Units

Système International (SI) units are a uniform system for reporting numerical values based on the actual amount of reactants in moles rather than on mass concentration units. Most journals and professional societies in the biomedical sciences have endorsed the reporting of clinical laboratory data in SI units. The biochemical data included in this report are expressed in SI units, with conversions given for the more common clinical units.

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Chapter 3

Update of Dietary and Nutritional Status: Individual Foods and Food Components

Introduction

This chapter is the first of two intended to provide an update of information reviewed in the JNMEC report. It contains data, mainly from the NNMS, on dietary and nutritional status related to individual foods and food components that have been released since publication of the JNMEC report. A conceptual model, adapted from the general model shown in chapter 1, that illustrates the topics and data to be considered in this chapter is presented in figure 3-1. Components of the model relevant to the discussions in this chapter are highlighted by the shaded boxes; individual topics noted with an asterisk are those for which data are available for discussion. Potential data sources are represented by the numbers that appear above or below the boxes; numbers noted with an asterisk represent those surveys or studies from which data were obtained for consideration in this chapter.

Information on the surveys that provided most of the data for the foods and food components discussed in this section is presented below (see appendix I for a detailed description of these and other surveys included):

- U.S. Food Supply Series (1909-85; especially 1985)--per capita data for foods and nutrients.

- Continuing Survey of Food Intakes by Individuals (CSFII 1985-86) (all income and low-income)--dietary intake data for men, 19-50 years (1 day); women, 19-50 years (1-4 days); children, 1-5 years (1-4 days).

- Hispanic Health and Nutrition Examination Survey (HHANES) (1982-84)--health and nutritional status data for Mexican Americans from the Southwest, Cubans from Dade County, Florida, and Puerto Ricans from the Metropolitan New York area, 6 months-74 years. Dietary data (a single 24-hour recall and food frequency) were also collected in HHANES but were not available for inclusion in this report.

- Centers for Disease Control (CDC) Pediatric and Pregnancy Nutrition Surveillance Systems (PedNSS and PNSS, respectively) (1987)--anthropometric and hematological data for low-income children and pregnant women in selected States.

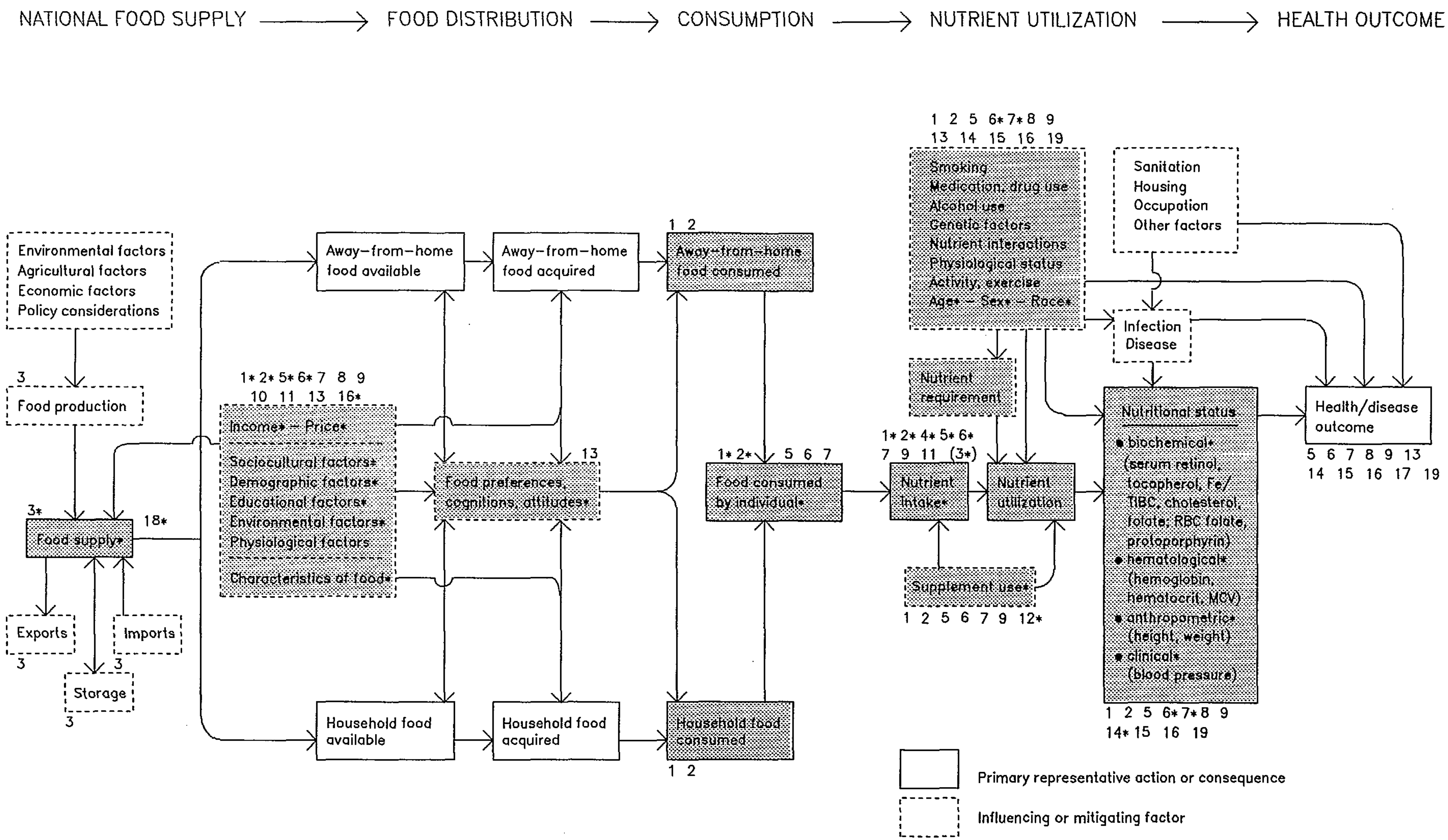
- Food and Drug Administration (FDA) Vitamin/Mineral Supplement Intake Survey (1980)--data on use of vitamin and mineral supplements by adults.

Data from these sources are used to examine trends in food availability and consumption, to assess the dietary and nutritional status of the U.S. population, and to reevaluate the public health monitoring priority status accorded to individual food components by the JNMEC. The ability to draw conclusions about the U.S. population by the EPONM in this update is limited by the selected population groups for which new data are available.

Trends in Food Availability and Consumption

Food Availability

The availability of food in the United States is determined by production and market demand for various foods. Demand is primarily, although not exclusively, a reflection of economic factors such as real income and prices. The interrelationships of economic and other factors with components of the national food supply are depicted in figure 3-1. Since 1909-13, major changes in the availability of various foods and patterns of availability within several food groups have occurred in the United States (USDA, 1988a). The broad patterns of change in the availability of various foods over this time period are



National Nutrition Monitoring System and other data sources: 1 = CSFII 1985–86, 2 = NFCS 1977–78, 3 = U.S. Food Supply Series, 4 = National Nutrient Data Bank, 5 = NHANES I, 6 = NHANES II, 7 = HHANES, 8 = NHEFS, 9 = NHIS, 10 = FLAPS, 11 = Total Diet Study, 12 = Vit/Min, 13 = Health and Diet Study, 14 = PedNSS, 15 = PNSS, 16 = BRFSS, 17 = U.S. Vital Statistics, 18 = AEDS, 19 = NHES. See appendix III for definitions of acronyms. Shaded boxes highlight portions of the model discussed; an asterisk (*) indicates data and data sources considered in this chapter

Figure 3–1. Conceptual model for the update of dietary and nutritional status in the United States (see text for explanation)

illustrated in figure 3–2. Since 1970, noteworthy changes in food consumption patterns in the United States have spurred further shifts in availability of various foods. Data for food availability on a yearly basis for 1970 through 1985 are shown in figure 3–3. Since the early 1970s, the total per capita availability of animal products has increased slightly (approximately 3 percent), while that of crop products has increased by 11 percent. In terms of percentage changes, increases occurred (in descending order) for lowfat milks, vegetable fats and oils, cheese, poultry, dark green and deep yellow vegetables, sugars and sweeteners, fish, fruits, legumes, nuts, soy, and grain products; decreases occurred for whole milk, animal fats, eggs, coffee, tea, and cocoa, and meat (mainly beef). Traditional demand determinants that have influenced these trends are changes in relative prices, changes in real income (income adjusted for inflation), shifts in the demographic structure of households, and changes in tastes and preferences. As well, changes in nontraditional demand determinants, such as concern for nutrition and health, changes in lifestyles, changes in technological forces, advertising techniques, and recommendations by public health officials on diet and nutrition have influenced food availability and consumption patterns. The following paragraphs describe these influencing factors and their impacts on foods available in the food supply.

During the period 1970 through 1985, real prices of most major food items decreased rather substantially (Capps, 1986). The most notable declines were for food purchased for home consumption such as red meat (primarily pork), poultry, eggs, dairy products, fats and oils, and processed vegetables. On the other hand, real price increases were evident for sugar and sweets, fishery products, fresh fruit, and food away from home. Real price changes of cereal and bakery products and processed fruit were for the most part negligible. Relative price changes can make some foods less attractive and others more attractive. For example, over the last 15 years, the real price of poultry has decreased 28 percent, while the real price of red meat has declined 13.5 percent. The per capita quantity of poultry increased roughly 14 pounds from 1970–74 to 1980–84, while the per capita quantity of red meat decreased roughly 8 pounds over the same time (figure 3–3A); one factor that may have contributed to this decline is the relative price difference. Another example is the increase in the per capita quantities of vegetable oils in the food supply (figure 3–3C) during the time of the expansion of the U.S. soybean industry that brought about a dramatic increase in the supply of soybean oil at competitive prices.

From 1970–74 to 1975–79, real income rose by 12.1 percent; from 1975–79 to 1980–84, real income rose by 6.5 percent. The effect of income growth on food consumption patterns depends on the level of income and the "income elasticity" of specific foods. (Income elasticity refers to the percentage change in consumption associated with a 1 percent change in income.) As real income rose, demand increased for some foods (for example, beef, poultry, shellfish, fresh fruits, and vegetables) and decreased for others (for example, sugar, processed milk, potatoes, eggs, and cereal products) (Economic Research Service, 1981). Because the income elasticity of most foods is small, large increases in real income are necessary to generate substantial increases in consumption. In addition, rising real incomes are associated with an increase in demand for convenience attributes of food products (Capps, Tedford, and Havlicek, 1985; Connor, 1981; Redman, 1980a) and with a rise in demand for away-from-home food (Kinsey, 1983). Raunikar, Huang, and Purcell (1985) noted that prior to the 1980s, the trend in real income increases was toward the relative enhancement of the lower income groups, but this trend reversed in the 1980s with a shift in income distribution toward the high income groups. The primary impact of this shift in the income distribution is the emphasis placed on the value of time and willingness to pay for convenience, quality, and variety. The shift in income distribution and the increase in real income levels account, in part, for the decline in the average budget for all food and the rise in the average budget share for away-from-home food over the past two decades.

Shifts in population demographics also influence patterns of food availability and food consumption. From 1970–74 to 1975–79 and from 1975–79 to 1980–84, the population grew 5.4 and 5.7 percent, respectively; the total quantity of food used domestically has changed in direct proportion to the increase in population. The composition of the population also plays a role in the changing demand for food and for particular types of foods. The proportions of persons in the age groups 18–44 years and 65 years and older are rising (U.S. Bureau of the Census, 1977, 1986). The shift in age distribution of the population may account, in part, for the decline in whole milk consumption (figure 3–3B) and the increases in demand for soft drinks, fruit drinks, and other beverages. Demographic shifts and changes in income distribution interact to affect food consumption and expenditures away from home (Sexauer, 1979). Finally, the distribution of households of various sizes influences the domestic food market (Sexauer and Mann, 1979). The percentage of single-person and two-person households has increased in the last 25 years, while the percentage of more-than-two-person households has declined (U.S. Bureau of the Census, 1986). Single-person and two-person households use more

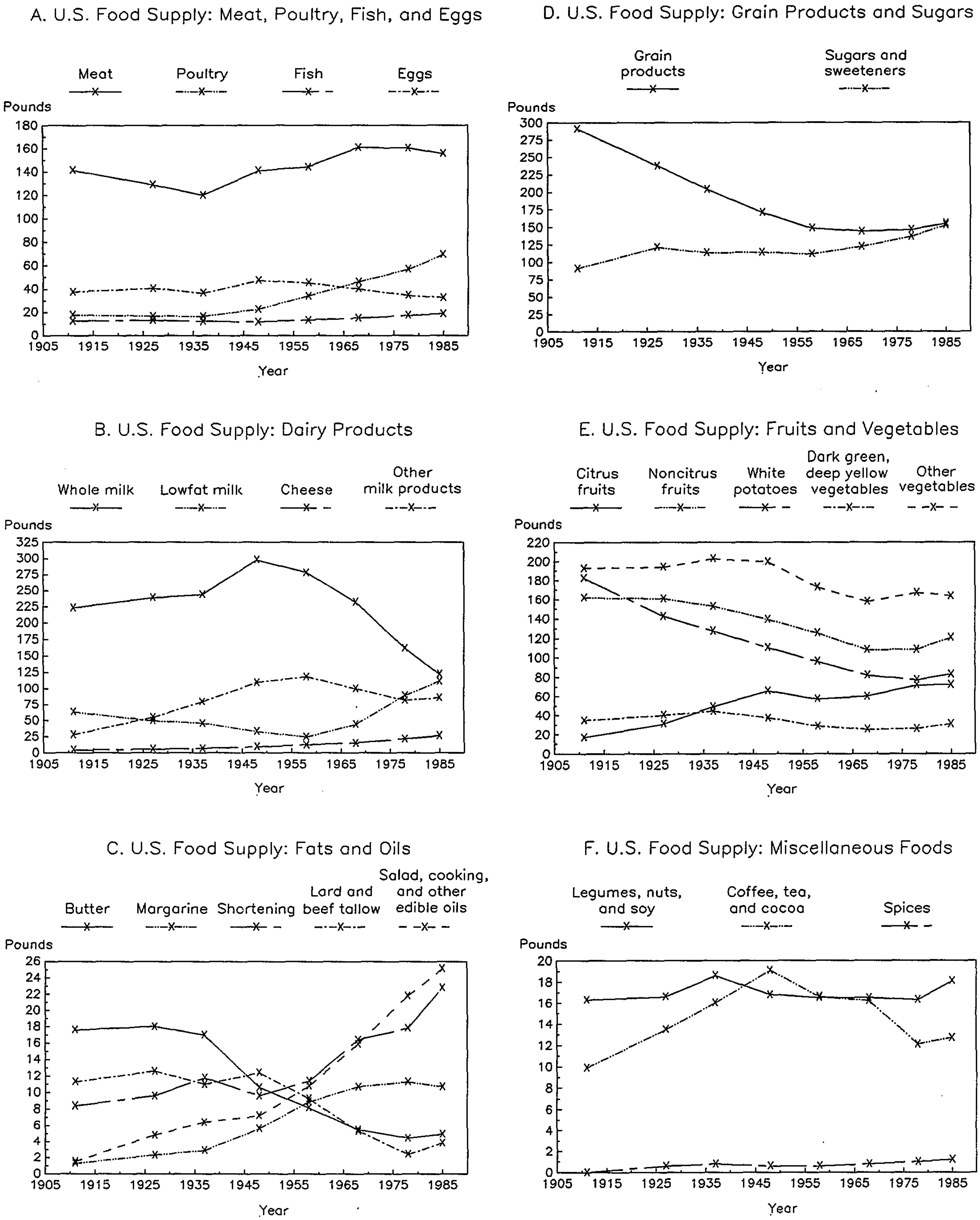


Figure 3–2. Per capita availability (pounds/year) of (A) meat, poultry, fish and eggs, (B) dairy products, (C) fats and oils, (D) grain products and sugars and sweeteners, (E) fruits and vegetables, and (F) legumes, nuts, and soy; coffee, tea, and cocoa; and spices in the U.S. food supply: U.S. Food Supply Series, 1909–13, 1925–29, 1935–39, 1947–49, 1957–59, 1967–69, 1977–79, and 1985

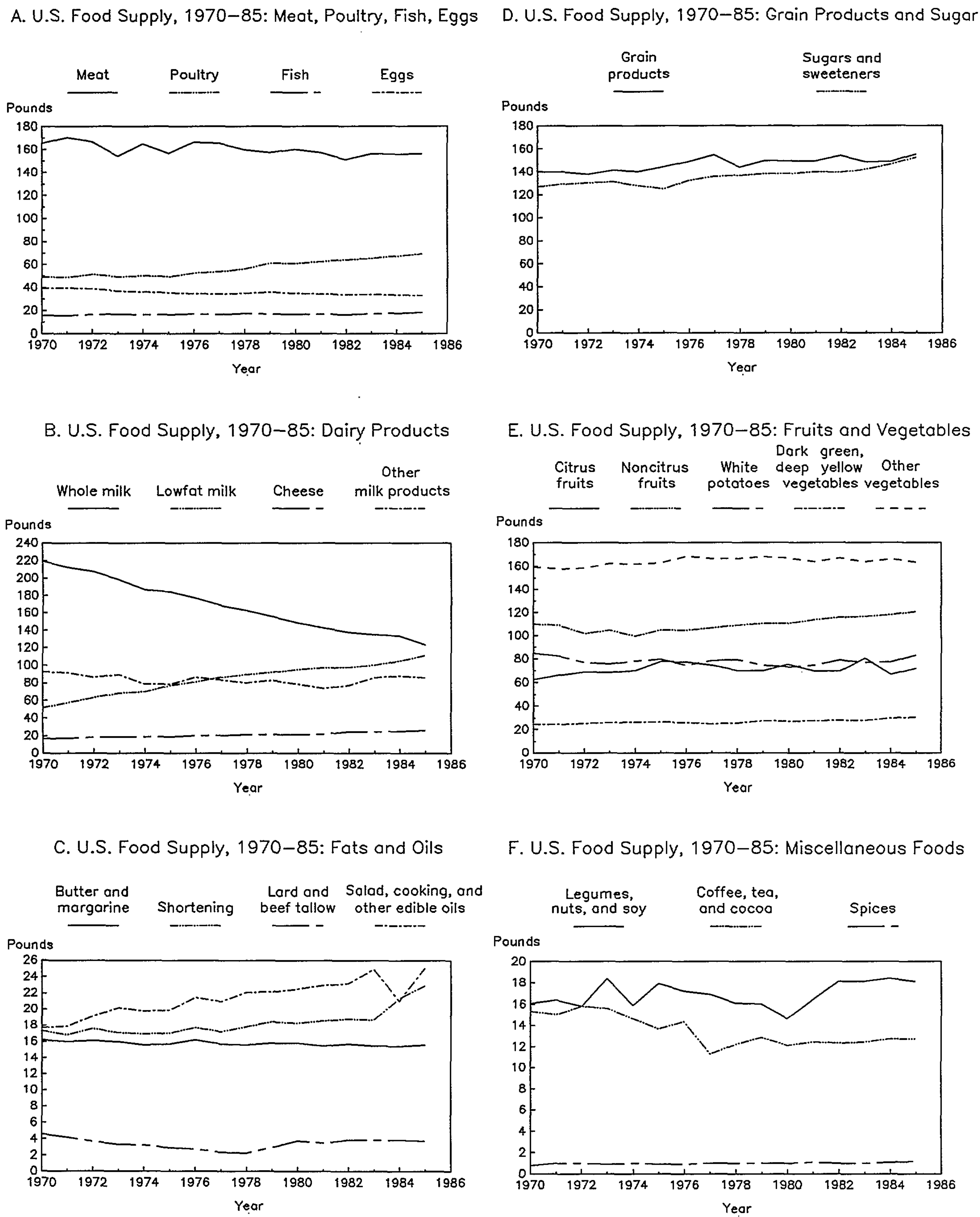


Figure 3-3. Annual per capita availability (pounds/year) of (A) meat, poultry, fish and eggs, (B) dairy products, (C) fats and oils, (D) grain products and sugars and sweeteners, (E) fruits and vegetables, and (F) legumes, nuts, and soy; coffee, tea, and cocoa; and spices in the U.S. food supply: U.S. Food Supply Series, 1970–85

convenience foods per person than do more-than-two-person households because time available for food preparation may be scarcer and there is less of a tendency for household members to specialize in food preparation (Capps, Tedford, and Havlicek, 1985).

In addition to the traditional demand determinants discussed above, notable changes have been evident in nontraditional demand determinants such as concern for nutrition and health. Recent trends in the availability of various foods in the food supply may reflect this concern and indicate the possibility that more Americans are making some dietary changes consistent with the U.S. dietary guidelines (USDA/DHHS, 1985). For example, the availability of red meat (mainly beef) fell 6 percent over the period 1970–85 (figure 3–3A). Beef is still the most popular meat, but available quantities of poultry and fishery products, which are often perceived as lower in fat, are rising. Similarly, as the quantities of lowfat and skim milk increased dramatically, probably in response to public health concerns with dietary fat, the availability of whole milk declined more than 44 percent since 1970 (figure 3–3B). Although the total quantities of fats and oils in the food supply have not declined, there has been a major shift towards a greater proportion of vegetable fats and oils and a decline in the proportion of fats of animal origin (figure 3–3C) which again may reflect efforts on the part of consumers to switch from saturated fats to unsaturated fats and oils. Other changes such as the decline in the quantities of eggs available (figure 3–3A), and increases in the quantities of grain products, fruits, and vegetables available (figures 3–3D and 3–3E) may also be influenced by the improved dissemination of information about the links between diet and health.

The dynamic nature of food demand is also attributable in part to changes in lifestyles of the U.S. population (Padberg and Westgren, 1983; Redman, 1980b) and to technological forces. For example, the frequency of both spouses working outside the home has resulted in less time for food preparation. With more women working outside the home, breakfast habits are changing; together with a concern for health, these changing habits may have contributed to the decline in the quantities of eggs in the food supply. New technology in household food preparation, especially microwave ovens, and concomitant innovations in food processing continue to decrease the time needed for meal preparation. During the past few decades, a myriad of convenience foods, particularly frozen items, ready-to-serve items, and mixes have been introduced into the marketplace. The total retail market for prepared foods reached approximately $8 billion in 1986, up 2.9 percent from the previous year. In addition, enormous growth has occurred in the number of fast-food restaurants. The market for frozen potato products, cheese, tomatoes, and (more recently) chicken has increased because of increased consumption away from home. Improvements in processing and marketing have also boosted the popularity of certain foods. The food industry has been responsive to the desire by consumers for food ingredients that could have an influence on health, such as fiber and calcium, and has actively promoted foods that contain such ingredients or foods to which these ingredients have been added.

In summary, changes in relative prices, the level and distribution of real income, population distribution and demographics, concern for health and nutrition, lifestyles, and technological forces have had important impacts on food consumption in the United States during the period 1970–85. Their varied and sometimes conflicting influences are reflected in the shifts in the quantities of food available in the U.S. food supply during that period.

Food Consumption

Recent trends in food consumption can be examined by comparing the consumption of men and women assessed in the CSFII 1985 with consumption assessed in the NFCS 1977–78 (USDA, 1985, 1986a). Selected results, based on data for a single day, are presented in table 3–1.

The total intake of meat, poultry, and fish per person declined slightly in men and women (9 and 3 percent, respectively). Evaluating the changes in this food group is difficult because meats are categorized as meat mixtures (reported as a unit) and individual meats (reported separately). (Meat mixtures are defined as mixtures having one or more types of meat, poultry, or fish as a major ingredient, such as stews; casseroles; sandwiches, including hamburgers; and frozen dinners.) The quantities of beef reported separately declined dramatically (35 percent for men and 45 percent for women). Smaller declines were observed in the amounts of poultry and pork reported separately. The quantity of fish consumed increased for both men and women (50 and 18 percent, respectively). These changes are not entirely consistent with trends observed in the quantities of these foods in the food supply over the same time period. Changes in the total quantities of meats consumed may be obscured by the shift away from eating meat separately and toward eating meat as part of a mixture, especially for women.

Another change in individual intakes between 1977 and 1985 occurred for milk. The intake of lowfat and

Table 3-1. Percentage of persons using selected foods and mean intakes for men and women, aged 19–50 years, in 1 day[1] in 1985 and percentage change in mean intakes from 1977[2]: Continuing Survey of Food Intakes by Individuals 1985 and Nationwide Food Consumption Survey 1977–78 (USDA, 1985; USDA, 1986a)

Food group or subgroup	Men			Women		
		Mean intakes[3]			Mean intakes[3]	
	Individuals using	1985	Change from 1977 to 1985	Individuals using	1985	Change from 1977 to 1985
	Percent	Grams	Percent	Percent	Grams	Percent
Total meat, poultry, and fish	93	268	-9	88	181	-3
Meat mixtures	40	110	+5	37	88	+35
Beef (reported separately)	28	52	-35	23	27	-45
Pork (reported separately)	25	26	-7	20	14	-22
Poultry (reported separately)	16	25	-22	19	22	-8
Fish and shellfish (reported separately)	11	21	+50	12	13	+18
Total fluid milk	48	205	-5	51	141	-5
Whole milk	27	117	-25	26	64	-35
Lowfat or skim milk	21	87	+53	26	77	+60
Cheese	33	17	+6	34	18	+6
Eggs	28	26	-26	24	18	-28
Total vegetables	85	272	+3	83	173	-8
Total grain products	94	278	+8	94	209	+29
Grain mixtures	25	94	+31	26	74	+72
Total carbonated soft drinks	61	433	+74	54	287	+53
Regular soft drinks	48	332	+43	36	179	+28
Low-calorie soft drinks	16	101	+494	20	105	+123

1 Data for men were collected on a day in the summer; data for women were collected on a day in the spring.

2 Comparisons of data collected in 1985 with data collected in 1977 should be made cautiously because of changes in data collection procedures and probing techniques which might affect conclusions about increases or decreases in the intake of certain foods. In some cases, further analysis is required to determine whether a change in intake between the two periods should be attributed to a change in the diets of individuals or to a change in methodology. See appendix I for information on differences between the two surveys.

3 Mean values represent intakes of all persons.

skim milks increased greatly (53 and 60 percent for men and women, respectively), while the intake of whole milk declined (25 and 35 percent for men and women, respectively). These changes correspond to changes in the availability of whole and lowfat milks in the food supply over the same time.

Other notable changes include decreases in the intake of eggs reported separately; increases in the intake of total grain products and grain mixtures, with larger increases seen for women than for men; and a small increase in the intake of vegetables by men and a small decrease in the intake of vegetables by women. Because many meat mixtures and grain mixtures (such as pizza, spaghetti with sauce, and rice dishes) include vegetables, some of the vegetables consumed are reported elsewhere. Thus, several of the observed changes are in directions consistent with dietary guidelines that suggest avoiding too much fat, saturated fat, and cholesterol and eating foods with adequate starch and fiber (USDA/DHHS, 1985).

In addition, there have been changes in beverage consumption. The consumption of carbonated soft drinks has increased substantially, with a greater increase occurring in the intake of low-calorie soft drinks than regular soft drinks, even though regular soft drinks are consumed by a larger proportion of both men and women. The proportion of men and women consuming alcoholic beverages and the mean intakes of alcoholic beverages both increased between 1977 and 1985 (USDA, 1985, 1986a), a finding that is contrary to the declining trend in the retail sales of alcoholic beverages over this time (Alcohol Epidemiological Data System, 1986). A 1985 survey question that probed for forgotten food items including alcoholic beverages may have contributed to the increase in the amounts reported (USDA, 1985, 1986a).

Update on Individual Food Components

Food components for which data have become available since the completion of the JNMEC report are the following:

Food Energy	Vitamin A	Iron
Protein	Carotenes	Calcium
Fat, Fatty Acids, and Cholesterol	Vitamin E	Phosphorus
	Thiamin	Magnesium
	Riboflavin	Sodium
Carbohydrates and Dietary Fiber	Niacin	Potassium
	Vitamin B6	Copper
	Vitamin B12	Zinc
Alcohol	Vitamin C	
	Folacin	

Dietary and nutritional status related to these components, as well as to fluoride, are considered by the EPONM in this report. For each food component discussed, a summary of its function in the body, identification of good sources in the diet, consequences of inadequate and excessive intake, and available indicators of status are presented in table 3-2. Foods are identified as good sources of the various nutrients and other components in the diet based primarily on information contained in *Good Sources of Nutrients* (USDA, 1989) as well as the JNMEC report (DHHS/USDA, 1986) and *Recommended Dietary Allowances* (National Research Council, 1980). For each nutrient with a U.S. RDA, the criterion of providing 10 percent of the U.S. RDA per serving was used to identify foods that are good sources of the nutrient. These foods do not necessarily represent the foods that are the major sources of the component in the diet. For example, grain products do not contain a large amount of iron per serving (less than 10 percent of the U.S. RDA) and, thus, are not considered good sources of iron; however, they are consumed in large amounts and represent a major source (41 percent) of iron in the food supply.

Quantity and Quality of Data

The availability of relevant update data on dietary, nutritional, and health status from the various surveys of the NNMS for each food component discussed in this chapter is summarized in table 3-3. The data elements from the NNMS common to most of the food components listed above are per capita amounts in the food supply and individual dietary intakes. The quality and quantity of data, as well as the availability of appropriate assessment criteria, differ for different components and influence the confidence with which evaluations of status may be made.

Since the JNMEC report was prepared, new food composition data have become available for fatty acids, cholesterol, dietary fiber, carotenes, vitamin E, vitamin B6, vitamin B12, folacin, magnesium, potassium, copper, and zinc. However, composition data are still relatively less complete for dietary fiber, vitamin E, vitamin B6, vitamin B12, and magnesium than for other components. Only vitamin E and dietary fiber have analytical data available for fewer than half the major sources in the diet (Hepburn, 1987). Data on the intake of sodium are also somewhat limited; estimates of amounts in the food supply are not available and the accuracy of estimates of individual intake are uncertain because of difficulties in quantifying salt used in cooking or at the table.

Table 3-2. Summary description of food components assessed in the EPONM report

Food component	Function in body	Good sources in diet	Consequences of inadequate intake	Consequences of excessive intake	Indicators of status in NNMS
Food energy	Metabolic functions: maintenance of body temperature, growth and repair of bones and tissue, and movement of muscles; body fat storage	–	Underweight, semi-starvation, growth retardation in children	Overweight, obesity	Body weight for height as indicator of energy balance
Protein	Involved in most metabolic processes; essential for growth, development, and maintenance of body tissues; amino acids are structural elements of muscle, connective tissue, bone, enzymes, hormones, and antibodies	Meat, poultry, fish, eggs, milk, cheese	Protein-energy malnutrition	Protein intake converted to body fat	Serum albumin levels
Fat, fatty acids, cholesterol	Concentrated source of energy; carrier for the fat-soluble vitamins; structural and functional components of cell membranes; precursors of compounds involved in many aspects of metabolism	Saturated fatty acids: butter, lard Monounsaturated fatty acids: olive oil Polyunsaturated fatty acids: corn and soybean oils Cholesterol: liver, kidney, brains, egg yolk, meat, poultry, fish, cheese Omega-3 fatty acids: fatty fish	No public health problem; clinical deficiencies of essential fatty acids and fat-soluble nutrients have occurred	Relation to development of obesity, cardiovascular disease, and some cancers	Serum levels of total cholesterol, HDL-cholesterol, triglycerides
Carbohydrate	Energy source; stored as glycogen or converted to body fat	Simple carbohydrates: fruits, vegetables, milk, sugar, other caloric sweeteners Complex carbohydrates: grain products and vegetables	Ketosis	Contribution to excess calorie intake	–
Fiber	Bulk in diet; promotes normal elimination	Whole-grain products, many fruits and vegetables, dry beans, nuts	Constipation	Possible decrease in mineral absorption	–
Alcohol	Source of calories; depressant	Beer, wine, and other alcoholic beverages	–	Inadequate nutrient intake; possible overweight; cirrhosis of liver, pancreatitis, cancer of the throat; social and public safety problems	–
Vitamin A (retinol)	Formation and maintenance of skin, hair, and mucous membranes; essential for vision, bone growth, tooth development, and reproduction	Preformed retinol: liver and vitamin A-fortified foods Carotene: dark green leafy vegetables, yellow and orange vegetables and fruits	Changes in eyes (keratomalacia) and skin, vision problems (xerophthalmia)	Teratogenicity; toxicity symptoms including effects on skin and bone	Serum retinol levels
Vitamin E (tocopherol)	Antioxidant functions	Vegetable fats and oils, some cereal products, nuts, some seafood	Enhanced fragility of red blood cells	–	Serum tocopherol levels
Thiamin	Component of enzymes involved in energy metabolism; required for cell reproduction, fatty acid metabolism, and nervous system functions	Pork, beef and pork liver, whole-grain and enriched grain products	Loss of appetite, decreased muscle tone, depression, neurological changes (beriberi)	–	–

Table 3-2. Summary description of food components assessed in the EPONM report--continued

Food component	Function in body	Good sources in diet	Consequences of inadequate intake	Consequences of excessive intake	Indicators of status in NNMS
Riboflavin	Component of enzymes involved in protein and energy metabolism	Milk, some cheeses, meat, liver	Cracks at corner of mouth; soreness and and inflammation of mouth, lips, and tongue	-	-
Niacin	Involved in energy metabolism and synthesis of protein and fat	Liver, peanuts, poultry, red meat, fish (also dairy products and eggs as sources of tryptophan)	Dermatitis, diarrhea, depression (pellagra)	Vascular dilation	-
Vitamin B6 (pyridoxal)	Functions in metabolism of protein; nervous system function	Poultry, fish, bananas, red meat	Depression, confusion, convulsions	Possible damage to peripheral nervous system	-
Vitamin B12 (cobalamins)	Required for formation of red blood cells, building genetic material, function of nervous system, and metabolism of protein and fat	Liver, red meat, fish, eggs, milk	Pernicious anemia; neurological damage	-	-
Vitamin C (ascorbic acid)	Formation of collagen; maintenance of capillaries, bones, and teeth; iron absorption; antioxidant	Citrus fruits, other fruits, tomatoes, potatoes, dark green vegetables	Hemorrhages in skin and gums, weakness, defects in bone development (scurvy)	Gastrointestinal symptoms	Serum ascorbic acid levels
Folacin (folate)	Formation of hemoglobin and genetic material	Liver, dark green leafy vegetables, dry beans, wheat germ	Pallor, weakness, neurological changes, anemia	-	Serum and red blood cell folate levels
Iron	Carrier of oxygen in body; red blood cell formation	Liver, beef, dry beans, spinach	Iron deficiency, iron deficiency anemia	Iron overload (persons with genetic predisposition)	Hemoglobin, hematocrit, MCV, erythrocyte protoporphyrin, transferrin saturation, serum ferritin
Calcium	Formation and maintenance of bone and teeth; muscle contraction; blood clotting; integrity of cell membranes	Milk, cheese, broccoli, spinach, turnip greens, canned fish	Osteoporosis (other factors also contribute significantly)	Renal calculi; possible soft tissue calcification	-
Phosphorus	Structural element of bones and teeth; participates in a variety of chemical reactions	Dairy products, meat, poultry, fish (protein sources)	None of practical concern	-	-
Magnesium	Component of bone; protein synthesis; release of energy from glycogen; regulation of body temperature and blood pressure	Whole-grain products, some dry beans, some dark green vegetables, nuts	Rarely - muscle spasms, tremor, nausea, apathy, convulsions, coma	-	-
Sodium	Regulation of body fluid volume and acid-base balance of blood; transmission of nerve impulses; principal extracellular cation	Salt (sodium chloride), sodium-containing additives and condiments	-	Edema, hypertension	-
Potassium	Regulation with sodium of body fluid volume and acid-base balance; principal intracellular cation	Red meat, milk, many fruits and vegetables, seafood	-	Hyperkalemia, cardiac arrest (acute intoxication)	-
Copper	Component of several proteins and enzymes; iron utilization	Shellfish, nuts, liver, kidney, corn oil, margarine, lentils	Anemia, bone disease	-	Serum copper levels
Zinc	Formation of protein; component of many enzymes; wound healing, blood formation, general growth and maintenance of all tissues	Shellfish, red meat, poultry, ricotta cheese, whole-grain cereals, dry beans	Growth retardation, poor appetite, mental lethargy, skin changes, retarded sexual development	Emesis (acute intoxication)	Serum zinc levels
Fluoride	Component of bones and tooth enamel	Fluoridated water, certain fish, tea (also from fluoridated toothpastes and rinses)	Impaired dental health	Mottled teeth	-

Table 3-3. Major sources and types of data related to individual food components available from the National Nutrition Monitoring System and used to update the 1986 JNMEC report

Food component	Nutrient Database (nutrient composition)	U.S. Food Supply Series (per capita amounts)	CSFII 1985-86 (dietary intake)	HHANES (nutritional status)	CDC PedNSS (nutritional status)	CDC PNSS (nutritional status)	CDC BRFSS (knowledge, behavior)	FDA Vit/Min (supplement intake)	FDA Health & Diet (knowledge, behavior)	NHIS HPDP (knowledge, behavior)
Food energy	X	X	X[1]	X[1]	X[1]	X[1]	X	–	X	–
Protein	X	X	X	–	–	–	–	–	–	–
Total fat	X	X	X	X[2]	–	–	X	–	X	–
Fatty acids[3]	X	X	X	X[2]	–	–	X	–	X	–
Cholesterol	X	X	X	X[2]	–	–	X	–	X	X
Carbohydrate	X	X	X	–	–	–	–	–	–	–
Dietary fiber	X[4]	–	X	–	–	–	–	–	X	–
Alcohol (ethanol)	X	–	X[5]	–	–	?	X	–	–	X
Vitamin A	X[6]	X	X	X[7]	–	–	–	X	–	–
Carotenes	X	X	X	–	–	–	–	–	–	–
Vitamin E	X[4]	X	X	X[8]	–	–	–	X	–	–
Thiamin	X	X	X	–	–	–	–	X	–	–
Riboflavin	X	X	X	–	–	–	–	X	–	–
Niacin	X	X	X	–	–	–	–	X	–	–
Vitamin B6	X[4]	X	X	–	–	–	–	X	–	–
Vitamin B12	X[4]	X	X	–	–	–	–	X	–	–
Vitamin C	X	X	X	–	–	–	–	X	–	–
Folacin	X	X	X	X[9]	–	–	–	X	–	–
Vitamin D	–	–	–	–	–	–	–	X	–	–
Pantothenic acid	–	–	–	–	–	–	–	X	–	–
Biotin	–	–	–	–	–	–	–	X	–	–
Iron	X	X	X	X[10]	X[11]	X[11]	–	X	–	–
Calcium	X	X	X	–	–	–	–	X	–	–
Phosphorus	X	X	X	–	–	–	–	X	–	–
Magnesium	X[4]	X	X	–	–	–	–	X	–	–
Sodium	X	–	X	X[12]	–	–	X	–	X	–
Potassium	X	X	X	–	–	–	–	X	–	–
Copper	X	X	X	–	–	–	–	X	–	–
Zinc	X	X	X	–	–	–	–	X	–	–
Iodine	–	–	–	–	–	–	–	X	–	–
Manganese	–	–	–	–	–	–	–	X	–	–
Fluoride	–	–	–	–	–	–	–	–	–	X

1 Body weight and height or stature (self-reported in CSFII 1985-86 and measured in HHANES, PedNSS, and PNSS); caloric intake measured in CSFII 1985-86 and HHANES.
2 Serum cholesterol, HDL-cholesterol, and triglyceride levels.
3 Saturated, monounsaturated, and polyunsaturated fatty acids.
4 Analytical values in CSFII 1985-86 database for <75 percent of important sources of nutrient.
5 Alcohol estimates from the daily recalls administered are likely to be underestimates.
6 Analytical values in CSFII 1985-86 database for 89 percent of the important sources in International Units; 73 percent of the best sources as retinol equivalents.
7 Serum retinol levels.
8 Serum alpha-tocopherol levels.
9 Serum and red blood cell folate levels for a subsample.
10 Hemoglobin, hematocrit, mean corpuscular volume (MCV), transferrin saturation, erythrocyte protoporphyrin, and serum ferritin.
11 Hemoglobin or hematocrit.
12 Blood pressure.

CSFII 1985-86 = Continuing Survey of Food Intakes by Individuals 1985-86
HHANES = Hispanic Health and Nutrition Examination Survey
CDC = Centers for Disease Control
PedNSS = Pediatric Nutrition Surveillance System
PNSS = Pregnancy Nutrition Surveillance System

BRFSS = Behavioral Risk Factors Surveillance System
FDA = Food and Drug Administration
Vit/Min = Vitamin/Mineral Supplement Intake Survey
NHIS = National Health Interview Survey
HPDP = Health Promotion and Disease Prevention

Biochemical, hematological, anthropometric, and/or clinical assessments of nutritional status or health conditions related to food energy; fat, fatty acids, and cholesterol; vitamin A; folacin; iron; and sodium are available in recent data from the NNMS. Some biochemical measurements that were included in NHANES II (serum levels of albumin, vitamin C, vitamin B12, copper, and zinc), however, are not available in the more recent HHANES. Criteria for the interpretation of many of these values are uncertain. Details on the limitations in data and availability of interpretative criteria are provided in the discussions of individual components later in this chapter.

Classification of Food Components by Monitoring Priority

As part of the update of information on dietary and nutritional status and the classification by monitoring priority, the EPONM addressed the question of which food components examined in the NNMS might constitute public health issues with respect to deficiency or excess. Ideally, all food components shown to be required for the maintenance of good health or for which excesses may represent a health risk should be monitored; practically, greater monitoring efforts should be directed to those shown to represent public health problems in the population. The classification scheme developed by the EPONM, together with the equivalent classification scheme used by the JNMEC, is presented in table 3-4.

The JNMEC classification and the classification used in this update report by the EPONM are similar philosophically. In the JNMEC report, nutrients and other food components were prioritized in three categories to contrast those components having high and moderate priority status for continued monitoring with the third group identified as those requiring further investigation. In this report, the EPONM labeled the categories somewhat differently to place emphasis on their evaluation in regard to public health significance. The category of food components considered to be current public health issues by the EPONM can be equated to the JNMEC category of food components warranting public health monitoring priority status. The category of food components considered by the EPONM to be potential public health issues and requiring further study is most similar to the JNMEC category of

Table 3-4. EPONM and JNMEC classifications for monitoring priority status of food components

EPONM classification	JNMEC classification
• **Food components were considered to be current public health issues**	• **Food components warranting public health monitoring priority status**
- if dietary intakes were low or high for a substantial proportion of the population, and if evidence from NNMS surveys of health and nutritional status indicated related health problems in the population or in subgroups of the population, or	- if evidence from health and nutrition surveys indicated related health problems in the population, and a substantial proportion of the population had 3-day dietary intakes considerably higher or lower than recommended levels, or
- if dietary intakes were low or high for a substantial proportion of the population, and if evidence from epidemiological or clinical studies in the literature indicated related health problems in the population or in subgroups of the population.	- if evidence from epidemiological and controlled clinical studies indicated related health problems in the population, and a substantial proportion of the population had 3-day dietary intakes considerably higher or lower than recommended levels.
Food components in this category are recommended for high priority monitoring status; that is, multiple assessments, when possible, should continue to be employed. A high priority should be given to development of assessment tools when these are lacking.	

Table 3-4. EPONM and JNMEC classifications for monitoring priority status of food components--continued

EPONM classification	JNMEC classification
• **Food components were considered to be potential public health issues, for which further study is needed,**	• **Food components requiring further investigation**
- if dietary intakes were low or high for a substantial proportion of the population, and if limited evidence from either NNMS nutrition and health surveys or studies in the literature suggested related health problems in at least some subgroups in the population, or	- if information from dietary and health surveys was insufficient to permit judgment about public health significance, or
- if dietary intakes were adequate for the majority of the population, but limited evidence from either NNMS nutrition and health surveys or studies in the literature suggested related health problems in at least some subgroups in the population, or	- if intakes deviated from recommended levels for many in the population, but related health problems could not be found or methods for identifying health problems were not available, or
- if dietary intakes were low or high for a substantial proportion of the population, and if evidence was not available from either NNMS nutrition and health surveys or studies in the literature that permitted evaluation of the public health significance of observed dietary intakes.	- if, despite theoretical reasons for believing that the food component might have public health significance, intakes were in an acceptable range and related health problems could not be identified.
Food components in this category are recommended for moderate monitoring priority status, with continued assessment at the least in subgroups suspected to be at risk, and moderate priority for the development of improved assessment techniques.	
• **Food components were not considered to be current public health issues**	• **Food components warranting continued public health monitoring consideration**
- if dietary intakes were adequate for the majority of the population, and evidence from either NNMS nutrition and health surveys or studies in the literature did not suggest related health problems in the population, or	- if no currently available evidence from health and nutrition examination surveys indicated related health problems in the population, and most of the population had 3-day dietary intakes that met recommended levels, or
- if dietary intakes were low or high for a substantial proportion of the population, but evidence from either NNMS nutrition and health surveys or studies in the literature did not suggest related health problems in the population.	- if potential health problems related to inadequate intakes were ruled out at the time.
Food components in this category are recommended for lower monitoring priority status; continued assessment should include, at a minimum, estimation of dietary intake.	(The JNMEC assigned some components to more monitoring consideration and some to less monitoring consideration.)

components requiring further investigation. The type of additional study required for different components differs; basic research on the health consequences of high or low intake, additional data on food composition and dietary intake, and/or the development of methods for assessing status together with interpretative criteria may be needed. The EPONM category of food components that are not considered current public health issues is most similar to the JNMEC category of components warranting continued monitoring consideration. Assigning food components to this category does not necessarily indicate that there are no known health problems associated with these components, but that the prevalence of such problems on a national basis is known or expected to be so low that a lower level of monitoring effort than for food components in the other categories is appropriate.

All of the categorizations by the EPONM in this report should be considered provisional. As new data from the NNMS and other sources become available, changes are likely to occur in the assessment of public health significance and level of monitoring appropriate.

A schematic diagram that illustrates the decision-making process used by the EPONM for categorizing food components is shown in figure 3–4. This process differs from the one used by the JNMEC in that the evaluation of each food component begins with the dietary intake data. This choice to begin the evaluation of each food component with consideration of the dietary intake data was made recognizing that such data are available for most of the components included; the same is not true of related health data.

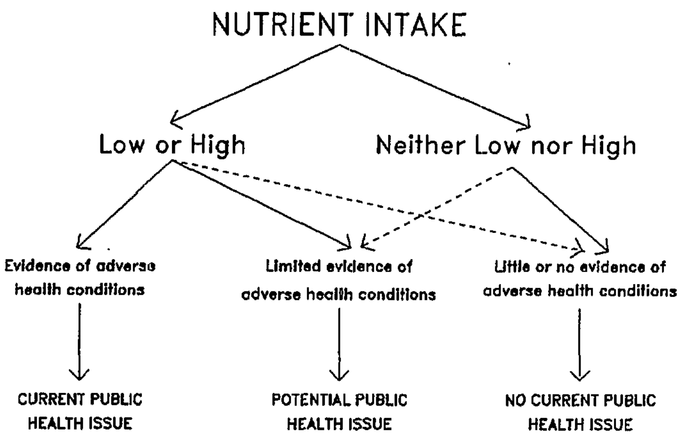


Figure 3–4. Decisionmaking process used by the EPONM in categorizing food components by monitoring priority status (Dotted lines indicate less likely outcomes.)

However, as illustrated in figure 3–4, the results of both processes are similar in that the evidence for adverse health consequences ultimately determines the categorization of food components. Criteria used by the EPONM in assessing dietary intake and health consequences are described in the following section.

Approach to Assessing Which Food Components Represent Public Health Issues in National Nutrition Monitoring

The variety of NNMS data available for the different components suggests that no single approach to assessment can be recommended for all components. Each component must be considered independently in terms of the data available, primarily from the NNMS, but also from the general biomedical literature in some cases. When data from the literature are used, reports such as *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) or *Diet and Health: Implications for Reducing Chronic Disease Risk* (National Research Council, 1989) that represent a consensus of scientific opinion constitute the primary sources of information.

For assessing the potential public health issues with respect to inadequacy of various food components, the RDA (or safe and adequate intakes) may be helpful as a first step in examining dietary intakes of food components. For the reasons indicated in chapter 2, it is inadvisable to use specified levels of the RDA, or numbers or percentages of persons with intakes above or below the RDA, <u>as a sole criterion</u> for identifying a public health issue with respect to dietary deficiency. The RDA (except for energy) are estimated to exceed the requirements of most healthy individuals. As noted by the Committee on Dietary Allowances of the Food and Nutrition Board (National Research Council, 1980), "In assessing dietary surveys of populations, if the amounts of nutrients consumed fall below the RDA for a particular age–sex group, some individuals can be assumed to be at nutritional risk. When the proportion of individuals with such low intakes is extensive, the risk of deficiency in the population is increased."

The approach used by the EPONM to assign food components to categories in its classification scheme was essentially similar to that used by the JNMEC. To de-emphasize reliance on the RDA as a standard for dietary adequacy, the EPONM has not tabulated dietary intake data in this report as a percent of the RDA. However, in the evaluations of individual food components that follow, the RDA (or safe and adequate intake), if available, was used as a rough initial screen for possible deficiency. Initially, a determination was made to ascertain whether the mean intake (based mainly on multiple days of data) of the population groups considered was above or below the RDA and whether there were substantial numbers of very low intakes in the population. Then:

- If the mean intake of a specified component exceeded its RDA, then very few individuals would be likely to be at risk of deficiency in that population.

  - If the biochemical and clinical evidence available from the NNMS (or other sources) confirmed the absence of a nutritional deficiency problem, the specified component was not considered to be a current public health issue with respect to deficiency in the population surveyed.

  - On the other hand, if additional evidence from the NNMS or other sources indicated the potential of deficiency in at least some groups in the population, the food component was classified as one considered to be a potential public health issue, for which further study is required to determine the nature and extent of the potential problem.

- Alternatively, if the mean intake of a component fell substantially below the RDA or if a substantial number of persons in the population or particular subgroups had very low intakes, a possible problem of undernutrition may be indicated.

  - However, additional evidence of a nutritional problem based on clinical or biochemical data from the NNMS was needed to determine that the component should be considered a current public health issue. Such clinical and biochemical data were accorded more weight than the dietary intake data.

  - If such data were not available from the NNMS, information in the general medical literature was used to assess the possibility that the specified component should be considered a current public health issue.

  - If intakes were low, but no data from the NNMS or elsewhere indicated a problem, the food component was not considered to be a current public health issue.

  - If intakes were low, and no data on health or nutritional status were available from the NNMS or any other source to assess the potential for deficiency, then the component was considered to be a potential public health issue, for which further study is required.

The EPONM used a similar approach for assessing high intakes of food components; however, the RDA is less useful in identifying potential public health problems with respect to excess intake or overnutrition. If the mean intake was near or above the RDA and the distribution of intakes was skewed to the side of high intakes, the possibility of deleterious health effects was evaluated. Other standards may be more applicable to components such as fat, saturated fat, cholesterol, and sodium for which excessive intake is presumed to be harmful. Evidence for possible excessive consumption from supplements was also considered. The same types of confirmatory evidence from the NNMS or from other sources about deleterious effects were required for the categorization of high intakes as for low intakes.

Evidence for health consequences is provided mainly by the biochemical and clinical data from the NNMS. The EPONM used the same criteria as the JNMEC to evaluate these data. As noted by the JNMEC (DHHS/USDA, 1986), "Much can be inferred about the nutritional status of the population, even with imperfect data judged by imperfect criteria, especially when a wider knowledge of nutrition is brought to bear." Thus, in addition to the criteria above, the members of the EPONM have applied their experience and judgment in categorizing food components.

The classification of food components into the categories by the EPONM is presented in table 3-5 and comparisons with the JNMEC categorizations are presented in table 3-6. The individual evaluations of each food component that justify the classifications follow.

Discussion of Individual Food Components

In the following sections on the individual food components, discussions are organized around the question, "What is the evidence from the current data (mainly from the NNMS) that a public health issue exists with respect to this component?" Comparisons of current data and earlier data are made as appropriate. Greatest weight is given to biochemical and clinical evidence. For the discussions of each food component, the following are included:

- Reasons for concern about inadequacy or excess of the component, including the JNMEC classification.

- Information on trends in the amount and food sources of the food component in the U.S. food supply, with emphasis on current status.

Table 3-5. EPONM classification of food components by monitoring priority[1]

Current public health issue	Potential public health issue; further study needed	Not current public health issue
Food energy	Dietary fiber	Protein
Fat	Vitamin A	Carbohydrates
Saturated fat	Carotenes	Vitamin E
Cholesterol	Folacin	Thiamin
Alcohol	Vitamin B6	Riboflavin
Iron	Vitamin C	Niacin
Calcium	Potassium	Vitamin B12
Sodium	Zinc	Magnesium
	Fluoride	Copper
		Phosphorus

[1] A graded priority should be accorded to those food components judged to be current or potential public health issues.

- Information on current individual dietary intakes and changes observed in recent surveys.
- Information on biochemical/clinical assessments, if any, related to the food component.
- Information on the extent of supplement use, if any.
- Evaluation of public health significance of findings based on the approach described above.
- Conclusion on monitoring priority status based on public health significance.

The data tables and graphs that support the discussions of the individual food components are included, by topic, in appendix II (these tables and graphs are numbered II-1, II-2, II-3, and so on). For some components identified as "current public health issues," additional analyses of the influence of sex, age, ethnic group, and socioeconomic status are shown in the text. The data (if available) presented in appendix II for each food component include the following:

- Graphs of per capita amounts provided by the U.S. food supply (U.S. Food Supply Series, 1909-85).
- Graphs of food sources in the U.S. food supply (U.S. Food Supply Series, 1985).
- Tables of dietary intake from food only (4 days) for women aged 20-49 years and their children aged 1-5 years (CSFII 1985-86).
- Tables of mean dietary intake from food only (1 day) for both sexes and all ages (NHANES I, 1971-74; NFCS 1977-78; NHANES II, 1976-80; and CSFII 1985-86).
- Tables of biochemical and clinical data for Mexican Americans, Cubans, and Puerto Ricans (HHANES, 1982-84) and comparable data for non-Hispanic whites and blacks (NHANES II, 1976-80).
- Tables reporting vitamin and mineral supplement use (FDA Vitamin/Mineral Supplement Intake Survey, 1980) (see tables II-132 and II-133).

Table 3-6. Comparison of JNMEC and EPONM conclusions on classification of food components assessed in the NNMS

Food component	JNMEC classification	EPONM classification	Comments
Food energy	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Protein	Public health monitoring consideration (more)	Not current public health issue	EPONM and JNMEC essentially in agreement
Fat	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Saturated fat	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Cholesterol	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Carbohydrates	Public health monitoring consideration (less)	Not current public health issue	EPONM and JNMEC in agreement
Dietary fiber	Further study required	Potential public health issue (further study needed)	EPONM and JNMEC in agreement
Alcohol	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Added caloric sweeteners	Further study required	Not evaluated	No comparison possible
Vitamin A	Public health monitoring consideration (more)	Potential public health issue (further study needed)	EPONM gave more weight to low serum levels in some groups
Carotenes	Not evaluated	Potential public health issue (further study needed)	No comparison possible
Vitamin E	Not evaluated	Not current public health issue	No comparison possible
Thiamin	Public health monitoring consideration (more)	Not current public health issue	EPONM and JNMEC essentially in agreement
Riboflavin	Public health monitoring consideration (more)	Not current public health issue	EPONM and JNMEC essentially in agreement
Niacin	Public health monitoring consideration (more)	Not current public health issue	EPONM and JNMEC essentially in agreement
Vitamin B6	Further study required	Potential public health issue (further study needed)	EPONM and JNMEC in agreement
Vitamin B12	Public health monitoring consideration (less)	Not current public health issue	EPONM and JNMEC in agreement
Vitamin C	Public health monitoring priority status	Potential public health issue (further study needed)	EPONM noted improved intake; little evidence of health effects
Folacin	Further study required	Potential public health issue (further study needed)	EPONM and JNMEC in agreement
Iron	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Calcium	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Phosphorus	Public health monitoring consideration (less)	Not current public health issue	EPONM and JNMEC in agreement
Magnesium	Further study required	Not current public health issue	Little evidence of health effects
Sodium	Public health monitoring priority status	Current public health issue	EPONM and JNMEC in agreement
Potassium	Not evaluated	Potential public health issue (further study needed)	No comparison possible
Copper	Not evaluated	Not current public health issue	No comparison possible
Zinc	Further study required	Potential public health issue (further study needed)	EPONM and JNMEC in agreement
Fluoride	Public health monitoring priority status	Potential public health issue (further study needed)	EPONM concluded data too limited to assess extent of possible problem

Food Energy

The diet must provide sufficient energy to meet the body's requirements for growth and development, metabolic functions, muscle activity, and repair of damage caused by injury or illness (DHHS, 1988). Food energy is provided by fat, carbohydrate, protein, and alcohol. Food energy is measured in kilocalories, commonly referred to as calories. The pure forms of fat, carbohydrate, protein, and alcohol provide approximately 9, 4, 4, and 7 kilocalories per gram, respectively (Merrill and Watt, 1973).

When sufficient food is available, healthy individuals normally consume enough food to maintain body weight and support growth. Chronically low intakes of energy in relation to requirements lead to underweight and, in extreme cases, semistarvation. In children, low energy intake may also lead to growth retardation. Most, but not all, persons in the United States have access to sufficient food, but insufficient consumption occurs among some individuals because of insufficient resources to purchase adequate food and as a clinical problem among patients with a variety of physical and mental diseases (DHHS/USDA, 1986). Over time, consumption of energy in excess of needs leads to overweight and obesity.

Body weight depends on complex physiological controls of the balance between energy intake and energy expenditure; both factors are equally important in regulating body weight (DHHS, 1988). The JNMEC accorded food energy a high priority for public health monitoring status because of evidence that energy imbalance was reflected in the high prevalence of overweight in the United States. Body mass index (BMI), defined as weight (kg)/height $(m)^2$, was considered to reflect long-term energy balance; the criteria for overweight and severe overweight were set, respectively, at the 85th and 95th percentiles of BMI for men and women aged 20–29 years. (Overweight, defined in this fashion, was considered an approximation of excess body fatness or obesity.) The criteria used by the JNMEC for assessing overweight were also used in this report. These cutoffs represent a statistical approach to defining overweight and are not based on morbidity or mortality experience; if the health consequences of overweight were considered, BMI standards might differ with age.

Per capita energy content of the food supply (3500 kilocalories in 1985) is substantially higher than the intakes recorded in surveys of individuals. There have been fluctuations in the energy content of the food supply over time, but no clear trends (figure II–1). The most notable changes in the food sources of energy from 1909 to 1985 have been an increase in the percentage of energy contributed by fats and oils (especially shortening and salad, cooking, and other edible oils), an increase in the percentage contributed by sugars and sweeteners, and a decrease in the percentage contributed by grain products. In 1985, the major sources of food energy in the food supply were fats and oils (20 percent); grain products (19.9 percent); meat, poultry, and fish (19 percent); and sugars and sweeteners (17.8 percent) (figure II–2).

Concern about low energy intakes in childhood arises from the possibility of growth retardation, based on evidence of short stature among children of low socioeconomic status (see chapter 4). However, the CSFII 1985–86 data indicate that children aged 1–5 years have mean intakes of energy that fall within the range of Recommended Energy Intakes (table II–2). Intakes did not differ greatly for blacks and whites or for children above and below poverty.

Data from CSFII 1985–86 suggest that a different situation exists for women (table II–1). Their reported mean intake falls below the recommended range, and intake is lower in older (40–49 years) than in younger (20–29 years) women, lower in blacks than in whites, and lower for women below poverty than those above poverty. Relationships of energy intake to the range of household income and to household composition are shown in tables 3–7 and 3–8. Intakes are observed to rise slightly with increasing income but plateau at higher income levels, and are substantially lower in women with children who lived in households without a male head than in women living in any other type of household. Mean (1-day) individual energy intakes measured in surveys conducted in the 1970s and 1980s show some fluctuations, but no clear trends, over time for most age and sex groups.

Data on overweight for persons aged 20–74 years in the HHANES (table II–4) permit comparison of the three ethnic groups in that survey to non-Hispanic blacks and whites in NHANES II (table II–7) (see also figure 4–2 in chapter 4). In all three Hispanic groups, the age-adjusted prevalence of overweight was higher in females than in males (table 3–9). Mexican-American and Cuban males had a slightly higher prevalence of overweight (31 and 28 percent, respectively) than did Puerto Ricans (26 percent); the prevalence in the latter group was similar to that in non-Hispanic whites and blacks (table 3–9). The prevalence of overweight in Mexican-American and Puerto Rican females (42 and 40 percent, respectively) was higher than in Cubans (32 percent) or non-Hispanic whites (24 percent) and similar to the prevalence in non-Hispanic blacks (44 percent) (table 3–9). The prevalence of overweight in Mexican-American men was not affected by poverty status, but the prevalence was greater in Mexican-American women below

Table 3–7. Mean intake of food energy in kilocalories for women aged 20–49 years, 4 nonconsecutive days, by household income (percent of poverty): Continuing Survey of Food Intakes by Individuals 1985–86

Household income (percent of poverty)	n	Intake: Mean	Intake: Standard error of the mean
All women	2,056	1,517	16
Quintiles			
First (0–113)	369	1,418	42
Second (114–207)	378	1,495	37
Third (208–305)	405	1,543	37
Fourth (306–426)	370	1,588	28
Fifth (427+)	368	1,562	29

Table 3–8. Mean intake of food energy in kilocalories for women aged 20–49 years and children aged 1–5 years, 4 nonconsecutive days, by household composition categories: Continuing Survey of Food Intakes by Individuals 1985–86

Household composition	n	Intake: Mean	Intake: Standard error of the mean
Women, 20–49 years			
Male head and			
– No children	412	1,526	28
– Child(ren)	1,151	1,546	19
No male head and			
– No children, no other adult	124	1,532	47
– No children, other adult	91	1,593	80
– Child(ren)	278	1,355	47
Children, 1–5 years			
Male head	563	1,421	24
No male head	84	1,453	45

Table 3–9. Age-adjusted percent of overweight and severely overweight persons aged 20–74 years, by sex and ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80[1]

Ethnic group or race	Percent overweight: Male	Percent overweight: Female	Percent severely overweight: Male	Percent severely overweight: Female
Mexican American	30.9	41.6	10.8	16.9
Cuban	27.6	31.6	10.7	6.6
Puerto Rican	25.6	40.2	8.0	15.7
Non-Hispanic white	24.2	23.9	7.7	9.4
Non-Hispanic black	26.0	44.4	10.0	19.8

[1] See text for definition of overweight and severely overweight.

poverty than in those above poverty (tables 3–10 and II–5). The same relationship was seen for non–Hispanic women below and above poverty; the prevalence of overweight was somewhat lower in non–Hispanic men below poverty than those above poverty (tables 3–10 and II–7). Although there are some exceptions, a general trend for higher prevalence of overweight with increasing age until the oldest age groups (60–69 and 70–74 years) exists (tables II–4 and II–7).

Table 3–10. Age–adjusted percent of overweight Mexican–American and non–Hispanic persons aged 20–74 years, by sex and poverty status: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80[1]

Sex and ethnic group	Percent overweight: Below poverty	Percent overweight: Above poverty
Males		
Mexican American	31.8	31.1
Non–Hispanic	21.5	24.6
Females		
Mexican American	46.1	40.1
Non–Hispanic	38.5	24.6

[1] See text for definition of overweight.

The low calorie intakes reported may be considered paradoxical in view of the high prevalence of overweight in this country, especially in women of low socioeconomic status. The JNMEC report (DHHS/USDA, 1986) concluded that, if reported diets represent usual energy intake and such a large proportion of the population is overweight, many Americans are underactive. Methodological constraints in assessing the role of eating practices in the genesis of overweight and obesity include possible underreporting of food intake and possible higher energy intakes at some time in the past, but other factors may also contribute to the development of obesity. These include heredity, decreased physical activity without an appropriate reduction in energy intake, and other reasons such as altered metabolism of adipose tissue, defective or decreased heat production in the body (thermogenesis), and the use of certain drugs (DHHS, 1988). Further research is needed to evaluate the relative contributions of these factors to the occurrence of obesity and overweight; data available from the NNMS do not permit assessment of their impacts. However, like the JNMEC, the EPONM considers it probable that low physical activity has a significant relationship to the high prevalence of overweight observed in the United States. The U.S. dietary guidelines (USDA/DHHS, 1985) recommend achieving and maintaining desirable weight by an appropriate balance of energy intake and expenditure. Recommendations indicate that energy intake can be reduced by limiting consumption of foods relatively high in calories, fats, and sugars and minimizing alcohol consumption; energy expenditure can be increased through regular and sustained physical activity. In the opinion of the EPONM, the current low levels of reported intake suggest that further reductions in energy content of diets, without a concomitant change in dietary pattern toward greater nutrient density, may compromise overall nutritional status, especially in women. These observations lead the EPONM to conclude that greater emphasis should be given by the scientific community to the role of physical activity in the etiology and treatment of obesity.

Conclusion: Food energy is considered a current public health issue. Reported dietary intakes of adults are lower than Recommended Energy Intakes, but the data available from the NNMS on the high prevalence of overweight (approximately one–fourth of adults) in many groups in the United States suggest a continuing public health problem in regard to energy balance. Food energy should be accorded high priority for monitoring status. Additional information on both energy intake and energy expenditure (physical activity) is required to evaluate the relative impact of these factors on the occurrence of obesity.

Protein

Protein is required for growth, development, and maintenance of body tissues and is involved in almost all metabolic processes. Food protein supplies the amino acids needed to form the body proteins that comprise muscle, connective tissue, bone matrix, and other body components, as well as enzymes, antibodies, and hormones. Protein–energy malnutrition is a serious public health problem in some countries but occurs rarely in the United States, except in association with child neglect, food faddism, or serious underlying disease (DHHS/USDA, 1986). Dietary protein in excess of need may be converted to body fat. High intakes of protein have been hypothesized to contribute to the decline in kidney function with age, but there is no evidence that current intakes by the U.S. population adversely affect the prevalence of renal disease (DHHS, 1988). Although associations between high intakes of animal protein and the incidence of coronary heart disease and some cancers have been suggested, these associations are likely confounded by the high correlation between animal protein and fat intake (National Research Council, 1989).

The JNMEC report classified protein as a component warranting continued public health monitoring consideration, because intakes exceeded recommended levels and there was no evidence from health and nutrition examination surveys of related health problems. The JNMEC evaluation, as well as information from the literature, suggested that there has been little concern about inadequacy or excess in regard to protein intake in any population subgroup.

A review of the per capita protein content in the U.S. food supply shows that the 1985 level of 104 grams per day is similar to the level available during most of the century (figure II–3). In 1985, the major sources of protein in the food supply were meat, poultry, and fish (43.4 percent); dairy products (20.6 percent); and grain products (19 percent) (figure II–4). The sources of dietary protein have changed over time, with increases since 1909–13 in the proportion provided by meat, poultry, and fish and dairy products and a large decrease in the proportion provided by grain products. Over the last 20 years, the percentage of dietary protein provided by meat has declined, with a concomitant increase in the percentage supplied by poultry and fish. During the same 20 years, the contribution of total dairy products has remained the same, but the proportion of protein supplied by particular dairy products has shifted, with decreased percentages for whole milk and increased percentages for lowfat milk and cheese.

Based on the CSFII 1985–86 data, mean intakes of dietary protein in all groups among women aged 20–49 years, and among children aged 1–5 years, were well above the RDA. Individuals above poverty and those with higher levels of education had greater intakes of protein. However, the differences in intake were relatively small; even among those individuals below poverty and those with less than a high school education mean protein intakes were 20–30 percent above the RDA. There did not appear to be any large differences in protein intake by age, race, region, or degree of urbanization. These data suggest that the percentage of individuals with a low protein intake that would put them at risk for having adverse health conditions probably continues to be very low. Data from surveys conducted during the 1970s and 1980s indicate little change in protein intake (1–day means) over this time (table II–14). The data also indicate that mean intakes are lower in the elderly than in younger adults, but still exceed the RDA.

Although biochemical assessments of protein nutritional status have not been included in NNMS surveys completed since the publication of the JNMEC report, earlier results from NHANES I and II showed little or no evidence of protein deficiency based on serum albumin levels. Protein status may be a greater concern in the elderly, especially the institutionalized elderly, but data are not available from the NNMS to address this concern.

Conclusion: Protein is not considered to be a current public health issue. Intakes appear to be adequate for almost all persons and there is no evidence of health problems associated with deficiency or excess. Monitoring should continue at a low level, especially for the elderly.

Fat, Fatty Acids, and Cholesterol

Excess consumption of dietary fats has been associated with heart disease, certain cancers, obesity, and gall bladder disease. The JNMEC classified total fat, saturated fatty acids, and cholesterol as components warranting public health monitoring priority on the basis of high dietary consumption. Other than the general recommendation that 3 percent of energy be obtained from essential fatty acids, there are no RDAs for fat or cholesterol. When calorie intake is adequate, public health problems have not been ascribed to inadequate intakes of fat or cholesterol. Excessive intake is, however, a public health concern; the dietary guidelines for Americans (USDA/DHHS, 1985) recommend avoiding too much fat, saturated fat, and cholesterol. *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) concurs that reducing the consumption of fat (especially saturated fat) and cholesterol is an issue for most people. The Adult Treatment Panel of the National Cholesterol Education Program has recommended a reduction in the intake of total fat to less than 30 percent of calories, saturated fatty acids to less than 10 percent of calories, and cholesterol to less than 300 milligrams per day for adults with high serum cholesterol levels and other risk factors for cardiovascular disease (NHLBI, 1987; NIH, 1987). Similar quantitative reductions have been recommended for the general population (for adults or for persons over 2 years of age) by other authoritative groups (American Cancer Society, 1984; American Heart Association, 1986; NIH Consensus Development Panel, 1985; National Research Council, 1989).

The per capita amount of fat in the U.S. food supply has increased between 1909 and 1985, equaling 169 grams per day in 1985 (figure II–5). (These food supply estimates include fat that is lost or discarded as waste and, thus, are much higher than estimates of the fat intake of individuals.) The distribution of types of fat in the food supply has shown change over the last several decades. The per capita amount of saturated fat has remained nearly constant (near 60 grams per day) (figure II-7), while the amount of monounsaturated fat has gradually increased since 1909 and equaled 68 grams per day in 1985 (figure II-9). The largest change has been in the amount of polyunsaturated fat which has more than doubled since 1909, with the greatest increase occurring since the mid-1960s (figure II-11). In 1985, per capita polyunsaturated fatty acids equaled 33 grams per day. Cholesterol in the U.S. food supply has decreased slightly since reaching a high in 1945, equaling 500 milligrams per capita per day in 1985 (figure II-13).

Food groups contributing fat in the food supply have shifted. The proportion of total fats from meat, poultry, and fish has changed only slightly, equaling 31.4 percent in 1985 (figure II-6). The proportion of fat from whole milk has declined steadily from a high of 10.4 percent in 1947-49 to 3 percent in 1985, while the proportion from fats and oils has increased from 38 percent to 47 percent in the same period. Other food groups make little contribution. For saturated fat, although there have been only small changes between 1909 and 1985 in the overall proportions provided by meat, fish, and poultry and dairy products, there has been a shift within the dairy group with the proportion from whole milk decreasing and that from cheese increasing. Within the fats and oils groups, the proportion of saturated fat from animal sources has decreased while the proportion from vegetable sources has increased. In 1985, meat, poultry, and fish; fats and oils; and dairy products contributed almost all of the saturated fat in the food supply (figure II-8). The proportion of polyunsaturated fatty acids from meat, poultry, and fish has decreased, but the proportion from the fats and oils group has more than doubled over the last 76 years. In 1985, 68 percent of polyunsaturated fatty acids were contributed by this food group (figure II-12). The three major food groups supplying cholesterol in 1985 were meat, poultry, and fish (43 percent); dairy products (13 percent); and eggs (39 percent) (figure II-14).

Based on 4-day dietary intake data from the CSFII 1985-86, estimates of the fat intakes of women aged 20-49 years and children aged 1-5 years were 37 and 35 percent of calories, respectively (tables II-17 and II-19). Only approximately 10 percent of women had fat intakes below 30 percent of calories. For women in the CSFII 1985-86, total fat intakes were higher for whites than for blacks and higher for those of higher socioeconomic status than for those of lower socioeconomic status; however, race and socioeconomic factors had little effect on percent of calories from fat (tables II-16 and II-17). Saturated fatty acids comprised an estimated 13 and 14 percent of calories in the diets of women and children, respectively (tables II-23 and II-25). Monounsaturated fats provided 13 percent of calories for both women and children (tables II-28 and II-30). Polyunsaturated fats provided 6 percent of calories for children and 7 percent for women (tables II-33 and II-35). Mean cholesterol intakes were 277 and 228 milligrams per day for women and children, respectively (tables II-37 and II-38). More than 25 percent of women had mean cholesterol intakes in excess of 300 milligrams per day (table II-37). The mean intake of dietary cholesterol of women did not vary greatly with age, poverty status, or education.

One-day data (table II-20) from the CSFII 1985-86 show that mean intakes of total fat for children and adult males are similar to the NFCS 1977-78 means, whereas for females 20-49 years old, total fat intake appears to have decreased about 10 percent between these surveys. The intakes for women from CSFII 1985-86 are similar to those from NHANES I and II. Whether the differences in intake seen in the different surveys truly reflect changes in consumption over time, or result from differences in survey methods, is uncertain. The analysis by Perloff (1988), described in chapter 2, evaluated one methodological difference between the NFCS 1977-78 and CSFII 1985-86 that may have affected the estimates of fat intake. This analysis examined changes in the nutrient composition database for fat and concluded that product changes contributed far more than data changes. However, the effects of other methodological differences among the surveys, such as degree of probing and rules for coding responses, have not been evaluated. Thus, the available data do not permit a confident assessment of whether fat intake has changed over time. The percent of calories from total fat (table II-21) has apparently decreased slightly for children (from 37 percent in 1977 to 35 percent in 1985-86), decreased for males (from 41-42 percent in 1977 to 36-37 percent in 1985), and decreased for females (from 40-42 percent in 1977 to 36-37 percent in 1985-86). Increases in consumption of carbohydrate during this time period may have contributed to the decline in the percent of calories from fat. Prior to 1985-86, intakes of the fatty acid groups were not reported in USDA surveys. The interpretation of cholesterol intake over time (table II-39) is complicated by the fact that data on the cholesterol content of many foods were not available at the time of NHANES I (Dresser, 1983). However, the estimated intakes of men have remained high; mean (1-day) values in CSFII 1985 (423-466 milligrams per day) are well in excess of recommended levels.

Despite the limitations in the interpretation of the individual dietary intake data (especially in the assessment of trends over time), it is clear that many persons have intakes of total fat, saturated fatty acids, and cholesterol that exceed recommended levels.

Data on mean serum cholesterol levels are available from HHANES (tables II-40 and II-41) and may be compared to NHANES II data (tables II-42 and II-43). In order to maintain comparability with the JNMEC evaluation in the update portion of this report, the criteria for "high-risk cholesterol" levels in serum were those recommended by the 1984 NIH Consensus Development Conference (NIH, 1985): >5.69 mmol/L (>220 milligrams/dl) for persons aged 20-29 years; >6.21 mmol/L (>240 milligrams/dl) for persons aged 30-39 years; and >6.72 mmol/L (>260 milligrams/dl) for persons aged 40 years and older. These criteria were chosen on the basis of observed statistical distributions of cholesterol values rather than on the basis of disease relationships. New standards for defining risk based on elevated blood cholesterol levels and other factors were defined by the National Cholesterol Education Program during preparation of this report; these are discussed in chapter 5. The prevalences of "high-risk cholesterol" levels in Mexican Americans, Cubans, and Puerto Ricans in HHANES and non-Hispanic whites and blacks in NHANES II are shown in figures 3-5 and 3-6 (see also tables II-40 and II-42).

For adult men (20-74 years) in the three Hispanic groups, the mean serum cholesterol levels ranged from 5.26 to 5.35 mmol/L, with 13.5-15.5 percent considered to have "high-risk cholesterol." For women, mean serum cholesterol levels were almost identical to those of men (5.15 to 5.39 mmol/L), and 11.3-15.4 percent had "high-risk cholesterol." Mean serum cholesterol levels did not differ greatly among the three Hispanic ethnic groups, whereas means for males above poverty tended to be greater than those below poverty, particularly in older adults. The prevalence of "high-risk cholesterol" in men and women of all three Hispanic groups was lower than the prevalence in non-Hispanic whites and blacks. Factors contributing to high serum cholesterol include obesity, dietary saturated fat and cholesterol, nondietary behaviors, and genetic factors (see chapter 5 for a detailed discussion of these factors).

<u>Conclusion</u>: Total fat, saturated fat, and cholesterol are considered to be current public health issues. The intakes of these food components by many

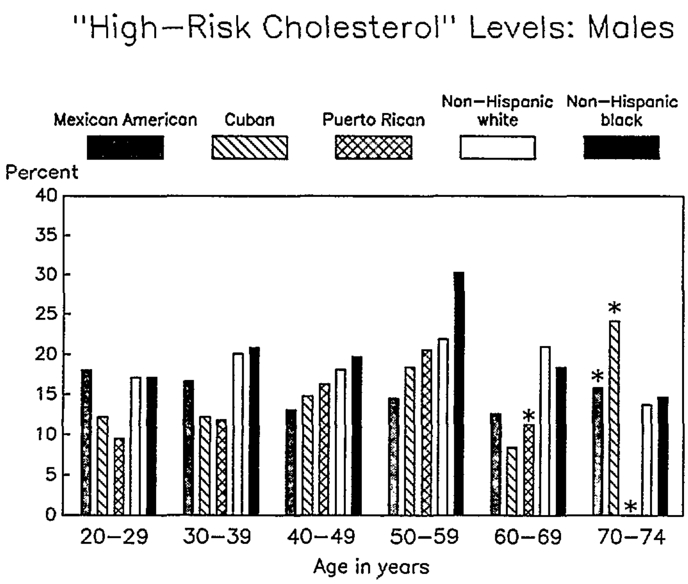


Figure 3-5. Prevalence of "high-risk cholesterol" levels in serum in males, by age and ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982-84, and second National Health and Nutrition Examination Survey, 1976-80 (See text for serum cholesterol values that are considered "high-risk." The asterisk indicates an unstable statistic or a statistic not reported because of small sample size.)

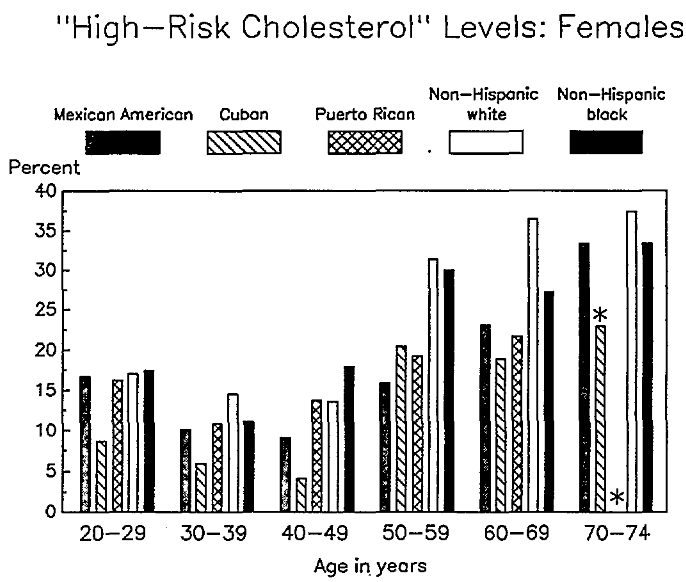


Figure 3-6. Prevalence of "high-risk cholesterol" levels in serum in females, by age and ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982-84, and second National Health and Nutrition Examination Survey, 1976-80 (See text for serum cholesterol values that are considered "high-risk." The asterisk indicates an unstable statistic or a statistic not reported because of small sample size.)

persons in the U.S. population exceed levels recommended by many authoritative groups. Serum cholesterol levels are affected by dietary intake of these components (and other factors); elevated levels of serum cholesterol are prevalent in the United States (11–22 percent) in men and women of all racial and ethnic groups examined and represent a risk factor for the development of coronary heart disease. Continued priority for the monitoring of serum cholesterol levels and the dietary intake of fat, fatty acids, and cholesterol is warranted. More specific recommendations are included in chapter 5.

Carbohydrates

Carbohydrates are sources of energy for the body and serve as constituents of various cellular structures and substances. Carbohydrates are classified as monosaccharides, disaccharides, and polysaccharides. The mono- and disaccharide sugars are called simple carbohydrates and the polysaccharides (such as starch) are called complex carbohydrates. The JNMEC classified total carbohydrate as a component warranting less consideration for public health monitoring priority.

Dietary guidelines (USDA/DHHS, 1985) for the general American public have focused on food choices designed to maintain health and reduce the risks of chronic and degenerative diseases. Among the dietary guidelines are recommendations to eat foods with adequate starch and fiber and to avoid too much sugar. A reduction in frequency of sugar consumption, particularly sugar found in sticky-type foods, is recommended to reduce dental caries, especially in vulnerable groups such as children. There are no specific guidelines for a quantitative requirement for carbohydrates in the diet.

The per capita amount of carbohydrates in the food supply, which had declined since 1909, has shown a fluctuating upward trend since the mid-1960s (figure II-15). In 1985, sugars and sweeteners contributed 39.6 percent of the carbohydrates in the food supply; grain products, vegetables, and fruits provided 35.8, 9.2, and 6.6 percent, respectively (figure II-16). There has been a substantial decrease in the proportion of carbohydrates contributed by grain products in the food supply since 1909. During the same time, there has been an increase in the proportion of carbohydrates supplied by sugars and sweeteners; most of the change since the 1960s has been caused by increased use of high fructose corn syrup.

Based on 4-day data from the CSFII 1985-86, the carbohydrate intake of women aged 20-49 years was 175 grams per day (46 percent of calories); the intake of children aged 1-5 years was 184 grams per day (52 percent of calories) (tables II-44 through II-47). The intake of carbohydrate as percent of calories was not greatly affected by race, poverty status, or educational level. Based on 1-day estimates, there has been a general trend during the 1970s and early 1980s for an increase in the mean percent of calories from carbohydrate for most age and sex groups (table II-49).

There are no health assessments, other than decayed teeth, specifically thought to be associated with intake of carbohydrates.

<u>Conclusion</u>: Carbohydrates are not considered to be a current public health issue. Carbohydrate intakes are lower than may be desirable, based on the dietary pattern recommended in the U.S. dietary guidelines (USDA/DHHS, 1985), but evidence does not suggest that current intakes pose a specific public health problem. Monitoring of intake should continue; if recommended decreases in the percent of energy from fats occur, concomitant increases in the proportion from carbohydrates are expected.

Dietary Fiber

Dietary fiber is a term that refers to a heterogeneous group of plant food components that are resistant to digestion by enzymes produced by the human gastrointestinal tract. Different dietary fibers are classified as soluble or insoluble depending upon their response to various extraction techniques. In general, the soluble fibers include gums, mucilages, and some pectins and hemicelluloses, while the insoluble fibers include cellulose, lignin, and other pectins and hemicelluloses. Grains, fruits, and vegetables are good sources of fiber; oat bran, beans, and dried fruit are good sources of soluble fiber components, while wheat bran is a good source of insoluble fiber components.

The JNMEC report considered dietary fiber to be a component that required further investigation. *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) concluded that consuming foods with dietary fiber is usually beneficial in the management of constipation and diverticular disease. In addition, some evidence from clinical studies suggests that soluble fibers are associated with lower blood glucose and blood lipid levels; although inconclusive, some evidence also suggests that an overall increase in intake of foods high in fiber might decrease the risk for colon cancer. The dietary guidelines for Americans advise eating foods with adequate starch and fiber (USDA/DHHS, 1985). Although there is disagreement whether quantitative recommendations for dietary fiber intake are appropriate at this time (National Research Council, 1989), the National Cancer Institute (1984) currently recommends that adults consume 20-30 grams per day with an upper limit of 35 grams for day.

Estimates of mean (4-day) daily dietary fiber intake from the CSFII 1985-86 are 11 grams for women aged 20-49 years and 10 grams for children aged 1-5 years (tables II-50 and II-51). These data indicate that only 5 percent of the women surveyed had intakes of 20 grams or more of dietary fiber per day. Intake of dietary fiber was greater among women with higher levels of education. Multivariable analyses conducted by Cronin (1988) showed that higher fiber intakes by women were associated with having more education, being in the "other" racial category, living in the Midwest or West, living alone, being employed part time, and not smoking. Additional analyses (Cronin, 1988) indicated that vegetables, grains, and fruits supplied 50, 30, and 12 percent, respectively, of the dietary fiber in the diets of women. One-day data from the CSFII 1985 indicate that on average the dietary fiber intake of men is higher than that of women (approximately 17 grams per day).

Because data on the fiber content of foods have become available only recently, there are neither estimates of individual fiber intake before the CSFII 1985-86 nor estimates of fiber contained in the food supply. The nutrient composition database for the CSFII 1985-86 contained analytical values for total dietary fiber for only 40 percent of the best sources of fiber (Hepburn, 1987). Additional food composition data for total dietary fiber, as well as for different components of fiber that have different physiological effects, and more basic research on the health effects of dietary fiber are needed.

Conclusion: Dietary fiber is considered a potential public health issue for which further study is needed. Dietary intakes of fiber are low in relation to suggested levels of intake and are not consistent with recommended dietary patterns, but the impact of these low intakes cannot be judged on the basis of available data. More information is required on the health effects of dietary fiber, the content in foods of various components of fiber (which have different physiological effects) as well as total dietary fiber, and recommendations for intake. Monitoring is recommended as this information is developed.

Alcohol

Despite the paucity of data on alcohol available from the NNMS, the JNMEC classified alcohol as a component warranting public health monitoring priority status because of concerns about high intake. Reasons for concern about alcohol intake related to diet and nutritional status include the following: alcohol is high in calories and can supply a high percentage of calories in the diets of drinkers; alcoholic beverages are low in nutrients other than calories; excessive consumption can lead to nutritional inadequacies caused by poor diet or interference with nutrient absorption; excessive consumption can elevate blood pressure and can lead to diseases such as cirrhosis of the liver, pancreatitis, cancer of the throat, and fetal alcohol syndrome. In addition, consumption is linked to poor fetal growth and development, accidents, homicide, assault, and other social problems.

The Economic Research Service of USDA compiles data on per capita alcoholic beverages on the basis of industry data. In 1985, per capita figures based on the adult population (all those aged 21 years and older) were 34.5, 3.8, and 2.5 gallons each for beer, wine, and distilled spirits (USDA, 1987). Data on long-range and recent trends in per capita amounts of alcohol are also available from the Alcohol Epidemiologic Data System (1986), based on beverage sales and/or tax receipts from 35 States and the District of Columbia and shipments data from industry for the nonreporting States. These disappearance data, expressed on an ethanol-equivalent basis, overestimate consumption because they do not account for waste or storage at various stages of distribution and use. Data for the years 1977-84 are shown in table 3-11. As indicated in this table, there was a slight decrease in the first four years since 1980. The overall changes mask changes in the types of beverages, with recent decreases in beer and spirits coupled with a slight increase in wine. The data for earlier periods indicated a very small increase in per capita alcohol through the 1950s, a rather rapid increase through the 1960s, and a moderate increase through the 1970s.

Even though abstainers are not taken into account in the per capita figures, these values are higher than self-reported alcohol intakes from national food consumption surveys. Difficulties in assessment such as deliberate underreporting by individuals, underrepresentation of very heavy drinkers, failure to classify as drinkers persons who did not consume alcohol during the survey period, proxy reports, and failure to assess consumption on atypical days are recognized as factors that may lead to underestimates of true consumption. In the CSFII 1985, the mean (1-day) intake of alcoholic beverages by women was 84 grams, with 59 grams from beer and ale (USDA, 1985); the mean (1-day) intake by men was 304 grams with 271 grams from beer and ale (USDA, 1986a). An extensive questionnaire on alcohol

Table 3-11. Per capita amounts of ethanol, in gallons of ethanol, based on the U.S. population aged 14 years and older, 1977-84[1]

Year	Beer	Wine	Spirits	All beverages
1977	1.29	0.29	1.06	2.64
1978	1.32	0.31	1.07	2.71
1979	1.37	0.32	1.06	2.75
1980	1.38	0.34	1.04	2.76
1981	1.39	0.35	1.02	2.76
1982	1.38	0.36	0.98	2.72
1983	1.37	0.36	0.96	2.69
1984	1.35	0.37	0.94	2.65

[1] Adapted from Alcohol Epidemiologic Data System (1986).

use was administered in the HHANES, but data analyses of these data have not yet been completed.

Data were also collected in the NHIS on Health Promotion and Disease Prevention with respect to drinking behavior, knowledge, and attitudes (NCHS, 1988). With "heavier drinking" defined as an average of more than 1 ounce of alcohol (two drinks or more) per day, the results of this survey indicated that 13 percent of men and 3 percent of women had consumed this level in the past two weeks. One-fourth of current drinkers (35 percent of men and 12 percent of women) reported they drank five or more drinks in 1 day at least five times in the past year. The national prevalence estimate of chronic heavy drinking was 8.7 percent based on data collected in the Behavioral Risk Factors Surveillance System, 1981-83 (Bradstock et al., 1985; Gentry et al., 1985). In the same survey, 6.1 percent of adults gave self-reports of drinking and driving (Bradstock et al., 1987).

NNMS data have also been used to examine the relationship of alcohol intake to various outcome variables. Data from NHANES II and the Behavioral Risk Factors Surveillance System have been used to examine the relationship of alcohol intake and body weight; in both surveys, alcohol consumption was associated with lower body weight (after adjustment for other factors that influence weight) in women but not in men (Williamson et al., 1987). In the NHANES I Epidemiologic Followup Study, data show a higher relative risk for breast cancer in moderate and high consumers of alcohol than in nonconsumers (Schatzkin et al., 1987). However, evidence for this association is contradictory (DHHS, 1988); the association appears to be specific to type of breast cancer and a more substantial database is required before conclusions can be drawn regarding risk.

Conclusion: Alcohol is considered a current public health issue. Self-reported intakes are high (an average of 1 ounce or more of ethanol per day) in a large number of persons (9 percent of adults). The public health and social consequences of excessive alcohol intake are sufficiently grave that continued efforts to improve monitoring of alcohol intake are warranted.

Vitamins

Vitamin A and Carotenes

Vitamin A (retinol and pro-vitamin A carotenoids) is a fat-soluble nutrient required in adequate amounts for vision, reproduction, bone growth, and maintenance of healthy epithelia. Clinical signs of chronic retinol deficiency include poor night vision and characteristic changes in the eyes and skin. Because the body can store vitamin A, acute deficiency does not produce symptoms in otherwise well nourished individuals. In chronic excess, retinol has adverse effects, particularly on bone and in reproduction; it is a potential teratogen. The JNMEC classified vitamin A as a component warranting continued public health monitoring consideration based on low dietary intakes. Earlier, the possibility of vitamin A deficiency, as suggested by low serum levels of the vitamin, was identified as a potential problem in some groups in the U.S. population by the Ten-State Nutrition Survey (DHEW, 1972a, 1972b), especially in the Hispanic population, and in children and low-income groups.

Beta-carotene and other pro-vitamin A carotenoids can be converted to vitamin A in the body. Interest in the carotenoids has increased in recent years because of the accumulation of a large body of evidence that foods high in carotenoids are protective against a variety of epithelial cancers (DHHS, 1988). High intakes of carotenes are not known to produce serious adverse effects.

Vitamin A content in the food supply is reported as "retinol equivalents" to express the equivalent quantities of retinol and carotenes in foodstuffs. The U.S. food supply shows an increase in per capita amount of vitamin A from 1909-85 (figure II-17) and an increase in carotenes since 1965 (figure II-19).

Vitamin A and carotene levels both reached a peak in 1985 at 1,610 and 660 retinol equivalents, respectively. The recent gains primarily reflected the development of new varieties of deep yellow vegetables with higher carotene contents. Fortification of margarine and some dairy products also contributed to the increase. Vegetables have accounted for three-fourths of the carotenes in the food supply over the years; dark green and deep yellow types were the most common source (figure II-20). Vitamin A (in the form of retinol) is also supplied by meat, poultry, and fish (26.4 percent) as well as dairy products (15.8 percent) (figure II-18).

Individual dietary intake data from CSFII 1985-86 indicate that the mean (4-day) intake of vitamin A for all women, 832 retinol equivalents, is near the RDA (table II-52). Nonetheless, individual variation was considerable, with the median intake (50th percentile) equaling 614 retinol equivalents. (The National Research Council [1980] estimated that 500-600 retinol equivalents per day is needed by adults to maintain serum vitamin A levels, with greater amounts needed to provide reserves.) In the CSFII 1985-86, median intakes appear to vary little with age and poverty status, but to differ by race and education, in the adult females. The mean intake for children, as well as the intake at the 25th percentile, is above the 1980 RDA. Individual 1-day intakes, expressed in International Units, from surveys conducted during 1971-86 show an increase over time (table II-54). Caution is needed in interpreting these estimates obtained with very few days of intake data as usual intakes because of the very high day-to-day variation in vitamin A intake (see chapter 2).

The intake of carotenes was also estimated in the CSFII 1985-86 (see tables II-59 and II-60 for data for women and children, respectively). Standards for evaluating the adequacy of intakes of carotenes are not available. These data should, however, provide useful baseline information on intake levels.

An evaluation of the data from the various HANES concluded that serum vitamin A levels alone are inadequate to provide estimates of the prevalences of vitamin A deficiency and toxicity in the U.S. population (LSRO, 1985). Nonetheless, epidemiological and clinical data indicate that there are age-specific physiological correlates of low serum vitamin A levels related to deficiency (LSRO, 1985). The prevalences of serum vitamin A levels below 0.70 µmol/L (20 µg/dl) were relatively low (0-6.1 percent) for all age groups in all three HANES. (Comparisons among surveys should be made cautiously because total serum vitamin A levels were measured in NHANES I and II, but serum retinol levels were measured in HHANES.) The prevalences of serum vitamin A levels between 0.70 and 1.01 µmol/L (20 and 24 µg/dl) were generally higher (0-23.5 percent), especially in children. The likelihood that functional impairment is associated with these low serum levels of vitamin A is greater for adults than for children. Multivariable analysis indicated that black persons had a greater prevalence of low serum vitamin A regardless of economic status, and that, generally, poor persons had a greater prevalence of low serum vitamin A regardless of race (LSRO, 1985). Data from HHANES (tables II-55 through II-58) do not indicate a significant prevalence of low serum vitamin A in any group, with the possible exception of 4-5 year-old Mexican Americans below poverty; 10.1 percent had serum retinol levels below 0.70 µmol/L (20 µg/dl). Clinical signs of overt vitamin A deficiency were not seen in this group.

A 1980 telephone survey conducted by the FDA on vitamin/mineral supplement use (Stewart et al., 1985) found that 25 percent of the adult U.S. population obtained vitamin A from supplementary sources. Among users of vitamin A supplements, the median intake from supplements was 125 percent of the RDA; at the 95th percentile, vitamin A obtained from supplements equaled 430 percent of the RDA.

<u>Conclusion</u>: Vitamin A is considered to be a potential public health issue for which further study is required. The content of vitamin A in the food supply and individual intakes suggest general adequacy. Intake and status may, however, warrant continued monitoring efforts in certain groups. HHANES data on low serum vitamin A levels suggest that poor young children, particularly Mexican Americans, may be such a group. Greater attention needs to be given to studying the relationships of biochemical assessments of status to functional impairments. Carotenes are also considered a potential public health issue for which further study is also required. Data on intake of carotenes are available from the CSFII 1985-86 and will be available from HHANES to provide a baseline for assessing future changes in intake. Future surveys should continue to collect and report intake separately for carotenes and total vitamin A. Additional research is needed on the health effects of consumption of specified levels of total carotenes, as well as individual carotenes.

Vitamin E

Vitamin E (tocopherol) is a fat-soluble nutrient. Its biological function is poorly understood but is most likely related to its antioxidant properties. Clinical or biochemical evidence of vitamin E deficiency has not been reported in adults (National Research Council, 1980). Decreased erythrocyte survival time has been reported in low-birth-weight infants with depleted vitamin E stores (National Research Council, 1980). Nutritional status is commonly estimated from serum or plasma concentrations. However, because most vitamin E is transported by plasma lipoproteins, there is a high correlation between total plasma lipids and vitamin E concentration (Bieri, 1976; Horwitt et al., 1972; Rubinstein, Dietz, and Srinavasan, 1969). Consequently, this must be considered when serum or plasma vitamin E levels are used to assess nutritional adequacy. The Food and Nutrition Board stated that, "it is generally accepted that a plasma level of total tocopherols below 0.5 milligrams/100 ml is undesirable, although it has not been shown that lower concentrations in adults, unless of a duration of a year or longer, are associated with inadequate tissue concentrations" (National Research Council, 1980). Compared to other fat-soluble vitamins, vitamin E is relatively nontoxic. Isolated and inconsistent reports of adverse effects of very high doses in adults have appeared; large doses in anemic children have inhibited the hematological response to iron treatment (National Research Council, 1980).

Vitamin E was not evaluated by the JNMEC. Neither vitamin E consumption in foods nor serum vitamin E levels have been measured previously in the NNMS. Thus, information on intake in the CSFII 1985-86 and the serum α-tocopherol concentrations determined in the 1982-84 HHANES provide baseline data.

Vitamin E in the food supply is reported as milligram equivalents of α-tocopherol. Fats and oils are the major sources. The vitamin E content of the food supply has increased steadily, doubling since 1909 to the current (1985) level of 16.1 milligrams per capita per day (figure II-21). Fats and oils contributed 66.4 percent of vitamin E, with 35.5 percent from salad, cooking, and other edible oils (figure II-22) in 1985. Vegetables contributed less than 8 percent and grain products just over 4 percent.

In the CSFII 1985-86, mean vitamin E intake (4 days) of all women equaled 7.0 milligrams per day, with considerable range (table II-61). At the 5th percentile, intake averaged 2.5 milligrams per day, whereas at the 95th percentile, intake averaged 13.8 milligrams per day. Thus, although the average intake is close to the RDA, most individuals were below this value. The mean intakes of dietary vitamin E, determined in the CSFII 1985-86, are above or very near the RDA for children 1-5 years and for men 20-49 years. The nutrient composition database for vitamin E contains analytical values for fewer food items than for most nutrients (approximately 40 percent of best sources), introducing some uncertainties in the estimates of intake (Hepburn, 1987).

The mean serum α-tocopherol levels for adults fall between 22 and 25 µmol/L (equal to 1-1.1 milligrams/dl) for the three groups of Hispanic Americans (table II-64). Children have somewhat lower serum α-tocopherol levels, averaging 14-18 µmol/L (equal to 0.6-0.8 milligrams/dl) (table II-63). The lower concentrations of total serum lipids normally found in children provide a likely explanation for this difference because of the correlation between serum lipids and α-tocopherol (National Research Council, 1980). Interpretation of serum α-tocopherol levels will remain problematic until clear interpretative guidelines are established. It can be noted, however, that all mean values exceed the level of 0.5 milligrams/dl that the Food and Nutrition Board (National Research Council, 1980) has considered to be the lowest desirable concentration. There is little relationship between socioeconomic status or sex and serum α-tocopherol concentrations.

According to a 1980 FDA survey (Stewart et al., 1985), 28 percent of the adult U.S. population uses vitamin/mineral supplements containing vitamin E. The median intake among users equaled 200 percent of the RDA. At the 95th percentile, intake from supplements equaled 6000 percent of the RDA. Thus, a substantial portion of the U.S. adult population consumes large amounts of vitamin E from nonfood sources.

Conclusion: Vitamin E is not considered to be a current public health issue. Although some intakes are lower than recommended levels (especially in women), data on serum α-tocopherol levels and clinical data on the rarity of vitamin E deficiency suggest little reason for a public health focus. Interpretation of serum α-tocopherol levels is confounded by other factors such as serum lipid concentrations, and clear interpretative guidelines to assess marginal vitamin E status do not yet exist.

Thiamin

Thiamin, an essential component of enzymes involved in the release of energy from carbohydrate and fat, is a water-soluble B vitamin. Formerly called vitamin B1, thiamin also plays a role in cell reproduction, fatty acid metabolism, and normal functioning of the nervous system. Clinical signs of thiamin deficiency in adults primarily involve the nervous and cardiovascular systems. Beriberi is the classic thiamin deficiency disease, occurring most frequently in areas where the diet consists mainly of unenriched white rice and white flour. In the United States, thiamin deficiency is usually associated with conditions such as alcoholism. The JNMEC classified thiamin as a component warranting continued public health monitoring consideration.

Key sources of thiamin in the food supply include grain products (42.3 percent) and meat, poultry, and fish (25.7 percent) (figure II–24). Other notable food sources of thiamin are vegetables (10.9 percent) and dairy products (8 percent). Thiamin provided by the U.S. food supply in the 1980s is roughly 2.2 milligrams per capita per day (figure II–23). This figure is approximately 40 percent higher than in the pre–World War II era (1909–39, 1.6 milligrams per capita per day). The introduction of enrichment of flour was responsible for this increase.

Women in the CSFII 1985–86 aged 20–49 years had mean (4–day) intake levels slightly above the RDA (1.00 to 1.05 milligrams per day) (table II–67). Only 5 percent had intakes below 50 percent of the RDA. Mean intake levels were similar among all age groups, and mean intake levels were slightly above the RDA among whites and other races (excluding blacks) and slightly below the RDA among blacks. Mean intake levels were reasonably similar regardless of poverty status, region, and urbanization; mean intake levels, however, rose with increases in educational status. The mean thiamin intakes of children aged 1–5 years (CSFII 1985–86) were above the RDA among all races and were highest among black children (table II–68). Mean intake levels were reasonably similar and above the RDA regardless of poverty status, education, region, and urbanization.

One–day data from the NFCS 1977–78, and from the CSFII 1985–86 (table II–69) indicate that mean intake levels of thiamin increased 9.3 percent for children 1–5 years of age; 18.0 percent for males 20–49 years of age; and 10.8 percent for females 20–49 years of age. All mean intake levels were above the RDA; they were the highest for males and lowest for females.

Biochemical assessments of thiamin status were not included in recent NNMS surveys. No clinical evidence of thiamin deficiency was detected.

In 1980, supplements containing thiamin were ingested by approximately 30 percent of the population, either singly or in combination with other vitamins and minerals (Stewart et al., 1985). This percentage is second only to vitamin C (35 percent of the population). Among users, the median intake of supplemental thiamin was 550 percent of the RDA; intake at the 95th percentile was 6,000 percent of the RDA.

Conclusion: Thiamin is not considered to be a current public health issue. Intakes appear to be adequate and no other evidence suggested a public health problem with respect to thiamin status.

Riboflavin

Formerly called vitamin B2, riboflavin is a water–soluble B vitamin. Riboflavin is a component of enzymes involved in release of energy from protein, fat, and carbohydrate. Clinical signs of riboflavin deficiency include cracks at the corners of the mouth and soreness and inflammation of the mouth, lips, and tongue. If riboflavin deficiency occurs, thiamin and niacin deficiencies are usually associated. The JNMEC considered riboflavin a component warranting continued public health monitoring consideration.

Major sources of riboflavin in the food supply include dairy products (34.7 pecent); grain products (24 percent); and meat, poultry, and fish (24.3 percent) (figure II–26). Riboflavin provided by the U.S. food supply in the 1980s is about 2.3 to 2.4 milligrams per capita per day (figure II–25). This figure is roughly 28 to 33 percent higher than in the pre–World War II era (1909–39, 1.8 milligrams per capita per day). However, riboflavin provided by the U.S. food supply in the 1980s is essentially the same as that provided in the period 1947–79. The changes observed reflect the introduction of enrichment of flour.

The mean (4–day) intake of riboflavin by women aged 20–49 years (CSFII 1985–86) was 12.5 percent above the RDA, with only 5 percent of individuals having intakes below 50 percent of the RDA (table II–70). Mean intake levels were highest among women aged 20–29 years, followed by those aged 30–39 years, and were lowest among those aged 40–49 years. Mean intake levels increased with increasing socioeconomic status and education but were reasonably similar according to region and urbanization. Mean riboflavin intakes in children aged 1–5 years (CSFII 1985–86) were at least 60 percent above the RDA, with 95 percent of children having intakes of at least 0.9 milligrams per day (table II–71). Mean intakes were above the RDA among all races. Mean intake levels were above the RDA in all regions and were reasonably similar regardless of poverty status, education status, and urbanization.

One–day data from the NFCS 1977–78 and from the CFSII 1985–86 (table II–72) indicate that the mean intake levels of riboflavin increased 4.3 percent for children 1–5 years of age; 8.1 percent for males 20–49 years of age; and 8.3 percent for females 20–49 years of age. Mean intake levels were above the RDA; they were highest for males and lowest for females.

Biochemical assessments of riboflavin status were not included in recent NNMS surveys. Clinical evidence of riboflavin deficiency was not detected.

Supplementary riboflavin was ingested by 30 percent of the adult population, either singly or in combination with other vitamins and minerals (Stewart et al., 1985). This percentage is third only to vitamin C and thiamin (35 percent and 30 percent of the population, respectively). Among users, the median intake of riboflavin from supplements was 420 percent of the RDA; intake at the 95th percentile was 5,000 percent of the RDA.

Conclusion: Riboflavin is not considered to be a current public health issue. Intakes appear to be adequate and no other evidence suggests a public health problem with regard to riboflavin status.

Niacin

Niacin plays an essential role in the release of energy from protein; it may be ingested from food as "preformed niacin" or produced in the body from ingested tryptophan (one of the amino acids found in protein). The JNMEC classified niacin as a component warranting continued public health monitoring consideration.

The per capita amount of preformed niacin in the food supply was 26 milligrams in 1985 (figure II-27). The level has increased, especially since the mid-1940s when enrichment of flour was introduced. The major sources of niacin in the food supply are meat, poultry, and fish (46 percent) and grain products (30 percent) (figure II-28). The contribution of grain products has increased over time.

Based on the results of the CSFII 1985-86, the mean (4-day) intakes of dietary preformed niacin in all age groups among women aged 20-49 years and among children aged 1-5 years were well above the RDA (tables II-73 and II-74) (these values would be even higher if the contributions of tryptophan to total niacin intake were included). Individuals above poverty status and those with more than a high school education had greater intakes of niacin. The differences in intake were very small, however, and among individuals below poverty and those with a high school education or less, mean niacin intakes were still 10-15 percent above the RDA. There did not appear to be any differences in niacin intake by age, race, or degree of urbanization. These data suggest that the percentage of individuals with low niacin intakes that would put them at risk for having adverse health conditions is probably very low. One-day mean intakes of preformed niacin (table II-75) indicate slight increases over time in surveys conducted during the period 1971-86.

Although biochemical assessments related to niacin nutriture have not been made in any of the component parts of the NNMS, data from the clinical examinations carried out in the NHANES I and II showed few, if any, clinical signs in relation to niacin deficiency.

Supplemental niacin was ingested by 30 percent of the adult population in 1980 (Stewart et al., 1985). The median intake of users was 190 percent of the RDA; the 95th percentile of intake was 1,200 percent of the RDA.

Conclusion: Niacin is not considered to be a current public health issue. Individual intakes of preformed niacin appear to be adequate (and additional niacin may be obtained from the conversion of dietary tryptophan in the body). No other evidence suggests a public health problem in relation to niacin status.

Vitamin B6

Vitamin B6 (a collective term for pyridoxine, pyridoxal, and pyridoxamine) is required for the formation of amino acids needed for protein synthesis, the conversion of tryptophan to niacin, and the production of substances involved in nervous system function. The JNMEC classified vitamin B6 as a component requiring further investigation.

The per capita amount of vitamin B6 in the food supply has not changed appreciably since the early 1900s (figure II-29), but food sources have changed: the contribution of meat, poultry, and fish has increased dramatically and the contributions of grains and vegetables (notably potatoes) have declined. In 1985, the per capita amount of vitamin B6 in the food supply was 2.1 milligrams; the major sources of vitamin B6 in the food supply were meats, poultry, and fish (41.1 percent); vegetables (21.9 percent); dairy products (10.7 percent); and fruits (10.6 percent) (figure II-30).

Dietary intakes of vitamin B6 by children aged 1-5 years in the CSFII 1985-86 exceeded the RDA and did not differ by race, poverty, or education (table II-78). In contrast, the mean dietary intakes of women were well below (approximately half) the RDA and varied with age (table II-76). The requirement for vitamin B6 is related to protein intake and the RDA for vitamin B6 is set assuming a protein intake of 100 grams for adult women and 110 grams for adult men (National Research Council, 1980). These assumed protein levels are higher than the levels actually consumed; thus, allowances for vitamin B6 may be overly generous and the low intake levels seen in women may not be indicative of potential deficiency. Moshfegh (1988) has determined that many more women met the protein-based allowance for vitamin B6 intake than met the RDA. Another complication in the interpretation of vitamin B6 intakes is the nutrient composition database; analytical values were available for 70 percent of important sources of vitamin B6 in the CSFII 1985–86 (Hepburn, 1987). As is true for all nutrients, the composition database cannot account for differing bioavailability, a factor that is important in understanding adequacy of vitamin B6 intakes.

Biochemical or clinical assessments of vitamin B6 status are not available from the NNMS. Frank vitamin B6 deficiency resulting in clinical manifestations is not suspected to be widespread in the general population. However, evidence of impaired status has been reported in some population groups, most notably the elderly and alcoholic individuals (National Research Council, 1980).

In 1980, 30 percent of the adult U.S. population consumed supplements containing vitamin B6 (Stewart et al., 1985). The median intake among users was approximately 140 percent of the RDA; the 95th percentile of intake was 5,000 percent of the RDA. Excessive intake of the vitamin from high-potency supplements is of concern because of possible damage to the peripheral nervous system (Dreyfus, 1988).

Conclusion: Vitamin B6 is considered to be a potential public health issue for which further study is needed. Intakes are lower than recommended levels for a substantial number of persons, especially women. In order to interpret the consequences of these intakes, further study is needed on the content and bioavailability of vitamin B6 in foods, vitamin B6 requirements, and biochemical or other techniques for assessing vitamin B6 nutritional status. Increased monitoring activity may be warranted as progress is made in these areas.

Vitamin B12

Vitamin B12 (cobalamins) is required for formation of red blood cells, synthesis of genetic material, function of the nervous system, and metabolism of protein and fat. The JNMEC classified vitamin B12 as a component warranting less consideration for continued public health monitoring. Severe vitamin B12 deficiency can result in pernicious anemia and in neurological damage if deficiency is prolonged. Deficiency is caused more often by impaired absorption rather than inadequate intake (DHHS/USDA, 1986). However, a dietary vitamin B12 deficiency can occur in strict vegetarians who avoid all foods derived from animals and in the breast-fed children of mothers who consume such diets (DHHS, 1988).

The per capita amount of vitamin B12 in the food supply has increased slightly since the 1940s and was 10.1 micrograms in 1985 (figure II–31). Vitamin B12 is found only in animal products, so the major sources in the food supply have remained fairly stable over time; in 1985, meat, poultry, and fish contributed 75.4 percent, and dairy products contributed 17.6 percent of the vitamin B12 in the food supply (figure II–32).

Individual intake data (4 days) from the CSFII 1985–86 indicate that almost 50 percent of women aged 20–49 years, and over 90 percent of children aged 1–5 years, had intakes in excess of the RDA (tables II–80 and II–81).

The early laboratory manifestations of vitamin B12 deficiency include an abnormally large number of lobes of the nuclei of neutrophils (a type of white blood cell) and a low serum concentration of vitamin B12. These findings are rare among hospital patients and indicate that health problems related to a deficient intake of vitamin B12 are too unusual to be detected in population surveys, although some concern has been raised about vitamin B12 status in the elderly. Serum vitamin B12 measurements were made in NHANES II but have not been released.

In 1985, 30 percent of the adult U.S. population consumed supplements (singly or in combination with other vitamins and minerals) of vitamin B12 (Stewart et al., 1985). Among users, intake at the median level was 200 percent of the RDA and intake at the 95th percentile exceeded 3,300 percent of the RDA.

Conclusion: Vitamin B12 is not considered to be a current public health issue. Intakes appear to be adequate for the majority of the population. Clinical or biochemical evidence for a public health problem with respect to vitamin B12 deficiency is not available. Further monitoring, at a low level, is warranted.

Vitamin C

Vitamin C functions in the formation of collagen; the maintenance of capillaries, bones, and teeth; the promotion of iron absorption; and protection of other vitamins and minerals from oxidation. Some evidence suggests a protective effect against certain cancers (DHHS, 1988). Vitamin C deficiency causes scurvy, characterized by weakness, hemorrhages in the skin and gums, and defects in bone development in children (DHHS/USDA, 1986). Although the average intake of vitamin C was above the RDA, the JNMEC report suggested that vitamin C was a nutrient warranting priority monitoring status based on low intakes in certain groups. Evidence of measurable clinical deficiency in all population groups was negligible, and the prevalence of low serum vitamin C levels was low in most groups.

The per capita amount of vitamin C in the food supply has fluctuated since the early 1900s but has not changed consistently; it was 115 milligrams in 1985 (figure II–33), an amount well in excess of the highest RDA. The major food sources have changed, with increases in the contributions of citrus fruits and decreases in the contributions of potatoes and vegetables other than dark green and deep yellow types. In 1985, the food groups that contributed the major shares of vitamin C in the food supply were vegetables (47.9 percent) and fruits (42.7 percent), especially citrus fruits (27.7 percent) (figure II–34).

Based on 4–day data from the CSFII 1985–86, mean intakes of dietary vitamin C in all age groups among women aged 20–49 years and among children aged 1–5 years were well above the RDA (tables II–82 and II–83). Women above poverty and those with higher levels of education had higher intakes of vitamin C. Among those individuals below poverty, mean intake of vitamin C was at or close to the RDA, while among individuals above poverty, mean intake of vitamin C was 37 percent greater than the RDA. Women with less than a high school education had mean vitamin C intakes close to the RDA, while individuals with greater than a high school education had intakes that exceeded 50 percent more than the RDA. Among children aged 1–5 years, intakes of vitamin C were much greater than the RDA in all groups, and the differences seen with the indices of socioeconomic status were similar to those seen among women. There did not appear to be any meaningful differences in vitamin C intake by age and race in the children. These data suggest that the percentage of individuals with low vitamin C intake that would put them at risk for having adverse health conditions is probably very low. However, the lower intakes of vitamin C among women and children of lower socioeconomic status suggest that they may be at greater, albeit still low, risk for adverse health outcomes related to low vitamin C intake than groups of higher socioeconomic status.

One–day data for vitamin C intakes assessed in surveys conducted in the period 1971–86 (table II–84) suggest some increases over the period studied, but results are not consistent over all surveys. Greater changes may be seen in the future because of the recent introduction of higher levels of vitamin C fortification in a variety of foods and beverages.

Although serum vitamin C determinations were not made in the HHANES, data from the NHANES II, 1976–80, indicated that among children the prevalence of low serum vitamin C levels was low. The prevalence of low values was higher in men than in women and higher in persons below poverty than in persons above poverty; the prevalence was highest (19.5 percent) in men below poverty aged 55–74 years. There was very little or no evidence of vitamin C deficiency in data from the clinical examination conducted in the NHANES II.

In 1980, 35 percent of the adult U.S. population consumed vitamin C in the form of supplements (Stewart et al., 1985). Vitamin C, consumed by more than 90 percent of all supplement users, was the most widely consumed nutrient. Among users of vitamin C supplements, median intake was 333 percent of the RDA; the 95th percentile of intake was 2,800 percent of the RDA.

Conclusion: Vitamin C is considered to be a potential public health issue for which more study is needed. Recent dietary intakes appear to be adequate in most of the population, even without consideration of the substantial contribution of vitamin C supplements. Older data for serum vitamin C (from NHANES II) indicate that the prevalence of low levels is generally higher in groups with low socioeconomic status, especially older men, but do not provide strong evidence for vitamin C deficiency. Although these data suggest the need for some continued surveillance, changes in vitamin C fortification practices may affect intake among many segments of the population. Continued monitoring is warranted to assess the impact of these changes, but the apparently adequate intakes do not provide support for priority monitoring status.

Folacin

Folacin, also called folate, a descriptor for compounds with properties and chemical structures similar to folic acid or pteroylglutamic acid, is required for the formation of red blood cells and genetic material. Folacin deficiency can result in anemia, weakness, forgetfulness, sleeplessness, and periods of euphoria. The JNMEC classified folacin as a component requiring further investigation. Individual dietary intake data for folacin were not available to the JNMEC.

The per capita amount of folacin has not changed substantially since the early 1900s; it was nearly 300 micrograms in 1985 (figure II-35). The contributions of meat, poultry, and fish and of fruits have increased, and the contributions of grain products have decreased over time. In 1985, the major share of folate in the food supply was contributed by vegetables (24.8 percent); legumes, nuts, and soy (19.5 percent); grain products (12.7 percent); meat, poultry, and fish (12.6 percent); and fruits (12.4 percent) (figure II-36).

Mean dietary folacin consumption (4 days) from CSFII 1985-86 is estimated to be below the 1980 RDA in over 95 percent of women aged 20-49 years and over 50 percent of children aged 3-5 years (tables II-85 and II-87). In contrast, over 90 percent of children aged 1-2 years had folate intakes above the RDA for this age group. For women, intake was higher in persons of higher socioeconomic status (as indicated by poverty status and education level). Some uncertainties exist in the nutrient composition database for folate. Folate in food is difficult to measure, and the database contained analytical values for approximately 70 percent of best sources of the nutrient (Hepburn, 1987).

Serum and red blood cell folate levels were measured in subgroups in both NHANES II and HHANES. Analyses of the NHANES II data indicated that women aged 20-44 years were at greatest risk of folate deficiency (LSRO, 1984). Results for Hispanic women aged 20-44 years from HHANES are presented in table 3-12. Prevalences of low values for serum and red blood cell folate levels were lower in women of all three Hispanic groups than in the women of all races and ethnic groups in NHANES II; however, different methods were used in the two surveys to measure blood folate levels. In addition, interpretative criteria for blood folate levels are not certain (LSRO, 1984); thus, prevalence of low values cannot be interpreted as indicating the prevalence of folate deficiency. Hematological signs of folate deficiency have not been detected in surveys. However, folate deficiency is believed to be rare, and there is little evidence that it constitutes a major public health problem. Furthermore, the discrepancy between observed intakes below estimates of recommended intakes of folate and the lack of evidence for folate deficiency suggests to the EPONM that allowances need to be reexamined.

Table 3-12. Percent of Hispanic women aged 20-44 years with low blood folate levels: Hispanic Health and Nutrition Examination Survey, 1982-84

Population group	n	Percent	Standard error of percent
	Low red blood cell folate level[1]		
Mexican American	1,040	3.5	0.7
Cuban	194	10.8	2.4
Puerto Rican	434	9.2	1.8
	Low serum folate level[2]		
Mexican American	1,090	11.1	1.2
Cuban	205	9.8	2.3
Puerto Rican	427	8.3	1.8

[1] Red blood cell folate <140 nanograms/milliliter.
[2] Serum folate <3.0 nanograms/milliliter.

Groups that are known to be most vulnerable to folate deficiency include premature infants and women during the last half of pregnancy. These groups are not sampled in sufficient numbers in the NNMS to analyze the available data on the prevalence of either low intakes or low blood values in these groups. A larger group that might be vulnerable to folacin deficiency is women who use oral contraceptives, because these agents may depress folacin absorption from foods in the diet. Although blood folate values were, on the average, lower in oral contraceptives users than in nonusers in NHANES II, the difference was not statistically significant (LSRO, 1984).

Supplemental folacin (in the form of folic acid) was consumed by 20 percent of the adult U.S. population in 1980 (Stewart et al., 1985). Intake among users was equivalent to the RDA at the median and was 20[illegible] percent of the RDA at the 95th percentile.

Conclusion: Folacin is considered to be a potential public health issue for which further study is required. Dietary intakes are much lower than recommended in some groups, especially women. Biochemical and other evidence for deficiency are limited, but suggest a risk of deficiency in women. Further study is required to evaluate folacin requirements, to develop methods and interpretative criteria for folacin nutritional status, and to examine the status of groups at risk.

Other Vitamins

Dietary and nutritional status with regard to vitamin D, vitamin K, pantothenic acid, and biotin is not currently assessed in the NNMS. The EPONM is not aware of evidence for public health issues with respect to these vitamins that is strong enough to justify a recommendation for their inclusion in the NNMS at this time, although the vitamin D status of the elderly may be of interest.

Minerals

Iron

Dietary iron deficiency is considered to be the most common nutritional deficiency in the United States. The JNMEC ranked iron as a component warranting public health monitoring priority status and it is one of the two conditions selected for special emphasis in this report (see chapter 6).

The risk of iron deficiency varies markedly according to the iron requirements in different age/sex groups. Iron deficiency is common among infants and young children between 6 months and 3 years of age, in whom the rate of growth is high, and whose diet is often dominated by milk, which contains little iron. Low-birth-weight infants are also at high risk of iron deficiency because they have particularly high iron requirements to support their rapid growth. The growth spurt during adolescence is also associated with a high prevalence of iron deficiency. Among adults, young women have much higher iron requirements than men, as a result of iron lost in menstrual blood or maternal iron lost to the fetus, particularly during the last half of pregnancy. Men and postmenopausal women are rarely iron deficient unless there is excessive blood loss due to chronic aspirin use, frequent blood donation (more than three times per year), or diseases such as gastrointestinal ulcer or cancer. Iron deficiency may be assessed using a combination of measurements undertaken in various NNMS surveys (see chapter 6).

The amount of iron in the food supply increased during the mid-1940s (in response to the introduction of iron enrichment of flour) and has also increased recently, equaling 17 milligrams in 1985 (figure II-37). The percentages of iron supplied by various food groups in the food supply were 41.0, 23.8, and 12.6 percent for grain products; meat, poultry, and fish; and vegetables, respectively, in 1985 (figure II-38).

Estimates of the mean iron intake (from 1-day data) in NHANES I and II, NFCS 1977-78, and CSFII 1985-86 are remarkably close, with a range of 9.2 to 10.8 milligrams per day in women of childbearing years (table II-93). The <u>mean</u> intakes are less than 60 percent of the RDA for this group. The distribution of intakes (based on 4-day data) in CSFII 1985-86 shows that over 95 percent of women aged 20-49 years, and over 90 percent of infants aged 1-2 years, have iron intakes below their respective RDA (tables II-89 and II-91). Over 50 percent of children aged 3-5 years have intakes below the RDA. The mean dietary iron intake, but not the iron density of diets, of women differed by race and socioeconomic status (tables II-89 and II-90).

These intake data would lead one to anticipate an even higher prevalence of iron deficiency than was found in the analysis of the extensive biochemical data collected in NHANES II and HHANES using the mean corpuscular volume (MCV) model (see chapter 6 for discussion of the model and tables II-98 through II-101 for data for persons aged 4-74 years). Estimates of the prevalence of iron deficiency in women of childbearing years (one of the vulnerable groups for which the NNMS provides extensive data) ranged from 2.4 to 14 percent (table 3-13). The discrepancy between the modest prevalence of iron deficiency and low intakes suggests to the EPONM that the RDA for iron are not only overly generous, they are also rarely achievable from usually consumed diets in the population groups who are at risk of developing iron deficiency. A major reason for the apparent contradiction is that intake of iron is not related to nutritional status outcome in a straightforward fashion; absorption of iron from food increases dramatically when body iron stores become low.

Efforts to decrease the prevalence of iron deficiency in the U.S. population have apparently been successful in the past decade, particularly among infants and small children. Data from the PedNSS indicate a declining prevalence of anemia in low-income children (see discussion of data in chapter 6). Factors responsible for this success include an increased prevalence of breast feeding, more use of iron-fortified infant formula, and avoidance of cows milk in early infancy. Furthermore, the food industry has increasingly used better absorbed forms of iron to fortify bread and other cereal products. These changes are not readily apparent in the individual intake data in the NNMS.

Iron deficiency among young women may prove difficult to eradicate, because it is likely to be related to unusually heavy menstrual blood loss for which adequate iron cannot be supplied readily by dietary means alone.

Supplemental iron (alone or in combination with other minerals and vitamins) was consumed by approximately 22 percent of the adult U.S. population in 1980 (Stewart et al., 1985). Iron was consumed by 56

Table 3-13. Percent of women aged 16-49 years with iron deficiency determined by the MCV model[1]: Hispanic Health and Nutrition Examination Survey, 1982-84, and second National Health and Nutrition Examination Survey, 1976-80

Age and ethnic group or race	n	Percent	Standard error of percent
16-19 years			
Mexican American	277	7.9	1.6
Cuban	42	0.0*	4.6
Puerto Rican	117	7.9	2.4
Non-Hispanic white	456	3.8	1.1
Non-Hispanic black	83	13.8	4.4
20-29 years			
Mexican American	468	8.2	1.5
Cuban	60	2.8	2.5
Puerto Rican	162	7.2	2.5
Non-Hispanic white	956	2.4	0.6
Non-Hispanic black	163	3.5	1.8
30-39 years			
Mexican American	407	11.7	1.8
Cuban	87	7.2	3.3
Puerto Rican	155	7.9	2.7
Non-Hispanic white	741	6.5	1.2
Non-Hispanic black	104	5.9	2.9
40-49 years			
Mexican American	288	12.9	2.0
Cuban	100	10.2	3.3
Puerto Rican	155	8.3	2.4
Non-Hispanic white	587	6.5	1.4
Non-Hispanic black	90	14.0	4.4

[1] The MCV model requires abnormal values for at least two of the following measurements: MCV, transferrin saturation, erythrocyte protoporphyrin. See chapter 6 for cutoffs indicative of abnormal values.

* Indicates a statistic that may be unreliable because of small sample size.

percent of all supplement users and was the most commonly consumed mineral. The intake of supplemental iron was approximately 120 percent of the RDA at the median and 500 percent of the RDA at the 95th percentile for users of iron supplements.

Conclusion: Iron is considered to be a current public health issue. Intakes are low for many in the population. Although the prevalence of iron deficiency has apparently declined in recent years, it is still relatively high in vulnerable groups such as women of childbearing years. Continued monitoring is warranted and is likely to yield useful information on iron nutritional status because of the wealth of indicators available for inclusion in the NNMS. A detailed discussion of iron nutriture data is contained in chapter 6.

Calcium

Calcium is essential in the formation of bones and teeth and in the maintenance of bone strength; it is also required for contraction of muscle, clotting of blood, and integrity of cell membranes. Low calcium intake is one of several factors associated with osteoporosis, a loss of bone mass that increases susceptibility to fractures (DHHS/USDA, 1986). Although bone mass declines with age and osteoporosis is common in older persons (more so in women than in men), definitive data for estimation of the prevalence of osteoporosis are lacking. Although the precise relationship of dietary calcium to osteoporosis has not been elucidated, it has been suggested that higher intakes of dietary calcium could increase peak bone mass during adolescence and early adulthood and delay the onset of bone fractures later in life (DHHS, 1988). Thus, increased consumption of foods rich in calcium may be especially beneficial for adolescents and young women. Adequate calcium intake is also important in later life to maintain bone mass. Calcium has also been found in some studies to be a factor in the control of hypertension although this effect is not certain and results of clinical studies must be regarded as inconclusive (DHHS, 1988; National Research Council, 1989). The JNMEC classified calcium as a component warranting public health monitoring priority because of low intake by some groups.

The per capita amount of calcium in the U.S. food supply in 1985 was greater than 900 milligrams (figure II-39). These data indicate that, overall, the U.S. food supply contains an adequate amount of calcium for the population. Dairy products supply the greatest proportion of dietary calcium in the food supply (76.8 percent in 1985) (figure II-40).

The CSFII 1985-86 data indicate that the mean (4-day) calcium intake of women aged 20-49 years (630 milligrams per day) continues to be below the RDA (table II-102). The mean intake (562 milligrams per day) for women aged 40-49 years was lower than for younger women (20-29 years). This finding is of concern because postmenopausal women (especially in the early stages of menopause) excrete more calcium than younger women and require more dietary calcium to maintain calcium balance. These data also indicate that black women in these age groups have lower mean calcium intakes than white women and that lower calcium intakes are associated with lower income and lower education levels. Despite the intake differences by race, black women have a much lower prevalence of osteoporosis, suggesting that factors other than calcium intake contribute to the prevalence of osteoporosis. In a multivariable analysis, factors found to be associated with higher intakes of calcium by women were: being younger, being in a racial group other than black, having more education, having a higher income, being employed part-time, being a participant in the Food Stamp Program, living in a central city, living in the Midwest or West, having a child aged 1-5 years in the household, being taller, being a regular supplement user, being pregnant, and lactating (Welsh, 1988).

For children aged 1-5 years, mean intake of calcium over 4 days was 804 milligrams per day (table II-104). The median intake for this group was 769 milligrams per day, indicating that over half of these children consumed less than the RDA. As with the women, mean intakes of black children were lower than those of white children. Lower mean intakes of calcium of children were also associated with lower income levels and lower education level of the mother.

Trends in calcium intake since 1971-74 are available based on 1-day food consumption data (table II-106). For males aged 20-49 years, data from NHANES I, NFCS 1977-78, NHANES II, and CSFII 1985-86 indicate that mean calcium intakes have ranged from about 750 milligrams per day to about 1,100 milligrams per day with little change over this time period, suggesting that calcium intakes for most adult men are probably adequate. For women aged 20-49 years, mean calcium intakes have ranged from 530 to 690 milligrams per day, well below the RDA. Each of the surveys shows the same trend of lower calcium intake within this age group. For children aged 1-5 years, mean calcium intakes ranged from 750 to 920 milligrams per day. Overall, levels of calcium intake seem to have stayed fairly constant over this 15-year period.

Clinical and biochemical assessments of calcium status have not been included in NNMS surveys because methods for direct assessment of calcium status appropriate for field surveys are not available. Measurements of bone density are planned for NHANES III.

Analysis of data collected in 1980 on supplement use indicated that 13.5 percent of the U.S. population and 34.9 percent of supplement users consumed calcium supplements (Stewart et al., 1985). The median and 95th percentiles of calcium intake supplied by supplements were 16 and 113 percent, respectively, of the 1980 RDA for calcium, indicating that calcium supplements were consumed in relatively small doses. Promotion and use of calcium supplementation, as well as use of calcium-fortified foods, as a means of preventing osteoporosis has occurred since the 1980 survey. This promotion provides an added impetus to monitor calcium intake, particularly intake of calcium from supplements and calcium-fortified foods by adult women.

Conclusion: Calcium is considered to be a current public health issue. The low intakes of calcium in vulnerable groups, especially women, suggest a reason for concern. The high prevalence and severity of osteoporosis, which is possibly related, in part, to low calcium intake of adolescents and young women, provide sufficient evidence for a public health concern. Calcium should be considered a nutrient about which there is public health concern even if there is some question about its exact role in health disorders. Monitoring the intake of calcium and including assessments of bone status in NNMS surveys is warranted, as is investigating the possible overuse of calcium supplements by adults.

Phosphorus

Phosphorus is an essential mineral because, together with calcium, it forms an insoluble compound that gives rigidity and strength to bones and teeth; as a part of other biological components, phosphorus is essential for many metabolic reactions. Some studies in experimental animals have suggested that a high ratio of phosphorus to calcium in the diet may decrease calcium utilization; however, more recent studies in humans suggest that the calcium:phosphorus ratio is less important than the adequacy of calcium intake. The JNMEC classified phosphorus as a component warranting less consideration for continued public health monitoring.

Phosphorus is widely distributed in foods and phosphates are often used in food processing. Thus, dietary deficiencies of phosphorus are very unlikely (National Research Council, 1980). The per capita amount of phosphorus in the U.S. food supply in 1985 was greater than 1500 milligrams (figure II-41). These data indicate that the U.S. food supply continues to provide a generous amount of phosphorus for the population. The major sources of phosphorus in the food supply in 1985 were dairy products (35.7 percent); meat, poultry, and fish (29.2 percent); and grain products (13.2 percent) (figure II-42).

The CSFII 1985-86 (4-day) data indicate that the mean phosphorus intake of women aged 20-49 years (975 milligrams per day) continues to be above the RDA (table II-107). Mean intakes were lower in black women and in women with lower economic and educational status; however, in all cases, mean intakes were at or above the RDA for phosphorus. For children aged 1-5 years, mean intake of phosphorus over 4 days was 1010 milligrams per day (table II-108). Mean intakes for all racial, education, economic, geographic, and urbanization groups were greater than the RDA for these children.

Information on trends in phosphorus intake since 1971-74 is available based on 1-day food consumption data (table II-109). For males aged 20-49 years, data from NHANES I, NFCS 1977-78, NHANES II, and CSFII 1985-86 indicate that mean phosphorus intakes have varied little and have been consistently well above the RDA for adult men over this time period. For women aged 20-49 years, mean phosphorus intakes have also been above the RDA although their intakes have been lower than those of men. For children aged 1-5 years, mean phosphorus intakes have been above the RDA. The elderly have lower intakes than young adults. Overall, levels of phosphorus intake within age and sex groups seem to have stayed fairly constant over this 15-year period.

Direct biochemical or clinical assessments of phosphorus status are not available for use in field surveys.

The analysis of data collected in 1980 on supplement use indicated that 8.4 percent of the U.S. population and 21.8 percent of supplement users consumed phosphorus from supplements (Stewart et al., 1985). Among users, the median and 95th percentiles of phosphorus intake supplied by supplements were 14 and 73 percent of the RDA, respectively, indicating that phosphorus supplements were consumed in relatively small doses.

Conclusion: Phosphorus is not considered to be a current public health issue. Intakes appear to be adequate, and no other evidence exists to suggest a public health problem. Monitoring should continue at a relatively low level.

Magnesium

Magnesium is an essential mineral in the diet, used in bone formation, protein synthesis, energy release from muscle glycogen, and body temperature and blood pressure regulation. The JNMEC classified magnesium as a component requiring further investigation because of low dietary intakes.

The magnesium content of the food supply has declined since the beginning of this century, but a slight increase has occurred since 1980 (figure II-43). Currently, the major sources of magnesium in the food supply are dairy products (19.8 percent); grain products (17.7 percent); vegetables (15.8 percent); meat, poultry, and fish (15.4 percent); and legumes, nuts, and soy (13 percent) (figure II-44). There has been a large decline in the percentage of magnesium obtained from grain products since 1909-13.

Data from the CSFII 1985-86 show that the mean (4-day) dietary intake of magnesium for women aged 20-49 years falls below the RDA (table II-110). This finding raises some concern about the possibility of inadequate dietary intake of magnesium in this group. However, the RDA is based primarily on balance studies of young men in which widely varying results were obtained (National Research Council, 1980). Among women in the CSFII 1985-86, mean intakes were lower for blacks than for whites, for persons below poverty than for persons above poverty, and for persons with a lower level of education than for persons with a higher level of education. Notable differences by age, region, or urbanization were not observed. The mean (1-day) intake of males of this same age group was higher than that of women and slightly lower than the RDA. The mean intake of children aged 1-5 years (table II-112) was also close to the RDA for this group, and the effects of race, poverty status, and education level on dietary intake were not as striking as they were for women. There has been little change in the mean individual intakes of these groups (small increases for most groups) since the NFCS 1977-78.

There are no clinical or biochemical indicators of magnesium status available in surveys of the NNMS (indeed, there are no good indicators of status available to measure). Magnesium deficiency has not been reported to occur in response to low dietary intake alone (National Research Council, 1980). Generally, deficiency occurs when conditions such as alcoholism or prolonged vomiting or diarrhea interfere with absorption or when magnesium-free parenteral solutions are administered.

Supplemental magnesium was consumed by approximately 14 percent of the adult U.S. population in 1980 (Stewart et al., 1985). The median intake of magnesium from supplements was 22 percent of the RDA and the 95th percentile of intake was nearly equal to the RDA among users.

Conclusion: Magnesium is not considered a current public health issue. Dietary intakes appear to be low, but there are no other data on magnesium status available and magnesium deficiency is very unlikely to result from low dietary intake alone. Further research on magnesium requirements and assessment of magnesium status would be desirable. Current information supports continued monitoring at a low level.

Sodium

Sodium is an essential mineral in the diet. The JNMEC classified sodium as a component warranting public health monitoring priority because of concerns about high intakes. The JNMEC report (DHHS/USDA, 1986) noted that when sodium intake exceeds excretion, there may be an increase in the sodium content of the extracellular fluid where most of this mineral is found in the body. The result of this imbalance between sodium intake and excretion is edema, which is manifest by swelling of the hands, feet, and legs. Epidemiological studies indicate a relationship between a high sodium intake and the occurrence of high blood pressure and stroke (DHHS, 1988). Clinical studies have generally shown that sodium restriction reduces elevated blood pressure (DHHS, 1988). However, the response to sodium is variable; while some individuals maintain normal blood pressure over a wide range of sodium intakes, others appear to be "salt-sensitive" and display increased blood pressure in response to high sodium intakes (DHHS, 1988).

The U.S. Dietary Guidelines recommend that Americans avoid too much sodium (USDA/DHHS, 1985). The text accompanying the Guidelines and *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) cite the major reasons for recommendations that most Americans reduce their sodium intakes, even though all individuals are not equally susceptible to the effects of sodium. These include the lack of a practical indicator for individual sodium sensitivity, the potential benefit to persons whose blood pressures are affected by sodium, and the lack of harm from moderate sodium restriction. The Food and Nutrition Board (National Research Council, 1980) considered 1,100 to 3,300 milligrams of sodium per day as a safe and adequate intake for healthy adults, with 3,300 milligrams as the upper limit for adults. *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) estimated, on the basis of survey results and industry information, the current average total sodium intake for adults to be in the range of 4,000 to 6,000 milligrams per day, well above the advised "safe and adequate" level.

Dietary sources of sodium include foods in which it occurs naturally, salt and sodium-containing compounds added to foods during processing, salt added in cooking or at the table, and drinking water. The JNMEC report (DHHS/USDA, 1986) estimated the sodium content of municipal water supplies to average 28 milligrams per liter, and noted that many water softeners increase the sodium content of drinking water. In addition, many over-the-counter medications such as antacids contain sodium. This multiplicity of sources makes it difficult to obtain accurate estimates of the total intake of sodium. The quantity supplied by salt used in cooking and at the table is particularly difficult to assess. The recent introduction of many low-sodium foods by food manufacturers has added an additional complication. Many foods in the marketplace are labeled with terms such as "unsalted," "no salt added," or "without added salt." The FDA defines other terms to be used in nutrition labeling, such as "sodium free" (<5 milligrams per serving), "very low sodium" (35 milligrams or less per serving), "low sodium" (140 milligrams or less per serving), or "reduced sodium" (a 75 percent reduction in sodium content). Subjects must be able to identify such products correctly in dietary reports, and food composition data for such products must be included in databases to produce accurate estimates of intake for persons consuming these foods.

Data on sodium in the U.S food supply are not available.

The CSFII 1985-86 data provide estimates of individual sodium intake including naturally occurring sodium, sodium contributed by compounds used in food processing, and an assumed amount used in food preparation. These estimates exclude sodium from salt added at the table. The mean (4-day) intake of women aged 20-49 years was 2,372 milligrams per day and many intakes exceeded the upper limit of the estimated range of safe and adequate intakes (table II-114). Intakes were slightly higher in whites than in blacks, slightly higher in those above poverty than in those below poverty, and higher among those with higher levels of education. The mean sodium intake of children aged 1-5 years was 2,036 milligrams per day; race and socioeconomic factors seemed to have less influence on the sodium intakes of children than on the intakes of women (table II-115).

Estimates of the mean (1-day) intakes of sodium for various age and sex groups are available from NNMS surveys conducted during the period 1971-86 (table II-116). These data must be interpreted with caution because different assumptions about the salting of foods were used in different surveys. Estimates from the NHANES II and CSFII 1985-86, however, were similar. Mean intakes in excess of 3,300 milligrams per day were reported for males aged 12-49 years.

The only health condition assessed in the NNMS related to sodium intake is hypertension. (Hypertension is also influenced by a variety of other factors in addition to sodium.) New data on the age-adjusted prevalence of hypertension in adults are available for the three Hispanic ethnic groups in HHANES (tables II-119 and II-120) and these are compared to estimates for non-Hispanic whites and blacks from NHANES II (tables II-121 and II-122) in table 3-14. Hypertension is defined herein (as in the JNMEC report) as a condition in which an individual had an average systolic blood pressure greater than 140 mm mercury, or had an average diastolic blood pressure greater than 90 mm mercury, or was taking anti-hypertension medication. Males and females of all three Hispanic ethnic groups had lower prevalences of hypertension than did non-Hispanic whites and blacks; prevalence estimates were highest in blacks. Among Mexican Americans and non-Hispanic persons, hypertension was slightly more prevalent in those below poverty than in those above poverty (tables II-120 and II-122). See chapter 5 for a more detailed discussion of hypertension.

Table 3-14. Age-adjusted prevalence of hypertension[1] in persons aged 20-74 years, by ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982-84, and second National Health and Nutrition Examination Survey, 1976-80

	Male	Female
Mexican American	23.9	20.3
Cuban	20.7	14.4
Puerto Rican	21.4	19.2
Non-Hispanic white	33.8	25.1
Non-Hispanic black	41.6	43.8

[1] See text for definition of hypertension.

Conclusion: Sodium is considered a current public health issue. Reported dietary intakes are high in many persons relative to estimates of safe and adequate levels of intake; reported intakes do not account for all sources of sodium. The prevalence of hypertension, which is related in some persons to sodium intake as well as other factors, is high in all adult groups examined (14-44 percent). Because of the serious, and largely preventable, deleterious effects of elevated blood pressure, a high level of monitoring effort is warranted. Blood pressure measurements should continue to be included in surveys and efforts to improve and validate the assessment of total sodium intake should be pursued.

Potassium

Potassium is an essential mineral and is a cation like sodium; however, potassium is concentrated in the cell rather than in the extracellular fluid like sodium. Population studies have shown that low potassium intake is associated with high blood pressure (DHHS, 1988). Although sodium intake may be the most important dietary determinant of blood pressure, variation in the ratio of sodium to potassium in the diet may also affect blood pressure under certain conditions (National Research Council, 1980). The Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (1988) has noted that high potassium intake has a modest blood pressure-lowering effect, but that evidence in this regard is still developing. *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) also noted that the relationship between sodium, potassium, and blood pressure in normotensive adults may be dependent on the family history of hypertension and that further research is needed to evaluate the effects on blood pressure of both increased potassium and reduced sodium intake. The National Research Council (1980) has set Estimated Safe and Adequate Daily Dietary Intake (ESADDI) ranges for potassium. The JNMEC did not evaluate potassium in its report.

The per capita amount of potassium in the U.S. food supply had been declining since 1909 but has increased slightly after reaching a nadir in 1980-81 (3,300 milligrams) to 3,460 milligrams in 1985 (figure II-45). In 1985, the food groups contributing the major shares of potassium in the food supply were vegetables (27.1 percent); dairy products (21.1 percent); meat, poultry, and fish (19.3 percent); and fruits (11.3 percent) (figure II-46).

Based on 4-day data from the CSFII 1985-86, the mean potassium intake of women aged 20-49 years was 2,073 milligrams per day (table II–123). At least 25 percent of mean intakes of women in this age group fell below the lower limit of the range suggested to be safe and adequate. Intakes were higher for white women than for black women, for women above poverty than those below poverty, and for women with more education. For children aged 1–5 years (table II–124), mean intakes were almost all above the lower limit of the safe and adequate range, and some intakes exceeded the upper limit. Few consistent changes in potassium intakes (based on 1–day data) have been detected in surveys of individual intake over the period 1971–86 (table II–125); however, the improvements in the food composition database for potassium over the same time period may have obscured changes in intake if any occurred.

There are no biochemical or clinical measurements of potassium nutritional status available; serum potassium levels may be measured but wide variations in intake are not reflected in changing levels of circulating potassium because potassium homeostasis is regulated tightly by excretion through the kidney.

In 1980, only 4.5 percent of the adult U.S. population obtained potassium in the form of supplements (Stewart et al., 1985). Among users, the median and 95th percentile levels of intake barely exceeded the upper limit of the ESADDI.

Conclusion: Potassium is considered a potential public health issue for which further study is needed. Intakes are lower than recommended levels in a substantial number of persons in the population. Further research on the role of potassium intake in the regulation of blood pressure and on the assessment of potassium status is needed to elucidate the public health significance of the low intakes observed.

Copper

Copper is an essential mineral that functions in a variety of enzymes and other proteins. It was not evaluated by the JNMEC. Copper deficiency in humans is rare; it is not known to occur among adults under normal circumstances, but has been diagnosed in malnourished children in Peru, in premature infants fed exclusively a cow milk formula, and in infants on prolonged parenteral nutrition (National Research Council, 1980). More recent studies by the Agricultural Research Service of USDA have suggested a role for copper in heart function, but further study is needed in this area. The National Research Council (1980) has set a range of ESADDI for copper.

The per capita amount of copper in the food supply has declined 19 percent since 1909 to a level of 1.7 milligrams in 1985 (figure II–47). The contributions of vegetables and grain products to copper in the food supply have declined, while the contributions of legumes, nuts, and soy have increased; in 1985, the food groups contributing the major share of copper were meat, poultry, and fish (20.6 percent); vegetables (20.3 percent); grain products (18 percent); and legumes, nuts, and soy (17.7 percent) (figure II–48).

Estimates of dietary copper consumption from 4–day data collected in the CSFII 1985–86 indicate that over 90 percent of women aged 20–49 years and children aged 1–5 years had intakes below the range of ESADDI (tables II–126 and II–127). Several questions may be raised about these apparently low intakes in view of the rarity of copper deficiency. First, intake estimates are uncertain because analytical data on the copper content of foods are lacking in the nutrient composition database for approximately 30 percent of food sources. Second, the National Research Council (1980) has noted that the remarkably steady tissue concentrations of copper in adults in the United States are probably an indication of a sufficient dietary intake and strong homeostatic control.

Early laboratory manifestations of copper deficiency include a low serum copper and decreased number of neutrophils in the blood. Serum copper levels were measured in NHANES II but not in HHANES; interpretative criteria to assess deficiency are uncertain. In the opinion of the EPONM, it does not appear that collection of such data should have a high priority at present.

In 1980, approximately 12 percent of the adult U.S. population consumed copper in the form of supplements (Stewart et al., 1985). The median intake of users was 67 percent of the upper limit of the ESADDI and intake at the 95th percentile was equal to the upper limit of the ESADDI.

Conclusion: Copper is not considered to be a current public health issue. Intakes appear to be low in a large number of persons in the population. Despite some unanswered questions about the estimation of intake and the assessment of status, the likelihood of a public health problem associated with copper is very low. Monitoring should continue at a low level, unless further research suggests more compelling reasons for concern.

Zinc

Zinc is an essential mineral in the diet and is a component of many enzymes. As such, it is involved in many metabolic processes including protein synthesis, wound healing, immune function, and growth and maintenance of tissues. The JNMEC classified zinc as a component requiring further investigation. Severe zinc deficiency characterized by hypogonadism and dwarfism has been observed in the Middle East, and evidence of milder forms of zinc deficiency (detected by biochemical and clinical measurements and responsiveness to increased zinc intake) has been found in several population groups in the United States (National Research Council, 1980).

The per capita amount of zinc in the U.S. food supply was essentially the same in 1985 as in 1909, although fluctuations have occurred in the intervening years (figure II–49). In 1985, the major sources of zinc were meats, poultry, and fish (48.7 percent); dairy products (19 percent); and grain products (12.6 percent) (figure II–50). There has been a large decline in the percentage of zinc obtained from grain products since 1909–13.

Data from the CSFII 1985–86 show that the mean (4-day) dietary intake of zinc for women aged 20–49 years is approximately half of the RDA and that a large percentage of intakes falls well below the RDA. This finding raises concern about the possibility of inadequate dietary intake of zinc and, consequently, zinc deficiency in this group. Among women in the CSFII 1985–86, mean intakes of zinc were lower for blacks than for whites, for persons below poverty than for persons above poverty, and for persons with a lower level of education than for persons with a higher level of education. There were no notable differences in zinc intake due to age, region, or urbanization. The mean intake (based on 1-day data) of males of this same age group was higher and closer to the RDA. The mean intake of children aged 1–5 years was also close to the RDA, and there was no notable effect of race, poverty status, region, or urbanization on dietary intake of zinc in children. The effects of education level on dietary zinc intake were not as striking for the children as they were for the women. Dietary zinc was not assessed in the NFCS 1977–78 or earlier surveys because adequate data on the zinc content of foods were not available at that time.

Serum zinc levels were not measured in HHANES. Very few low values for serum zinc were detected in NHANES II. However, serum zinc is not a reliable indicator of zinc status because factors other than zinc deficiency (such as infection, inflammation, or acute inflammatory response) can influence its level. Low zinc status has been reported to be associated with depressed growth, delayed sexual maturation, and impaired taste function in small groups studied in the United States. These associations have not been detected or (in most cases) measured in NNMS surveys.

An estimated 13.5 percent of the adult population used supplements containing zinc in 1980 (Stewart et al., 1985). The median intake of users from supplements was 50 percent of the RDA. A substantial portion of these users consumed doses in excess of the RDA (approximately 5 percent consumed levels three times the RDA). Excessive consumption of zinc can interfere with copper metabolism.

Conclusion: Zinc is considered a potential public health issue, for which further study is needed. Dietary intakes are lower than recommended levels in some groups, particularly women. The possibility of impaired zinc status is not supported by available biochemical or clinical data from the NNMS. However, findings from the clinical literature suggest evidence of zinc deficiency in some groups in the United States. The significance of the observed low dietary intakes of zinc cannot be evaluated until additional research to determine zinc requirements and to develop better measures of zinc status is conducted. Further monitoring is warranted.

Fluoride and Other Minerals

Fluoride is a preventive factor in dental caries and may have some benefit in increasing bone mass under certain conditions (DHHS, 1988). The efficacy, safety, and cost-effectiveness of fluoride in the prevention of tooth decay have been well established (DHHS, 1988). Even though fluoride may occur naturally in water or be added to municipal water supplies, the JNMEC expressed concern that fluoride intake might be too low for many Americans to benefit. They classified fluoride as a food component warranting public health monitoring priority status. Data on intake were not available from the NNMS then, and are not available now. *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) also noted the uncertainty regarding current fluoride intakes. When the optimal level for fluoride addition to drinking water was set, the water supply was the major source of the fluoride. Now, sources include toothpaste, mouth rinses, topical applications, and beverages and foods prepared with fluoridated water. The availability of fluoride has increased, perhaps to levels that may induce mild dental fluorosis (mottling in developing teeth) (DHHS, 1988). The incidence of caries in children has declined as much as 30-50 percent in the past two decades; this decline has been attributed to increased fluoride from drinking water, food, toothpaste, mouth rinses, and topical applications, but decreased intake of cariogenic foods and improved dental hygiene and care may also be contributing factors (DHHS, 1988). Based on the foregoing information, the EPONM considers fluoride to be a potential public health issue for which further study is needed. The EPONM agrees with the JNMEC concern that fluoride intake may be too low in some groups to provide maximal benefit, but data are not currently available that permit evaluation of this possibility. Assessments of fluoride intake that take all sources into account are warranted.

Other minerals for which RDA or ESADDI have been set are iodine, manganese, chromium, selenium, and molybdenum; these are not monitored in the NNMS at present. Despite current research interest in these minerals and others (for example, boron), the EPONM does not consider the evidence with respect to public health issues regarding these minerals compelling enough to justify a recommendation for their inclusion in the NNMS at this time.

Conclusions

- In the United States today, the amounts of food available in the food supply and the nutrient content on a per capita basis are generally adequate to prevent undernutrition and deficiency-related diseases. Although some Americans may not have sufficient food for a variety of reasons, the supply of food that is available is abundant.

- The NNMS does not provide sufficient population-based data to permit a full assessment of nutritional status in some groups for whom there are special concerns about nutritional status, such as young infants and pregnant and lactating women. In addition, some other groups whose nutritional status may reasonably be suspected to differ from that of the general population, such as the homeless, institutionalized persons, migrant workers, and Native Americans living on reservations, are not included in most of the current household-based surveys of the NNMS. Finally, very little information on the dietary and nutritional status of the elderly (a group for which standards for nutrient adequacy and normal physiologic status have been questioned) was available in the most recent NNMS data that were the focus of this evaluation.

- Evidence from recent analyses of the U.S. food supply and from surveys of individual food consumption suggests that some changes are occurring in eating patterns consistent with recommended dietary guidelines for Americans (USDA/DHHS, 1985) to avoid too much fat, saturated fat, and cholesterol and to consume adequate amounts of starch and dietary fiber. Recent data indicate that consumers are increasingly choosing some lower-fat alternatives within the meat and dairy product food groups and are increasing their consumption of grain products.

- Evidence available on dietary and nutritional status with respect to individual food components does not indicate substantial changes since the JNMEC report was completed in 1986. Consequently, the EPONM and JNMEC classifications of food components by public health monitoring priority are very similar (see table 3-6).

- The principal nutrition-related health problems experienced by Americans continue to be related to the overconsumption of some nutrients and food components, particularly food energy, fat, saturated fatty acids, cholesterol, sodium, and alcohol.

  - The high prevalence of overweight among adults in the United States is evidence that energy intakes exceed energy expenditures (probably because of low energy expenditures, although this possibility cannot be assessed currently in the NNMS); however, reported intakes of food energy do not exceed standards (Recommended Energy Intakes). The JNMEC noted that more than one-quarter of the adult U.S. population was overweight, based on data collected in NHANES II (1976-80). Data collected since then in the HHANES (1982-84) also indicate a high prevalence of overweight in three Hispanic groups not previously studied (26-42 percent), especially in Mexican-American and Puerto Rican women (40 and 42 percent, respectively). Overweight is a controllable risk factor for cardiovascular disease, high blood pressure, and diabetes.

  - Intakes of total fat and saturated fat continue to be higher than the levels recommended by many authoritative groups; cholesterol intakes are high for adult men. These high intakes are reflected in the high prevalence (11-22 percent) of elevated levels of total serum cholesterol, as defined by the 1984 NIH Consensus Development Conference (NIH, 1985), found in nearly all adult groups aged 20-74 years in the United States. Elevated serum cholesterol levels constitute an important controllable risk factor for coronary heart disease.

- Sodium intakes also exceed recommended levels in almost every group in the United States. Such intakes are of concern because of the sensitivity of blood pressure in some persons to sodium intake. Hypertension is prevalent (14–44 percent) in adult groups aged 20–74 years in the U.S. population. Hypertension is a controllable risk factor for cardiovascular disease and stroke.

- Although consumption of excessive alcohol does not appear to be prevalent in a large proportion of the population, reported intakes are high in a large number of Americans and the serious nature of the health and social consequences of such intakes justifies public health concern.

• In spite of the general adequacy of the supply of nutrients, there is evidence of inadequate individual dietary intake and/or impaired nutritional status in some subgroups in the population with respect to a few vitamins and minerals.

- Iron deficiency continues to be the most common single nutrient deficiency, even though some recent hematological and biochemical evidence from the NNMS suggests that its prevalence has declined in children aged 1–5 years. Among groups that are assessed adequately in the NNMS, women of childbearing years and young children are at greatest risk for iron deficiency.

- Although less evidence is available, the calcium status of women is a concern. The high prevalence of osteoporosis in later life is suggestive that calcium intake of many women may be inadequate to permit the accretion of maximal bone mass in early adulthood and/or to maintain bone mass later in life.

- Limited evidence from biochemical assessments suggests that the vitamin A, vitamin C, and folacin nutritional status of some subgroups of the population might be improved.

- Intakes of zinc and vitamin B6 are also low, and poor status has been reported in some population groups in the clinical literature, but further study is needed to assess the health consequences of the reported intakes in U.S. population groups.

• The risk of nutrition-related disorders is generally greater in low-income groups than in groups with higher incomes.

- The prevalences of both overweight and iron deficiency are greater in women below poverty than in women above poverty.

- The intakes of several vitamins and minerals are lower in persons below poverty than in persons above poverty. This finding is also highlighted in the low-income component of the CSFII 1985–86 (USDA, 1986b, 1987, 1988b). Women in the low-income survey had lower intakes of food energy than women in the all-income survey. Intakes of vitamin E, vitamin B6, folacin, calcium, magnesium, iron, and zinc were low in women in both surveys, but lower in the low-income survey than in the all-income survey. Low-income women and children who lived in households that participated in the Food Stamp Program had nutrient intakes that were generally the same or higher than those of low-income women and children living in households that did not participate in the program.

• The ability of the EPONM to examine excessive intakes of vitamins and minerals, and possibly to assess consequences of nutrient toxicity, was limited because none of the available NNMS surveys that assess nutrient intake from food included quantitative estimates of nutrient intake from vitamin/mineral supplements.

• Although the data available to the EPONM for their update on dietary and nutritional status of the U.S. population were not equivalent to the data reviewed by the JNMEC, in terms of the populations surveyed, the conclusions of the EPONM are very consistent with those of the JNMEC. The results of recently completed and ongoing national surveys of dietary and nutritional status by USDA and DHHS will provide a more extensive database for further evaluation of the nutritional status of the U.S. population and various subgroups in future reports on the NNMS.

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Chapter 4

Update of Selected Health Conditions and Behaviors: Relationship to Nutritional Status

Introduction

This chapter provides a brief summary that highlights recent information from the NNMS and related data sources associated with prevention, development, or prevalence of a number of health conditions that are influenced by nutritional status; dietary behaviors that may affect health; and other behaviors that may affect nutritional status. This chapter is intended to serve as an update rather than an exhaustive review of these topics because most of the health conditions and behaviors included were discussed in the JNMEC report. Cardiovascular diseases and anemia are discussed in detail in chapters 5 and 6, respectively; therefore, they are not included in this section. In addition, disorders such as cancer, kidney disease, AIDS, and other chronic diseases may have effects on nutritional status and may require special nutrition management. The nutritional consequences of such diseases are not appropriately included in the NNMS and are not considered in this report.

A conceptual model, figure 4–1, adapted from the general conceptual model shown in chapter 1, illustrates the topics and data considered. Components of the model that are most relevant to the discussions in this chapter are highlighted by the shaded boxes; individual topics noted with an asterisk are those for which some data are available. Potential NNMS and related data sources are represented by the numbers that appear above or below the boxes; numbers noted with an asterisk represent those surveys or studies from which data were obtained for consideration in this chapter. The information from the NNMS in this chapter bears on the model in numerous ways, from consideration of factors that influence food choice to health outcomes.

Nutrition, Morbidity, and Mortality

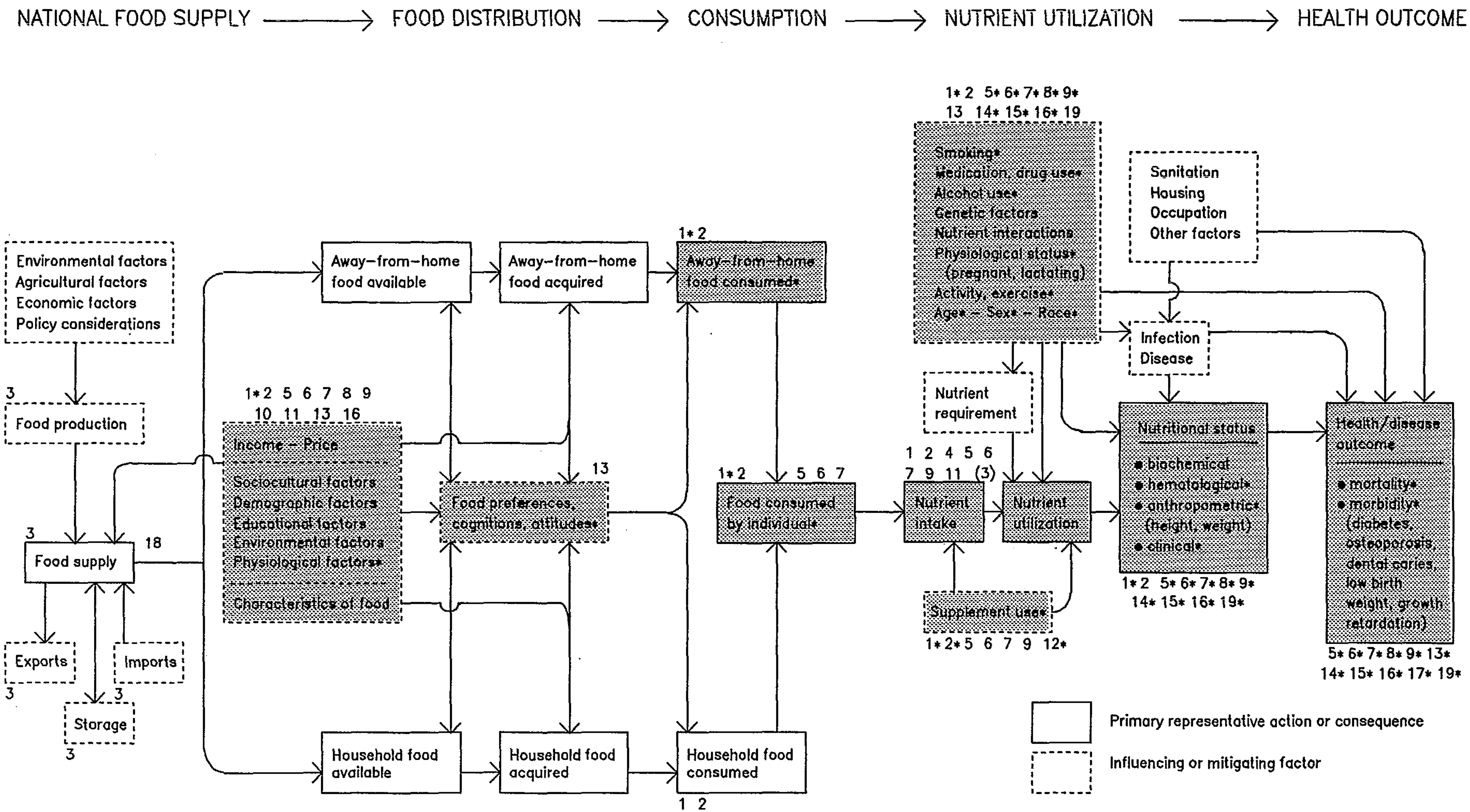
Several of the leading causes of death in the United States are associated with dietary and nutritional status. These include cardiovascular disease, cerebrovascular disease, some cancers, chronic liver disease (especially cirrhosis), and diabetes mellitus. The extent to which changes in diet might alter morbidity and mortality caused by these diseases is uncertain. The JNMEC report compared age-adjusted death rates from these and several other causes for the years 1950 and 1983. Similar information including the most recent data from 1985 is presented in figure 4–2. No striking changes in death rates have occurred between 1983 and 1985. The JNMEC (DHHS/USDA, 1986) noted that the downward trend in mortality rates for cardiovascular disease, diabetes, and digestive system cancers occurred simultaneously with improvements in the diagnosis and treatment of these diseases, improved health and nutrition education, and growing public awareness of the contribution of lifestyle factors to health.

Mortality experience and cause of death distribution for the NHEFS approximated closely the Vital Statistics data (Madans et al., 1986), suggesting the utility of this data set for examining associations between indicators of nutritional and dietary status and subsequent mortality.

Health Conditions Influenced by Nutritional Status

Obesity

Obesity has adverse effects on health and longevity; it is associated with the prevalence and incidence of hypertension; hypercholesterolemia; non-insulin-dependent diabetes mellitus; certain cancers; osteoarthritis of weight bearing joints, especially the knees; and psychological problems (DHHS, 1988; National Research Council, 1989). In the JNMEC report, obesity was defined as the accumulation of excess body fat. Overweight was defined as excess body weight for height; the criterion for overweight was body mass index (BMI) at or above the 85th



National Nutrition Monitoring System and other data sources: 1 = CSFII 1985–86, 2 = NFCS 1977–78, 3 = U.S. Food Supply Series, 4 = National Nutrient Data Bank, 5 = NHANES I, 6 = NHANES II, 7 = HHANES, 8 = NHEFS, 9 = NHIS, 10 = FLAPS, 11 = Total Diet Study, 12 = Vit/Min, 13 = Health and Diet Study, 14 = PedNSS, 15 = PNSS, 16 = BRFSS, 17 = U.S. Vital Statistics, 18 = AEDS, 19 = NHES. See appendix III for definitions of acronyms. Shaded boxes highlight portions of the model discussed; an asterisk (*) indicates data and data sources considered in this chapter.

Figure 4–1. Conceptual model for update of selected health conditions and behaviors related to nutritional status (see text for explanation)

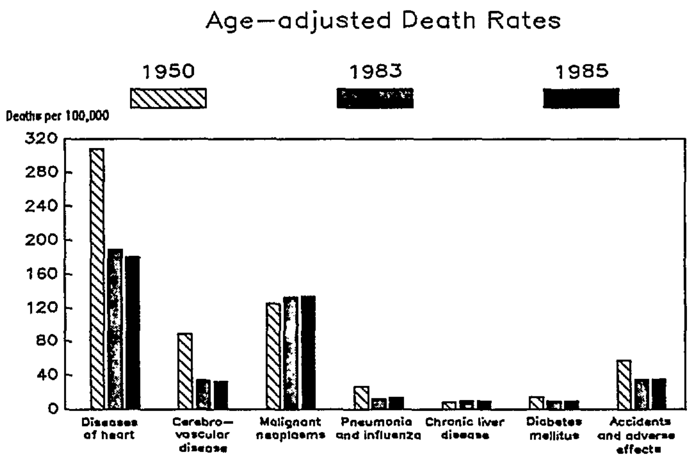


Figure 4–2. Age–adjusted death rates for selected causes of death: U.S. Vital Statistics, 1950, 1983, 1985

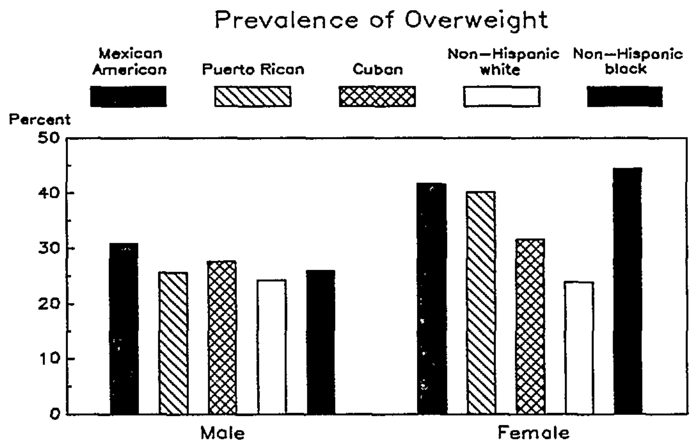


Figure 4–3. Age–adjusted percent of overweight Hispanic and non–Hispanic persons, 20–74 years: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80

percentile of the NHANES II reference population and the criterion for severe overweight was body BMI at or above the 95th percentile of the same population. Although BMI is highly correlated with body fat, increases in BMI can also result from increases in lean body mass or large body frame size (DHHS, 1988). Therefore, HHANES data on the prevalence of overweight and severe overweight, rather than obesity, are presented and compared to NHANES II data for non–Hispanics in figures 4–3 and 4–4 (see also tables II–4 through II–9 in appendix II).

The prevalence of overweight was generally higher in women than in men. Among the different ethnic groups compared, non–Hispanic white women showed the lowest prevalences of overweight, followed by Cuban women. Non–Hispanic black women had the highest prevalence, and the estimates for Mexican–American and Puerto Rican women fell between the two extremes. In general, socioeconomic status below poverty was associated with higher prevalences of overweight in females. Among the males, non–Hispanic whites had the lowest and Mexican Americans had the highest prevalences of overweight.

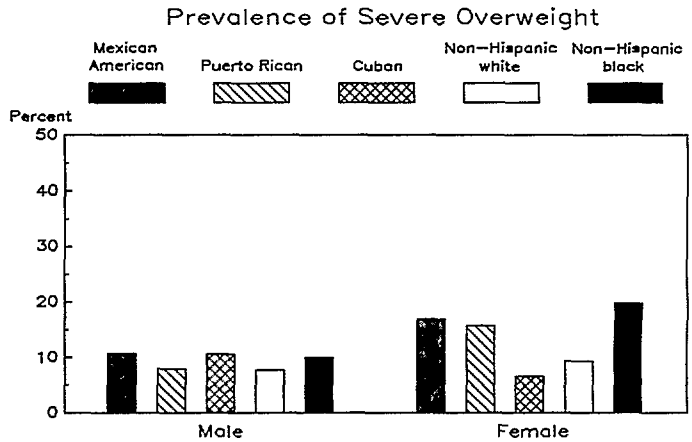


Figure 4–4. Age–adjusted percent of severely overweight Hispanic and non–Hispanic persons, 20–74 years: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80

The prevalence of overweight and obesity is high in the United States and higher, at most ages, than the prevalences in Britain or Canada (Millar and Stephens, 1987). The exact prevalence estimated depends on the criteria used to assess weight status (BMI, desirable weight standards) and the population to which the criteria are applied. Nevertheless, BMI and the prevalence of obesity are associated with socioeconomic status. Flegal, Harlan, and Landis (1988a, 1988b) have examined secular trends in BMI in men and women aged 18–34 years with data from the National Health Examination Survey (NHES) (1960–62), NHANES I (1971–74), and NHANES II (1976–80). Mean BMI for black and white men was similar and changed little over the time period studied. In both black and white men, mean BMI was higher with higher levels of education, except that mean BMI at the lowest education level increased over time. In both black and white men, higher income was associated with higher BMI. For young women, the mean BMI increased over this time period (1960–80) for both blacks and whites at all levels of education and income. However, higher mean BMI was observed in black and white women with lower educational levels; differences in BMI by education level increased over time. In addition, Flegal, Harlan, and Landis (1988a) observed that mean BMI of women tended to be lower in higher income categories but the differences at the various income levels became smaller over time.

Additional analyses of these data by Gillum (1987) showed that rural and southern black women aged 25–74 years were more overweight than their urban, northern, and western counterparts. Overall, age-adjusted prevalences for overweight were 47.1, 46.8, and 48.1 percent for 1960–62, 1971–74, and 1976–80, respectively. Gillum (1987) also confirmed that overweight in black women was inversely related to family income and education.

Self-reports of body weight and self-assessments of overweight are collected in other NNMS activities. Data from the BRFSS collected from 28 States and the District of Columbia in 1981–83 indicated that 23 percent of respondents considered themselves overweight (Forman et al., 1986). Based on comparison with desirable weight-for-height tables, more blacks and Hispanics were classified as overweight than whites. More overweight adults than normal-weight adults had uncontrolled hypertension, were binge drinkers, and had a sedentary lifestyle (Forman et al., 1986). Data from this survey also suggest the prevalence of obesity differs for men and women among the states participating; however, no clear trend in the prevalence of overweight was noted in data from states participating for the full study period (1984–86) (CDC, 1988). Among women aged 19–50 years surveyed in the CSFII 1985–86, those classified as overweight on the basis of BMI derived from self-reported body weight and height were more likely to be older (ages 35–50 years), to be black, and to have an income less than 130 percent of poverty. Moreover, these women less likely to report rigorous leisure activity and excellent health status than those classified as normal weight or underweight (Moshfegh, 1987). Somewhat similar observations were reported by Dawson (1988) based on analyses of data from the 1985 NHIS.

Williamson, Kahn, and Remington (1988) have used the NHEFS data to estimate the 10-year incidence of overweight in a national cohort of adults aged 20–74 years. The incidence of overweight was defined for those who were not overweight at baseline as an increase in BMI to ≥27.8 and ≥27.3 for men and women, respectively, and was highest in those aged 35–44 years (23.4 and 18.3 percent for men and women, respectively) and lowest for those aged 65–74 years (7.0 and 7.6 percent for men and women, respectively). The incidence of major weight gain (defined as an increase of ≥5.0 BMI units regardless of weight at baseline) was twice as high in women as in men, with the peak incidence occurring in persons aged 25–34 years (6.0 and 12 percent for men and women, respectively). Men who were underweight and women who were overweight at baseline had the highest incidence of major weight gain.

Diabetes

Diabetes mellitus includes a variety of conditions associated with the abnormal secretion or action of insulin from the pancreas and the resulting abnormal metabolism of glucose. Insulin-dependent (Type I) diabetes is distinguished clinically from non-insulin-dependent (Type II) diabetes by usual age of onset, pathology, and treatment. Most national statistics on the prevalence of diabetes do not distinguish between the two types. The development of diabetes is strongly influenced by genetic factors; obesity greatly increases the risk for developing Type II diabetes.

The JNMEC report presented data from NHANES II on the prevalence of diabetes in the general U.S. population. Persons were considered to have diabetes if results of an oral glucose tolerance test indicated a diabetic condition or if diabetes was reported during the medical history. Update data available from the NNMS are those for the prevalence of diabetes in the three Hispanic groups in HHANES (table 4–1). (The response rate for participation in the oral glucose tolerance test in HHANES was generally low and was especially low for the Cubans and Puerto Ricans as compared to the Mexican Americans.) The oral glucose tolerance test was administered to a subsample in each survey according to the recommendations of the National Diabetes Data Group: subjects fasted overnight for 10–16 hours (9–17 hours for HHANES); the test was performed in the morning; a fasting blood sample was taken; subjects drank a solution containing 75 grams of glucose; and additional blood samples were taken after one hour and two hours. Diabetes was considered to be indicated by the results of the glucose tolerance test if the fasting plasma glucose was 7.8 mmol/L (140 milligrams/deciliter) or more, or if the fasting value was less than 7.8 mmol/L (140 milligrams/deciliter) and the two-hour value was 11.1 mmol/L (200 milligrams/deciliter) or more.

Estimates of the prevalence of diabetes were, as might be expected, much higher in older (aged 45–74 years) than younger persons (aged 20–44 years). Prevalence estimates were lowest for non-Hispanic whites and highest for Mexican Americans and Puerto Ricans. Recent analyses of the NHANES II data confirmed the strong association between the

Table 4-1. Total prevalence of diabetes (sum of previously diagnosed diabetes and undiagnosed diabetes), by age group, survey, and ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982-84, and second National Health and Nutrition Examination Survey, 1976-80 (Flegal et al., 1988c)

Age group	Survey	Ethnic group or race	Prevalence (percent)	Approximate 95 percent confidence interval
20-44 years	HHANES	Mexican American	3.8	2.0-5.5
		Cuban	2.4	0.0-5.0
		Puerto Rican	4.1	2.8-5.3
	NHANES II	Non-Hispanic white	1.6	1.1-2.2
		Non-Hispanic black	3.3	0.0-5.7
45-74 years	HHANES	Mexican American	23.9	20.8-27.1
		Cuban	15.8	10.5-21.1
		Puerto Rican	26.1	22.2-30.1
	NHANES II	Non-Hispanic white	12.0	10.7-13.2
		Non-Hispanic black	19.3	15.1-23.6

prevalence of diabetes and body weight (NCHS, 1987a). Persons who were 50 percent or more above ideal body weight had diabetes at five times the rate of persons who were at ideal weight or lighter. Kovar, Harris, and Hadden (1987) have pointed out that comparisons of data collected over the past 40 years with results of the oral glucose tolerance tests in NHANES II suggest strongly that only about one-half of persons with diabetes are aware they have the disease. That is, while 3.4 percent of the adult population have been diagnosed as diabetic, an additional 3.2 to 3.4 percent meet the criteria for the disease but have not been diagnosed as diabetic. The analyses of Kovar, Harris, and Hadden (1987) suggest that prevalence of diabetes in the U.S. adult population may be twice the rate estimated from medical histories alone.

Examination of data from the NHEFS showed that the age-adjusted death rates for white men and women aged 40-77 years with diabetes were twice the rates for persons without diabetes, with little difference by sex or age (Kleinman et al., 1987). The percentage of the excess mortality attributable to coronary heart disease was approximately 75 percent and 57 percent for men and women, respectively. The relative risk of death and ischemic heart disease mortality remained higher in persons with diabetes even after adjusting for systolic blood pressure, serum cholesterol, body mass index, and smoking.

Cancer

Associations of certain types of cancer with body weight and calories; intake of dietary fat and fiber; and consumption of fruits and vegetables and smoked, salted, and pickled foods have been suggested. With respect to diet and cancer, *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) concluded the following:

- A decrease in fat consumption by the general public might reduce risk for certain cancers.
- Maintenance of desirable weight was recommended.
- Intake of foods high in dietary fiber might decrease the risk for colorectal cancer.
- An increase in consumption of fruits and vegetables containing carotenoids for persons who consume low amounts of these foods might be beneficial.
- A decrease in alcohol intake among heavy drinkers would help to reduce the prevalence of cancers of the mouth, esophagus, pharynx, and perhaps other sites.
- Selenium intake should not increase above levels now in the average diet.
- Evidence does not justify a recommendation to the general public to decrease protein intake on the basis of its relationship to cancer.
- The public should continue to limit its intake of salt-pickled, salt-cured, and smoked foods to current low levels of consumption.

The JNMEC report compared age-adjusted cancer death rates for 1950 and 1982. Similar information including the most recent data from 1985 is presented in figure 4-5. No striking changes between 1983 and

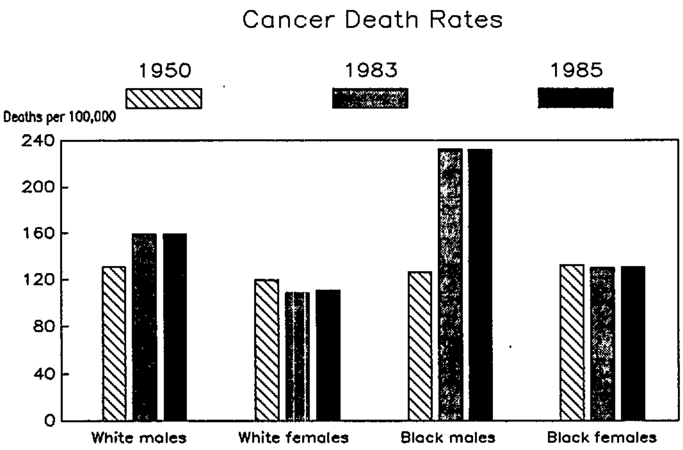


Figure 4-5. Age-adjusted death rates for malignant neoplasms, by race and sex: U.S. Vital Statistics, 1950, 1983, 1985

1985 are evident. The NHIS included a series of questions on cancer epidemiology and control in 1987. Nutrition-related questions addressed frequency of eating and portion sizes for 62 food items as well as use of vitamin and mineral supplements and changes in diet and cooking practices due to health reasons. Analyses of the data were not available to the EPONM.

Data collected by components of the NNMS must be interpreted with considerable caution in examining associations of diet and cancer. Even the dietary data collected in the more comprehensive components of NNMS is incomplete when viewed in relation to the time lag between possible dietary factors and occurrence of cancers. Similarly, Jabine (NCHS, 1987b) has noted that sensitive information such as occurrence of cancer is more likely to be underreported by subjects in telephone and face-to-face interviews than less sensitive personal medical information such as occurrence of asthma or hay fever.

Osteoporosis

Osteoporosis is a skeletal disorder characterized by a decrease in the amount of bone so severe that fractures may occur even after minimal trauma. There is moderate evidence that low dietary calcium is a positive risk factor for osteoporosis (DHHS, 1988). Other positive risk factors include age, postmenopausal status, corticosteroid use, extreme immobility, alcohol consumption, low body weight, and cigarette smoking. Protective factors include black race, estrogen use, and heavy exercise.

The Surgeon General's Report on Nutrition and Health (DHHS, 1988) noted that defining the relationships between diet and osteoporosis is difficult because of the many dietary factors associated with bone mass (calcium, phosphate, vitamin D, protein, sodium, fluoride, calories, and alcohol), the universality of bone loss with age, the interaction of diet and lifestyle with genetic factors, and the difficulties in measuring bone mass in populations. Data on the prevalence of osteoporosis have not been collected in the NNMS, but some information is available to suggest the scope of the problem. Data from the 1986 National Hospital Discharge Survey indicate that 816,000 of a total of 10,716,000 patients aged 65 years and over were discharged from U.S. hospitals with a first-listed diagnosis of fracture of the neck of the femur. Data from the 1985 National Nursing Home Survey show that 66,300 patients (4.4 percent) had a diagnosis of the same fracture upon admission to a nursing home. Data on bone density are being collected in the NHANES III and will be available. Age-specific data on dietary intake patterns collected in the NNMS, particularly the HANES, may be useful for future analyses of associations of diet and osteoporosis.

Dental Caries

Dental caries, or tooth decay, are caused by a progressive dissolution of mineral from tooth surfaces by acid produced by oral bacteria. Advanced disease can result in tooth loss. A causative role of dietary sugar (especially in sticky foods) in caries production and a protective role of fluoride are relatively well established. Ismail et al. (1987a, 1987b, 1988) have analyzed the dental exam data from the Mexican-American subjects in HHANES. The numbers of decayed, missing, and filled teeth for children from a national sample and Mexican-American children are shown in figures 4-6 and 4-7, respectively. With respect to findings in adults, Mexican Americans had lower scores for decayed, missing, and filled teeth overall, but higher numbers of untreated decayed teeth, than did participants of NHANES I (1971-74) of the same region.

Low Birth Weight

Low birth weight may result from inadequate fetal growth or premature birth, or both. The term low birth weight describes infants weighing less than 2,500 grams (about 5.5 pounds) and the term describes very low birth weight as infants weighing less than 1,500 grams (about 3.3 pounds). The lower the

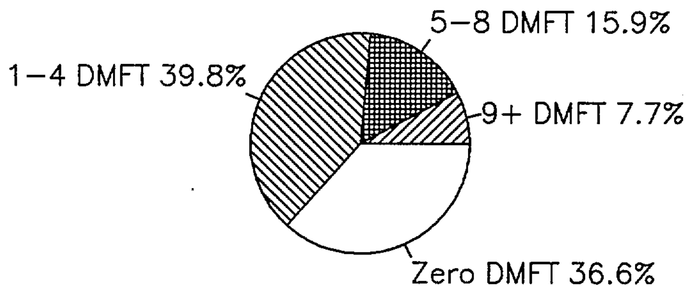


Figure 4-6. Percent distribution of children aged 5-17 years, according to the number of decayed, missing, and filled teeth (DMFT): National Dental Caries Prevalence Study, 1979-80

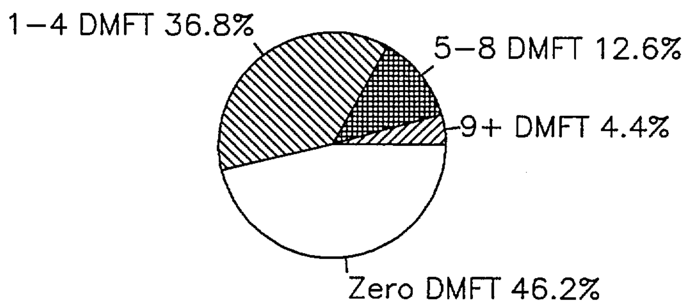


Figure 4-7. Percent distribution of Mexican-American children from the Southwest United States, aged 5-17 years, according to the number of decayed, missing, and filled teeth (DMFT): Hispanic Health and Nutrition Examination Survey, 1982-84 (Ismail et al., 1988)

birth weight the greater the risk of neonatal death (DHHS, 1988). Birth weight is a strong determinant of the chances of survival and postnatal growth, development, and health of the infant.

Low birth weight is also associated with increased morbidity, congenital abnormalities, and increased susceptibility to infection. Rates of low birth weight are linked to differences in mortality rates among subpopulation groups. Vital Statistics data (1983-85) are available to update information presented in the JNMEC report (figure 4-8). Black women are twice as likely as white women to have a low birth weight baby. The average annual rate of low birth weight from 1983-85 was 12.5 percent for nonwhite women and 5.6 percent for white women. The ratio of approximately two to one of low birth weight between black and white women has remained fairly constant over the past two decades. Such racial differences (much higher prevalences of low birth weight infants in blacks) are detected even in mothers at low risk (Kleinman and Kessel, 1987).

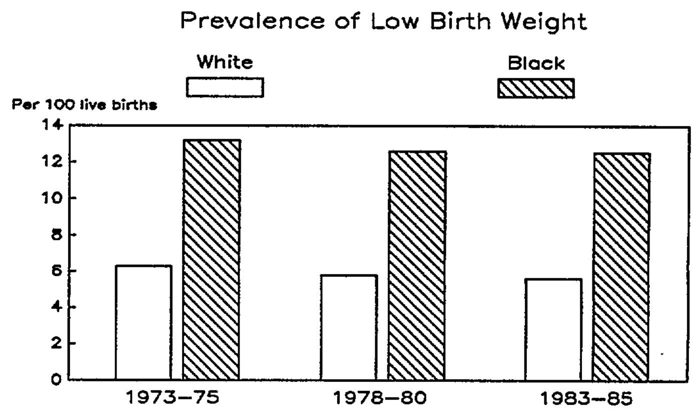


Figure 4-8. Percent of infants with low birth weight (2,500 grams or less): U.S. Vital Statistics, 1973-75, 1978-80, 1983-85

Several risk factors are associated with low birth weight. These include, but are not limited to, lack of or late entry into the prenatal care system, high parity, unintended pregnancy, teenage and older maternal age pregnancy, being unmarried, previous low birth weight, poor obstetrical health history, anemia, chronic diseases, low socioeconomic status, low maternal weight gain, smoking, and alcohol and drug abuse. Any one or more of these factors are useful in defining high-risk pregnancy and in targeting appropriate interventions.

Several studies have shown that nutrition has a positive influence on birth weight; however, the extent of its effect is difficult to evaluate because of the interrelationship of prepregnancy weight, weight gain during pregnancy, and socioeconomic status.

Data from the 1987 PNSS are presented in tables 4-2 through 4-4. These data are not from a nationally representative sample but rather represent a low-income, high-risk population of pregnant women from participating states. Nonetheless, they clearly demonstrate the association of smoking with low birth weight. In this population, the prevalence of low birth weight was lowest in whites and Hispanics and highest in blacks and Native Americans. The

Table 4–2. Prevalence of low birth weight (<2,500 grams), by race or ethnic group and smoking status: CDC Pregnancy Nutrition Surveillance System, 1987

Race or ethnic group	Total		Smokers		Nonsmokers	
	n[1]	Percent low	n	Percent low	n	Percent low
Total	69,346	6.7	20,393	9.3	48,953	5.6
White	37,207	5.6	15,335	8.3	21,872	3.7
Black	24,290	9.0	4,328	13.8	19,962	8.0
Hispanic	7,024	4.5	645	5.6	6,379	4.4
Native American	267	7.1	57	7.0	210	7.1
Asian	558	5.4	28	0.0	530	5.7

[1] n is the number of persons in the sample; for n < 100, interpret data with caution.

Table 4–3. Prevalence of low birth weight (<2,500 grams), by maternal age and smoking status: CDC Pregnancy Nutrition Surveillance System, 1987

Age (years)	Total		Smokers		Nonsmokers	
	n[1]	Percent low	n	Percent low	n	Percent low
Total	69,530	6.7	20,410	9.3	49,120	5.6
< 20	20,803	7.0	5,000	8.3	15,803	6.5
20–24	25,453	6.3	8,076	8.5	17,377	5.2
25–29	14,603	6.5	4,886	9.7	9,717	4.9
30–34	6,220	7.5	1,825	12.7	4,395	5.3
> 34	2,451	7.9	623	16.1	1,828	5.1

[1] n is the number of persons in the sample; for n < 100, interpret data with caution.

Table 4–4. Prevalence of low birth weight (<2,500 grams), by pregravid weight and smoking status: CDC Pregnancy Nutrition Surveillance System, 1987

Pregravid weight (percent of desirable weight)	Total		Smokers		Nonsmokers	
	n[1]	Percent low	n	Percent low	n	Percent low
Total	68,323	6.7	20,097	9.3	48,226	5.6
< 90 percent	13,882	9.9	5,026	12.8	8,856	8.3
90–120 percent	35,768	6.4	10,300	8.8	25,468	5.5
> 120 percent	18,673	4.9	4,771	6.9	13,902	4.1

[1] n is the number of persons in the sample; for n < 100, interpret data with caution.

prevalence was not greatly affected by maternal age, but was related to maternal weight before pregnancy.

Growth Retardation

Slowed growth may be one of the first clinically measurable indicators of inadequate dietary intake in children. Anthropometric data such as height and weight provide valuable information for identifying poor nutritional status in children. In cases in which intake of an inadequate diet is chronic and mild, the child's linear growth is often slowed, and height is low for age. This condition is termed "stunting" or "shortness." If energy intake is severely inadequate, the child loses weight and often has a low weight-to-height ratio. This condition is termed "wasting," sometimes called "thinness."

Information on the growth of children available since the 1986 JNMEC report consists of analyses of data from NHANES I and NHANES II, HHANES, and the PedNSS. Height for age and weight for height of children aged 2–17 years in the HHANES were compared to NCHS growth charts (see figures 4-9 and 4-10). The expected prevalence of both shortness

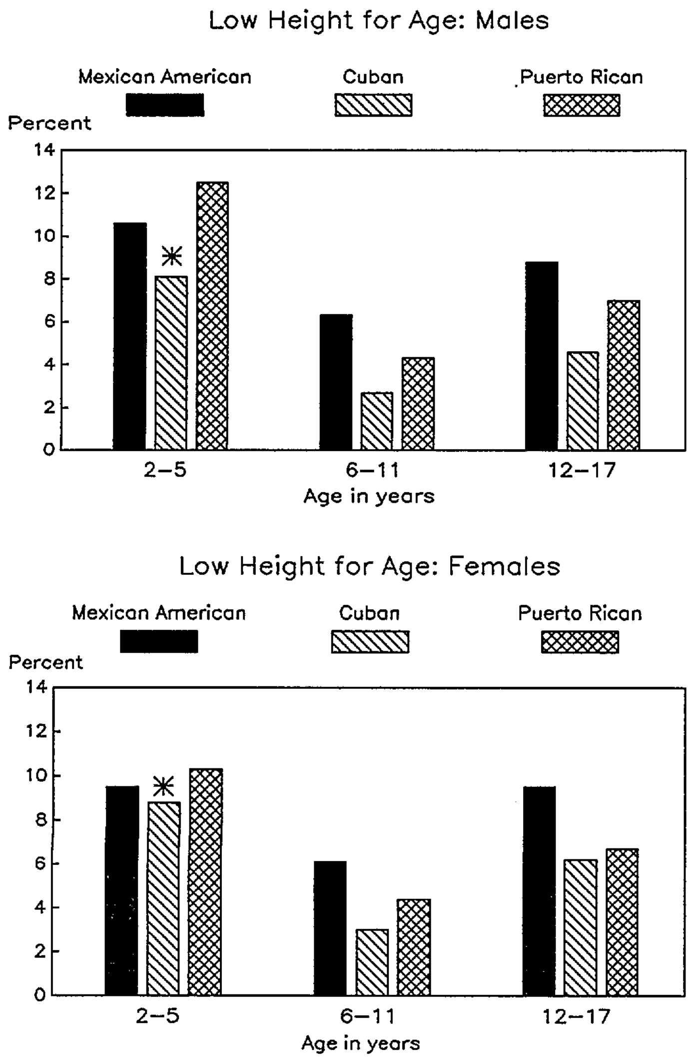


Figure 4-9. Percent of Hispanic children below the NCHS growth chart 5th percentile of height for age, by sex, age, and ethnic group: Hispanic Health and Nutrition Examination Survey, 1982–84 (The asterisk indicates an unstable statistic because of small sample size.)

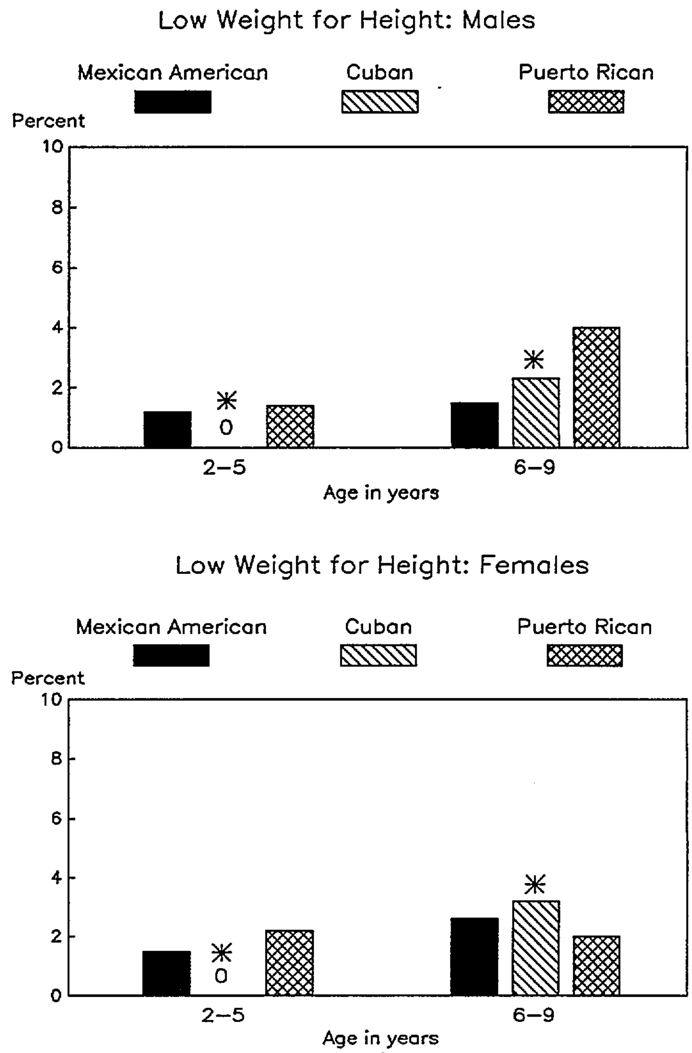


Figure 4-10. Percent of Hispanic children below the NCHS growth chart 5th percentile of weight for height, by sex, age, and ethnic group: Hispanic Health and Nutrition Examination Survey, 1982–84 (The asterisk represents an unstable statistic because of small sample size; the zero represents a prevalence estimate of 0.0 percent.)

and thinness in the reference population is 5 percent. Mexican-American, Cuban, and Puerto Rican males aged 2-5 years had a higher prevalence of shortness than the reference population; however, a higher prevalence of shortness was evident only for Mexican American and Puerto Rican males by the ages of 12-17. Cuban and Puerto Rican females aged 2-5 years tended to be shorter than the reference population; however, by ages 12-17 years, females in all three Hispanic groups exhibited a higher prevalence of shortness than the reference population. For Hispanic males and females aged 2-9 years, incidence of underweight was less than in the reference population of children of these ages. Although the data on height-for-age could be considered indicative of mild dietary inadequacy, other factors, both genetic and environmental, need to be evaluated before making this conclusion. Also, height for age is regarded as a more sensitive indicator of dietary adequacy in prepubertal children than in adolescents.

The PedNSS continuously monitors the nutritional status of high risk groups of low-income infants and children in various states. The database is obtained from selected health service delivery programs such as Maternal and Child Health; Early and Periodic Screening, Diagnosis, and Treatment; the Supplemental Food Program for Women, Infants and Children; and Head Start. Data compiled between 1973 and 1987 have consistently shown 9-11 percent of children below the NCHS growth chart 5th percentiles for height for age (shortness or stunting) and 3-4 percent below the 5th percentile for weight for height (thinness) (figure 4-11).

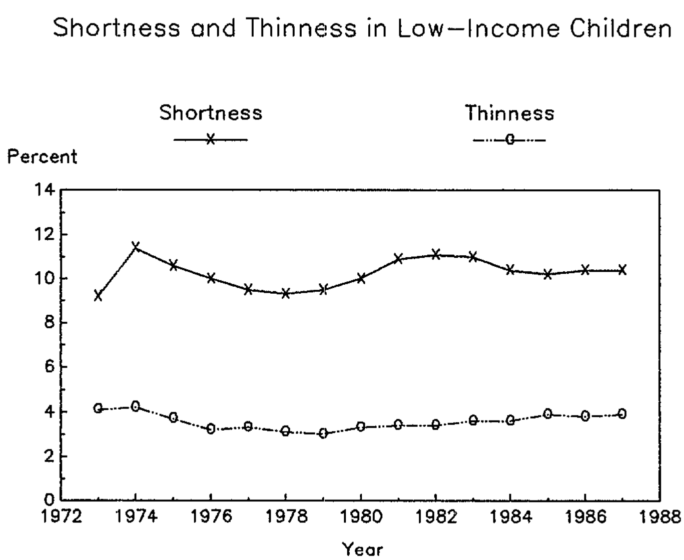


Figure 4-11. Percent of low-income children below the NCHS growth chart 5th percentile of height for age (shortness) or below the NCHS growth chart 5th percentile of weight for height (thinness): CDC Pediatric Nutrition Surveillance System, 1973-87

These CDC data are based on children who are in low-income families participating in government-supported service programs; consequently, this group is less representative of the total U.S. population with respect to poverty status and related characteristics. This fact helps to explain the higher risk of stunting that exists in the CDC surveillance population than in the reference population that was used to establish the 5th percentile criterion. The EPONM is in agreement with the JNMEC that the CDC surveillance system seems to be sensitive enough to detect trends in nutritional status among persons seeking health services.

Growth parameters in black and white children aged 1-17 years in the NHANES I (1971-75) and NHANES II (1976-80) were analyzed in relation to poverty status (Jones et al., 1985). Mean values for height and weight were generally lower for children living below the designated poverty threshold than for children living above poverty. Growth factors for fatness (skinfolds) were less affected by poverty status. The magnitude of these poverty-associated differences decreased between the times of NHANES I and NHANES II. The differences in growth were not consistently associated with differences in energy intakes between poverty status groups or between surveys, suggesting that environmental factors other than nutrition (for example, infections, parasitic diseases, or family instability) may be responsible for part of the differences in growth observed.

Pregnancy

There is increased demand for nutrients during pregnancy. The CSFII 1985-86 data indicate that pregnant women make specific and appropriate alterations in their diets which include avoidance of alcohol, increased dairy product consumption, and use of vitamin/mineral supplements; these changes would be expected to lead to a higher nutrient density for several nutrients in pregnant than in nonpregnant women (Harrison et al., 1988; Krebs-Smith, 1988).

The number of pregnant women included in most national sample surveys of the general population is usually too small for analyses that take into account the nutrition-related physiological changes that occur over the nine months of pregnancy. However, data for the prevalence of low hematocrit, by trimester, from the 1987 PNSS are presented in tables 4–5 and 4–6. (Criteria for low hematocrit are given in chapter 6.) Prevalence of low hematocrit was highest in the third trimester, was higher in blacks than in other ethnic groups, and was higher in younger women than in older women.

Dietary Behaviors That May Affect Health

The NNMS provides some data on dietary behaviors that may affect health. Most of these behaviors are motivated by food preferences, attitudes, and cognitions (see conceptual model in figure 4–1). Some may be related to perceptions about health (breastfeeding, vitamin/mineral supplement use, vegetarianism, weight reducing diets); some may be related to body image (weight reducing diets); some may be motivated by religious or ethical beliefs (vegetarianism); and some may be responsive to advertising (food away from home) and education (breastfeeding).

Breastfeeding

A number of benefits of breastfeeding have been reported; human milk contains factors that provide

Table 4–5. Prevalence of low hematocrit at initial visit, by race or ethnic group and trimester of pregnancy: CDC Pregnancy Nutrition Surveillance System, 1987

Race or ethnic group	Total		First trimester		Second trimester		Third trimester	
	n[1]	Percent low	n	Percent low	n	Percent low	n	Percent low
Total	77,771	14.7	15,261	5.6	36,367	9.9	26,143	26.8
White	43,908	9.4	10,575	3.2	19,885	5.8	13,448	19.4
Black	25,702	24.2	3,609	12.2	12,584	16.8	9,509	38.6
Hispanic	7,130	13.6	902	7.5	3,450	7.9	2,778	22.8
Native American	263	9.1	48	0	111	4.5	104	18.2
Asian	592	15.2	99	9.1	265	12.1	228	21.5

[1] n is the number of persons in the sample; for n < 100, interpret data with caution.

Table 4–6. Prevalence of low hematocrit at initial visit, by maternal age and trimester of pregnancy: CDC Pregnancy Nutrition Surveillance System, 1987

Age (years)	Total		First trimester		Second trimester		Third trimester	
	n[1]	Percent low	n	Percent low	n	Percent low	n	Percent low
Total	77,771	14.7	15,261	5.6	36,367	9.9	26,143	26.8
< 20	23,064	17.3	4,044	6.1	10,819	11.3	8,201	30.6
20–24	28,882	14.1	5,861	5.3	13,332	9.5	9,692	25.6
25–29	16,375	13.2	3,439	5.6	7,726	9.1	5,210	24.4
30–34	6,829	13.5	1,418	5.8	3,203	9.1	2,208	24.7
> 34	2,615	12.5	499	6.0	1,286	7.7	830	24.0

[1] n is the number of persons in the sample; for n < 100, interpret data with caution.

some degree of immunity against infections, supplies protection from iron deficiency, and rarely causes allergic reactions (DHHS, 1988). Data on breastfeeding are presented from an analysis of HHANES by Carter et al. (1988) in tables 4–7 and 4–8. The nationwide increases over time in the percent of children ever breastfed and the percent breastfed for 6 months or more that have been observed in the non-Hispanic population were also observed in the Mexican-American population.

Dietary intake data for breastfeeding women from the CSFII 1985–86 indicated that intakes of energy and energy-yielding nutrients (protein, fat, and carbohydrate) appeared to be higher than intakes of nonpregnant, nonlactating women. Intakes of all vitamins and minerals analyzed in CSFII 1985–86 also appeared to be higher among women who were breastfeeding. Values for nutrient intakes represent nutrient content of all foods and beverages (except water); they do not include nutrient intakes from vitamin and mineral supplements (Krebs-Smith, 1988). Eighty-two percent of breastfeeding women reported using nutrient supplements and thereby had higher intakes for some vitamins and minerals than intakes from foods alone would indicate.

Vitamin/Mineral Supplement Use

There are concerns about nutrient toxicity or imbalances due to intake of high doses of vitamin/mineral supplements. For data from the FDA Vitamin/Mineral Supplement Intake Survey, see tables II–132 and II–133 in appendix II. Data from this survey indicated that, excluding pregnant and lactating women, nearly 40 percent of the adult population used one or more supplements (Stewart et al., 1985). Of those users, more than half consumed only one supplement; vitamin C, either alone or in combination with other nutrients, was most widely consumed (more than 90 percent of users). Supplement use was more prevalent among women than among men, and more prevalent in the West than in other parts of the country. A wide range of intakes (up to 500 times the RDA for individual nutrients) was found. Heavy supplement use was more common in older adults,

Table 4–7. Percent of children who were ever breastfed, by year of birth and ethnic group: National Survey of Family Growth, 1982, and Hispanic Health and Nutrition Examination Survey, 1982–84 (Carter et al., 1988)

Ethnic group	Year of birth: 1971–73	1974–76	1977–79	1980–82
Non-Hispanic	27.9	37.0	44.8	53.2
Mexican American	33.7	33.6	39.7	50.6
Cuban	39.8	27.2	44.5	32.9
Puerto Rican	17.8	16.0	15.9	26.1

Table 4–8. Percent of children who were breastfed for 6 months or more, by year of birth and ethnic group: National Survey of Family Growth, 1982, and Hispanic Health and Nutrition Examination Survey, 1982–84 (Carter et al., 1988)

Ethnic group	Year of birth: 1971–73	1974–76	1977–79	1980–82
Non-Hispanic	6.7	14.9	20.7	18.8
Mexican American	14.0	12.9	16.6	18.8
Cuban	14.9	4.1	5.7	5.0
Puerto Rican	6.8	3.6	4.7	7.1

and such users were typically taking two or more specialized vitamin and mineral products at a time as part of a personalized supplement regimen (Levy and Schucker, 1987). Heavy supplement use was also found to be associated with more frequent visits to health food stores, greater interest in and concern with influencing their own nutritional status, and less physician involvement in prescribing nutrient supplements.

Data from the NFCS 1977–78 indicated that 35 percent of individuals one year of age and older used supplements, regularly or irregularly, and confirmed higher prevalences of use for women and persons living in the West (Moshfegh, 1985). Education was also positively associated with supplement use. The diets of supplement users provided a larger amount of many nutrients from food alone than did the diets of nonusers. Comparison of supplement use by participants in the NFCS 1977–78 and participants in the CSFII 1985 showed greater use of vitamin and mineral supplements by men aged 19–50 years (50 percent increase), women aged 19–50 years (48 percent increase), and children aged 1–5 years (26 percent increase) (USDA, 1985, 1986). In all cases supplement use was greater than the average of 40 percent reported in 1980 from the FDA Vitamin/ Mineral Supplement Intake Survey: 45 percent for men, 58 percent for women, and 60 percent for children in 1985.

Changing Dietary Practices

Vegetarianism

In the CSFII 1985–86, very few individuals (no more than about 2 percent of men and women and no more than 1.7 percent of children) identified themselves as vegetarians (USDA, 1985, 1986). Vegetarianism was found to be associated with lower intakes of protein, vitamin B12, iron, zinc, and thiamin (Harrison et al., 1988). Vegetarianism was not found to be significantly associated with body weight status.

Weight Reducing Diets

Eight percent of the women in the CSFII 1985–86 reported they were on a special diet, which they described as a weight-loss diet. The percent was higher (13 percent) in women classified as overweight as determined by body mass index (Moshfegh, 1987). Results of the NHIS on Health Promotion and Disease Prevention (NCHS, 1988a) indicated that 56 percent of persons who were classified as overweight (24 percent of the total population) were trying to lose weight.

Food Away From Home

Since 1970, the percentage of disposable income going to food at home has declined steadily; the percentage going to food away from home has remained relatively constant (The Food Institute, 1988). Americans spent an estimated $454 billion for food, both at home and away from home, in 1987. Consumer food expenditures accounted for 15.3 percent of the total spent for all goods and services in the United States during the year (The Food Institute, 1988). Of the total spent for food in 1987, $305.8 billion, or 67 percent, was spent for food consumed at home. About one-third of personal consumption expenditures for food was for food away from home, which totaled $148.7 billion in 1987 (The Food Institute, 1988).

The $454.4 billion spent for food in 1987 represented 14.3 percent of disposable personal income, continuing the historic decline in the proportion of income Americans allot to food. The proportion allocated to food at home has dropped from 17 percent in 1950–54 to 13.6 percent in 1970–74, to 11.6 percent in the three most recently detailed years. Away-from-home spending experienced a decline from the early 1950s to the mid-1960s; however, the percentage of expenditures allotted to food outside the home has increased slightly since 1970–74 from 4.5 percent to 4.9 percent (The Food Institute, 1988).

Based on the Bureau of Labor Statistics Consumer Expenditure Survey for 1984, expenditures for food at home took 19.1 percent of the pre-tax income of the $5,000–$9,999 group and 4.9 percent of the income of the $40,000-and-over group (The Food Institute, 1988). The percentage of income going to food away from home was 6.6 percent for the $5,000–$9,999 group and 3.7 percent for the $40,000-and-over group (The Food Institute, 1988). Analysis of the proportion of the food dollar for at-home versus away-from-home consumption by income shows that as income increases, the proportion of the food dollar for away-from-home consumption increases and at-home consumption decreases in monotonic fashion (The Food Institute, 1988).

Based on the results of a recent survey of the take-out food market, eight of ten households buy take-out food in any month (purchased outside but consumed inside the home) (Food Marketing Institute, 1987).

Put another way, 71 million households buy take-out food on a regular basis. According to this study, approximately 15 percent of total food dollars go to take-out purchases; 19 percent of total food dollars is spent on food eaten in restaurants; and the remaining 66 percent is spent on food prepared at home. In essence, then, currently one of every three dollars spent on food is going to away-from-home food outlets.

The Census Bureau divides eating and drinking place sales by broad format type. One group includes restaurants, lunchrooms, and cafeterias, called full-menu restaurants. The other includes what the Census Bureau terms "refreshment places," primarily fast-food operations, called limited-menu restaurants. In 1987, full-menu operations accounted for 54.1 percent of eating and drinking place sales, while limited-menu operations accounted for 36.9 percent.

The total volume of eating and drinking place sales was almost $153 billion (The Food Institute, 1988). Since 1982, sales in eating and drinking places have continued to rise. Sales by various types of establishments have remained relatively constant over the five-year period with eating place sales at 92 percent and drinking place sales at 8 percent of total food-based retail trade. Within eating place sales alone, full-menu units command about 60 percent and limited-menu units 40 percent of total sales, although the percentage of sales by limited-menu units has increased from 38.7 percent in 1982 to 40.1 percent in 1986.

The evidence substantiates the claim that nominal sales from away-from-home outlets, either from take-out purchases or from full-menu or limited-menu restaurants, are growing over time. Away-from-home outlets are key components of the retail food distribution sector.

Adults interviewed in the CSFII 1985 reported that they consumed 25 to 33 percent of their intakes of food energy and nutrients away from home (USDA, 1985, 1986). According to Haines et al. (1988), between 1977-78 and 1985, significant shifts were evident in the numbers of women aged 19-50 years classified into various eating patterns. The eating patterns were described multidimensionally in terms of percent of calories consumed at eight eating locations. The numbers of women classified into restaurant groups increased by nearly 60 percent; those classified into fast-food groups increased approximately 120 percent; and those classified into the cafeteria group increased by 38 percent. In short, over this period, the rise in the number of women who frequent restaurants, fast-food places, and cafeterias is noteworthy. Unequivocally, eating patterns of women shifted between 1977-78 and 1985. Changes in employment status, income, age, and education of the female head of household contributed to these trends.

Frequently, it is assumed that away-from-home food is high in energy, fat, and sodium relative to food consumed at home. Although differences existed among the diets of women classified into the various away-from-home groups, overall, these women had higher intakes of energy, fat, and saturated fat than women who reported eating all food at home. Some, but not all, away-from-home groups had cholesterol intakes that were lower than those of women consuming all food at home. Intakes of fat, as percent of energy, tended to be higher for women categorized as consuming food away from home, whereas intakes of carbohydrate and protein, as percent of energy, tended to be lower. For the most part, intakes of sodium, potassium, copper, and zinc tended to be higher in women categorized in the away-from-home groups. Patterns of intake of other food components, including calcium, dietary fiber, folacin, vitamin C, vitamin A, and carotenes differed among categories of away-from-home eaters and were not consistent in direction of change from those of women consuming all foods at home (Haines et al., 1988).

Guenther and Ricart (1988), using data from the CSFII 1985, explored the relationship between eating at food service establishments and the nutritional quality of women's diets (intakes per 1,000 kilocalories of 13 dietary components). Food service establishments included restaurants, fast-food places, and cafeterias. Small but significant correlations were found between extent of food service eating and lower densities of carbohydrate, vitamin C, fiber, calcium, and iron. On the other hand, small, but significant, correlations were found between extent of food service eating and higher densities of alcohol, polyunsaturated fatty acids, saturated fatty acids, and total fat. No statistically significant relationships were evident for protein, cholesterol, vitamin A, or zinc.

In summary, national survey data indicate that nutrient intakes are affected by the increase in consumption of food away from home. Overall, intakes of total energy and fat appear to be higher while intake of carbohydrate appears to be lower away from home. Less consistent changes have been observed for intakes of other nutrients. These changes may be more related to the type of away-from-home eating location than to eating away from home, per se.

School Lunches

Akin et al. (1983a,b) evaluated the impact of the National School Lunch Program on nutrient intakes of children and adolescents aged 6–18 years. Data from the NFCS 1977–78 were used for these analyses. Participants in the school lunch program had greater daily nutrient intakes than children and adolescents who consumed other types of lunches or who skipped lunch. The increased nutrient intakes were generally greater for children aged 6–11 years than for adolescents.

Nondietary Behaviors That May Affect Nutritional Status

The NNMS provides some limited data on the prevalence and impact of several nondietary behaviors that may affect nutritional status (substance abuse, smoking, exercise, and use of oral contraceptives and medications). Many of these behaviors influence nutritional status by affecting nutrient requirements and/or utilization, as well as having independent effects on health outcome (see conceptual model in figure 4–1).

Substance Abuse

Excessive use of alcohol may precipitate nutrient deficiencies, lead to cirrhosis of the liver, and increase blood pressure; addiction to illicit drugs may also contribute to poor nutritional status. See data on alcohol in chapter 3. An extensive questionnaire on illicit drug use was administered in HHANES, but the data analysis was incomplete, and therefore the data were not available to the EPONM.

Smoking

Smoking is a risk factor for cancer and cardiovascular disease. The data from the NHIS on Health Promotion and Disease Prevention (NCHS, 1988a) indicated that 30 percent of persons aged 18 years and older smoked in 1985. The prevalence of smoking was equal for men and women under 30 years of age. Of all age groups, the highest prevalence of smoking was found in the men aged 30–44 years.

The food consumption patterns and dietary intakes of smokers and nonsmokers differ. For example, 18 percent of nonsmokers habitually skip breakfast but 38 percent of smokers do not eat breakfast. However, approximately similar percentages (38 percent) of both groups report eating snacks on a daily basis (NCHS, 1988b). Data from the CSFII 1985–86 indicate that women smokers consumed less of fruits and vegetables and more of eggs, sugars, coffee, and alcoholic beverages than nonsmokers (Larkin et al., 1989 in press). Their intakes of carbohydrate, fiber, vitamin C, and thiamin per 1,000 kilocalories were also lower than the intakes of nonsmokers. In this sample, smoking was associated with lower income, less education, youth, and lack of employment outside the home (Harrison et al., 1988). Smoking was a marker for a poor diet, in terms of both nutrient intake and adherence to the major recommendations of the Dietary Guidelines for Americans (USDA/DHHS, 1985). Analysis of NHANES II data showed that median vitamin C intakes were lower in current cigarette smokers than in nonsmokers, and the reported frequency of consumption of fruits and vegetables high in vitamin C was also lower in current smokers than in nonsmokers (Woteki, Johnson, and Murphy, 1986).

Exercise

Forty percent of the respondents to the NHIS on Health Promotion and Disease Prevention (NCHS, 1988a) reported that they exercised or played sports regularly in 1985, but only 28 percent were considered very physically active as defined by energy expenditure of 3 or more kilocalories/kilogram body weight/day. (Examples of activities that achieve this level of energy expenditure are walking with a moderate increase in heart rate for 45 minutes every day and running or jogging with a large increase in heart rate for 15 minutes every day.) Regular exercise was more prevalent among men (43 percent) than women (38 percent); however, walking for exercise was more prevalent among women (46 percent) than men (38 percent). Fifty percent of women aged 18–29 years walked for exercise while only 37 percent of men in the same age group reported walking as exercise. Data from the CSFII 1985–86 indicate that overweight women were less likely to be physically active than normal-weight women (Moshfegh, 1987). Physical activity levels were rated as light (golf or strolling occasionally), moderate (rigorous exercise once or twice a week or steady walking three or more times per week), or rigorous (running or playing tennis three or more times per week).

Use of Oral Contraceptives

Some evidence suggests that the use of oral contraceptives may negatively affect nutritional status with respect to zinc, folacin, and vitamin B6; however, oral contraceptive use may improve iron nutritional status by decreasing menstrual blood loss. The prevalence of use of oral contraceptives by premenopausal females aged 12–54 years has changed little in the time between NHANES I and NHANES II, having been 17.9 percent in 1971–74 and 16.7 percent in 1976–80 (Russell-Briefel et al., 1985). In NHANES II, women aged 20–44 years who used oral contraceptives were found to have decreased glucose tolerance compared with women of the same age who did not use oral contraceptives (Russell-Briefel et al., 1987).

Use of Medications

Some medications may exacerbate nutrient deficiencies (for example, aspirin stimulates gastrointestinal blood loss that can lead to iron deficiency) or contribute sources of nutrients (calcium-containing antacids). The HHANES data on medication use, however, are not currently available. Special concern is justified about the relationship of medication use and nutritional status in the elderly. The elderly take more drugs than other groups and may be particularly vulnerable to adverse interactions.

Summary

The availability of the data discussed in this chapter is a strength of the NNMS, contributing to a more comprehensive view of nutrition-related health outcomes and practices that affect dietary intake and nutritional status as well as their associations. Much of this information adds support to the identification of public health issues associated with nutrition in chapter 3.

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Chapter 5

Nutritional and Dietary Factors in Cardiovascular Disease

Purpose

Cardiovascular disease is a major cause of morbidity and mortality in the United States. Despite recent declines in mortality, cardiovascular diseases still account for more deaths annually than any other group of diseases. Several of the food components identified as public health issues by both the JNMEC and EPONM (food energy, total fat, saturated fat, alcohol, and sodium) were considered to be of concern, in part, because of their relationships to the development of cardiovascular diseases (see chapter 3). The purpose of this chapter is to demonstrate how NNMS data can contribute to the understanding of dietary and nutritional factors as they relate to cardiovascular diseases as well as to identify the strengths and weaknesses of data and information available from specific components of the NNMS. The major strength of NNMS and related data is their potential to provide information that permits monitoring of trends in morbidity and mortality from nutrition-related diseases, nutrition-related risk factors for diseases, and dietary intake of components associated with diseases. Although the NNMS data are not intended to contribute to determining the mechanism of diet and disease relationships, they do permit investigation of cross-sectional associations of disease with risk factors, and of disease or risk factors with food and nutrient intake. The focus of this chapter is on identifying and discussing NNMS data related to 1) populations at risk, 2) trends in disease prevalence and risk factor status, and 3) determining factors. Limits to interpretation of data and gaps in the database are also addressed.

To accomplish the objectives described above, data from the NNMS and related sources are used to examine the prevalence of cardiovascular diseases, primarily coronary heart disease; the distribution and prevalence of nondietary risk factors for cardiovascular diseases; the distribution of and trends in dietary factors associated with cardiovascular diseases as well as factors affecting dietary intake; and relationships among dietary and other risk factors and disease.

Definitions

Cardiovascular disease includes a variety of pathological processes pertaining to the heart and blood vessels. Terms employed in the discussion of cardiovascular diseases in this chapter are defined below. The relevant codes from the most recent revision of the *International Classification of Diseases* (ICD) (DHHS, 1980) for the disorders described below are also specified.

Coronary (or ischemic) heart disease (ICD-9 410-414) is a term used to identify several cardiovascular disorders resulting from inadequate circulation of blood to local areas of the heart muscle. This impaired blood circulation to the heart is almost always the result of focal narrowing of the coronary arteries by atherosclerosis. Atherosclerosis is a progressive process that begins in childhood with the appearance of lesions in the form of fatty streaks in the lining of the coronary arteries or aorta. The fatty streaks may eventually progress to fatty and fibrous plaques or even larger, more complicated lesions. As the lesions develop, the progressive narrowing of the vessels reduces blood flow to the tissues supplied by the affected vessels, resulting in angina pectoris (chest pain), myocardial infarction (heart attack), or sudden death. These are the most common manifestations of coronary heart disease. Hypertension (ICD-9 401) is defined as persistently elevated arterial blood pressure. Hypertensive heart disease (ICD-9 402) includes hypertensive cardiomegaly (enlargement of the heart), hypertensive cardiopathy (disease or disorder of the heart), hypertensive cardiovascular disease, and hypertensive heart failure. Cerebrovascular disease (ICD-9 430-438) includes a group of disorders characterized by ischemic stroke (atherothrombotic stroke), a serious and sudden decrease of blood supply to the brain resulting from atherosclerosis, and by cerebral hemorrhage (hemorrhagic stroke).

Cardiovascular disorders not thought to be related to diet, such as congenital heart disease and ruptured aortic aneurysm, are not considered in this report.

Background

An extensive literature on the relationship of dietary and nutritional factors, as well as other risk factors, to the development of cardiovascular diseases has accumulated in recent decades. The evidence linking diet and nutrition to cardiovascular diseases has been examined in *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) and in the report of the National Academy of Sciences' Committee on Diet and Health (National Research Council, 1989). The major conclusions of these two authoritative reports are summarized below.

Comparisons of populations in different countries and within countries show large differences in incidence and mortality for cardiovascular diseases, particularly coronary heart disease, and the underlying pathological vascular process for many of these diseases, atherosclerosis. The differences in rates between and within populations are strongly associated with differences in average levels and distributions of the blood lipoproteins (for coronary heart disease) and of blood pressure (for stroke).

Coronary Heart Disease

Coronary heart disease rates and the levels of risk across populations are strongly related to average plasma cholesterol levels and, more specifically, to low density lipoprotein (LDL)-cholesterol levels. Mean cholesterol levels, in turn, have been found to be related to the composition of a population's habitual diet, especially the intake of saturated fat and cholesterol. In populations with a high prevalence of coronary heart disease, the impact of dietary variations on individual risk is strongly influenced by inherent (genetic) differences in blood lipoprotein levels, and by the presence of other characteristics such as high blood pressure, cigarette smoking, and diabetes. Thus, within populations, depending on the homogeneity of a number of population characteristics and the degree of variability in the nutrient intake among individuals, varying degrees of association with blood lipid and lipoprotein levels have been found.

Although habitual physical activity has not been shown to be related to population risk of coronary heart disease (National Research Council, 1989), individual risk as well as fatality rates of myocardial infarction may be lowered in those who are physically active. Within populations, the major risk factors of elevated serum cholesterol levels, blood pressure, and smoking, individually and combined, are related to the risk and occurrence of coronary heart disease in a strong, continuous, and graded fashion (DHHS, 1988).

In controlled experiments in both humans and animals, changes in dietary composition, particularly of fatty acids (type and amount) and cholesterol, influence individual levels of lipoproteins fairly predictably. Dietary saturated fat and cholesterol increase blood total cholesterol and LDL-cholesterol levels; polyunsaturated fat decreases blood total cholesterol and LDL-cholesterol levels, while monounsaturated fat may decrease blood cholesterol. In randomized clinical trials, experimental lowering of total and LDL-cholesterol levels, and possibly elevation of high density lipoprotein (HDL)-cholesterol levels, by diet and/or medication, have, in a majority of studies, been associated with a reduction in risk of coronary heart disease in proportion to the degree of lowering.

Influences of diet may also be manifest through effects on arterial thrombosis, a blood clot occluding a blood vessel by affecting the stickiness of the platelets responsible for blood clotting. Evidence suggests that intake of particular polyunsaturated fats, the omega-3 fatty acids, may offer some protection against the development of clinical manifestations of atherosclerosis by decreasing platelet aggregation and clotting activity and preventing arterial thrombosis (National Research Council, 1989).

Hypertension

With respect to hypertension, the most prominent dietary influences are energy imbalance (obesity), alcohol, and, in some persons, the intake of sodium. Effects of other dietary components such as calcium, potassium, chloride, magnesium, dietary fiber, and fatty acids are currently under investigation.

That increased body weight is related to increased blood pressure is well supported by studies in both the epidemiological and clinical literature (DHHS, 1988). Weight loss is an important component in the treatment of hypertension in obese persons.

Epidemiological studies have shown a relationship between the consumption of large amounts of alcohol and elevated blood pressure. In many of these studies, the relationship of alcohol intake to blood pressure was independent of age, body weight, exercise, and smoking. The available evidence indicates the potential importance of alcohol restriction in blood pressure control (DHHS, 1988).

Ecological evidence from comparisons of diet and blood pressure in populations throughout the world shows that in non-Western populations with low salt intake there is no rise in blood pressure with age and little or no hypertension. Studies among individuals within populations have shown inconsistent results, in part, because of large variation in salt intake within individuals and, in many populations, because of homogeneity in regard to the level of usual salt intake. In addition, obtaining accurate estimates of sodium intake is very difficult. In clinical studies, moderate reduction of dietary sodium intake results in reduction of elevated blood pressure, but response is variable, suggesting that only some individuals are salt-sensitive (DHHS, 1988).

In regard to other minerals for which intake has been related to blood pressure level, a number of studies have suggested that potassium intake may have an independent and beneficial antihypertensive effect on blood pressure. Clinical trials using potassium salts have indicated that their lowering effects on blood pressure are moderated by the amount of sodium in the diet. That calcium intake may be associated with level of blood pressure has been suggested by experimental studies in animals, epidemiological studies, and clinical trials. Because of conflicting evidence, *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) concluded that the role of calcium in blood pressure remains uncertain and that current evidence is inconclusive. Another mineral nutrient considered is magnesium. Clinical trials have provided most of the data relating magnesium to blood pressure (DHHS, 1988). The same ecological data suggesting a relationship between calcium intake and blood pressure, that is, the evidence that elevated blood pressure is more prevalent in hard-water areas than soft-water areas, also suggest a possible relationship of magnesium intake and blood pressure.

Increased levels of intake of dietary fiber also have been suggested as being associated with lower levels of blood pressure as well as with lower serum cholesterol levels. However, because of the association of dietary fiber with other nutritional factors known to affect blood pressure levels, the finding of an association of dietary fiber and blood pressure may not be due to an independent effect of fiber.

In the limited number of studies available (epidemiological studies and short-term trials), increased intake of polyunsaturated fats, including omega-3 fatty acids, has been shown to be associated with lower blood pressure levels. This relationship has not been established in long-term studies, including clinical trials.

Cerebrovascular Disease

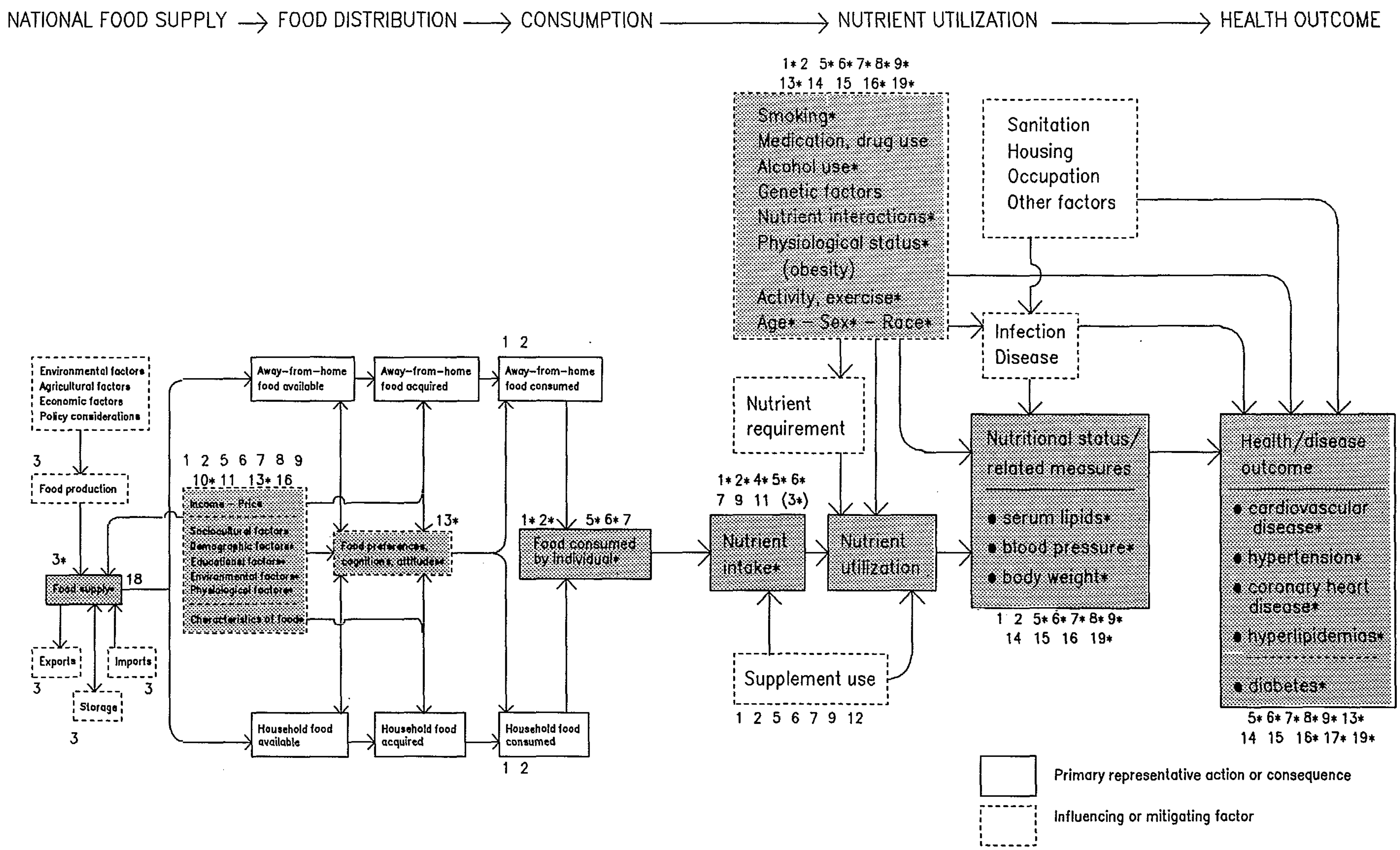
Cerebrovascular disease in the form of atherothrombotic stroke is largely influenced by the same risk factors as coronary heart disease and has a generally similar distribution. Dietary associations may differ and, in general, are a neglected area of research. The risk of hemorrhagic stroke, on the other hand, is more strongly influenced by average blood pressure and by level of control of hypertension, both in individuals and populations, than by serum cholesterol levels and other risk factors associated with coronary heart disease. There is some evidence that high intakes of omega-3 fatty acids increase the risk for hemorrhagic stroke (National Research Council, 1989).

Conceptual Model

Based on the background presented above, a conceptual model, modified from the general conceptual model (figure 1-1) described in chapter 1, that illustrates the broad relationships between dietary and nutritional status and cardiovascular disease and risk factors for cardiovascular disease is provided in figure 5-1. Components of the model that are most relevant to cardiovascular disease are shown in shaded boxes; individual topics noted with an asterisk are those for which data are available. Potential NNMS and related data sources are represented by the numbers above or below the boxes; numbers noted with an asterisk indicate those surveys or studies from which data were used in this chapter.

The U.S. Food Supply Series data provide information on the per capita amounts of foods and nutrients related to cardiovascular diseases and can be used to examine trends from 1909 through 1985. Individual intakes of foods and nutrients from foods are assessed in the NFCS 1977-78 and CSFII 1985-86 (which provide the best measures of usual intake) and in the HANES. Trends in individual intake may also be examined in these surveys, but care is needed in their interpretation because of methodological differences between the different surveys and differences within surveys over time.

Direct measures of nutritional status related to cardiovascular diseases (such as serum lipid levels, blood pressure, and body weight) are made in the HANES;



National Nutrition Monitoring System and other data sources: 1 = CSFII 1985–86, 2 = NFCS 1977–78, 3 = U.S. Food Supply Series, 4 = National Nutrient Data Bank, 5 = NHANES I, 6 = NHANES II, 7 = HHANES, 8 = NHEFS, 9 = NHIS, 10 = FLAPS, 11 = Total Diet Study, 12 = Vit/Min, 13 = Health and Diet Study, 14 = PedNSS, 15 = PNSS, 16 = BRFSS, 17 = U.S. Vital Statistics, 18 = AEDS, 19 = NHES. See appendix III for definitions of acronyms. Shaded boxes highlight portions of the model discussed; an asterisk (*) indicates data and data sources considered in this chapter.

Figure 5-1. Conceptual model for nutritional and dietary factors in cardiovascular disease (see text for explanation)

self-reports about occurrence and/or knowledge about some of these risk factors are collected in several surveys (CSFII 1985-86, BRFSS, NHIS). Data on behaviors related to cardiovascular disease (such as smoking, exercise, and diet) are also collected in several surveys. Only in the HANES are data on both dietary intake and direct measures of nutrition-related risk factors for cardiovascular disease obtained for the same persons. Emerging information from the NHEFS permits evaluation of the relationship of measures of dietary and other risk factors taken at one time to subsequent development of cardiovascular disease. Finally, the Vital Statistics System provides data on mortality rates from cardiovascular diseases; changes in these rates over time can be examined in relationship to changes in dietary and other risk factors over the same time.

Prevalence of Disease

Since 1950, Vital Statistics data (NCHS, 1988a) indicate that the age-adjusted death rate for all causes of death has declined markedly in the U.S. population (figure 5-2). Similar declines, of lesser magnitude, have been observed for death rates from diseases of the heart and cerebrovascular disease (figure 5-2). In the period 1950-85, heart disease continued to be the leading cause of death in the United States and cerebrovascular disease was the third leading cause; together, the two accounted for approximately one-half of total deaths. Thus, despite the declines in mortality from these cardiovascular diseases in recent years, they remain major public health concerns.

There are striking differences by sex and race in mortality from heart disease and cerebrovascular disease (figures 5-3 and 5-4, respectively), with males experiencing greater mortality than females and blacks experiencing greater mortality than whites. All four of the major sex-race groups have experienced a decline in death rates from these diseases during the period 1950-85, but the rates of change have differed among the groups. Sempos et al. (1988) have examined this phenomenon in greater detail for coronary heart disease mortality during the period 1968-85 (figure 5-5). Their evaluations were based on reclassification of cause of death to maximize the comparability of cause-of-death codes from the 8th and 9th Revisions of the *International Classification of Diseases* (DHHS, 1980). The analysis indicated a leveling off in the rate of decline of coronary heart disease mortality since 1976. During 1968-75, the age-adjusted absolute rate of decline in coronary heart disease mortality rates was essentially the same in white and black males and black females, and was slightly lower in white females. In the 1976-85 period, however, mortality rates continued to decline at the same rate for white males, but the decline was much less for the other three sex-race groups.

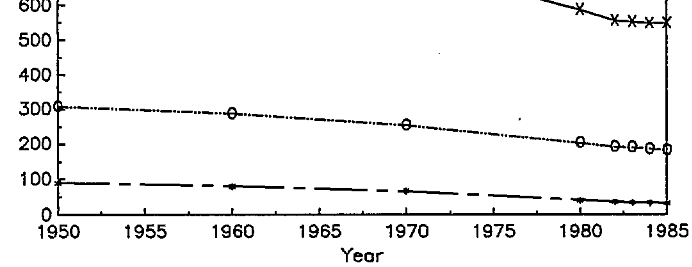


Figure 5-2. Age-adjusted death rates for selected causes of death, United States, selected years: National Vital Statistics System, 1950-85

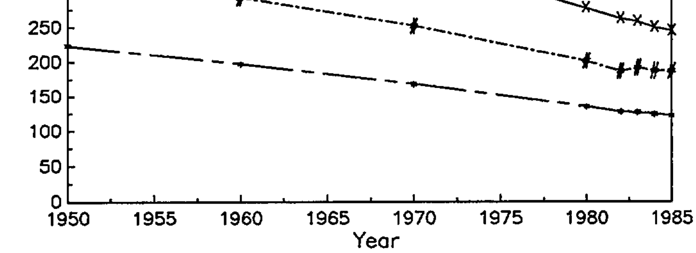


Figure 5-3. Age-adjusted death rates for diseases of the heart, by sex and race, United States, selected years: National Vital Statistics System, 1950-85

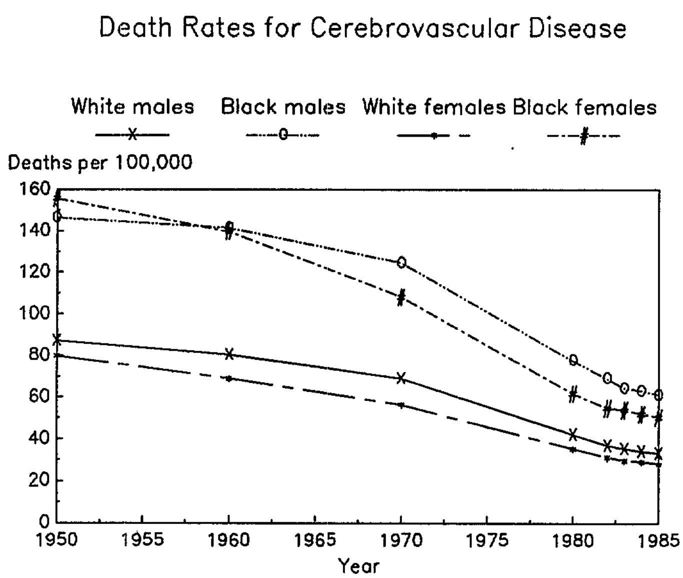


Figure 5-4. Age-adjusted death rates for cerebrovascular disease, by sex and race, United States, selected years: National Vital Statistics System, 1950-85

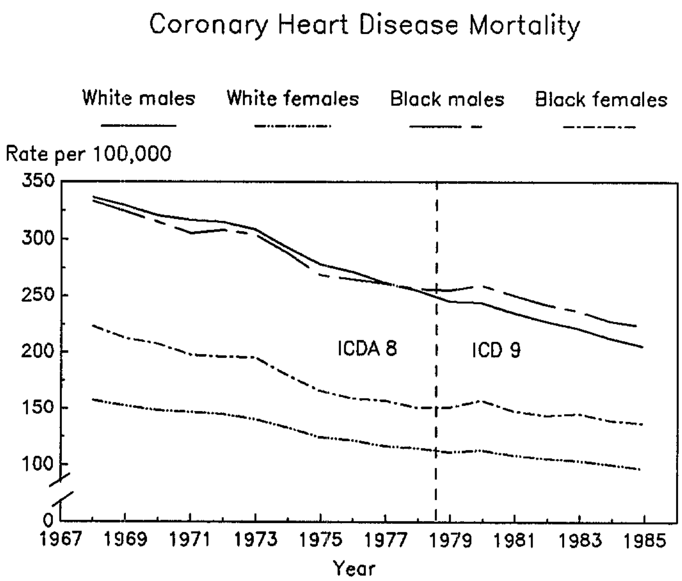


Figure 5-5. Trends in coronary heart disease mortality, for all ages, United States: National Vital Statistics System, 1968-85. Coronary heart disease coding: 1968-78 (ICDA 8), ICDA Nos. 410-413; 1979-85 (ICD 9) ICD Nos. 410-414, 402, 429.2 (Sempos et al., 1988)

Another way to examine the changes in mortality from heart disease and cerebrovascular disease over time is to examine the death rates at specified ages among persons in successive birth cohorts. Such an analysis (NCHS, 1988a) indicates that the heart disease death rate for middle-aged men (45-54 years) increased in the successive birth cohorts of 1891-1900 and 1901-10, and then declined in the next three birth cohorts, with lower deaths rates and a greater decline in death rates being observed in whites than in blacks (figure 5-6). For middle-aged women (45-54 years), heart disease death rates declined in each successive birth cohort from that of 1891-1900 to that of 1931-40, with rates being higher in blacks than in whites (figure 5-7). In all birth cohorts, death rates were higher among males than among females. A similar analysis for stroke death shows a progressive decline in rates for males and females of all races in the successive birth cohorts from 1891-1900 to 1931-40 (figures 5-8 and 5-9). Racial differences in stroke death rates are striking, with much higher rates in blacks than in whites of both sexes and in all birth cohorts.

Data from the National Hospital Discharge Study also provide information on the occurrence of cardiovascular disease. There was no downward trend in the hospital discharge rate for first listed or all listed diagnoses of myocardial infarction in the period 1970-81 (Gillum, 1987a), but the hospital case fatality rates have declined. Hospital discharge rates increased for all coronary artery-related diagnoses between 1984 and 1986 (Feinleib et al., 1988).

These data provide information on the magnitude of the public health problem associated with cardiovascular disease and help to identify groups at greater or lesser risk with respect to coronary heart disease mortality. Males are at greater risk than females and, within sex, blacks are at greater risk than whites. With respect to cerebrovascular disease mortality, blacks are at greater risk than whites and, within races, men are at greater risk than women.

Risk Factors

The major risk factors for cardiovascular diseases are hypercholesterolemia, smoking, and hypertension. Each of these factors may be controlled or modified to reduce risk. Other risk factors such as diabetes, obesity, and physical inactivity are also controllable. Increasing age and male sex are also risk factors. The risk factors considered in detail in this section are

Figure 5–6. Death rates for heart disease among men aged 45–54 years, by race, United States, selected birth cohorts 1891–1940: National Vital Statistics System

Figure 5–8. Death rates for stroke among men aged 45–54 years, by race, United States, selected birth cohorts 1891–1940: National Vital Statistics System

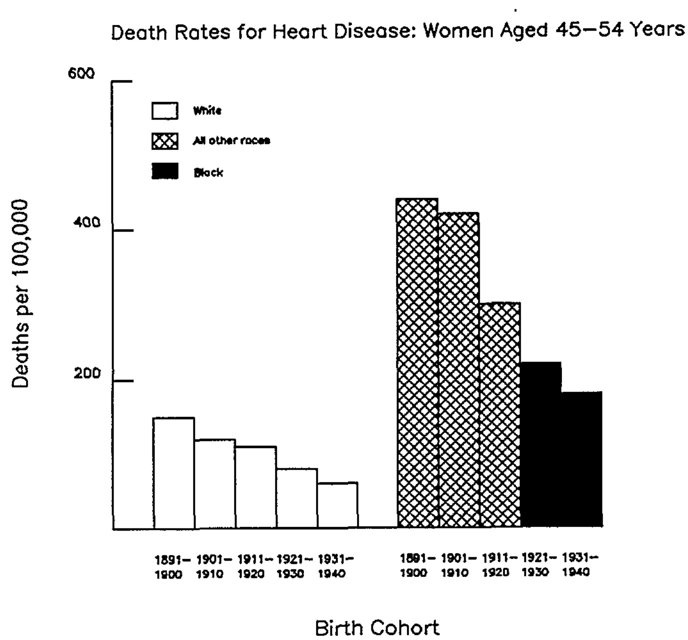


Figure 5–7. Death rates for heart disease among women aged 45–54 years, by race, United States, selected birth cohorts 1891–1940: National Vital Statistics System

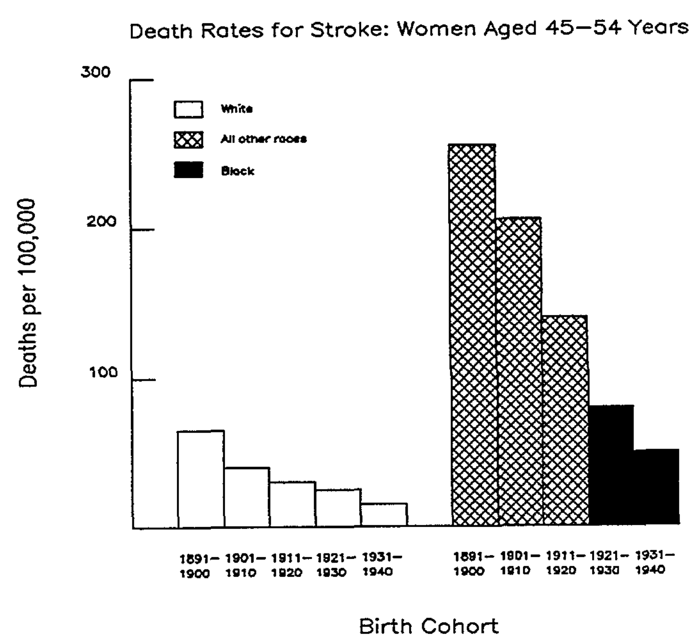


Figure 5–9. Death rates for stroke among women aged 45–54 years, by race, United States, selected birth cohorts 1891–1940: National Vital Statistics System

those for which a dietary or nutritional relationship has been hypothesized--hypercholesterolemia, hypertension, diabetes, and obesity. Because the risk of cardiovascular disease also differs by age, sex, and race, these factors are considered in the discussion that follows. Data from the NNMS that permit assessment of the distribution and prevalence of these risk factors are highlighted.

Hypercholesterolemia

Cholesterol is the blood lipid most strongly related to cardiovascular disease. Cholesterol is produced by the body as well as being obtained from the diet; it is an essential component of cell membranes and serves as a precursor for bile acids and steroid hormones. The lipoproteins on which cholesterol is transported in the blood are: low density lipoproteins (LDL), high density lipoproteins (HDL), and very low density lipoproteins (VLDL) (DHHS, 1988). The LDL usually contain 60–70 percent of the total serum cholesterol and high levels are associated with risk for coronary heart disease. Most of the total cholesterol is contained in the LDL, and serum total cholesterol and LDL-cholesterol are highly correlated, so that high levels of serum total cholesterol are also associated with coronary heart disease risk. The HDL usually contain 20–30 percent of the total cholesterol, and high levels are associated with low risk for coronary heart disease. The VLDL contain approximately 10-15 percent of the total cholesterol and are composed largely of triglyceride. Whether elevated serum triglyceride levels pose an independent risk for coronary heart disease is still uncertain.

The level of total circulating cholesterol and the partitioning of cholesterol among its lipoprotein carriers are controlled partly by genetic factors and partly by dietary intake, particularly of saturated fats and cholesterol. Other factors such as obesity and physical inactivity also play a role.

Total serum cholesterol levels were measured in each of the HANES and in the earlier NHES, 1960–62, presenting the opportunity to examine time trends in this risk factor. (From this point forward in this report, the term "serum cholesterol" refers to "total serum cholesterol.") Data on the levels of HDL-cholesterol are also available from NHANES II. Data for the means and prevalences of elevated serum cholesterol from the most recent HANES (HHANES) are tabulated in appendix II (tables II–40 through II–43) and discussed in chapter 3, together with comparable data for non-Hispanic whites and blacks from NHANES II.

NHANES II and HHANES data for mean serum cholesterol levels by racial and ethnic groups are illustrated in figure 5–10; there was little difference among the groups. Analyses of the most recent national data on serum cholesterol (NCHS, 1986a) show the effects of demographic and socioeconomic variables. Mean serum cholesterol levels are significantly higher in older persons with levels peaking at age 45–54 years among men and levels peaking at age 55–64 years among women. After age 54 years, mean cholesterol levels are higher in women than in men. Racial (black-white) differences in mean levels were not significant for either sex. In the four race-sex groups, age-adjusted mean serum cholesterol levels were higher among individuals with higher economic levels (based on poverty status and family income), but lower among individuals with higher levels of education.

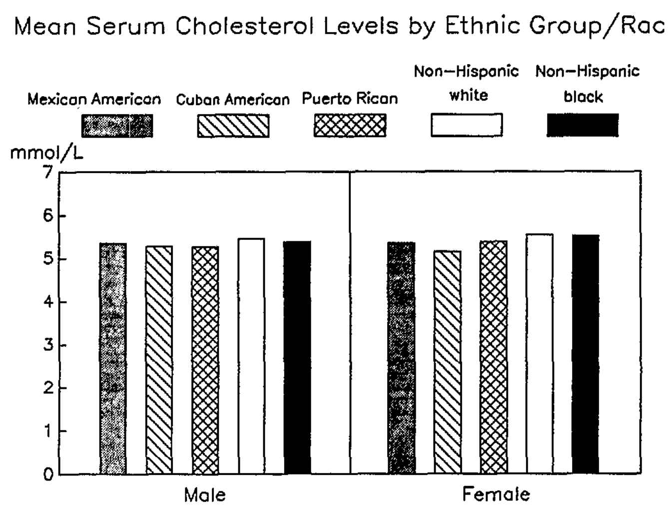


Figure 5–10. Age-adjusted mean serum cholesterol levels, by sex and ethnic group or race, for persons aged 20–74 years: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80

Values for mean serum cholesterol levels over time for specific age groups are presented in figures 5–11 and 5–12 for men and women, respectively. These data, analyzed after standardization of the values obtained with the different analytical methodologies used in the three surveys (NCHS/NHLBI, 1987), indicate that age-adjusted cholesterol levels decreased 3–4 percent in the total adult population between the

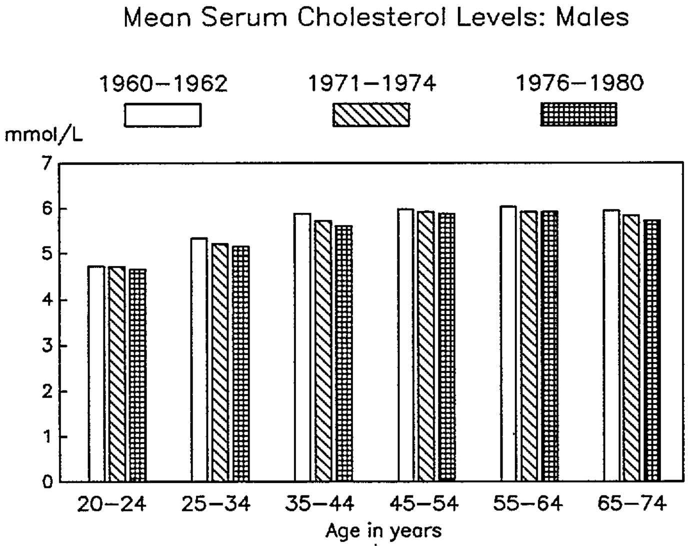


Figure 5–11. Mean serum cholesterol levels in males aged 20–74 years: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80

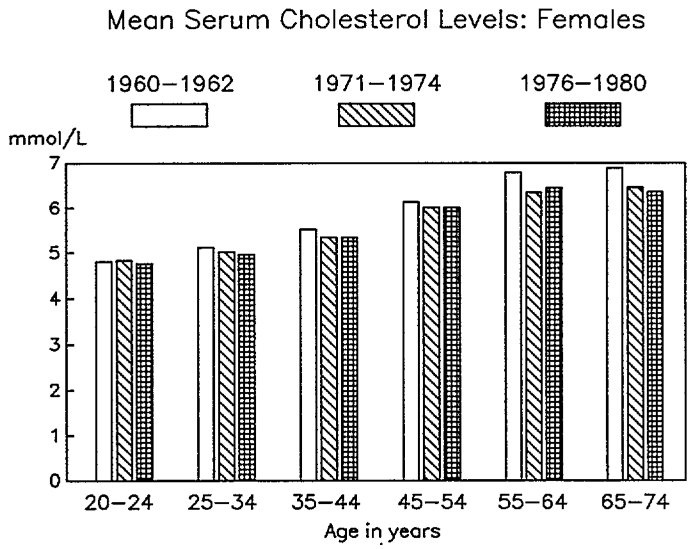


Figure 5–12. Mean serum cholesterol levels in females aged 20–74 years: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80

1960–62 and 1976–80 surveys. Declines were statistically significant for both men and women and for all whites, but not for blacks. Although differences in mean levels over time are very small, even small changes in the distribution of serum total cholesterol values may significantly shift the prevalence of risk for coronary heart disease.

The development of cutoff values for serum cholesterol levels that identify persons or groups with increased risk of coronary heart disease has been an evolving process. The cutoffs used to define "high risk" in the tables II–40 through II–43 in appendix II and discussed in chapter 3 were the age–specific ones recommended by the 1984 NIH Consensus Development Conference (NIH, 1985) and were reported to maintain comparability with the JNMEC report. Recently, new guidelines for the treatment of high blood cholesterol in adults have been promulgated as part of the National Cholesterol Education Program (NCEP) (NIH, 1987). These classification recommendations are outlined in figure 5–13. Although consideration of all components of the screening and treatment plan is beyond the scope of this project and the available data, the EPONM considered it useful to examine the distribution of serum cholesterol levels over time according to the initial serum cholesterol screening categories delineated in these new guidelines (see figures 5–14 through 5–17).

Over the period from 1960–62 to 1976–80, information available from the NHES and NHANES I and II shows that in the total population the age–adjusted prevalence of serum cholesterol levels <5.20 mmol/L (<200 mg/dl) has increased more than 18 percent, while the prevalence of levels ≥6.20 mmol/L (≥240 mg/dl) has decreased 16 percent (figure 5–14). These population distributional shifts have been such that the prevalence of serum cholesterol levels in the range 5.20–6.19 mmol/L (200–239 mg/dl) has decreased only 4.7 percent. More than 55 percent of the adult American population aged 20–74 years had high serum cholesterol levels ≥5.20 mmol/L (≥200 mg/dl) that may lead to increased risk of developing coronary heart disease. According to the NCEP criteria in figure 5–13, many of these persons would be referred for lipoprotein analysis; men would be more affected because being male constitutes an additional risk factor. Among males, the pattern of change in prevalence was similar to that seen in the total population, whereas among the women there was a small increase in the proportion of individuals with cholesterol levels 5.20–6.19 mmol/L (200–239 mg/dl) between 1960–62 and 1971–74 (figure 5–15).

Initial classification and recommended followup based on total cholesterol

A. Classification

<5.20 mmol/L (<200 mg/dl)	Desirable blood cholesterol
5.20–6.19 mmol/L (200–239 mg/dl)	Borderline–high blood cholesterol
≥6.20 mmol/L (≥240 mg/dl)	High blood cholesterol

B. Recommended followup

Total cholesterol <5.2 mmol/L (<200 mg/dl) → Repeat within 5 years

Total cholesterol 5.20–6.19 mmol/L (200–239 mg/dl)

- Without definite CHD[1] or two other CHD risk factors (one of which can be male sex) → Dietary information and recheck annually
- With definite CHD or two other CHD risk factors (one of which can be male sex) → Lipoprotein analysis; further action based on LDL–cholesterol level

Total cholesterol ≥ 6.20 mmol/L (≥ 240 mg/dl) → Lipoprotein analysis; further action based on LDL–cholesterol level

1 CHD = coronary heart disease

Classification and treatment decisions based on LDL–cholesterol

A. Classification

<3.35 mmol/L (<130 mg/dl)	Desirable LDL–cholesterol
3.35–4.14 mmol/L (130–159 mg/dl)	Borderline–high–risk LDL–cholesterol
≥4.15 mmol/L (≥160 mg/dl)	High–risk LDL–cholesterol

B. Dietary treatment	Initiation level	Minimal goal
Without CHD or two other risk factors[1]	≥4.15 mmol/L (≥160 mg/dl)	<4.15 mmol/L (<160 mg/dl)[2]
With CHD or two other risk factors[1]	≥3.35 mmol/L (≥130 mg.dl)	<3.35 mmol/L (<130 mg.dl)[3]
C. Drug treatment		
Without CHD or two other risk factors[1]	≥4.90 mmol/L (≥190 mg/dl)	<4.15 mmol/L (<130 mg/dl)
With CHD or two other risk factors[1]	≥4.15 mmol/L (≥160 mg.dl)	<3.35 mmol/L (≥130 mg/dl)

1 Patients have a lower initiation level and goal if they are at high risk because they already have definite CHD, or because they have any two of the following risk factors: male sex, family history of premature CHD, cigarette smoking, hypertension, low HDL–cholesterol, diabetes mellitus, definite cerebrovascular or peripheral vascular disease, or severe obesity.

2/3 Roughly equivalent to total cholesterol <6.20 mmol/L (<240 mg/dl) (2) or <5.20 mmol/L (<200 mg/dl) (3) as goals for monitoring dietary treatment.

Figure 5–13. Guidelines for treatment of elevated blood cholesterol levels in adults from the National Cholesterol Education Program (NIH, 1987)

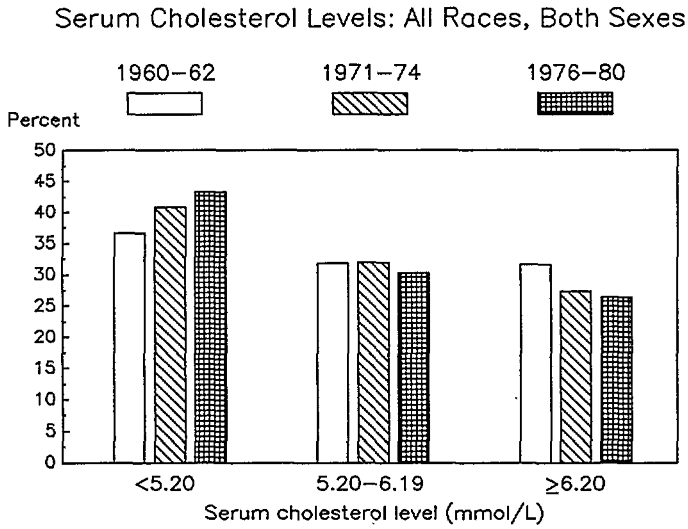


Figure 5–14. Percent of persons aged 20–74 years with specified serum cholesterol levels: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80

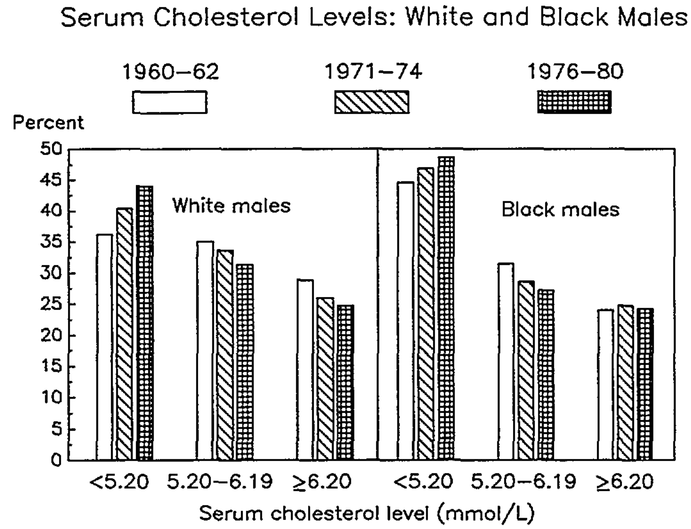


Figure 5–16. Percent of males aged 20–74 years with specified serum cholesterol levels, by race: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80

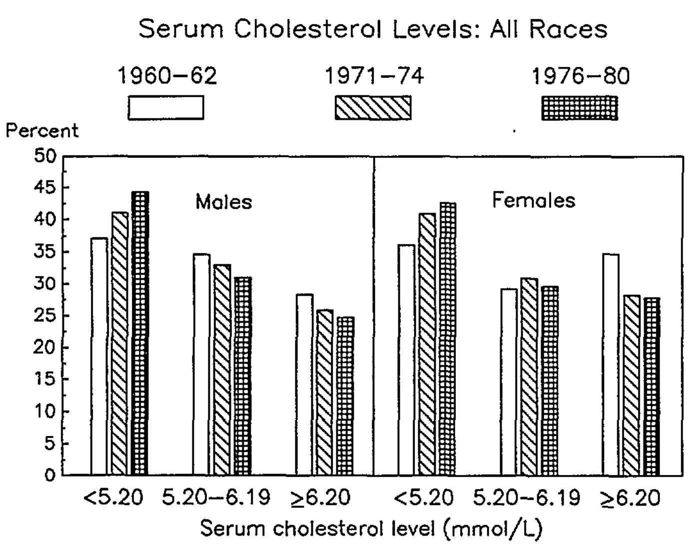


Figure 5–15. Percent of persons aged 20–74 years with specified serum cholesterol levels, by sex: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80

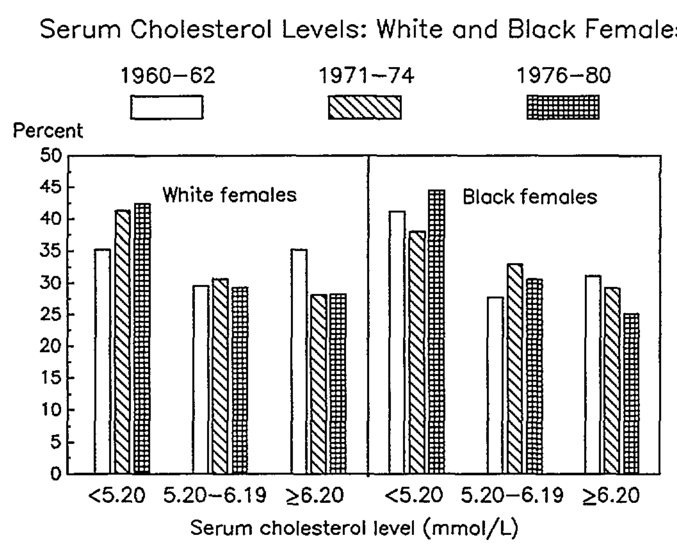


Figure 5–17. Percent of females aged 20–74 years with specified serum cholesterol levels, by race: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80

Among black males as compared to white males, the patterns of change were quite different (figure 5–16). The prevalence of serum cholesterol levels <5.20 mmol/L (<200 mg/dl) increased only 4 percentage points among black males as compared to 8 percentage points among white males. In fact, the prevalence of cholesterol levels ≥6.20 mmol/L (≥240 mg/dl) decreased only 0.2 percent age points among black males suggesting that the increase in the lowest category came from the shift of individuals from the intermediate category rather than from the high cholesterol category. Among black and white women the pattern of net increase in the lowest cholesterol category was similar to that seen among males, while the percent decrease in the proportion with the highest cholesterol levels was similar in black and white women (figure 5–17). Both white men and women showed a greater increase in the proportion with cholesterol levels <5.20 mmol/L (<200 mg/dl) than among black men and women. However, a higher proportion of blacks than whites had serum cholesterol levels <5.20 mmol/L (<200 mg/dl).

Data are also available from NHANES II for serum HDL–cholesterol levels, a factor which is inversely associated with risk of coronary heart disease. Levels of HDL–cholesterol were found to be higher in women than in men, and higher in blacks than in whites (Linn et al., 1989). In a multivariable model, predictors of high serum HDL–cholesterol were female gender and black race, while higher frequency of alcohol consumption, smoking, and higher body mass index were associated with lower HDL–cholesterol levels.

These data, and the age–specific data available in appendix II, illustrate the utility of the repetitious nature of the NCHS components of the NNMS in identifying changes in serum cholesterol levels, one of the major nutrition–related risk factors for coronary heart disease, and the nature and magnitude of these changes in different population subgroups. These data are clearly important in identifying those subgroups of the population that should be targeted for increased education and intervention efforts.

Blood Pressure

Elevated blood pressure is a risk factor for both coronary heart disease and cerebrovascular disease. The major nutrients and diet–related factors that may influence blood pressure and their possible mechanisms were identified in *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988); they are obesity, alcohol intake, and, in some persons, sodium intake. In addition, potassium, calcium, magnesium, and unsaturated fatty acids may also be related to blood pressure levels. The strength and independence of these associations remain inconclusive and constitute an active research area.

Data for the prevalence of hypertension from the most recent HANES (HHANES) are tabulated in appendix II, tables II–119 through II–122 and are presented in figure 5–18, together with comparable data for non–Hispanic whites and blacks from NHANES II. Persons were classified as hypertensive if the average of three systolic blood pressure readings was greater than or equal to 140 mm mercury, and/or the average of three diastolic blood pressure readings was greater than or equal to 90 mm mercury, or if individuals reported during the medical history interview that they were taking antihypertensive medication. The blood pressure criteria were those recommended by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (Subcommittee on Definition and Prevalence, 1984). Among Mexican Americans, Cubans, and Puerto Ricans the prevalence of hypertension among both males and females was lower than among non–Hispanic whites or blacks. Among both males and females, non–Hispanic blacks had the highest prevalences of hypertension.

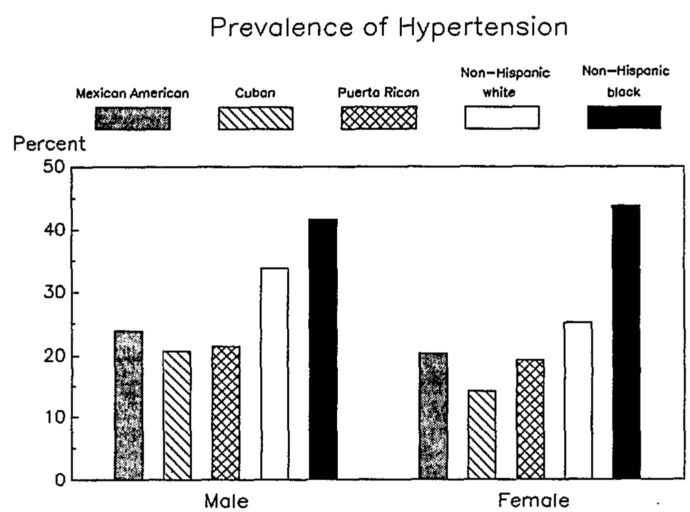


Figure 5–18. Prevalence of hypertension (average systolic blood pressure ≥140 mm mercury, and/or average diastolic blood pressure ≥90 mm mercury, or history of use of antihypertensive medication) for persons aged 20–74 years, by sex and ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80

Blood pressure measurements from the NHES, NHANES I, and NHANES II provide an opportunity for examining time trends in this risk factor. For these trend data, blood pressure values are given for the first (sitting) measurement in each survey, because these were collected in an identical fashion. Values for mean systolic and diastolic blood pressure over time (Persky et al., 1986) are presented in figure 5-19, showing differential changes occurring by race with greater decreases in blacks. In all surveys, mean diastolic blood pressure levels were higher in men than in women, and were higher in blacks than in whites, while systolic blood pressure was higher in women than in men. In the most recent national data (NHANES II), mean systolic blood pressure levels were higher in older age groups and were higher among blacks than whites in most age groups (NCHS, 1986b). Dannenberg et al. (1987) have also shown that, in all the examination surveys, mean blood pressures were higher in older age groups.

Trends in the prevalence of "elevated blood pressure" have also been assessed using criteria different from those described above for hypertension. Over the period 1960–62 through 1976–80, the prevalence of "elevated blood pressure" (systolic pressure of at least 160 mm mercury and/or diastolic pressure of at least 95 mm mercury, based on a single measurement of blood pressure) has increased slightly in white males, decreased in black males and females, and decreased modestly in white females (table 5–1). Changes in the prevalence figures for hypertension are a result of a combination of factors including prevention and improved methods of treatment and control.

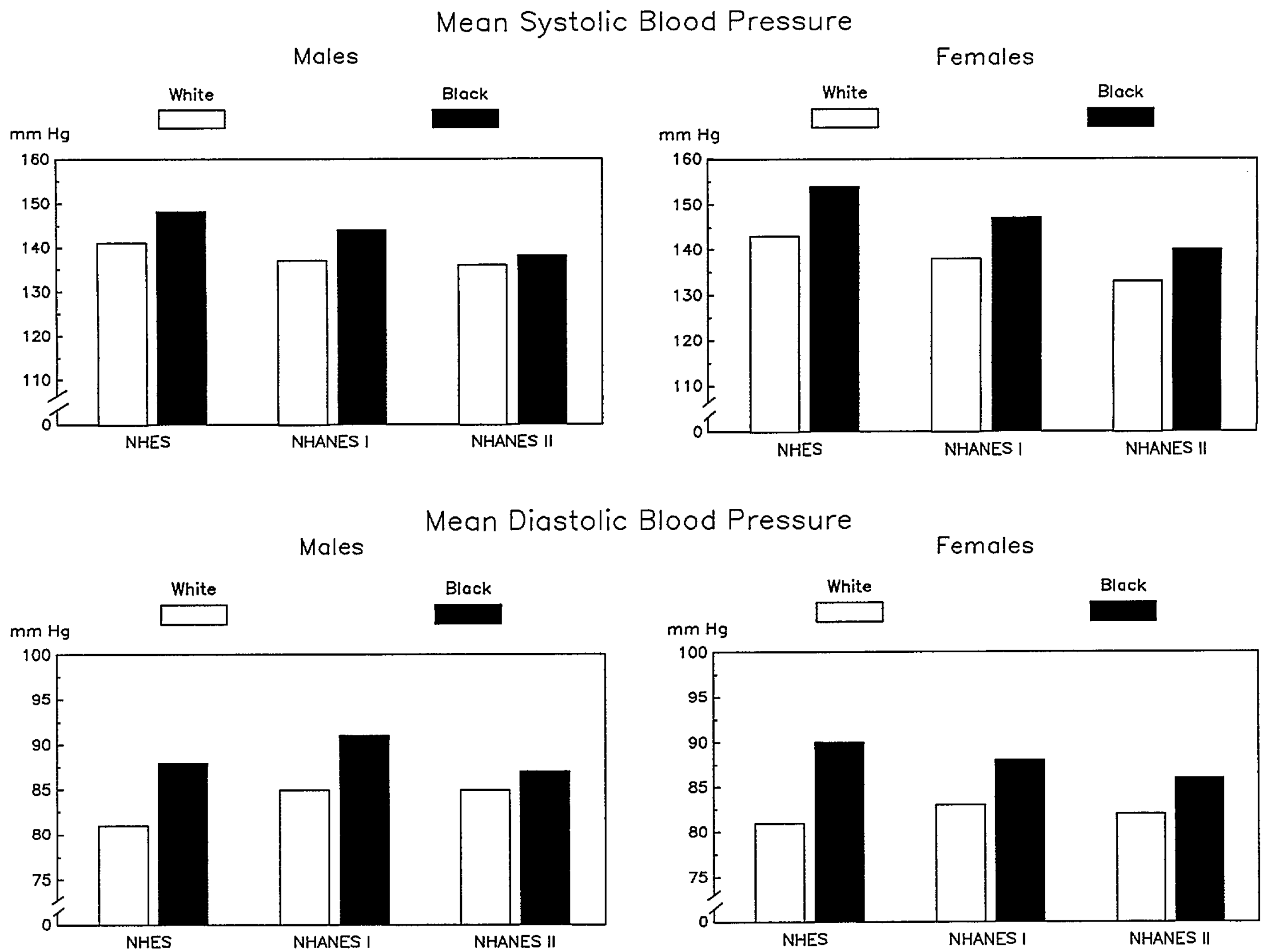


Figure 5–19. Age-adjusted mean systolic and diastolic blood pressures for persons aged 20–74 years, by sex and race: National Health Examination Survey, 1960–62; first National Health and Nutrition Examination Survey, 1971–74; and second National Health and Nutrition Examination Survey, 1976–80 (Persky et al., 1986)

Table 5-1. Percent of persons aged 25-74 years with definite elevated blood pressure[1], by race, sex, and age: National Health Examination Survey, 1960-62; first National Health and Nutrition Examination Survey, 1971-74; and second National Health and Nutrition Examination Survey, 1976-80 (NCHS, 1988a)

	White			Black		
Sex and age	1960-62	1971-74	1976-80	1960-62	1971-74	1976-80
			Percent of population			
Male						
Age adjusted, 25-74 years	19.0	21.7	22.3	36.3	35.8	29.7
25-34 years	6.1	8.3	12.2	21.8	16.1	13.4
35-44 years	14.9	17.2	15.2	28.0	36.8	33.2
45-54 years	19.6	25.8	28.6	34.6	37.0	29.3
55-64 years	27.5	31.2	29.7	49.7	49.5	45.7
65-74 years	38.6	35.1	32.7	63.3[2]	50.3	32.1
Female						
Age adjusted, 25-74 years	19.2	18.5	16.3	37.7	37.4	26.2
25-34 years	2.3	3.8	3.2	8.8	10.7	5.8
35-44 years	8.2	9.9	9.9	29.2	28.2	17.4
45-54 years	18.8	18.8	20.1	44.3	49.4	42.9
55-64 years	32.5	32.0	24.4	50.5	54.2	34.2
65-74 years	53.8	42.9	35.0	79.0[2]	59.8	40.0

[1] Definite elevated blood pressure is defined as either systolic pressure of at least 160 mm mercury or diastolic pressure of at least 95 mm mercury or both based on a single measurement.
[2] Based on fewer than 45 persons.

Diabetes

The Diabetes Data Group (NIH, 1985) noted that approximately twice as many persons with diabetes have a medical history of heart disease or cardiac abnormalities as do persons without diabetes. About half of all diabetic individuals have a history of hypertension. The occurrence of stroke in diabetic persons is about 2 to 6 times greater than in nondiabetic persons.

Data on the prevalence of diabetes in recent NNMS surveys are presented in chapter 4. These prevalence estimates were based on identifying persons with abnormal results for an oral glucose tolerance test plus persons who gave a history of diabetes. In NHANES II, only half of the persons classified as diabetic knew of their condition (NCHS, 1987). The prevalence of diabetes, both diagnosed and undiagnosed, was greater among older individuals and was higher in blacks than in whites. At younger ages, women were more likely to be diabetic than men. Prevalence increased with higher levels of percent desirable weight. Kovar et al. (1987) noted that the prevalence of self-reported diabetes increased over the period 1958 to 1985. The major reason for including diabetes in this section is its relationship to obesity and overweight. These NNMS data, although not adding directly to our knowledge of the association between diabetes and cardiovascular diseases, indicate that diabetes is a highly prevalent health condition which is known to be related to these diseases.

Obesity

Obesity and/or overweight is positively associated with the prevalence of hypertension and with risk of cardiovascular disease. Obesity is also clearly and strongly associated with diabetes, a previously noted risk factor for cardiovascular disease (DHHS, 1988).

Rates of both diabetes and hypertension are nearly tripled in persons 20 percent or more overweight (DHHS, 1988). Data on overweight from the most recent NNMS surveys are presented in chapters 3 and 4 and tables II-4 through II-9 in appendix II. Changes in the prevalence of overweight during the period 1960-62 through 1976-80 are shown in table 5-2, and indicate little change over time. Although estimates of the prevalence of obesity and/or overweight vary with the criteria used, most estimates indicate that at least 25 percent of the adult American population is either overweight or obese.

Clearly, components of the NNMS provide some of the best available data on body weight and changes in body weight over time. The interpretation of these data in terms of risk of cardiovascular disease is complicated by the use of different standards to classify persons as overweight and by uncertainty about the degree of overweight that increases risk. Further information on the relationships of obesity and other risk factors for cardiovascular disease can be found later in this chapter.

Smoking, Exercise, Others

Smoking has been identified in numerous studies as a major risk factor for the development of coronary heart disease. Overall, the weight of evidence suggests that increased physical activity is associated with reduced risk of cardiovascular disease. The 1985 NHIS on Health Promotion and Disease Prevention (NCHS, 1988b,c) showed that smokers, who comprised 30 percent of the adult population, perceived themselves to be less physically active and more likely to be sedentary in terms of leisure time sports

Table 5-2. Overweight[1] persons aged 25-74 years, by race, sex, and age: National Health Examination Survey, 1960-62; first National Health and Nutrition Examination Survey, 1971-74; and second National Health and Nutrition Examination Survey, 1976-80 (NCHS, 1988a)

	White			Black		
Sex and age	1960-62	1971-74	1976-80	1960-62	1971-74	1976-80
			Percent of population			
Male						
Age adjusted, 25-74 years	25.1	26.0	26.7	24.1	27.6	30.9
25-34 years	21.4	23.6	20.9	34.3	26.1	17.5
35-44 years	22.4	28.9	28.2	28.6	39.3	40.9
45-54 years	29.3	28.2	30.5	18.5	22.4	41.4
55-64 years	28.5	24.9	28.6	20.1	25.6	26.0
65-74 years	24.8	23.1	25.8	11.7[2]	21.6	26.4
Female						
Age adjusted, 25-74 years	27.3	27.4	27.5	47.3	47.8	49.5
25-34 years	13.9	15.9	17.9	29.6	31.5	33.5
35-44 years	21.2	24.5	24.8	46.1	49.9	40.8
45-54 years	28.5	29.9	29.9	47.8	53.5	61.2
55-64 years	40.5	36.6	34.8	71.4	58.7	59.4
65-74 years	43.2	37.0	36.5	47.8[2]	49.2	60.8

[1] Overweight is defined for men as body mass index greater than or equal to 27.8 kilograms/meter^2, and for women as body mass index greater than or equal to 27.3 kilograms/meter^2. These cutoff points were used because they represent the sex-specific 85th percentiles for persons aged 20-29 years in the second National Health and Nutrition Examination Survey. Excludes pregnant women.

[2] Based on fewer than 45 persons.

activities than former smokers or nonsmokers, and that activity level was lowest in those who smoked the most cigarettes. Smokers were also more likely to be heavier drinkers, but less likely to be obese, than former smokers or nonsmokers. Data from the same survey indicated that 40 percent of all American adults exercised or played sports regularly in 1985. For almost all age groups, exercise was more prevalent in men than in women and was related to level of education. Although many persons are exercising, knowledge of the level of exercise required for cardiovascular fitness is very limited.

Dietary Factors

Dietary and nutritional factors related to cardiovascular disease (see background of this chapter) are discussed in this section. Information is included on dietary factors that exert effects on serum lipids (food energy, total fat, fatty acids, cholesterol, dietary fiber) and those with established or suspected effects on blood pressure (sodium, potassium, calcium, magnesium, alcohol). With respect to these food components, the NNMS provides data on the amounts and food sources in the food supply, individual dietary intakes and trends in dietary intake, personal and demographic factors that are associated with diet, and characteristics of population groups at various levels of intake. Tables and graphs of the most current available cross-sectional and trend data for supply and intake of the relevant dietary factors are included in appendix II.

Although the inferences that may be drawn about food consumption and nutrient intake from the food supply data are limited, these data provide a sound basis for examining trends. Assessing trends in individual intake is less certain because of the lack of comparability in the techniques used to collect dietary intake data among surveys carried out at different times and by different Agencies. Another current limitation in studying dietary factors related to cardiovascular diseases is that the most recent data that provide good estimates of usual intake (CSFII 1985-86 4-day data) are for women aged 19-50 years and young children, groups not considered to be at high risk of cardiovascular diseases. Data on dietary intake alone cannot identify groups at risk because of the multifactorial etiology of cardiovascular diseases, but NNMS data can be used to characterize groups with varying levels of intake of relevant food components.

In the following sections, examples are given of uses of NNMS data to examine dietary factors related to cardiovascular diseases. Studies about the relationships of dietary factors to other risk factors are examined in the section on Associations.

Food Energy

Obesity is an important risk factor for the development of cardiovascular disease and is associated with many coronary heart disease risk factors such as hypertension, low levels of HDL-cholesterol, elevated plasma glucose levels, high blood cholesterol levels, and hypertriglyceridemia (DHHS, 1988). Food energy is the food component most logically associated with obesity. Calorie intake and physical activity determine an individual's energy balance and, together with genetic factors, ultimately determine whether or not he or she will be obese or overweight. Total calorie consumption has been associated with coronary heart disease prevalence in international comparisons (DHHS, 1988); most studies within populations, however, have shown that high calorie intakes are associated with decreased coronary heart disease risk, but increased body weight is associated with increased risk. This finding suggests that high calorie intakes are related to increased energy expenditure which, in turn, is related to decreased coronary heart disease risk.

The paradox of the inverse relationship between calorie intake and body weight noted in chapter 3 argues for the need to develop and include measures of physical activity in future NNMS surveys. The currently available NNMS data cannot be used to estimate an individual's level of physical activity. In view of the high prevalence of overweight noted in chapters 3 and 4 and the increasing evidence that overweight is an independent risk factor for the development of coronary heart disease and hypertension, more emphasis should be given in NNMS activities to collecting information that will broaden our understanding of this major public health problem. Another concern, also noted in chapter 3, is the possibility of underreporting of food and alcohol intake in surveys.

Fat, Fatty Acids, and Cholesterol

There is a strong, continuous, and graded risk between increasing levels of serum cholesterol and risk of coronary heart disease (DHHS, 1988). There is also a large body of evidence showing a relationship of diet to elevated serum cholesterol levels. Intake of dietary fats shows the strongest relationship in this regard. Increasing total fat, especially saturated fat, intake tends to raise serum cholesterol levels, while higher levels of polyunsaturated fat intake tend to decrease serum cholesterol levels. Formulas that have been used to predict the change in serum cholesterol levels resulting from given changes in dietary lipids are presented below.

Keys, Anderson, and Grande (1965) formula:

$$\Delta SC = 1.26(2\Delta S - \Delta P) + 1.5\Delta\sqrt{1000\ C/E}$$

Hegsted et al. (1965) formula:

$$\Delta SC = 2.16\Delta S - 1.65\Delta P + 0.0677\Delta C - 0.53$$

Where

- Δ = Change in component
- SC = Serum cholesterol in milligrams/100 ml
- C = Cholesterol intake in milligrams
- E = Energy intake in kilocalories
- S = Percent of kilocalories from saturated fatty acids
- P = Percent of kilocalories from polyunsaturated fatty acids

From these equations, it can be seen that the cholesterol–lowering effect of a decrease in the intake of a given amount of saturated fat is greater than the increase in the intake of the same amount of polyunsaturated fat; dietary cholesterol intake also has a small but definite effect on serum cholesterol levels. Recent studies have suggested that monounsaturated fat may also have an independent effect on lowering cholesterol levels (National Research Council, 1989). Other studies have shown that different saturated fatty acids may have different effects on serum cholesterol levels; not all are hypercholesterolemic (DHHS, 1988). Epidemiological studies have shown that higher intakes of fish, a source of omega–3 fatty acids, are associated with a lower incidence of coronary heart disease. In clinical studies, omega–3 fatty acids lower triglyceride levels, a possible risk factor for coronary heart disease (DHHS, 1988). As previously stated, evidence that triglycerides are an independent coronary heart disease risk factor is inconclusive. Finally, *trans* fatty acids, isomers of naturally occurring *cis* unsaturated fatty acids, have little, if any, hypercholesterolemic effect (DHHS, 1988; National Research Council, 1989).

Reliable estimates of the total fat content of foods have been available in the NNMS for some time. The same is not true of values for the individual fatty acids or fatty acid groups; analytical values for these components were not available for many foods in earlier surveys (Dresser, 1983). Further improvement in the nutrient database, that is, obtaining values for individual fatty acids by the most current gas–liquid chromatographic techniques, would be desirable. Data for the omega–3 fatty acid content of the food supply have become available only recently (Raper and Exler, 1988). Data on *trans* fatty acid content in a wide variety of foods are not available in the NNMS. In view of the conclusions that current levels of intake (in conjunction with current levels of intake of linoleic acid) have no significant deleterious effects (LSRO, 1985; British Nutrition Foundation Task Force, 1987; Zevenbergen, 1986), there is little urgency in modifying the USDA nutrient databases in regard to *trans* fatty acid composition of foods or in monitoring the intake of *trans* fatty acids in national surveys. Validating and maintaining a nutrient database for fatty acids is very difficult. Composition values represent foods as used throughout the country on a year–round basis for a particular time (Dresser, 1983). Differences may be expected when an analysis of a single food is compared with average values for a group of similar foods reported under a generic name in a database. Another difficulty with respect to maintaining a nutrient database for fatty acids is that manufacturers of processed foods may change the types of fats and oils used in response to changes in price and other demand and supply factors; thus, the fatty acid content of such foods may change frequently and unpredictably.

Despite the caveats given above, and as noted below, the increased availability of data from the NNMS on intake of different fats and fatty acids is important to understanding changes in coronary heart disease prevalence and incidence over time. Examples of useful data from the NNMS on dietary fat, fatty acids, and cholesterol and their food sources are highlighted in the discussions below.

<u>Trends in the amounts and sources of fats in the food supply</u>

Estimates of nutrients in the food supply exclude nutrients from the inedible parts of foods (such as bones, rinds, and seeds) but include nutrients from parts of foods that are edible but not always eaten (such as the separable fat on meat). Estimates do not account for losses after food is measured, such as during processing, marketing, or cooking. Rizek et al. (1983) have calculated that approximately one–fourth of the fat in the 1980 food supply was wasted. Despite the limitations of these data, the trend information they provide is useful.

Since the late 1940s, although there has been an absolute increase in the availability of total fat, from

137 to 169 grams per capita per day, the change has been primarily due to increases in monounsaturated fat (24 percent) and polyunsaturated fat (94 percent) (see figure 5–20 and II–5). This change in total fat is attributable to an increase in fat from vegetable sources; the changing levels of monounsaturated and polyunsaturated fats reflect this shift to vegetable sources. Per capita amounts of saturated fat have changed little over this time period. The amount of cholesterol has also decreased from 590 to 500 milligrams per capita per day. During this period of time the percent of calories available from total fat increased from 38 to 43 percent. Within the different fatty acid groups, the percent of calories from saturated fat decreased only slightly from 17 to 16 percent of calories, while the percent of calories from monounsaturated and polyunsaturated fat increased. These shifts among the fatty acid groups, which presumably bear some relation to consumption of these fats, are consistent with current dietary guidelines to avoid consumption of too much saturated fat (USDA/DHHS, 1985).

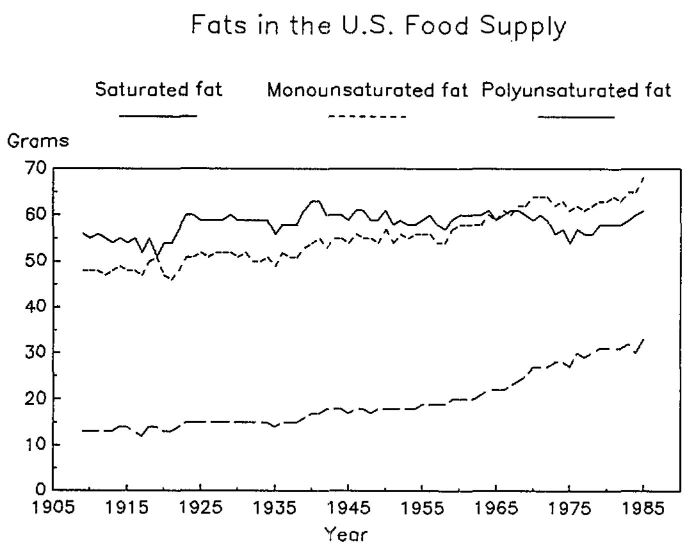


Figure 5–20. Per capita amounts of saturated, monounsaturated, and polyunsaturated fats in the U.S. food supply: U.S. Food Supply Series, 1909–85

The only information available from the NNMS regarding omega-3 fatty acids in the U.S. diet is from the U.S. Food Supply Series (Raper and Exler, 1988). These data indicate that in the period 1947–49 through 1985 the amount of the two major omega-3 fatty acids found in fish increased by 52 percent and the amount of linolenic acid (from plant sources) increased by 65 percent. These changes reflect the increased consumption of fish and soybean oil that occurred over this period of time.

Although from the late 1940s to the present there was little overall change in the percentage of total fat that was contributed by the meat, poultry, and fish food group (31.3 to 31.4 percent), the contribution of meat decreased by 3 percentage points while that of poultry and fish increased by 3.1 percentage points. The contribution of dairy products to total fat decreased by 6.6 percentage points while within the fats and oils food group, the collective availability of fat from butter, margarine, shortening, lard, and beef tallow decreased by 3 percentage points and that from salad, cooking, and other edible oils increased 11.9 percentage points. See figures 5–21 and 5–22 for a comparison of food supply sources of fat in 1947–49 and 1985. In regard to saturated fat intake, since the late 1940s, the contribution of the meat, poultry, and fish food group increased by 4.7 percentage points, while that of dairy products and butter, margarine, shortening, lard, and beef tallow decreased by 8.5 percentage points. The percentage increase of monounsaturated and polyunsaturated fats contributed by salad, cooking, and other edible oils were 11 and 20 percentage points, respectively. The contribution of eggs and butter, margarine, shortening, lard, and beef tallow to the cholesterol content of the food supply decreased by more than 12 percentage points.

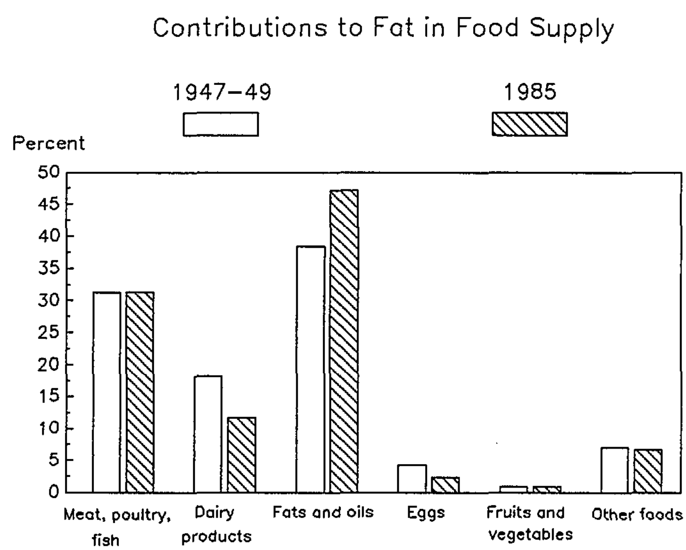


Figure 5–21. Food sources of fat in the U.S. food supply: U.S. Food Supply Series, 1947–49 and 1985

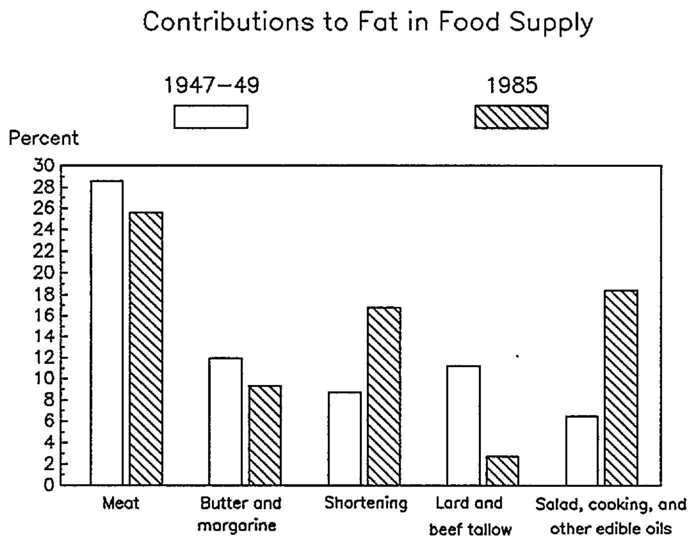


Figure 5–22. Contributions of meat and fats and oils to per capita fat in the U.S. food supply: U.S. Food Supply Series, 1947–49 and 1985

Trends in individual consumption of foods contributing to fat intake

Recent trends in individual food consumption contributing to fat intake can be examined in women using data from the CSFII 1985 and the NFCS 1977–78. Such analyses have been performed (Popkin, Guilkey, and Haines, 1989, in press; Popkin, Haines, and Reidy, 1989) examining refined food groupings based on the fat and fiber contents of foods (per 100 grams of food). Overall, the quantity consumed within most food groups decreased, and the diversity of women's diets and the number of lower–fat foods used increased between 1977 and 1985. In terms of average consumption, increases in the amounts of lower–fat milk and lower–fat beef and pork products were associated with decreases in the amounts of the higher–fat products in the same category; however, there was also an increase in the average consumption of higher–fat grain–based mixed dishes and a small decrease in the average consumption of higher–fiber vegetables. In examining the proportion of women that consumed selected food groups, a slightly different pattern emerges: there was a striking increase in the percentage of the population that consumed lower–fat milk, lower–fat high–fiber bread, and lower– or medium–fat poultry, beef, and pork, as well as higher–fat items such as cheeses, mixed grain dishes, and salty snacks. Decreases in the proportion of the population consuming higher–fat milk and higher–fat beef and pork were also observed. Despite a general downward trend in the quantities of foods consumed, there was an increase in the quantity of higher–fat mixed grain dishes consumed and a slight increase in the quantity of higher–fat desserts. Additional analyses, in which sample weights were not considered, suggested that these changes in consumption were affected by behavioral changes as well as by changes in the socioeconomic and demographic characteristics of the population over time.

Data from NHANES I and NHANES II also indicate a trend toward a decrease in the consumption of high–fat foods (Sempos et al., 1987). These findings are discussed in detail later.

Contribution of foods to individual intake of fat

Information from the CSFII 1985 on the (4–day) dietary intake of women can be used to study the contributions of different foods and food groups to nutrient intake. One of the problems in reporting consumption by food groups has been classification of mixed dishes, such as casseroles and sandwiches. The contributions of various food groups to fat, saturated fat, and cholesterol intakes were determined in two ways by Krebs–Smith, Cronin, and Haytowitz (1988): first, by classifying food mixtures as single items and assigning them to groups according to their main ingredient and second, by separating nearly all mixtures into their component ingredients and assigning the ingredients to their appropriate groups. These analyses suggest that a more complete picture of the contribution of foods to fat intake is obtained when the ingredients of food mixtures are considered separately rather than categorizing each mixture according to its main ingredient. This situation is exemplified by the data presented in table 5–3; when mixtures are separated a major decrease in the contribution to fat intake occurs for the grain group (in which fats and oils are major components of many grain–based dishes) together with a corresponding large increase in the contribution of the fats and oils food group. Meat, poultry, and fish dishes contributed the largest percentage of fat, but as separate ingredients, fats and oils contributed the largest percentage of fat.

Factors associated with fat intake

Estimates of fat intake for women in the CSFII 1985–86 (see tables II–16 and II–17 in appendix II) suggest that total fat intake varies with race, poverty status, and education. Analyzing the CSFII 1985 data from women, Krebs–Smith (1988) found that the characteristics of living in the Midwest or West,

Table 5-3. Percentage contribution of selected food groups to total intake of selected food components for women aged 19-50 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals 1985 (Krebs-Smith, Cronin, and Haytowitz, 1988)

Food group	Total fat		Saturated fatty acids		Cholesterol	
	As reported	Mixtures separated	As reported	Mixtures separated	As reported	Mixtures separated
Meat, poultry, fish	31	26	30	27	37	36
Milk and milk products	15	19	25	33	12	15
Eggs	4	4	3	3	31	42
Legumes, nuts, seeds	4	4	2	2	--[1]	--
Grain products	22	9	20	6	16	2
Vegetables	8	6	7	4	1	--
Fats and oils	14	30	10	21	3	4
Sugars, sweets	1	1	2	2	--	--

[1] Dashes denote value is less than one, but not zero.

having a child less than one year of age, being white, having more than a high school education, and being a current smoker were all associated with a higher probability of having a fat intake in the upper two quintiles. In the future, such analyses may be helpful in identifying target groups for education.

Sodium

Information about sodium consumption is difficult to collect accurately from surveys owing, in large part, to the multiplicity of sources and wide variations in food preparation and dietary practices. An accurate assessment of sodium intake must take into account that occurring naturally in foods and water, sodium added to prepared foods as salt, sodium added in other capacities (for example, as sodium nitrate or citrate for preservation), and discretionary sodium added by the consumer. The NNMS provides very limited information about the availability and consumption of sodium. Data on sodium were not collected in the U.S. Food Supply Series or in the NFCS 1977-78. In the NHANES I, NHANES II, and CSFII 1985-86, participants were questioned about their use of salt, but quantitative estimates were not made for salt used at the table. Different assumptions were made in different surveys when the participants did not specify their salting of foods. Thus, because of the complexities discussed above, the data from these surveys are not considered precise and accurate.

The FDA has collected information on sodium labeling in its FLAPS. These surveys have found that the sodium content of established food products has not decreased in recent years, but that the total sodium in labeled foods is lower because of the introduction of low-salt foods.

Calcium, Potassium, Magnesium, Fiber

Although it has been suggested that there is a relationship between the consumption of these food components and different cardiovascular diseases, these hypotheses are still being tested. Inasmuch as the levels of these nutrients that may be protective or deleterious are not known, it is not useful to discuss NNMS data regarding supply and intake in any more detail than is presented in chapter 3.

Alcohol

Data available from the NNMS on the availability and intake of this component can be found in the discussion of alcohol in chapter 3. Although there is some evidence of a relationship between alcohol intake and certain cardiovascular diseases, particularly hypertension, the difficulty in assessing the intake of this component in dietary surveys makes the currently available NNMS data inadequate for assessing usual levels of intake.

Associations

Associations among cardiovascular diseases, cardiovascular risk factors, and dietary factors that have been assessed using NNMS data are examined in this section. Such associations can be analyzed using a number of epidemiological study designs: ecological, cross-sectional, and prospective. A variety of ecological and cross-sectional studies investigating relationships between dietary variables and cardiovascular diseases have been carried out using NNMS data. To date, the only NNMS survey to use a prospective cohort design has been the NHEFS.

The hallmark of the ecological study design is that grouped data are used to describe both the dependent and independent variables. One type of ecological study is that in which cross-sectional group data on both a risk factor and a disease or risk factor outcome are compared among a number of different population groups. A second type of ecological design uses trend data for both the dependent and independent variables to look for associations between changes over time in one variable as compared with changes over time in the other variable. An example would be the investigation of changes in national fat availability (from the U.S. Food Supply Series) and changes in mortality due to cardiovascular disease (from the Vital Statistics Data). Ecological associations detected in populations often overestimate the strength of the relationship among individuals.

In a cross-sectional study one may attempt to relate differences in the dependent and independent variables among individuals who have been examined. Data regarding both variables are available from the same individuals. The most common methods of analysis used in these studies are correlation and regression. In some cases, where there is a high degree of intraindividual variation in one of the variables, a quantile analytic approach may be used. One potential drawback of the cross-sectional design is the inability to determine temporal relationships; chronic disease may develop many years after the consumption or exposure that caused the disease. Moreover, persons who have been diagnosed as having a disease may currently be consuming a diet different from the one they consumed before the diagnosis. Misleading associations may be identified if analyses do not account for possible confounding factors. In order to determine whether or not a factor associated with a disease is or is not causally related to the development of that disease, it is necessary that a clear temporal relationship be shown between the presence of the risk factor in individuals without evidence of disease and the future development of disease among these same individuals. In cross-sectional studies, where associations are determined at one point in time, it is not possible to identify or infer causal relationships when significant associations are found between risk factors and disease.

The cohort, or prospective study design, is one in which individuals in a population who are free of disease are first classified on the basis of exposure to a risk factor (on a yes or no basis in the case of dichotomous variables or on a continuous basis in the case of many biological variables such as blood pressure, nutrient intake, or serum cholesterol). These individuals are then followed over time and are reexamined at periodic intervals to ascertain the presence or absence of disease (in the case of death, the cause of death is determined). The risk of developing disease can be compared between the exposed and unexposed groups. A number of analytic techniques may be used, the most common being relative risks calculation, where the proportion of individuals exposed to the risk factor is compared to the proportion of unexposed individuals developing the disease over the same period of time.

Ecological Associations of Changes in Cardiovascular Mortality, Dietary Factors, and Risk Factors Over Time

<u>Trends in mortality and food supply</u>

The availability of data collected over extended periods of time on cardiovascular disease, diet, and other risk factors makes possible the examination of ecological associations and temporal relationships among the changes observed (based on group characteristics of the U.S. population) among these factors. Slattery and Randall (1988) have performed such an analysis using the Vital Statistics data on coronary heart disease mortality, together with data on food "consumption" implied from disappearance data in the U.S. Food Supply Series. Their analysis shows an increase in coronary heart disease mortality for men aged 45–54 and 55–64 years from 1925 to the early 1950s when the rate began to level off. In the mid-1960s the mortality rate began to decline and the decline persisted through 1978, the last year included in this study. Pertinent changes in the food supply include the following changes in the availability of selected foods:

- A decrease in eggs beginning around 1950.
- A decrease in dairy products after the late 1940s.
- Fluctuations in fruits and vegetables beginning around 1955.
- A decrease in whole milk and an increase in low-fat milk after 1950.
- A change to margarine being substituted for butter occurring in the mid-1950s.
- An increase in poultry starting in the late 1940s.
- An increase in cheese.

The net changes in the use of food groups and the substitutions within groups suggested a diet higher in saturated fat through the 1950s with a decrease thereafter. These changes preceded the national decline in coronary heart disease mortality, lending some support to the diet-heart hypothesis.

<u>Trends in serum cholesterol and intake of dietary fats and cholesterol</u>

Sempos et al. (1987) compared age-adjusted aggregate trends in the consumption of foods that contributed fats and cholesterol in the diet; calculated the intakes of total fat, saturated fat, linoleic acid (the major polyunsaturated fat), and cholesterol as percent of kilocalories; and predicted and observed changes in serum cholesterol levels between NHANES I (1971–74) and NHANES II (1976–80). For all adults, there was a consistent pattern leading to a decrease in the consumption of dairy products, meat, poultry, eggs, and fats, oils, and gravies, although the magnitudes of some changes were very small. Within dairy products, there was a shift away from consumption of whole milk to consumption of low-fat milk; there were also decreases in the consumption of butter and increases in the consumption of margarines. Changes in the intake of vegetables were not consistent for all race-sex groups; food composition data for vegetables assumed added saturated fat (butter) in 1971–74 and added unsaturated fat (margarine) in 1976–80, if not specified by respondents. This change in coding, plus the introduction of fatty acid composition data for many new foods in the NHANES II nutrient composition database, suggests that caution should be applied in the interpretation of trends between the two surveys. The results for nutrient intakes (table 5-4) indicated an increase in intake of linoleic acid

Table 5-4. Trends in age-adjusted[1] mean intakes of energy, fats, and cholesterol for persons aged 20–74 years, by sex and age: first National Health and Nutrition Examination Survey, 1971–74, and second National Health and Nutrition Examination Survey, 1976–80 (Sempos et al., 1987)

Dietary component	Sex	Race	1971–74	1976–80	Change in mean
Energy (kilocalories)	Male	White	2,483	2,481	-2
	Female	White	1,558	1,541	-17
	Male	Black	2,233	2,227	-6
	Female	Black	1,410	1,439	+29
Total fat (percent)	Male	White	36.9	36.8	-0.1
	Female	White	36.1	36.0	-0.1
	Male	Black	36.2	36.2	0
	Female	Black	35.5	35.8	+0.3
Saturated fat (percent)	Male	White	13.6	13.3	-0.3
	Female	White	13.0	12.5	-0.5
	Male	Black	12.7	12.8	-0.1
	Female	Black	12.4	12.3	-0.1
Linoleic acid (percent)	Male	White	3.9	5.1	+1.2
	Female	White	4.0	5.4	+1.4
	Male	Black	3.7	4.9	+1.2
	Female	Black	4.0	5.3	+1.3
Cholesterol (milligrams)	Male	White	483	436	-47
	Female	White	310	272	-38
	Male	Black	535	476	-59
	Female	Black	313	295	-18

[1] Age-adjusted by the direct method to the U.S. population at the midpoint of the NHANES II.

(polyunsaturated fat) and a decrease in intake of saturated fat and cholesterol. These changes in nutrient intake were used in the equations of Keys, Anderson, and Grande (1965) and Hegsted et al. (1965) (see page 111) to predict the change that might be expected in mean serum cholesterol. The predicted and observed changes in serum cholesterol levels between the two surveys are shown in table 5-5. The predicted changes in the mean serum cholesterol levels, based on changes in the mean consumption of fats and cholesterol, are consistent in magnitude and direction with those observed. This finding improves confidence in the trends in dietary intake, despite the caveats noted above.

Table 5-5. Change in age-adjusted[1] mean serum cholesterol levels (milligrams/dl) for persons aged 20-74 years, by race and sex: first National Health and Nutrition Examination Survey, 1971-74, and second National Health and Nutrition Examination Survey, 1976-80 (Sempos et al., 1987)

Race and sex	Formula[2]	Predicted	Observed
White men	Keys et al.	-3	-3
	Hegsted et al.	-6	
White women	Keys et al.	-2	-1
	Hegsted et al.	-6	
Black men	Keys et al.	-4	-4
	Hegsted et al.	-6	
Black women	Keys et al.	-3	-4
	Hegsted et al.	-4	

[1] Age-adjusted by the direct method to the U.S. population at the midpoint of the NHANES II.

[2] See page 111 for formulas.

Cross-sectional Associations of Dietary Intake and Other Risk Factors

Dietary intake and serum cholesterol level

Published studies of the cross-sectional association of dietary variables and serum cholesterol using the NHANES I data (NCHS, 1983a) did not show any consistent associations when mean serum cholesterol was assessed for groups with different levels of dietary intake. Some of the dietary variables examined in this study were frequency of consumption of high-fat foods, total dietary calories, total fat, percent of calories from fat, and the ratio of dietary linoleic acid to saturated fatty acids. The lack of association is not surprising because only a single day of dietary data was available, a situation in which potential associations are attenuated by the high level of intra-individual variation present in these data (see chapter 2). Other factors such as confounding variables and lag time for development of hypercholesterolemia contribute to these findings.

Data analyses prepared for the EPONM using NHANES II data examined many of the same associations, but classified individuals into groups based on quartile of serum cholesterol. These analyses also revealed no consistent associations between dietary variables and serum cholesterol levels. These findings suggest the relative weakness of this type of cross-sectional design to assess such dietary associations with disease or other risk factors (Jacobs, Anderson, and Blackburn, 1979).

Dietary intake and blood pressure

Studies similar to those carried out with serum cholesterol as the dependent variable (in the preceding section) have also been carried out with blood pressure (NCHS, 1983b). The results have been similarly nonrevealing, showing positive associations of blood pressure only with alcohol and with dietary sodium to potassium ratio in blacks. Since 1982 a number of papers have been published suggesting an inverse association between calcium intake and blood pressure. Although some of these studies have utilized the NHANES I data set (Harlan et al., 1984; McCarron et al., 1984), other studies using the same data set have shown inconclusive results (Feinleib, Lenfant, and Miller, 1984; Gruchow, Sobocinski, and Barboriak et al., 1985). A recent study (Sempos et al., 1986) utilizing a quantile approach to both the NHANES I and II data did not find any significant association between calcium intake and either blood pressure or the prevalence of hypertension. Reported dietary intake was estimated in both NHANES I and II from a 24-hour recall, a technique that does not take into account the large within-person variation that exists in dietary intake; the use of such data in regression analyses often will greatly underestimate the magnitude of any association that might exist. Because of the potential for misclassification due to the large amount of within-person variation in this data set, "quantile" methods of analysis that decrease the probabilities of such misclassification should be used. It is evident from these and other attempts (preceding section) to utilize the NHANES dietary intake data to search for associations between nutrient intake and chronic disease risk factors that such analyses must be performed and interpreted carefully.

Dietary patterns of women smokers and nonsmokers

The food consumption patterns and dietary intakes of smokers and nonsmokers differ. Data from CSFII 1985 indicate that women smokers consumed less of fruits and vegetables and more of eggs, sugars, coffee, and alcoholic beverages than nonsmokers (Larkin et al., 1989). Their intakes of carbohydrate, fiber, vitamin C, and thiamin per 1,000 kilocalories were also lower than the intakes among nonsmokers. The total energy and fat intakes of smokers and nonsmokers did not differ significantly. There do not appear to be large differences in the food components associated with cardiovascular disease (such as fat) between smokers and nonsmokers. Smoking is a risk factor independent of dietary patterns.

Cross-sectional Associations Among Nondietary Risk Factors

Relationship of serum cholesterol to body mass and skinfold thickness

Analysis of data from NHANES I (NCHS, 1983a) showed that successively greater quintiles of body mass index, weight (kg)/height $(m)^2$, were associated with higher serum cholesterol levels in adults. The association was found to be independent of age, sex, and race. A similar relationship (in magnitude and direction) was found between serum cholesterol level and the sum of subscapular and triceps skinfold thicknesses. These findings are consistent with other data showing an association between obesity and hypercholesterolemia.

Relationship of serum cholesterol to selected biochemistries

Analyses of data from NHANES I (NCHS, 1983a) showed several unsuspected associations between serum biochemical measurements and serum cholesterol. Serum calcium and magnesium levels and serum glutamic acid transaminase (SGOT) were directly and independently related to serum cholesterol levels. No metabolic activities of calcium or magnesium suggest an explanation for their association with circulating cholesterol levels, and no diseases marked by excesses or deficiencies of these minerals are accompanied by striking changes in serum cholesterol levels. SGOT is frequently used as a marker for liver impairment. Alcohol is the most common liver toxin; thus, the relationship between SGOT and serum cholesterol may be mediated by alcohol intake. The association between serum cholesterol, SGOT, and alcohol intake has not been adequately explored with NNMS data.

Relationship of blood pressure to body mass and skinfold thickness

An analysis of data from NHANES I (NCHS, 1983b) indicated that body mass index, weight (kg)/height $(m)^2$ and the sum of subscapular and triceps skinfolds were significantly and positively related to systolic and diastolic blood pressure in all race, sex, and age groups among adults.

Relationship of blood pressure to selected biochemistries

Analyses of data from NHANES I (NCHS, 1983b) indicated that hemoglobin levels were directly related to systolic blood pressure in women and to diastolic blood pressure in men and women in most age groups, even after controlling for body mass differences. Serum cholesterol levels were also found to be directly related to blood pressure. Serum inorganic phosphate levels were inversely related to systolic and diastolic blood pressure, while serum calcium levels were directly related to blood pressure in women but not in men. The ratio of serum calcium to phosphate was strongly and directly related to blood pressure independent of age, sex, race, and body mass index. Multiple regression analysis showed age to be the best predictor of blood pressure, followed by body mass index.

Associations of selected measures of body size and body fat distribution with cardiovascular disease risk factors

Several studies have reported an increased ratio of waist to hip girth to be associated with increased occurrence of cardiovascular disease and diabetes independent of overall body weight. Gillum (1987b,c) used data from NHES (1960–62 and 1963–65) to analyze associations of various body measures with cardiovascular disease risk factors by race and sex in a nationally representative sample. In adults, the ratio of waist girth (measured directly) to hip girth (estimated from seat breadth and thigh clearance) was found to increase steadily with age; be higher in men than in women; be higher in blacks than in whites; and have higher values associated with higher blood pressure, higher post-load glucose levels, and greater prevalences of hypertension and hypertensive heart disease, independent of multiple confounders. In children (aged 6–11 years) and youths (aged 12–17 years), waist to hip girth declined with age; was higher in boys than in girls; and was significantly associated with systolic blood pressure in youths and with diastolic blood pressure in children, independent of confounders.

These studies confirmed and extended findings from smaller studies in a nationally representative sample and indicate the opportunity for further research on the determinants and associations of body fat distribution.

Multiple cardiovascular disease risk factors in the same individuals

Rowland and Fulwood (1984) studied changes in the prevalence of the three major risk factors for cardiovascular disease (hypertension, cigarette smoking, and elevated serum cholesterol levels) in blacks and whites between NHANES I and NHANES II. The criteria for elevated blood pressure were systolic pressure at least 160 mm mercury, and/or diastolic pressure at least 95 mm mercury; elevated serum cholesterol levels were defined as 6.70 mmol/L (260 mg/dl) or more; and a smoker was defined as a person who had smoked at least 100 cigarettes in his or her lifetime and was a current smoker. The prevalence of elevated blood pressure and of cigarette smoking was found to have declined dramatically in blacks between the two surveys. The proportion of adults with zero, one, and two or more of the specified risk factors was also examined; a striking decrease in the proportion of black men and women with two or more risk factors for cardiovascular disease was observed between the two surveys, while the decline for white women was very modest (see table 5–6). In all sex–race groups the percentage of individuals with none of the three risk factors increased between 1971–75 and 1976–80.

Cardiovascular disease risk factors (cigarette smoking, serum cholesterol, blood pressure) and oral contraceptive use

Analyses of data from NHANES II (Russell-Briefel et al., 1986) showed that oral contraceptive users had

Table 5–6. Age–adjusted[1] percent distribution among groups with zero, one, and two or more risk factors for cardiovascular disease for persons aged 25–74 years, by race and sex: first National Health and Nutrition Examination Survey, 1971–74, and second National Health and Nutrition Examination Survey, 1976–80 (Rowland and Fulwood, 1984)

	Risk factor groups[2]											
	None				One				Two or more			
	1971–1975		1976–1980		1971–1975		1976–1980		1971–1975		1976–1980	
Race–sex group	Percent	SE[3]	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
White males	39.0	1.3	42.5	1.1	46.2	1.3	44.5	1.1	14.8	0.8	13.0	0.6
White females	45.4	1.1	47.0	0.9	41.9	1.0	42.9	0.8	12.7	0.7	10.1	0.5
Black males	23.4	3.2	29.3	2.0	44.3	3.9	50.9	2.3	32.3	4.1	19.8	2.1
Black females	28.0	2.4	41.4	2.3	49.2	2.5	43.7	2.0	22.8	1.8	14.9	1.2

1 Age–adjusted by direct method to the total U.S. population estimated at the midpoint of the 1976–80 NHANES II.
2 Risk factors included the following: systolic blood pressure of at least 160 mm mercury and/or diastolic blood pressure of at least 95 mm mercury, serum cholesterol level of at least 6.70 mmol/L (260 mg/dl), or smoker.
3 SE = Standard error.

higher prevalences of elevated serum cholesterol levels and smoking, and a slightly higher age-adjusted prevalence of high blood pressure, than did nonusers. The prevalence of two or more of these risk factors was also found to be higher in users than in nonusers. These data confirm observations on the effects of oral contraceptive agents from clinical studies in a nationally representative population.

Risk Factors and Subsequent Morbidity and/or Mortality Experience (Cohort Studies)

Data from the NHEFS (Leaverton et al., 1987) were used to evaluate the generalizability of the Framingham risk model for the prediction of death from coronary heart disease. The model, which employed systolic blood pressure, total serum cholesterol level, and cigarette smoking, predicted remarkably well for the nationally representative sample studied in NHANES I and permit the conclusion that the major risk factors for coronary heart disease described in Framingham analyses are applicable to the U.S. white population.

Rowland and Fulwood (1984) also employed a model derived from the Framingham study to estimate the expected change in coronary heart disease mortality between NHANES I and NHANES II based on changes in risk factors (hypertension, elevated serum cholesterol level, and cigarette smoking) between the surveys. Comparisons of the expected and observed mortality rates are shown in table 5-7. These results suggested that the changes in risk factors accounted for a significant proportion of the decrease in coronary heart disease mortality.

Table 5-7. Percentage decrease in age-adjusted[1] rates for observed and expected coronary heart disease mortality (ICD-8, 410-413) between 1974 and 1978 for adults aged 35-74 years, by race and sex: first National Health and Nutrition Examination Survey, 1971-74, and second National Health and Nutrition Examination Survey, 1976-80 (Rowland and Fulwood, 1984)

	Percent decrease	
Race and sex	Observed[2] mortality	Expected[3] mortality
White males	14	7
White females	15	8
Black males	13	13
Black females	20	16

[1] Age adjusted by direct method to the total U.S. population as estimated at the midpoint of the 1976-80 NHANES II.

[2] From the Division of Vital Statistics.

[3] Predicted from NHANES I and NHANES II survey data based on Framingham risk model.

Knowledge, Attitudes, and Behaviors Related to Cardiovascular Disease Prevention

Various surveys of the NNMS assess knowledge, attitudes, and behaviors related to the occurrence and prevention of cardiovascular disease. For example, the 1985 NHIS (NCHS, 1986c, 1988a) included questions to assess knowledge of factors related to high blood pressure, heart disease, and stroke. The survey results indicated that more than 90 percent of adults knew that having high blood pressure, smoking cigarettes, or being very overweight increased a person's chances of getting heart disease. Fewer (61 percent) knew that diabetes was also a risk factor. Seventy-seven percent recognized that a person's chance of having a stroke was increased by high blood pressure. Knowledge was greater when family income and level of education were higher. The percentage of elderly subjects (65 years and over) who knew of these associations was smaller than that of younger subjects (but educational levels were lower in the elderly subjects). The survey did not attempt to relate knowledge of the risks associated with high blood pressure to risk-avoidance behavior; however, nearly 85 percent of the population had had their blood pressure checked in the past year. Elderly subjects were more likely than younger subjects to have had their blood pressure checked.

The 1985 NHIS (NCHS, 1986c) also assessed knowledge of the associations of dietary and nutritional factors with cardiovascular diseases. In the survey population, 80 percent stated that eating a diet high in animal fat either definitely or probably increases a person's chances of getting heart disease, 58 percent indicated that sodium or salt is the food substance most often associated with high blood pressure, and 86 percent stated that "high cholesterol" increases a person's chances of getting heart disease.

The Health and Diet Surveys (Heimbach, 1986, 1987), conducted in 1982, 1984, and 1986, have confirmed the increasing public awareness of the association of diet and disease, including the relationships of fat intake to heart disease and of sodium intake to high blood pressure (tables 5–8 and 5–9). Data from these surveys also suggest that increasing numbers of persons engage in risk-avoidance behaviors such as using ingredient list information to avoid or limit the consumption of salt or sodium and fats or cholesterol (table 5–10).

In Health and Diet Surveys of the general public and practicing physicians jointly sponsored by FDA and NHLBI in 1983 and 1986 (Schucker et al., 1987a,b), results indicated increases in the percentages of persons in both groups who believed that reducing high blood cholesterol would have a large effect on heart disease (from 64 to 72 percent in the general population, and from 39 to 64 percent among physicians). Among adults in the general public, 46 percent reported they had had their serum cholesterol level checked in 1986 compared to 35 percent in 1983. In both years, more than 60 percent identified dietary changes (eating less cholesterol and fat) as a way to reduce serum cholesterol. In 1986, physicians reported initiating dietary intervention at lower levels of blood cholesterol in their patients than they had reported in 1983. Together, these surveys show gains in public awareness and action and in physician beliefs and therapeutic interventions in relation to high blood cholesterol risk.

Table 5–9. Perceived major dietary factors related to high blood pressure: Health and Diet Surveys, 1982–86 (Heimbach, 1986)

	Percent of respondents		
Factor	1982	1984	1986
Salt/sodium	54	49	49
Alcohol	26	31	31
Fats/saturated fats	20	16	22
Cholesterol	17	13	18
Caffeine	9	8	10

Major Limits to Interpretation of Data and Gaps in the Database

- The most recent dietary survey, the Continuing Survey of Food Intakes by Individuals 1985–86, provides estimates of dietary intake of several food components associated with cardiovascular diseases--food energy, fat, saturated fat, mono-unsaturated fat, polyunsaturated fat, cholesterol, dietary fiber, calcium, and potassium. Estimates of

Table 5–8. Perceived relationships between diet and disease: Health and Diet Surveys, 1982–86 (Heimbach, 1987)

	Percent of respondents[1]		
Issue	1982	1984	1986
Heard of health problems linked to sodium	70		83
High blood pressure	51		65
Heard of health problems linked to fat		78	84
Heart/atherosclerotic disease		64	75
Cancer		4	7
Sodium named as cause of high blood pressure	34		
Fat named as cause of heart disease	29		43
Cholesterol named as cause of heart disease	26		40
Fat named as cause of cancer		12	19
Food additives named as cause of cancer		25	21

[1] The denominator for all estimates is all respondents.

Table 5-10. Reported food control behavior: Health and Diet Surveys, 1978-86 (Heimbach, 1987)

Issue	Percent of respondents[1]			
	1978[2]	1982	1984	1986
Pay attention to ingredient list	77	75	78	79
Use information to avoid/limit[3]	54	57	62	68
Salt/sodium	14	40	38	44
Sugar	27	30	30	32
Additives	18	17	20	26
Fats/cholesterol	7	8	9	15
On sodium-controlled diet		38	39	43
On blood cholesterol-lowering diet			14	24
On weight-loss diet			16	19

1 The denominator for all estimates is all respondents.
2 FDA Consumer Food Labeling Survey (personal interviews with 1,374 consumers selected through a national area-based probability sample).
3 Multiple responses were permitted; specific responses may sum to more than the percent of respondents who used any information.

sodium intake from food are also available, but these exclude sodium from salt added at the table; thus, total sodium intake is underestimated. Estimates of alcohol intake from self reports are also less certain, because of methodological difficulties such as underreporting. Because the properties of individual fatty acids differ, estimates of their intake would also be desirable; the nutrient composition databases available during the Panel's review do not contain composition information with respect to individual fatty acids.

- With respect to implications for cardiovascular disease, the most recent data on the distribution of usual dietary intakes are limited because they are for women and children, groups not thought to be at high risk of cardiovascular disease. The earlier Nationwide Food Consumption Survey 1977-78 obtained dietary intake data for multiple days for both sexes and all ages, but the nutrient composition database was more limited with respect to information on fatty acids and cholesterol at the time.

- The ability to assess the distribution of usual dietary intakes from the data obtained in the Health and Nutrition Examination Surveys is limited because only 1 day of dietary data is collected.

- Trends in dietary intake of individuals with respect to fat and cholesterol, as assessed by the dietary and health surveys of the NNMS, must be interpreted with caution because of differences in survey methodology and improvements in the nutrient composition databases over time. The ability to interpret changes in intake over time could be improved by the conduct of methodological studies designed to assess the consequences of changes in survey procedures on the estimates generated.

- Cross-sectional associations of dietary influences and risk factors for cardiovascular diseases may be examined using data from the Health and Nutrition Examination Surveys, but the power of such analyses is severely restricted, because of the large day-to-day differences in the food and nutrient intake of any individual. The results of analyses of 1-day food intakes of individuals do not represent the average usual intake of any individual over a longer period of time. In studying diet and disease relationships, it is generally recognized that an estimate of average, or "usual," nutrient intakes is needed. With respect to studying relationships between diet and cardiovascular disease risk factors in the NNMS, measurements of "usual" dietary intake are not obtained for the same individuals in whom measurements of risk factors are performed. Other limitations in interpretation of such associations exist because of the nature of cross-sectional data: an "association" between a postulated risk factor and a disease may be identified, not because it is causally related to the disease, but because it is related to another factor which is really one of the causes of the disease.

- Because a single 24–hour recall was used to obtain dietary intake information, there are also limitations in the interpretation of relationships between dietary intake and subsequent morbidity and mortality in the longitudinal NHANES I Epidemiologic Followup Study.

- Surveys have not assessed directly the impact of knowledge and attitudes about cardiovascular disease risk factors and diet on patterns of food consumption or nutrient intake.

Conclusions

Based on the analyses discussed in this chapter, the major contributions of the NNMS to the understanding of dietary and nutritional factors as they relate to cardiovascular diseases are the following:

Populations at Risk

- Measurements of body weight, blood pressure, serum lipids, and glucose tolerance, and questionnaires in the Health and Nutrition Examination Surveys permit the assessment of the prevalence of several major diet– and nutrition–related risk factors for cardiovascular diseases--obesity (overweight), hypertension, elevated serum cholesterol level, and diabetes--in nationally representative samples. By comparing the prevalence estimates of different population groups, some characteristics of groups most affected by each risk factor can be identified. Characteristics of the groups at risk differ depending on the risk factor considered. For example, blacks are at greater risk of hypertension than whites; women of low socioeconomic status are at greater risk of obesity than women of high socioeconomic status, and persons above poverty are at greater risk of hypercholesterolemia than persons below poverty. The characteristics of individuals with multiple risk factors can also be examined: black males have a higher prevalence of multiple risk factors than white males and black or white females. However, a model that quantitates the relative contribution of all risk factors, including genetic predisposition, has not been developed for application with the NNMS data to assess overall risk of cardiovascular diseases.

- High intakes of fat, especially saturated fat, and cholesterol constitute risk factors for hypercholesterolemia, and characteristics of populations with high intakes can be assessed in the NNMS. For example, in women, high fat intake is associated with being white, having more than a high school education, and smoking.

Trends

- Data from the U.S. Food Supply Series provide information on trends in the foods and amounts of food components in the food supply over time. Although the inferences about food consumption and food component intake that may be drawn from these data are limited, they are nonetheless useful to demonstrate shifts over time within food supply sources of various food components related to cardiovascular diseases (notably, total fat and fatty acid groups) in the national diet. These data indicate recent shifts from animal sources of fat to vegetable sources of fat, consistent with dietary guidance to avoid too much saturated fat.

- Data from the surveys that collect information on food consumption indicate a decline in the consumption of some high–fat foods and foods containing saturated fat. Some changes observed in the past 20 years include a shift from whole milk to low–fat milks, an increased consumption of leaner types and cuts of meat, and an increase in the use of margarine with a concomitant decrease in the use of butter.

- However, as noted earlier, interpretation of trends in nutrient intake is problematic because of changes in survey methods over time.

- Biochemical and clinical measurements that permit assessment of the prevalence of overweight, hypertension, and elevated serum cholesterol levels have been made repeatedly over time (with limited changes in methodology). Thus, trends in the prevalence of these risk factors can be assessed. Data from the NNMS indicate a recent decline in the prevalence of hypertension and elevated serum cholesterol levels, but no decline in the prevalence of overweight. Associations between risk factors (for example, body weight and serum cholesterol level) and the occurrence of multiple risk factors in population groups can also be examined.

- The NNMS trend data are useful for examining concurrent changes in group intakes or status over time. For example, changes in food availability in the food supply contributing to a decrease in the content of saturated fat have been observed to precede the decline in coronary heart disease mortality. Changes in mean serum cholesterol levels consistent with changes in mean dietary intake of fats and cholesterol can also be detected between the first and second National Health and Nutrition Examination Surveys.

Determining Factors

- Sex and age are important determining factors for the risk of coronary heart disease and cerebrovascular disease. Men are at higher risk than women for coronary heart disease and hypertension. Although serum cholesterol levels do not vary dramatically with sex, elevated levels constitute a greater risk for men than for premenopausal women. The dietary intakes of fat, saturated fat, and cholesterol are higher in males than in females.

- Race also has an important impact on relative risk of cardiovascular disease. NNMS and related data indicate that blacks are at greater risk than whites for coronary heart disease, cerebrovascular disease, hypertension, and hypercholesterolemia. More black women are significantly overweight than white women or men of either race.

- The effects of socioeconomic factors such as poverty status and education do not seem consistent for all risk factors related to cardiovascular diseases. Indicators of high socioeconomic status tend to be associated with a higher level of hypercholesterolemia and higher intakes of fat, but with lower prevalences of hypertension and, for women, overweight.

- Several surveys of the NNMS permit the assessment of knowledge and attitudes about diet and nutrition-related risk factors for cardiovascular diseases. Such surveys have been repeated over time and show a trend for increasing knowledge and changing diet-related practices.

Future Concerns and Recommendations

Examples highlighted by the EPONM include the following:

- The rapid changes that can be expected to occur in the food supply (increases in the availability and consumption of low-fat and low-salt foods) should be monitored.

- Nutrient composition databases should reflect changes in food composition and introduction of new food products, as appropriate, as they occur. There is a particular need for information on the specific fatty acid composition of food items.

- To the extent possible, greater formulation and/or product specificity in the collection of food consumption data and the compilation of food composition data should be sought.

- Methods for assessing usual dietary intake should be employed in the Health and Nutrition Examination Surveys to enhance the usefulness of longitudinal followup.

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Chapter 6
Assessment of Iron Nutriture

Purpose

Iron deficiency is the most common single nutrient deficiency in the United States and is also the most common cause of anemia (a reduction below normal in erythrocytes, hemoglobin, or hematocrit). The JNMEC (DHHS/USDA, 1986) considered iron to be a food component warranting public health monitoring priority. The U.S. Dietary Guidelines (USDA/DHHS, 1985) recommend that Americans eat a variety of foods to provide enough essential nutrients. *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) notes the importance of children, adolescents, and women of childbearing age consuming foods that are good sources of iron. The consequences of iron deficiency include impaired work performance, body temperature regulation, behavior, and intellectual performance; decreased resistance to infections; and increased susceptibility to lead poisoning (DHHS, 1988).

The purpose of this chapter is to demonstrate how NNMS data can contribute to the understanding of iron nutriture as well as identify the strengths and weaknesses of data and information available primarily from components of the NNMS in addressing this topic. In this regard, the major strength of the NNMS is the information it contains on iron intake coupled with abundant data on iron status, which provides a basis for reevaluating the reasonableness of current estimates of iron requirements and dietary allowances. The discussions in this chapter focus especially on the NNMS capabilities for identifying 1) populations at risk, 2) trends, and 3) determining factors. Limits to interpretation of data and gaps in the database are also addressed.

To accomplish the objectives described above, data from the NNMS and related sources are used to examine the prevalence of iron deficiency and anemia, the distribution of dietary iron intakes, factors affecting dietary iron intake and assimilation, nondietary risk factors for impaired iron status, and relationships among dietary and other risk factors and iron status.

Background and Definitions

The discussion below is based mainly on the reviews contained in *The Surgeon General's Report on Nutrition and Health* (DHHS, 1988) and in the evaluation of iron data from NHANES II by the Expert Scientific Working Group (LSRO, 1984).

Functions of Iron in the Body

The iron in the body that functions to transport oxygen and utilize it in the production of cellular energy may be categorized as <u>essential iron</u>. Essential iron comprises that in hemoglobin (which contains most of the body's iron), in myoglobin, and in iron-dependent enzymes. The other category of iron is <u>storage iron</u>. Ferritin and hemosiderin comprise the storage forms of iron that serve as a reserve for the production of hemoglobin and other essential iron compounds.

Iron Balance

Iron balance is controlled chiefly by absorption, but the control of excretion may also serve as a mechanism for "fine-tuning" balance in normal individuals. Iron absorption is ordinarily fairly low, 5–15 percent of ingested iron, and is affected by a variety of factors, including the combination of foods in each meal and factors associated with intestinal regulation.

<u>Heme iron</u>, found principally in animal products, is absorbed to a far greater extent than <u>nonheme iron</u>, which is found primarily in plant products. Heme iron accounts for a relatively small proportion of iron in the diet, and its absorption is not greatly influenced by other components of the diet. In contrast, absorption of nonheme iron, which accounts for most of the iron in food, is very much influenced by the composition of each meal. The absorption of nonheme iron is greatly enhanced when meat, fish,

poultry, or foods containing vitamin C are consumed in the same meal. Conversely, the absorption of nonheme iron is decreased by the concurrent consumption of certain vegetables such as spinach and eggplant, calcium-rich foods, and tea. The iron in breast milk is relatively well absorbed in comparison with that in cow milk. Various forms of iron used for food fortification differ in bioavailability.

Important interactions with other minerals also occur. Supplements of calcium and magnesium decrease iron absorption. High doses of iron impair the absorption of zinc and copper. In iron deficiency, the absorption of the toxic minerals lead and cadmium is increased.

Intestinal regulatory factors also have an effect on absorption. When iron stores are low, intestinal mucosa readily takes up iron, and the normally low proportion of dietary iron absorbed can be increased greatly. Failure to reduce iron absorption when stores are adequate occurs in a genetic disorder called hemochromatosis and leads to a toxic accumulation of iron in the body. On the other hand, malabsorption may occur in the presence of gastrointestinal disorders such as celiac disease, atrophic gastritis, and chronic inflammatory disease of the gastrointestinal tract.

Iron Deficiency: Stages of Development and Assessment

Iron deficiency is likely to result when ingestion or assimilation of iron from the diet is insufficient to match iron losses from the body or the additional requirements imposed by growth or pregnancy. The risk of iron deficiency increases during periods of rapid growth, notably in infancy (especially in premature infants), adolescence, and pregnancy. In addition, iron deficiency commonly <u>may</u> result from excessive blood loss that cannot be compensated by dietary intake arising from heavy menstrual losses in women of childbearing years, frequent blood donations, early feeding of cow milk to infants, frequent aspirin use, or disorders characterized by gastrointestinal bleeding. The consequences of iron deficiency include reduced work performance, impaired body temperature regulation, impairments in behavior and intellectual performance, increased susceptibility to lead poisoning, and decreased resistance to infections.

The risk of iron deficiency is increased when there is a <u>depletion of iron stores</u>, assessed as a decrease in serum ferritin levels, without other laboratory abnormalities. This <u>first stage of iron depletion</u> is not associated with adverse physiological effects, but it does represent a state of vulnerability. Low stores occur in healthy individuals and appear, in fact, to represent the usual physiological condition for growing children and menstruating women. The risk of developing deficiency is minimized by the adaptive increase in iron absorption that occurs with reduced iron stores. Serum ferritin values fall to low levels during this stage, reflecting directly the decline in iron stores. Identification of this stage can be obscured by infection, which causes a rise in serum ferritin.

The <u>second stage of iron depletion</u> can be considered to represent early or mild <u>iron deficiency</u> because, at this stage, there is the first possibility of adverse physiological consequences. This stage is characterized by changes that indicate a lack of sufficient iron for the normal production of hemoglobin and other essential iron compounds, assessed by a decrease in transferrin saturation and an increase in erythrocyte protoporphyrin levels or by a significant rise in hemoglobin concentration in response to iron administration. At this stage, hemoglobin levels are not greatly affected. The level of erythrocyte protoporphyrin, a precursor of hemoglobin, increases when too little iron is available for synthesis of hemoglobin at an optimal rate; it also increases in lead poisoning, infection, and chronic disease. Transferrin saturation declines during this stage, but its measurement is subject to diurnal variation and large analytical variation; it also declines with infection and chronic disease.

In the <u>third stage of iron depletion</u>, frank <u>iron deficiency anemia</u> occurs, assessed by low hemoglobin concentration (below the normal reference range for individuals of the same sex and age) and typically accompanied by reduced mean corpuscular volume (MCV), as well as decreased transferrin saturation, decreased serum ferritin level, and/or increased erythrocyte protoporphyrin level. (Anemia may also result from causes other than iron deficiency including infection, chronic disease, and deficiencies of other nutrients such as folacin and vitamin B12.) Changes in the body iron stores and the laboratory indicators of iron status that occur during the various stages of iron depletion are illustrated in figure 6-1. Laboratory measurements appropriate to the assessment of each stage are noted in table 6-1.

No single biochemical indicator has proven to be diagnostic of iron deficiency. The use of several indicators in concert provides a much better measure of iron status. The NNMS data permit this type of assessment because of the number of different measures of iron status included in the two most recent HANES: hemoglobin, hematocrit, mean corpuscular

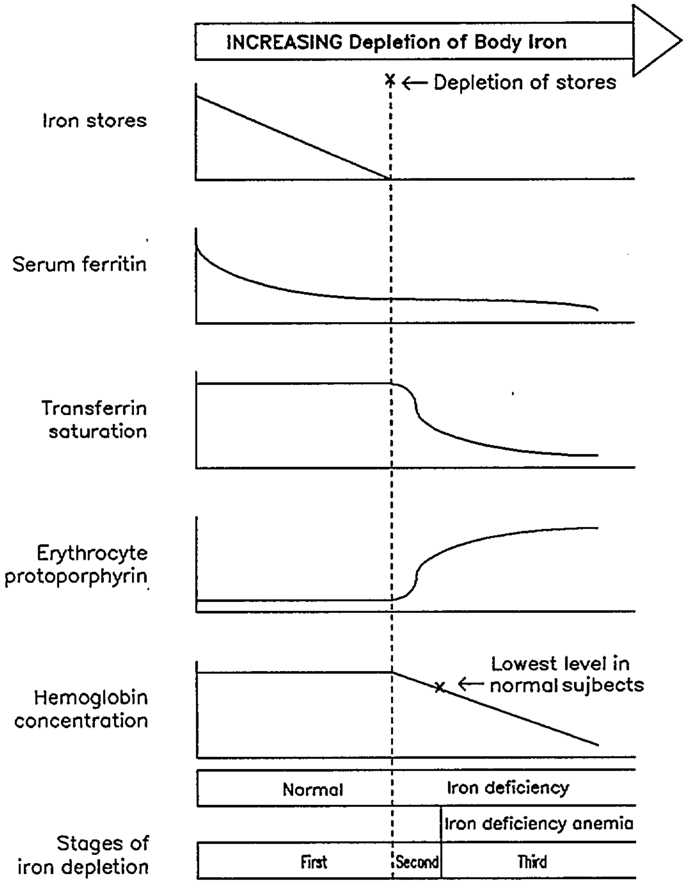


Figure 6–1. Changes in body iron compartments and laboratory assessments of iron status during the stages of iron depletion (adapted from International Nutritional Anemia Consultative Group [1977])

Table 6–1. Stages of iron depletion and appropriate laboratory assessments

Stage	Descriptive term	Laboratory assessments
First	Depleted iron stores	Serum ferritin level
Second	Iron deficiency (without anemia)	Transferrin saturation
		Erythrocyte protoporphyrin
Third	Iron deficiency anemia	Hemoglobin
		Mean corpuscular volume (MCV)

hemoglobin, MCV, serum iron; and serum total iron-binding capacity (which are used to calculate transferrin saturation), free erythrocyte protoporphyrin, and serum ferritin. For analyses of NHANES II data, the Expert Scientific Working Group (LSRO, 1984) developed two different models for evaluating iron status in which two or more abnormal values for indicators of iron status were considered indicative of iron deficiency or "impaired iron status." The first, termed the ferritin model, employed serum ferritin, transferrin saturation, and erythrocyte protoporphyrin as indicators; the second, termed the MCV model, employed MCV, transferrin saturation, and erythrocyte protoporphyrin as indicators. The decision to devise two models was guided partially by practical considerations (serum ferritin was not measured in the entire population) and partially by theoretical considerations. In theory, the ferritin model would be expected to yield higher prevalences indicative of an earlier stage of iron deficiency, because it includes ferritin which reflects only depletion of iron stores. The MCV model, on the other hand, includes three laboratory tests all of which reflect altered erythropoiesis. Both models identify individuals in the second and third stages of iron depletion. The cutoff values, developed for use with the NHANES II data, which are indicative of the presence of iron deficiency, are given below:

Age (years)	Serum ferritin (µg/L)	Transferrin saturation (percent)	Erythrocyte protoporphyrin (µmol/L RBC)	MCV (fl)
1–2	–	<12	>1.42	<73
3–4	<10	<14	>1.33	<75
5–10	<10	<15	>1.24	<7
11–14	<10	<16	>1.24	<78
15–74	<12	<16	>1.24	<80

Some of the indicators used (transferrin saturation and erythrocyte protoporphyrin) are also affected by inflammatory disease. Thus, the two models may overestimate the contribution of iron deficiency. However, analyses of NHANES II data showing the increase in the prevalence of low hemoglobin values with increasing numbers of abnormal values for indicators of iron status support the usefulness of the models for identifying populations with iron deficiency (see table 6–2). Similar analyses also show that the models developed with the NHANES II data are applicable to the three ethnic groups represented in HHANES.

Table 6-2. Percent[1] of persons with low hemoglobin concentrations[2] in iron status groups as defined by the MCV model[3]: second National Health and Nutrition Examination Survey, 1976-80, and Hispanic Health and Nutrition Examination Survey, 1982-84

Sex	Age (years)	Population	MCV model: 3 normal values	MCV model: 1 abnormal value	MCV model: 2 or 3 abnormal values
Males and females	5-10	Non-Hispanic white	2.5	1.5	5.9
			(939)[4]	(313)	(47)
		Mexican American	0.5	0.4	6.0
			(674)	(220)	(35)
		Puerto Rican	1.4	1.6	*
			(217)	(63)	(10)
		Cuban	0	*	*
			(68)	(13)	(3)
Females	20-44[5]	Non-Hispanic white	2.4	6.2	31.3
			(1,558)	(351)	(103)
		Mexican American	2.0	9.5	37.3
			(680)	(222)	(103)
		Puerto Rican	2.9	11.0	39.8
			(275)	(76)	(25)
		Cuban	0	5.8	*
			(138)	(33)	(15)
Males	45-74	Non-Hispanic white	2.2	8.2	29.4
			(2,154)	(313)	(63)
		Mexican American	0.6	5.8	*
			(435)	(64)	(5)
		Puerto Rican	3.4	*	*
			(170)	(22)	(1)
		Cuban	1.5	*	*
			(210)	(16)	(1)
Females	45-74	Non-Hispanic white	2.0	6.1	24.8
			(2,196)	(520)	(104)
		Mexican American	12.2	6.4	39.8
			(485)	(113)	(49)
		Puerto Rican	3.9	3.1	*
			(219)	(58)	(24)
		Cuban	0	2.3	*
			(207)	(48)	(8)

[1] All statistics are weighted.

[2] See page 134 for criteria for low hemoglobin.

[3] The MCV model employs mean corpuscular volume, transferrin saturation, and erythrocyte protoporphyrin. See page 131 for age-specific cutoff values used in this analysis.

[4] Value in parentheses is number of examined persons.

[5] Pregnant women are excluded.

* Indicates a statistic not reported because of small sample size.

When data for all four measures (serum ferritin, erythrocyte protoporphyrin, transferrin saturation, and MCV) are available, there may be an advantage in constructing a single, four-variable model in which either the value for serum ferritin or for MCV plus one additional value must be abnormal. This model not only simplifies presentation of information about iron status, but also helps to eliminate the contribution of inflammatory conditions to the prevalence estimates. This model was tested using the data for non-Hispanic persons in NHANES II; comparisons of estimates of iron deficiency obtained with the MCV, ferritin, and four-variable models are shown in figures 6-2, 6-3, and 6-4, for children aged 4-11 years, males aged 12-74 years, and females aged 12-74 years, respectively. These comparisons indicate show that, as expected, prevalence estimates with the four-variable model were similar to those given by the ferritin model in groups with a relatively high or moderate prevalence of iron deficiency. For those groups suspected of having a high prevalence of inflammatory disease (the elderly), the estimates of the prevalence of iron deficiency obtained with the four-variable model were lower than those obtained with the MCV model. The EPONM concluded that the four-variable model represents a promising approach for the assessment of iron nutriture in the future. Further development and refiniement of the

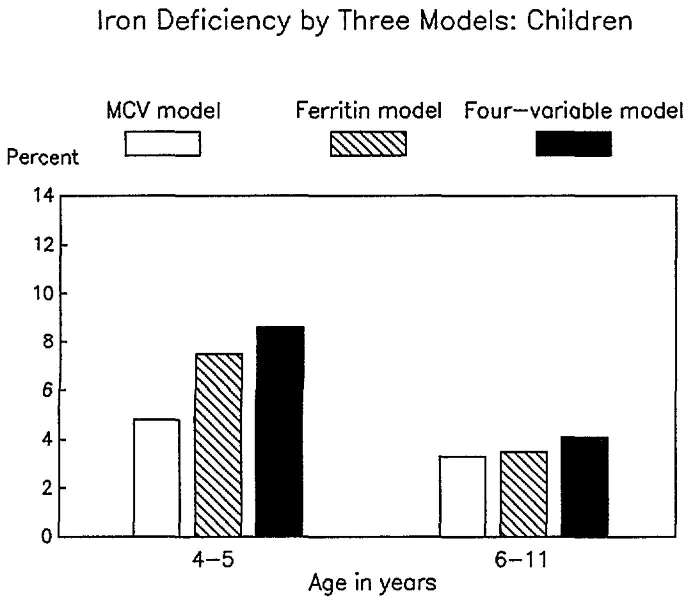


Figure 6-2. Prevalence of iron deficiency assessed by three models in non-Hispanic children aged 4-11 years: second National Health and Nutrition Examination Survey, 1976-80 (See text for explanation of models.)

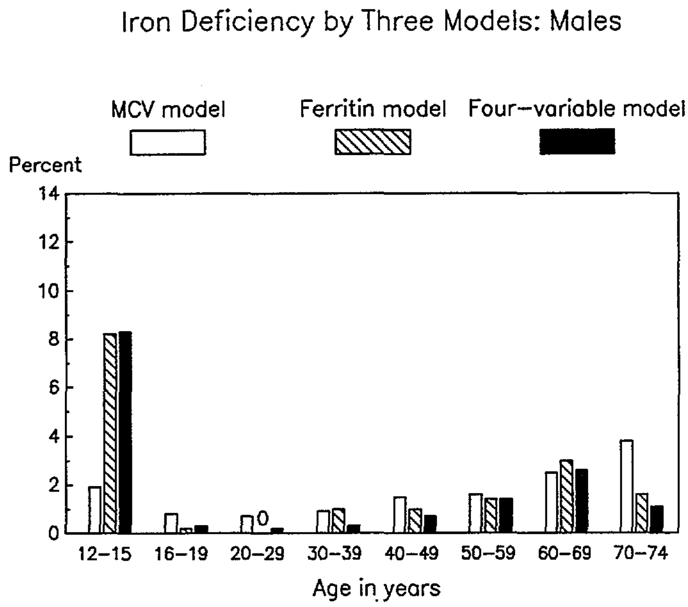


Figure 6-3. Prevalence of iron deficiency assessed by three models in non-Hispanic males aged 12-74 years: second National Health and Nutrition Examination Survey, 1976-80 (A zero in the figure indicates a prevalence estimate of 0.0 percent. See text for explanation of models.)

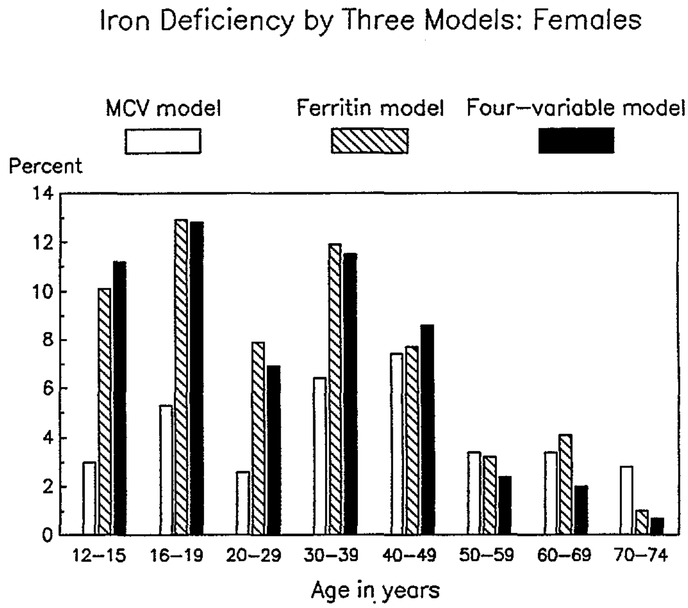


Figure 6-4. Prevalence of iron deficiency assessed by three models in non-Hispanic females aged 12-74 years: second National Health and Nutrition Examination Survey, 1976-80 (See text for explanation of models.)

model and the cutoffs for indicators are recommended.

The variables used in each of the three models are summarized in table 6–3. An advantage of all three models in estimating the prevalence of iron deficiency in blacks is that they do not include the hemoglobin concentrations. Hemoglobin concentrations are lower in blacks than in other racial groups, independent of iron status, for reasons that are thought to have a genetic basis.

In the remainder of this chapter, estimates of prevalence of iron deficiency are provided using the MCV model only for the following reasons:

- Use of a single model simplified the presentation of data, but nonetheless permitted useful illustrations of the factors that influence iron nutriture.
- Serum ferritin was measured only in a subsample of subjects in NHANES II.
- Although serum ferritin was measured in all subjects in HHANES, the data were not available for review by the EPONM.

Data on hemoglobin concentrations from the HANES are also useful for estimating the prevalence of anemia and iron deficiency anemia. The criterion used was the 2.5th percentile of hemoglobin concentration in reference populations formed by eliminating persons with abnormal values for other iron status indicators. The age-specific values derived from this criterion and used to evaluate NHANES II and HHANES data appear in the next column:

Age (years)	Hemoglobin cutoff values (g/L)[1]		
	Males and females	Males	Females
1–2	109[2]	–	–
3–4	109	–	–
5–10	112	–	–
11–14	–	120	118
15–19	–	131	117
20–44	–	134	119
45–64	–	132	118
65–74	–	136	119

[1] The cutoff values were estimated using the method of Dallman et al. (1984), for whites only: second National Health and Nutrition Examination Survey, 1976–80 (LSRO, 1984).

[2] Because of the small sample size, the value obtained for subjects aged 3–4 years was also used for subjects aged 1–2 years. This value was also in accord with data from other sources.

Hemoglobin level or hematocrit is measured in the women and children included in the PNSS and PedNSS. For these surveillance activities, the criterion for low hemoglobin and hematocrit was developed recently by CDC, based on 5th percentile values for a reference population from NHANES II.

Table 6–3. Laboratory measurements used in three different models for assessing iron deficiency

MCV model[1]	Ferritin model[1]	Four-variable model[2]
MCV	Serum ferritin	MCV or serum ferritin
Transferrin saturation	Transferrin saturation	Transferrin saturation
Erythrocyte protoporphyrin	Erythrocyte protoporphyrin	Erythrocyte protoporphyrin

[1] Two of three values must be abnormal.

[2] Values for either MCV or serum ferritin (or both) must be abnormal, in addition to at least one other abnormal value.

Hemoglobin and hematocrit values derived from this criterion and used with most of the CDC surveillance data in this report are as follows:

Age (years)	Hemoglobin (g/L)	Hematocrit (percent)
1– 1.9	110	33
2– 4.9	112	34
5– 7.9	114	35
8–11.9	116	36
12–14.9 (females)	118	36
12–14.9 (males)	123	37
15–17.9 (females)	120	36
15–17.9 (males)	126	38
18+ (females)	120	36
18+ (males)	135	40
Pregnancy		
1st trimester	110	33
2nd trimester	105	32
3rd trimester	110	33

Iron Overload and Hemochromatosis

Iron overload results in the toxic accumulation of storage iron in tissues. The most common cause is the hereditary condition hemochromatosis in which a genetic defect in iron absorption is considered the antecedent of abnormal iron accumulation over years with eventual damage to the liver, heart, pancreas, and adrenal glands. Arthritis is also a frequent manifestation of hemochromatosis. Individuals who are homozygous frequently develop symptoms by middle age; heterozygous carriers of the gene may be at increased risk for iron overload. The expression of symptoms may be influenced by age, sex, alcohol intake, and other factors. Iron overload may also result from frequent transfusions or, under extreme circumstances, from excessive oral intake.

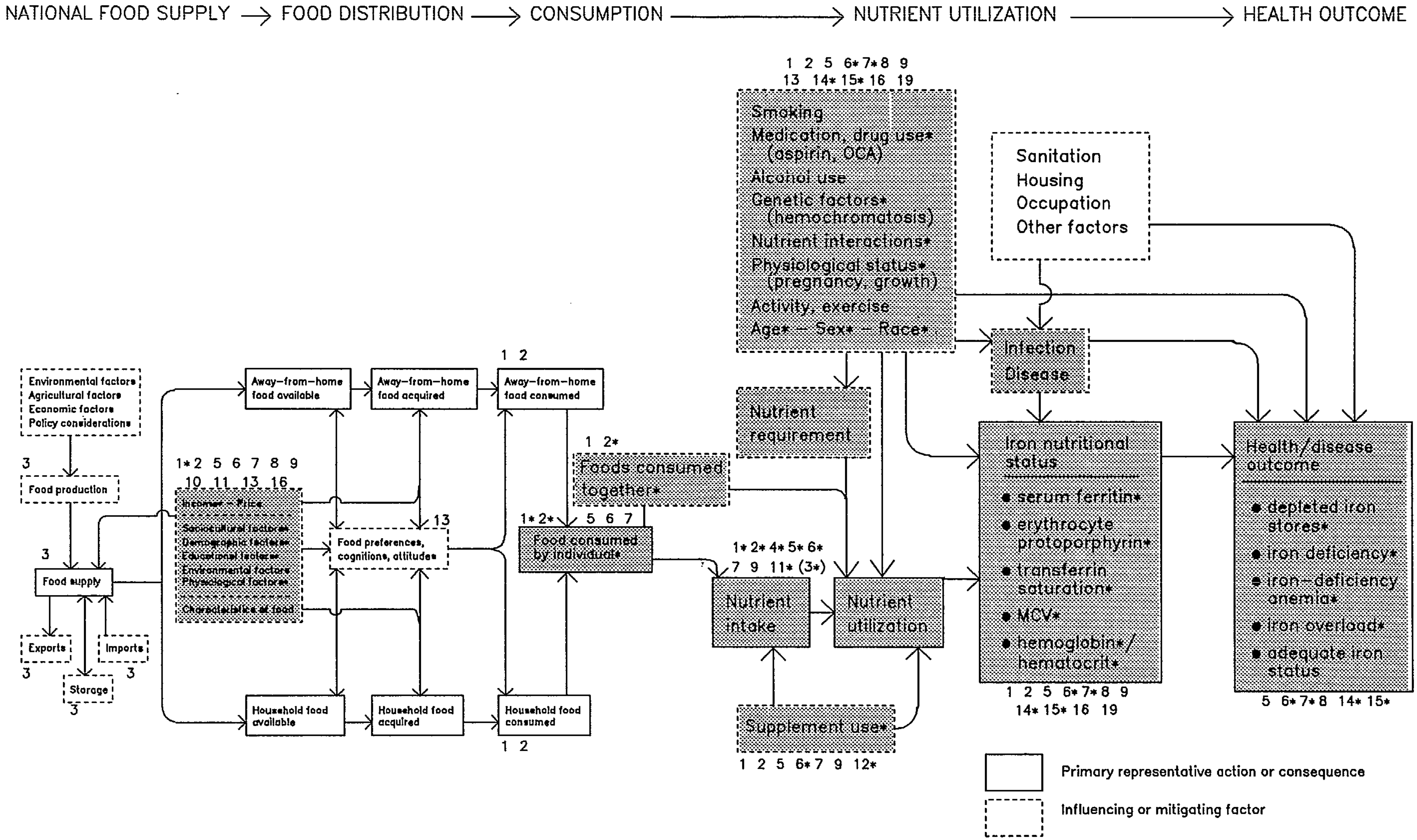
The ability to assess iron overload using the biochemical indicators of iron status available in the NNMS is limited. For analyses from NHANES II conducted by LSRO (1984) and discussed in this report, the presence of transferrin saturation greater than 70 percent plus an elevated serum ferritin value was regarded as indicative of possible iron overload. Age– and sex–specific criteria were used for the evaluation of elevated serum ferritin values.

Difficulties arise in assessing both the prevalence and the health consequences of hemochromatosis. Edwards et al. (1980) found that in 35 homozygotes identified through pedigree studies, thirteen were asymptomatic. Symptoms were rare in all women and in men less than 30 years; men usually had no symptoms until 50 years of age or older. Lindmark and Eriksson (1985) screened 941 men aged 55 years or older and reviewed 8,834 autopsies on males in Sweden (where the level of iron fortification of cereal products is two to three times greater than that in the United States) during a nine–year period. They estimated that clinically important idiopathic hemochromatosis was present in fewer than 1:1,000 males, but concluded that the higher prevalence found in certain parts of northern Sweden, France, and Australia probably represented real regional differences. (It should be noted that the HANES and other NNMS surveys are not designed to estimate reliably the prevalence of conditions that occur so infrequently in the population.) Edwards et al. (1988) screened 11,065 blood donors in presumed good health. Their calculations indicated that the frequency of fasting serum transferrin values greater than or equal to 62 percent was 0.008 in men and 0.003 in women. Based on HLA typing, the frequency of the homozygous condition was estimated at 0.0045.

Conceptual Model

Based on the review above, figure 6–5 presents a conceptual model which illustrates the relationships among dietary and other factors and iron status, as well as relevant sources of data from the NNMS. Components of the model that are most relevant to iron nutriture are highlighted by the shaded boxes; individual topics that appear in boldface type are those for which some data are available. Potential NNMS and related data sources are represented by the numbers that appear above or below the boxes; numbers that appear in boldface type represent those surveys or studies from which data relevant to assessment of iron nutriture were obtained.

Dietary iron intakes and factors affecting iron intake were measured in the NFCS 1977–78, CSFII 1985–86, and the HANES. In addition, the data from the NFCS 1977–78 have been used to assess the contribution of foods consumed together to the "absorbable iron" (Raper et al., 1984). Supplement intake was assessed in a variety of surveys, but quantitative estimates of intake are currently available only from the FDA Survey of Vitamin/Mineral Supplement Intake. The iron status indicators used in the various models for assessing iron deficiency were measured in NHANES II and HHANES; various factors that influence iron status have also been assessed. Data on hemoglobin or hematocrit status of low–income



National Nutrition Monitoring System and other data sources: 1 = CSFII 1985–86, 2 = NFCS 1977–78, 3 = U.S. Food Supply Series, 4 = National Nutrient Data Bank, 5 = NHANES I, 6 = NHANES II, 7 = HHANES, 8 = NHEFS, 9 = NHIS, 10 = FLAPS, 11 = Total Diet Study, 12 = Vit/Min, 13 = Health and Diet Study, 14 = PedNSS, 15 = PNSS, 16 = BRFSS, 17 = U.S. Vital Statistics, 18 = AEDS, 19 = NHES. See appendix III for definitions of acronyms. Shaded boxes highlight portions of the model discussed; an asterisk (*) indicates data and data sources considered in this chapter.

Figure 6–5. Conceptual model for the assessment of iron nutriture (see text for explanation)

children and pregnant women are collected in the CDC surveillance activities and permit some limited evaluation of trends in iron nutritional status. The NHEFS offers the possibility to examine the influence of iron nutritional status on subsequent health.

Estimates of Prevalence

Iron Deficiency

The prevalence of iron deficiency determined by the MCV model is presented for non-Hispanic persons aged 4–74 years, by sex, age, and race, from NHANES II in tables II-98 and II-99, and for the three ethnic groups from HHANES in tables II-94 and II-95 in appendix II. The results are summarized in figures 6-6, 6-7, and 6-8 for children aged 4–19 years, males aged 20–74 years, and females aged 20–74 years, respectively. Analyses by poverty status for non-Hispanic persons in NHANES II (tables II-100 and II-101) and Mexican Americans in HHANES (tables II-96 and II-97) are also presented (see discussion of poverty below in this chapter). Because these analyses do not include data for children under 4 years, results for younger children (1–4 years), based on

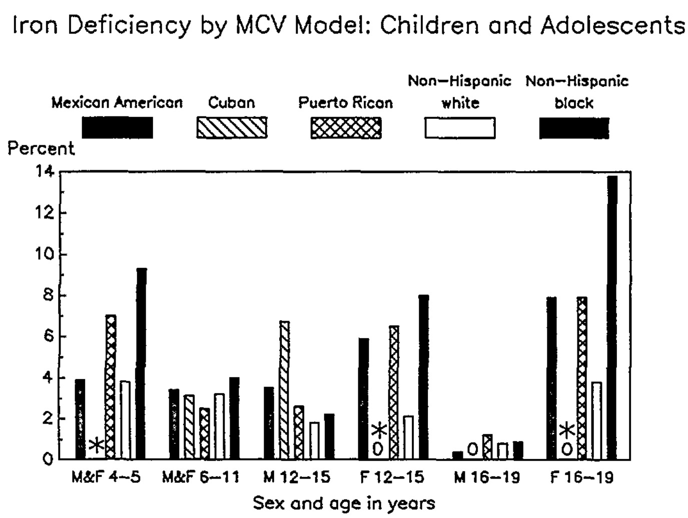


Figure 6-6. Prevalence of iron deficiency assessed by the MCV model in children and adolescents aged 4–19 years, by ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80 (A zero indicates a prevalence estimate of 0.0 percent; an asterisk indicates an unstable statistic or a statistic not reported because of small sample size.)

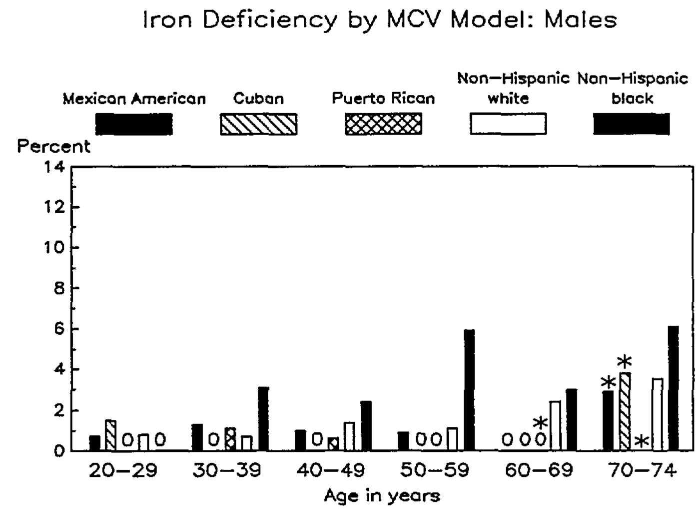


Figure 6-7. Prevalence of iron deficiency assessed by the MCV model in males aged 20–74 years, by ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80 (A zero indicates a prevalence estimate of 0.0 percent; an asterisk indicates an unstable statistic or a statistic not reported because of small sample size.)

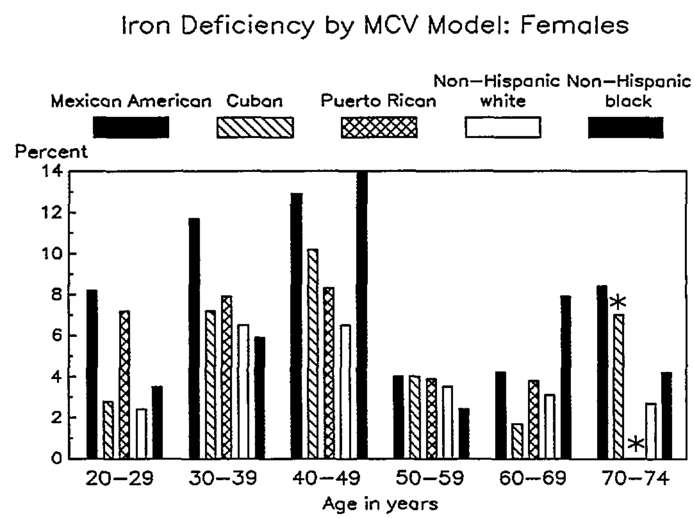


Figure 6-8. Prevalence of iron deficiency assessed by the MCV model in females aged 20–74 years, by ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80 (A zero indicates a prevalence estimate of 0.0 percent; an asterisk indicates an unstable statistic or a statistic not reported because of small sample size.)

analyses reported by the Expert Scientific Working Group (LSRO, 1984), are provided separately in iron table 1 following the references in this chapter.

Based on these data analyses, the major populations currently at risk are clearly delineated: infants, adolescents, and women during the childbearing years. Men, elderly persons of both sexes, and children between infancy and adolescence are much less likely to be iron deficient. The risk in HHANES Mexican Americans was similar to that in non-Hispanic whites in NHANES II, except that the prevalence in women of childbearing years was higher; this difference may be explained by increased parity among Mexican-American women. Among the age and sex groups at risk, there is as much as a threefold difference in the prevalence of iron deficiency according to poverty status. The overall prevalence of iron deficiency in the groups at greatest risk was lower than anticipated from earlier estimates based on different criteria. Nevertheless, iron deficiency remains the most common known nutritional deficiency in the United States.

Anemia

The prevalence of iron deficiency anemia in females, defined by low hemoglobin values plus evidence of impaired iron status based on the MCV model, is shown in table 6-4 (Looker et al., 1989); the prevalence of iron deficiency anemia in males was very low. Women in the age group 20-44 years were the only ones with relatively high prevalence estimates.

The prevalence of anemia from any cause (low hemoglobin values) for white persons in NHANES II and HHANES is reported in iron table 2 following the references at the end of this chapter (Looker, 1988). These analyses indicate that the prevalence of anemia was low in most groups. Hemoglobin criteria are given for whites only because of uncertainty about appropriate values for blacks. The mean hemoglobin concentration in blacks is lower than in whites, irrespective of iron status, probably because of a genetically determined difference in globin synthesis.

Table 6-4. Percent of females with iron deficiency anemia[1], by age and race or ethnic group: second National Health and Nutrition Examination Survey, 1976-80, and Hispanic Health and Nutrition Examination Survey, 1982-84 (Looker et al., 1989)

Age (years)	Population	n[2]	Percent	Standard error of the percent
11-14	Non-Hispanic white	110	0.2	0.24
	Mexican American	310	0.6	0.42
	Cuban	40	0*	0*
	Puerto Rican	124	2.7	1.41
15-19	Non-Hispanic white	197	0.8	0.50
	Mexican American	302	1.7	0.71
	Cuban	40	0*	0*
	Puerto Rican	152	2.9	1.31
20-44	Non-Hispanic white	618	1.5	0.25
	Mexican American	889	4.1	0.76
	Cuban	172	4.8	1.93
	Puerto Rican	363	2.8	1.08
45-64	Non-Hispanic white	460	1.0	0.31
	Mexican American	478	3.0	0.74
	Cuban	193	0	0
	Puerto Rican	242	1.8	0.76
65-74	Non-Hispanic white	339	0.7	0.27
	Mexican American	97	1.0	1.0
	Cuban	53	3.9	2.59
	Puerto Rican	48	0	0

[1] Iron deficiency anemia is defined as having two or three abnormal values for the indicators in the MCV model and a low hemoglobin value (see page 131 for criteria for cutoff values).
[2] Number of examined persons.
* Indicates statistic that may be unreliable due to sample size.

Data on the prevalence of anemia (low hemoglobin or low hematocrit) in low-income children from the PedNSS, 1973-88, are shown in figure 6-9. Interpretation of trends over time is complicated because the number of States participating has increased over time; thus, the base population has changed. To overcome this difficulty, Yip et al. (1987a) have analyzed data from 1975 to 1985 from six States in the PedNSS to assess trends in the prevalence of anemia (low hematocrit or hemoglobin values) in low-income children over time. The criteria for defining anemia in this study were lower than the usual CDC cutoffs for surveillance in order to exclude any doubtful cases of anemia. These data are shown in figure 6-10 and suggest a generalized improvement in child iron status as well as a positive impact of public health programs. The former suggestion is supported by the observation of a declining prevalence of anemia in a group of middle class children in Minneapolis (Yip et al., 1987b). Racial differences in the prevalence of anemia were also evident, with blacks showing the highest prevalence, Native Americans the lowest, and whites an intermediate level (the same criteria were used for all racial groups, probably resulting in overestimation of the prevalence of anemia in blacks).

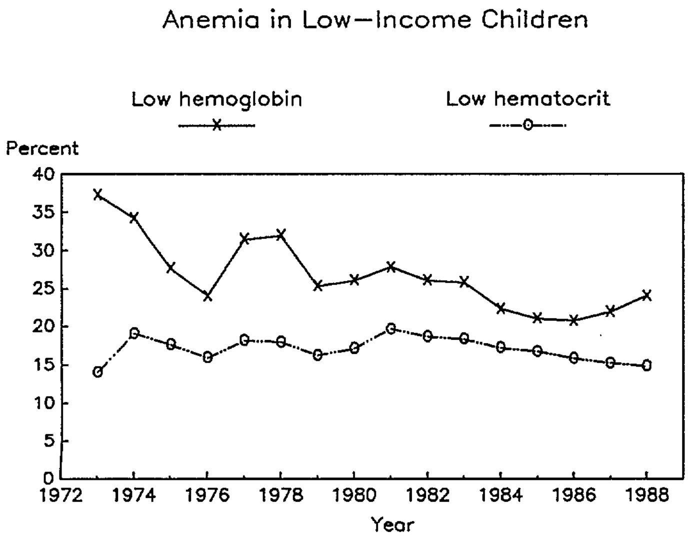


Figure 6-9. Prevalence of anemia (hemoglobin or hematocrit <5th percentile) in children 0-59 months: Pediatric Nutrition Surveillance System, 1973-88

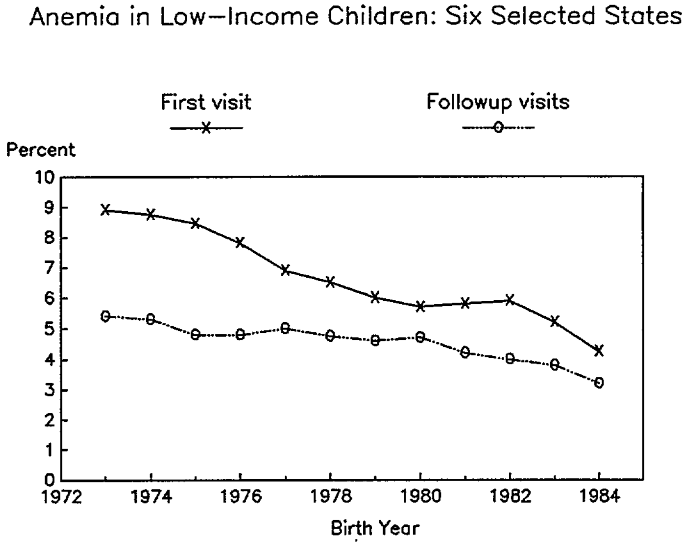


Figure 6-10. Prevalence of anemia in children 6-60 months for each birth-year cohort, six selected States: Pediatric Nutrition Surveillance System, 1973-84 (Yip et al., 1987a) (Top line represents the prevalence for children seen at initial visit to qualify for WIC program only; bottom line, prevalence for children covered by the WIC program seen at followup visits.)

Iron Overload

Only limited assessment of iron overload is possible with NNMS data. Among the 3,540 adults in NHANES II with serum ferritin values, 22 had elevated transferrin saturation and only 9 had both elevated transferrin saturation and serum ferritin values. Of these nine, only five had other biochemical measurements suggesting uncomplicated idiopathic hemochromatosis. Although the NHANES II was not designed to yield statistically reliable estimates of conditions which are expressed at such low frequency in the population, these values were not out of line with estimates of prevalence in the medical literature.

Dietary Factors and Supplement Intake

Iron Available in the Food Supply

The changes in the per capita iron content of the food supply over time are shown in figure II-37 in appendix II. Iron content was lower prior to the 1940s when enriched white flour was introduced and rose approximately 24 percent from 1935-39 through the early 1980s, with a further increase since 1982. The iron level achieved a peak in 1985 at 17 milligrams per capita per day. The recent upward trend in iron is the result of increased iron content for enriched flour concomitant with an increase in per capita use of flour and cereal products, especially fortified cereal products.

Food Sources of Iron Available in the Food Supply

The food sources of iron available in the food supply have also changed over time (see figure 6-11 for comparisons of 1909-13, 1970, and 1985), with a slight decrease in the percentage of iron contributed by meats since 1970 and an increase in the percentage contributed by grains. The primary reason for these recent changes was an increase in the standard used for enrichment of white flour in 1983, coupled with an increase in the use of flour and cereal.

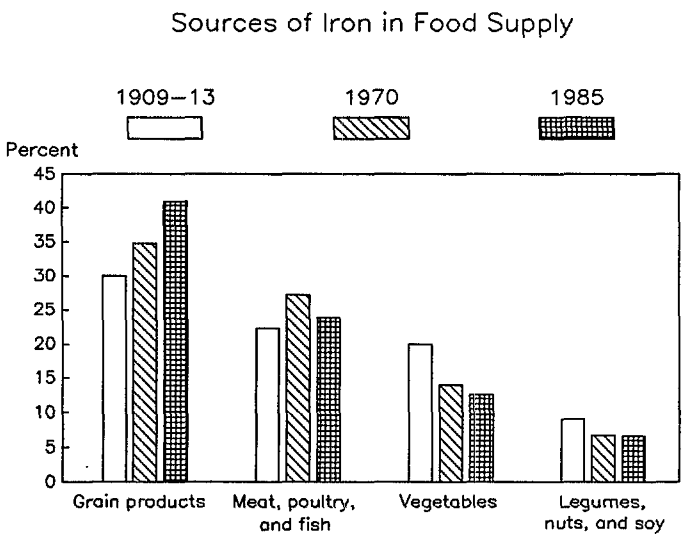


Figure 6-11. Major food sources of iron in the food supply: U.S. Food Supply Series, 1909-13, 1970, and 1985

Iron Content of Typical U.S. Diets

Data from the FDA Total Diet Study (Pennington et al., 1984) indicate that the analyzed mean content of iron in typical U.S. diets changed little in the period 1974-82 for adult male, toddler, and infant diets (table 6-5). The measured iron contents of the adult male and toddler diets agreed well with the calculated dietary iron intakes from the NFCS 1977-78 and NHANES II (this finding is reassuring because the foods collected for the Total Diet Study were based on the foods most commonly reported in the NFCS 1977-78). However, the measured iron content of the infant diet (based on 1965 food consumption data) was lower than dietary intake estimates from the two surveys and the level over time does not reflect changes known to have occurred in infant diets. A possible contribution to this discrepancy was that the infant formula collected for the infant total

Table 6-5. Iron levels of adult male, infant, and toddler diets: Food and Drug Administration Total Diet Study, 1974-81/82 (Pennington et al., 1984)

Diet and year	Number of collections	Mean[1] (mg/day)	Standard deviation
Adult diets[2]			
1974	30	20.0[ab]	3.0
1975	20	18.0[b]	3.1
1976	20	18.2[ab]	5.9
1977	25	18.3[ab]	5.8
1978	20	17.9[b]	4.1
1979	20	18.3[ab]	4.2
1980	20	21.0[a]	5.1
1981/82	27	18.4[ab]	3.2
Infant diets[3]			
1975	10	7.4[a]	5.7
1976	10	7.3[a]	4.0
1977	12	6.8[a]	3.6
1978	10	4.7[a]	2.1
1979	10	9.6[a]	10.3
1980	10	10.2[a]	4.8
1981/82	13	9.5[a]	6.3
Toddler diets[4]			
1975	10	11.1[a]	3.8
1976	10	10.1[a]	3.2
1977	12	8.5[a]	2.6
1978	10	7.7[a]	2.3
1979	10	11.9[a]	11.5
1980	10	9.1[a]	2.0
1981/82	13	9.0[a]	1.7

[1] Mean values within each diet category with the same superscript are not significantly different.

[2] Adult diets are based on 2,850 kilocalories per day.

[3] Infant (6 months) diets are based on 880 kilocalories per day.

[4] Toddler (2 years) diets are based on 1,300 kilocalories per day.

diet was not specified to be iron fortified. The use of iron-fortified formula has increased in the last 20 years (Martinez and Ryan, 1985) The major source of iron in all diets was grain and cereal products (contributing 52, 54, and 48 percent of the iron in the adult male, infant, and toddler diets, respectively).

Mean Dietary Iron Intakes Among Age and Sex Groups

Mean dietary iron intakes by age and sex, based on 1-day data from NHANES I, NFCS 1977-78, NHANES II, and CSFII 1985-86 are shown in table II-93 in appendix II. These values are remarkably similar over time, with the exception of a slight increase in intake in the youngest children. This observation is not unexpected based on market changes in infant formula (infants are now fed more iron-fortified formulas than previously). In fact, this change would be expected to have a greater impact in younger infants (not included in the table), especially those less than 9 months old.

The trends in individual intakes do not seem to reflect the recent increase in the iron content of the food supply. Methodological differences in the food consumption surveys may contribute to this finding. Perloff (1988) has examined the impact of differences in composition databases for iron in the NFCS 1977-78 and the CSFII 1985-86 on the iron intake of women. The analyses indicated an increase due to product changes (increased fortification) and a decrease due to data changes (revised values for some meats), with little net change.

Estimates of the mean dietary iron intakes of women and children, based on 4-day CSFII data are shown in tables II-89 through II-92. For women aged 20-49 years, mean dietary iron intake was 10.1 milligrams per day. Mean intake did not differ greatly with age, but did vary by race, poverty status, and education level. Black women had intakes 11 percent lower than white women and 15 percent lower than women of other races, women below poverty had intakes 8 percent lower than women above poverty, and women with less than a high school education had intakes 18 percent lower than those with more than a high school education. The intake of iron per 1,000 kilocalories did not differ by socioeconomic status. Using a logistic regression analysis with these data, Moshfegh (1988) found that the following factors were significantly associated with high iron intake (intake in the highest tertile):

- Being a race other than white or black.
- Living alone.
- Living with a male.
- Being a former smoker.
- Having no days of less than usual intake.
- Being pregnant.

The mean dietary iron intake of children aged 1-5 years was 9.8 milligrams per day; older children (3-5 years) had higher intakes than younger ones (1-2 years). Poverty status and education of the mother did not have notable effects on the children's intakes.

Relationship of Iron Deficiency and Iron Intake

More than 95 percent of the women in the most recent dietary survey (CSFII 1985-86) had iron intakes below the RDA and about half of women in childbearing years had intakes below estimated mean requirements[1]. This finding would suggest that a very large number of women might be iron deficient, yet only about 5 percent had biochemical evidence of deficient iron status in the NHANES II. Even allowing for substantial underreporting of intakes, this observation suggests that in women with decreased iron stores, homeostatic mechanisms that promote the increased absorption of dietary iron are very effective in preventing iron deficiency. These findings also suggest that the RDA may be overly generous.

Mean intakes of iron by young children with and without iron deficiency determined by the MCV model in NHANES II are shown in table 6-6. Intakes

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1 Mean iron requirements for women during the childbearing years can be estimated as follows: (1) Basal iron losses average 0.9 milligram per day corrected for smaller body surface area in women, and based on the value of 1.0 milligram per day reported from experiments in men (Green et al., 1968). (2) Menstrual iron losses average 0.5 milligram per day (Hallberg et al., 1966). (3) Total iron losses average 1.4 milligrams per day (0.9 plus 0.5). (4) Absorbed iron has to equal 1.4 milligrams per day to balance total iron losses. (5) An assumed iron absorption of 12.5 percent is proposed in the draft of the 10th edition of the *Recommended Dietary Allowances*. The figure of 12.5 percent is midway between the values of 15 and 10 percent which were suggested by Monsen et al. (1978) for diets characterized by good and moderately good bioavailability of iron, respectively. The value seems appropriate because intakes of protein and ascorbic acid, which enhance iron absorption, are relatively high in U.S. diets. (6) Dietary iron has to average 11 milligrams per day in order to yield 1.4 milligrams iron absorbed, assuming 12.5 percent iron absorption.

Table 6–6. Dietary iron intake (milligrams per day) for non–Hispanic children aged 1–5 years, by iron status determined by the MCV model: second National Health and Nutrition Examination Survey, 1976–80

	Iron status					
	Deficient			Not deficient		
Age (years)	n[1]	Mean	Standard error of mean	n[1]	Mean	Standard error of mean
1–2	46	7.5	0.49	434	9.1	0.24
3–5	70	9.5	0.36	1,313	10.2	0.10

[1] Number of examined persons. Children with blood collected by finger stick were excluded. Data were combined for all race and sex groups.

were slightly higher in the children aged 1–2 years without iron deficiency than in those with poorer status. An earlier study of the association of dietary iron and iron deficiency with NHANES I data (NCHS, 1982) had found no association between dietary intake and status except in the youngest children, probably because of the large contribution of intra-individual variation to the dietary intake data, which were based on a single day's recall. It may be hypothesized that the dietary intakes of infants and young children vary less from day to day than those of older individuals, so that the single 24–hour recall used in the HANES may provide a relatively good estimate of usual intake for the youngest children.

Food Combinations

Using the model developed by Monsen et al. (1978), Raper et al. (1984) calculated bioavailable iron intake in the NFCS 1977–78. For each eating occasion (foods consumed within 60 minutes), total iron, heme iron, nonheme iron, and the enhancing factors, ascorbic acid and meat, poultry, or fish were calculated. Then, for each eating occasion, available heme and nonheme iron were calculated using a factor of 23 percent for heme iron and factors of 3–8 percent (based on logarithmic function with enhancing factors) for nonheme iron. Finally, the available heme iron and nonheme iron were summed to yield an estimate of total available iron. Results of these calculations are shown in tables 6–7 and 6–8; available iron intakes also appeared low in relation to requirements. This approach has promise in providing information about dietary iron adequacy, but needs to be tested to determine whether available iron intake correlates better with iron nutritional status than does total iron intake.

Table 6–7. Total, nonheme, and heme iron intakes of persons, by sex and age, 1 day: Nationwide Food Consumption Survey 1977–78 (Raper et al., 1984)

		Dietary iron intake		
Sex and age (years)	n	Total iron (mg)	Nonheme iron (percent)[1]	Heme iron (percent)[1]
Males and females				
1–2	268	7.7	94	6
3–5	437	9.2	94	6
6–8	469	10.7	92	8
Males				
9–11	216	12.7	91	8
12–14	313	15.0	92	8
15–18	400	16.7	90	10
19–22	287	15.1	89	12
23–34	770	14.8	90	11
35–50	784	14.5	90	11
51–64	634	14.0	89	11
65–74	295	13.9	91	9
75 and over	128	12.2	91	8
Females				
9–11	241	11.6	92	8
12–14	309	11.0	91	9
15–18	402	10.7	92	9
19–22	337	10.7	90	10
23–34	949	9.9	90	10
35–50	942	9.9	90	10
51–64	792	10.4	90	10
65–74	377	9.9	92	9
75 and over	197	9.9	93	7

[1] Components may not add to 100 percent due to rounding.

Table 6-8. Available iron intakes for persons, by sex and age, 1 day: Nationwide Food Consumption Survey 1977-78 (Raper et al., 1984)

Sex and age (years)	Available iron (mg)	Available iron (percent of total)
Males and females		
1-2	0.50	6.5
3-5	0.64	7.0
6-8	0.80	7.5
Males		
9-11	0.96	7.6
12-14	1.17	7.8
15-18	1.39	8.3
19-22	1.32	8.7
23-34	1.28	8.6
35-50	1.25	8.6
51-64	1.19	8.5
65-74	1.13	8.1
75 and over	0.95	7.8
Females		
9-11	0.86	7.4
12-14	0.86	7.8
15-18	0.86	8.0
19-22	0.83	8.2
23-34	0.80	8.1
35-50	0.81	8.2
51-64	0.85	8.2
65-74	0.79	8.0
75 and over	0.73	7.4

Heme and nonheme iron intakes for the women and children in CSFII 1985-86 have also been determined. Heme iron, which is best absorbed, comprises only 8 and 5 percent of the total iron intake of women and children, respectively.

Use of Supplements: Iron and Ascorbate

Information on iron and ascorbate use by age and sex from the FDA Vitamin/Mineral Supplement Intake Survey is provided in appendix II, tables II-132 and II-133. Twenty-two percent of the adult population surveyed consumed iron supplements and more than half of all supplement users consumed iron; use was highest in women aged 16-64 years. The majority of supplement users (approximately 90 percent) also consumed ascorbic acid.

Dietary iron intake and iron status of vitamin/mineral supplement users in NHANES II have been examined by Looker et al. (1987, 1988). The type and amount of the supplement(s) used were not specified. Supplement users aged 1-19 years consumed more ascorbic acid and more fruits and vegetables than nonusers, but values for iron status measures were not consistently associated with supplement use. The same was true for persons aged 20-74 years, with the exception that several values for iron status indicators were higher for users than for nonusers in the age group 65-74 years. Prevalences of "impaired iron status" or iron deficiency determined by the MCV model did not differ by supplement use. Possibly, these findings are explained by the fact that supplement use is highest among groups with higher socioeconomic status whose risk for iron deficiency is low.

Iron Fortification of Foods

Changes in the type of iron compounds used for fortification, as assessed by National Academy of Sciences' surveys of industry use (poundage) of Generally Recognized as Safe (GRAS) substances, suggest increased use of forms that are more bioavailable (Committee on GRAS List Survey [Phase III], 1979; Subcommittee on Review of GRAS List [Phase II], 1972).

The contribution of enriched and fortified grain products to iron intake of individuals was assessed in the NFCS 1977-78 (Cook and Welsh, 1986) and was found to be substantial. These sources of added iron provided 20 percent of the total dietary iron.

There has also been an increase in the proportion of infant formula that is iron fortified, and the feeding of cow milk to infants has decreased (Martinez and Ryan, 1985). These factors seem to have contributed to improved iron nutritional status in infants, in addition to the increased rates of breastfeeding. Because of the limited current information available for young infants, these recent trends are not readily apparent in the NNMS data.

Nondietary Factors

Poverty

Differences in the prevalence of iron deficiency in women of childbearing age by poverty status are presented in figure 6-12 (see also tables II-96, II-97, II-100, and II-101 in appendix II for other groups). Results in figure 6-12 indicate a consistent trend for a higher prevalence of iron deficiency in women below poverty than in those above poverty, even though all differences between the groups were not great. The effects of poverty on iron intake are shown in tables II-89 through II-92 for women and children in the CSFII 1985-86. For women of childbearing years above and below poverty, mean intakes of iron differ by about 0.8 milligram per day but the iron density of the diet is the same. Women aged 19-50 years in the low-income CSFII 1985 had a mean iron intake (based on 4-day data) of 9.6 milligrams per day, which was slightly lower than the mean for women in the all-income portion of the survey (10.1 milligrams per day) (USDA, 1987, 1988). Older women (35-50 years) in the low-income survey had lower iron intakes than younger women (8.6 and 10.1 milligrams per day, respectively) (USDA, 1988). Intake was slightly higher (9.7 milligrams per day) for women in households participating in the Food Stamp Program than for those in nonparticipating households (9.4 milligrams per day). These findings support concerns expressed in *The Surgeon General's Report on Nutrition and Health* about iron intake in low-income groups.

Education

The prevalence of iron deficiency in adults by level of education, based on data from NHANES II, is shown in figure 6-13. The intake of iron by adults by level of education, based on CSFII 1985-86 data, is shown in tables II-89 and II-90 in appendix II. Status and intake improve with increased education. The difference in dietary intake by education level disappeared in multivariable analysis when other factors were controlled for (Moshfegh, 1988). If race and income had not been controlled for, education might have been found to have a significant effect (Moshfegh, 1988).

Parity

The prevalence of impaired iron status by level of parity in women of childbearing years is presented in figure 6-14, based on data from NHANES II and HHANES. These results generally indicate that greater parity is associated with poorer iron status. However, differences in parity do not fully explain differences in iron status among the different ethnic groups of women during childbearing years.

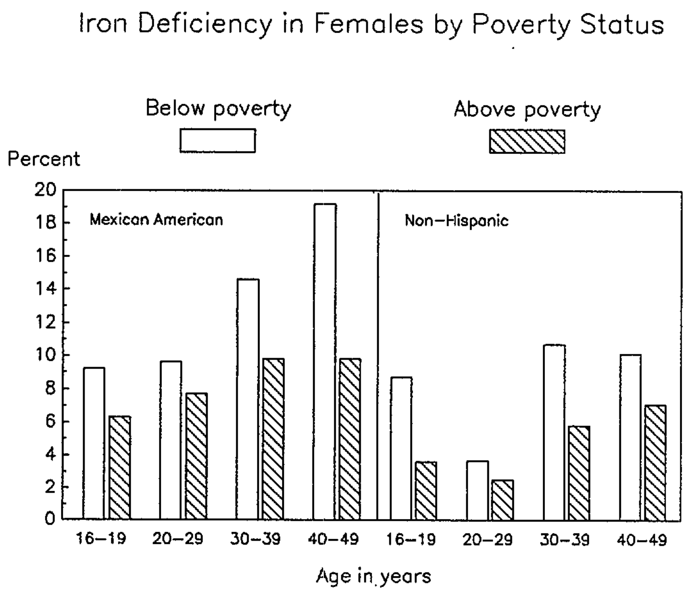

Figure 6-12. Percent of Mexican-American and non-Hispanic women aged 16-49 years with iron deficiency assessed by the MCV model, by poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84, and second National Health and Nutrition Examination Survey, 1976-80

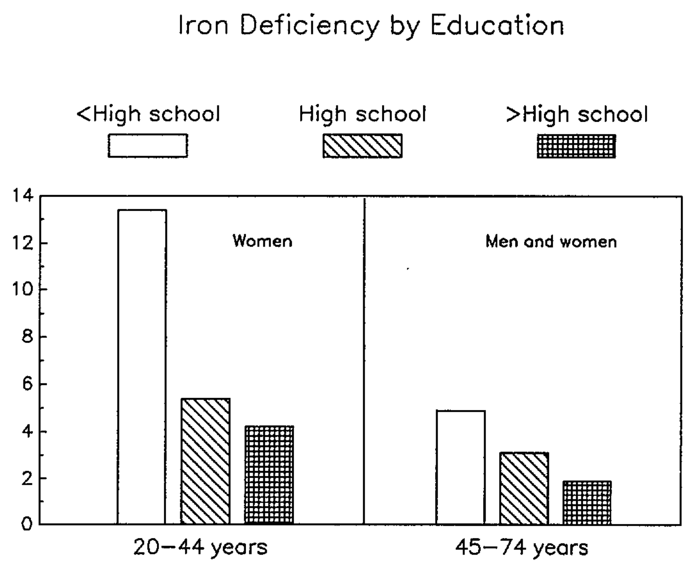

Figure 6-13. Percent of women aged 20-44 years and men and women aged 45-74 years with iron deficiency assessed by the MCV model, by level of education: second National Health and Nutrition Examination Survey, 1976-80

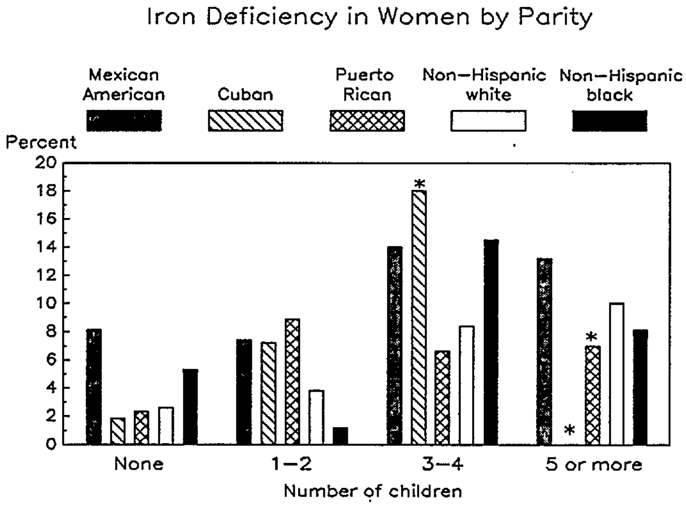

Figure 6–14. Percent of women aged 20–44 years with iron deficiency assessed by the MCV model, by parity and ethnic group or race: Hispanic Health and Nutrition Examination Survey, 1982–84, and second National Health and Nutrition Examination Survey, 1976–80 (An asterisk indicates an unstable statistic or a statistic not reported because of small sample size.)

Pregnancy

Data on iron status in various stages of pregnancy are not available in the NNMS for a nationally representative sample because of the small number of pregnant women sampled in such surveys. For women in all stages of pregnancy, the prevalence of iron deficiency according to the MCV model was 10.7 percent in NHANES II (LSRO, 1984). Data on the prevalence of low hemoglobin and hematocrit in low–income pregnant women, by trimester, from the PNSS are shown in table 6–9. The data (see also chapter 4) indicated that the prevalence of low hematocrit in these low–income women was highest in the third trimester and was higher in blacks than in any other race or ethnic group. The same hemoglobin criteria were used for blacks and whites; thus, this finding should be interpreted with caution. Studies from the medical literature show that the mean hemoglobin concentration in unsupplemented women drops below that of iron–supplemented women during the second and third trimesters. In an analysis of CSFII 1985–86 data, pregnancy was found to be associated with higher iron intakes (Moshfegh, 1988). Mean dietary intakes were 2 milligrams per day higher in pregnant women than in nonpregnant women (Krebs–Smith, 1988).

Growth in Children

Rapid growth in individuals would be anticipated to increase iron requirements and, consequently, the risk of developing iron deficiency. Data from the NNMS are not available to assess the effect of growth in children on iron status; longitudinal studies would be required. However, the relatively high prevalence of iron deficiency seen in the NHANES II data for young children and young adolescents (LSRO, 1984) is suggestive of the increased demands on iron stores during these periods of rapid growth.

Blood Loss

Studies of blood donors suggest that women who donate more than three times per year and men who donate more than five times per year are at high risk of developing iron deficiency. Data from the NNMS are not available regarding blood donation. High menstrual blood losses are responsible for much of the iron deficiency in young women; collection of information on menstrual blood loss by self report is not reliable; other measures are not feasible in field surveys.

Table 6–9. The prevalence of low hemoglobin and/or low hematocrit in low–income pregnant women at initial visits: Pregnancy Nutrition Surveillance System, 1987

Trimester	Low hemoglobin		Low hematocrit		Low hemoglobin or low hematocrit	
	n	Percent	n	Percent	n	Percent
First	5,344	6.2	9,917	5.3	15,261	5.6
Second	14,055	9.2	22,372	10.2	36,367	9.9
Third	10,414	26.7	15,729	26.8	26,143	26.8

Use of Medications

Gable et al. (1987) found no relation of iron status to use of aspirin in NHANES II, but did find a positive association with use of oral contraceptives.

Major Limits to Interpretation of Data and Gaps in the Database

- Information about selected groups at risk of iron deficiency, pregnant women and infants under age 1 year, is inadequate. In pregnant women, anemia is associated with increased neonatal mortality and a higher prevalence of low birth weight. Iron deficiency during the brief period of infancy is believed to lead to long-term harmful consequences in regard to subsequent development. In both groups, dietary practices differ from other age and sex groups. In both of these groups, dietary intake and use of supplements over a period of 6 to 9 months determine the risk of iron deficiency. These groups require longitudinal assessment over at least 6 months for an adequate assessment of their nutritional status because iron status changes rapidly over a period of a few months.

- The combination of foods eaten at each meal is the most important determinant of iron absorption. Such information is even more important than the amount of iron consumed and has only been analyzed on a very limited scale. Improvements in the ability to provide such analyses should be incorporated into the NNMS.

- Distinguishing iron deficiency from mild inflammatory conditions is difficult because laboratory measurements in mild inflammatory conditions or following infections may mimic iron deficiency, thereby suggesting a higher than actual prevalence. This problem, which is greatest among the elderly, may be alleviated by using the four-variable model (see table 6-3) and laboratory tests that reflect the presence of inflammation.

- Criteria for anemia in blacks are uncertain. Blacks have lower hemoglobin concentrations than whites irrespective of iron status. These lower concentrations lead to misleadingly higher prevalences of anemia among blacks if uniform criteria for low hemoglobin values are used for all races. This problem can be circumvented by using the three- or four-variable models for iron deficiency (that do not include hemoglobin as a variable) and by using laboratory tests that reflect the presence of inflammatory disease (C-reactive protein).

- No information on blood donation has been collected in the NNMS. (Information on the number of donations in the last 12 months and the time of most recent donation is being collected in NHANES III.)

- More detailed information is needed on the type and amount of supplement intake. Total iron intake could not be determined because quantitative estimates of iron intake from supplements were not available from any of the surveys in which estimates of intake from food were made.

Conclusions

Based on the analyses in this chapter, the EPONM drew the following conclusions about assessment of iron nutriture in the United States using NNMS data:

Populations at Risk

- The variety of biochemical and hematological measures of iron nutritional status collected in the NNMS permits estimation of the prevalence of iron deficiency and iron deficiency anemia in the U.S. population and some characterization of population groups at risk of iron deficiency.

- The prevalence of iron deficiency anemia (based on findings of low hemoglobin levels plus evidence of iron deficiency) in NHANES II and HHANES is low (less than 5 percent); however, the prevalence of iron deficiency without anemia is still appreciable (up to 14 percent) in several groups.

- Groups at greatest risk of iron deficiency, as indicated by the data from the NNMS, are young children, adolescents, and women of childbearing age.

- Pregnant women and infants under 1 year of age are risk groups not well covered in current nationally representative surveys. CDC surveillance data indicate that low-income pregnant women are at high risk of anemia.

- Dietary iron intake, assessed in the CSFII 1985-86, is very low in women of childbearing years relative to recommended levels. Available iron intake, determined using data from the NFCS 1977-78, is also low for women relative to apparent requirements. The intake estimates do not include the contribution from iron supplements.

- In contrast to iron deficiency, iron overload cannot be assessed adequately with current NNMS data to identify groups at risk. The prevalence of hemochromatosis is too low to be estimated reliably by available surveys.

Trends

- The best trend data available are those on the nutrient content of the U.S. food supply, which indicate an increase in the level of iron in recent years.

- Assessing trends in individual intake of iron by various population groups is more difficult because of methodological differences in the surveys over time, including revised nutrient composition data. The available NNMS data indicate little change during the last 20 years.

- Assessing trends in iron nutritional status is also difficult, because the measures used to estimate the prevalence of iron deficiency have not been used in many surveys. Limited data from the PedNSS suggest recent improvements iron status among low-income children aged 1–5 years.

Determining Factors

- Sex and age are powerful determining factors relative to iron nutritional status. Evidence of iron deficiency is rare in males, in the elderly of both sexes, and in school children.

- Univariate analyses of NNMS data indicate that the prevalence of iron deficiency is influenced by race and socioeconomic factors such as poverty status and education. Iron intake also differs with these variables, but not as consistently as iron status, suggesting differences in bioavailable iron.

- Parity is also observed in NNMS data to be an influence on iron status in women during childbearing years; women who have given birth to many children are at greater risk of deficiency.

- Other determining factors, such as iron supplement use, blood donation, use of medications, and growth, could not be assessed with current data from the NNMS.

Future Concerns and Recommendations

Based on their review, the EPONM identified the following needs:

- Dietary intake data for multiple days for the same persons for whom biochemical data are obtained to better assess iron adequacy and the appropriateness of estimated requirements. Such data will facilitate estimates of the range of usual intakes in subgroups of the population.

- Adjustment of iron intake data for differences in iron absorption from different types of meals. The usefulness of such calculations in relation to iron status, as indicated by the biochemical data, should be tested.

- Special surveys to monitor longitudinally two high-risk groups that are presently not adequately covered by the NNMS: infants and pregnant women. Even if larger numbers were included in existing cross-sectional surveys, assessments would still be limited because of the rapid changes occurring in these two groups over a short time.

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Iron Table 1. Prevalence of iron deficiency determined by the MCV model in children aged 1–4 years, by age, race, and poverty status: second National Health and Nutrition Examination Survey, 1976–80 (LSRO, 1984)

Race/ poverty status	Age (years)	n	Percent	Standard error of the percent
All races	1–2	542	9.4	1.4
	3–4	989	3.9	0.7
White	1–2	434	8.4	1.5
	3–4	803	3.2	0.6
Black	1–2	89	10.9	3.0
	3–4	157	8.5	1.9
Above poverty	1–2	409	6.7	1.2
	3–4	720	2.5	0.6
Below poverty	1–2	121	20.6	4.1
	3–4	241	9.7	2.1

Iron Table 2. Percent of persons with anemia (hemoglobin below age-specific cutoffs[1]), by age, sex, and race or ethnic group: second National Health and Nutrition Examination Survey, 1976–80, and Hispanic Health and Nutrition Examination Survey, 1982–84 (Looker et al., 1989)

Sex and age (years)	Ethnic group	n[2]	Percent	Standard error of the percent
Males and females				
5–10	Non–Hispanic white	1,299	2.4	0.51
	Mexican American	862	0.7	0.25
	Cuban	79	0	0
	Puerto Rican	271	1.5	0.70
Males				
11–14	Non–Hispanic white	443	1.9	0.49
	Mexican American	335	0.5	0.37
	Cuban	47	0	0
	Puerto Rican	121	2.1	1.25
15–19	Non–Hispanic white	626	2.1	0.57
	Mexican American	264	1.4	0.77
	Cuban	54	0	0
	Puerto Rican	161	3.7	1.46
20–44	Non–Hispanic white	1,934	2.2	0.46
	Mexican American	747	1.1	0.50
	Cuban	130	0.6	0.87
	Puerto Rican	205	2.2	1.33
45–64	Non–Hispanic white	1,561	3.4	0.56
	Mexican American	367	2.2	0.75
	Cuban	174	1.8	0.98
	Puerto Rican	163	7.3	1.89
65–74	Non–Hispanic white	969	3.8	0.71
	Mexican American	66	1.6	1.73
	Cuban	38	0*	0*
	Puerto Rican	21	**	**

See footnotes at end of table.

Iron Table 2. Percent of persons with anemia (hemoglobin below age-specific cutoffs[1]), by age, sex, and race or ethnic group: second National Health and Nutrition Examination Survey, 1976-80, and Hispanic Health and Nutrition Examination Survey, 1982-84--continued (Looker et al., 1989)

Sex and age (years)	Ethnic group	n[2]	Percent[3]	Standard error of the percent
Females				
11-14	Non-Hispanic white	415	3.4	1.02
	Mexican American	310	1.9	0.72
	Cuban	40	0*	0*
	Puerto Rican	124	5.4	1.95
15-19	Non-Hispanic white	552	3.1	0.98
	Mexican American	302	4.0	1.09
	Cuban	40	0*	0*
	Puerto Rican	152	5.3	1.75
20-44	Non-Hispanic white	2,012	4.4	0.58
	Mexican American	889	7.9	1.03
	Cuban	172	5.9	2.14
	Puerto Rican	363	7.6	1.74
45-64	Non-Hispanic white	1,668	3.7	0.56
	Mexican American	478	4.8	0.92
	Cuban	193	0	0
	Puerto Rican	242	4.9	1.23
65-74	Non-Hispanic white	1,152	3.3	0.76
	Mexican American	97	3.7	1.95
	Cuban	53	5.9	3.17
	Puerto Rican	48	5.9	3.07

[1] See page 134 for criteria for low hemoglobin.

[2] Number of examined persons.

[3] Pregnant women were excluded.

* Indicates statistic that may be unreliable due to sample size.
**Statistic not reported due to inadequate sample size.

Chapter 7

Recommendations

The EPONM was charged to recommend ways to strengthen the NNMS based on experiences involved in reviewing data analyses for this report. In deciding how to frame their recommendations, the EPONM reviewed the recommendations for improving the collection, dissemination, and usefulness of NNMS data offered by the JNMEC (DHHS/USDA, 1986) and the Coordinating Committee on Evaluation of Food Consumption Surveys (National Research Council, 1984). The EPONM finds that the conclusions of these groups, which dealt mainly with the HANES and NFCS, remain timely and of continued importance. In recently completed surveys (NFCS 1987–88) and in surveys currently in the field (NHANES III, CSFII 1989), progress has been made in implementing some of these recommendations, but most of the suggested changes were not reflected in the data available to the EPONM. In addition, both the USDA and DHHS have developed plans for survey activities, to a large extent, through 1995; thus, recommendations offered now may not be implemented for some time. As a result of this Panel's deliberations, we wish to emphasize the following general areas: comparability and compatibility among components of the NNMS; needs for data collection, analysis, and dissemination; and future reports on the NNMS. (Specific recommendations related to dietary and nutritional status in cardiovascular disease and to the assessment of iron nutriture are included in chapters 5 and 6, respectively.)

Comparability and Compatibility Among Components of the NNMS

The EPONM's objective of integrating data from the NNMS survey and surveillance activities was constrained because of differences among the various data-collecting activities. The different programmatic obligations and logistical requirements of the Agencies make it impractical to suggest that data collection methodologies should be identical in all survey and surveillance activities. They do not, however, preclude more serious efforts to improve the comparability of data. Because the EPONM was not informed about the details of content and methodology in the current and planned surveys, it is difficult to be specific in recommending many changes to improve comparability, but some particular concerns and suggestions arising from experiences in preparing this report are discussed below.

In the past, USDA and NCHS developed the nutrient composition databases for the NFCS and HANES independently. Because of this and other methodological differences, it has been impossible to determine the reason(s) for differences in nutrient intake between surveys conducted at the same time. The situation changed with the CSFII 1985–86 and HHANES; in fact, the most recent NFCS 1987–88 and the current CSFII 1989 and NHANES III all use the same food codes, descriptors, and nutrient composition data. However, there are still differences as to whether various food mixtures (such as casseroles) are coded as standard recipes or as separate ingredients reported by the respondents. Such differences in coding may introduce discrepancies in apparent nutrient intakes (especially for type of fat and amount of sodium) that may or may not be related to real differences in nutrient intakes. The Panel favors introducing greater similarity in data collection methods. As long as methods differ, questions will continue to arise about the comparability of data. In such cases, studies evaluating the effects of methodological differences on the data gathered should be conducted jointly by USDA and NCHS. If the goal of greater integration of the components of the NNMS is to be achieved, resources must be allocated to the conduct of such studies and the results should be made readily available to the community of data users.

The same situation is true for changes in methodology within surveys over time. Information is needed on the impact of any such changes, which are instituted to improve the accuracy or efficiency of data collection, on the resultant data. For example, comparison studies are usually conducted when new analytical methods are introduced for blood chemistry measurements in the HANES. The analyses performed by Perloff (1988a,b) on the impact of changes in the nutrient database between the NFCS 1977–78 and the CSFII 1985–86 and the ongoing USDA 1988 Bridging Survey evaluating methodology changes between the NFCS 1977–78 and the NFCS 1987–88 also represent the types of studies needed if the NNMS is to achieve one of its important objectives of assessing changes in diet and nutritional status over time. Results of these studies should be made more readily available to data users.

The Panel recommends introduction of a common core of sociodemographic descriptors in all NNMS surveys to enhance the capacity to establish linkages among surveys (USDA and NCHS currently use many common descriptors). For example, if groups could be characterized by age, race, income, and education on the basis of the same descriptors, knowledge and attitudes of specified groups assessed in the BRFSS or the Health and Diet Study could be related ecologically to dietary intakes of the groups in the NFCS characterized in the same fashion. With improved capability for linking survey results, the need to add additional measures to individual surveys could be reduced.

The Panel also noted that the capability of more thorough and complete comparisons from various components of the NNMS would be enhanced if there were greater similarities in data reporting from various Agencies, for example, using the same age groups. The Panel recommends that the Agencies coordinate data reporting to the extent possible.

Needs for Data Collection, Analysis, and Dissemination

Coverage of Groups Currently Excluded

The sampling plans of many NNMS surveys necessarily exclude some groups of the population. Nationally representative samples of the civilian noninstitutionalized population exclude military personnel, persons living in institutions such as prisons and long-term care facilities, Native Americans living on reservations, and persons without fixed addresses (migrant workers and the homeless). Conclusions of the EPONM about the rarity of nutritional deficiencies in the United States were made cautiously because of the exclusion of some groups suspected to be at higher risk of being malnourished (notably the homeless and the institutionalized elderly). Assessments of at least some of these excluded groups are necessary if statements about the nutritional status of the entire U.S. population are desired. Special-purpose surveys may be a more efficient mechanism for obtaining information about these groups than their inclusion in one of the existing surveys. Special methodologies will need to be developed for sampling (in the case of the homeless) and for collecting dietary intake and medical history information (from the mentally impaired elderly) in order to provide assessments for some of these groups.

Improved Coverage of Groups Currently Included

The EPONM noted limitations in the information available for several groups of particular interest surveyed in the NNMS. These included young infants, children, pregnant women, lactating women, and the elderly.

- Relatively small numbers of infants, pregnant women (including teenagers), and lactating women are included in the nationally representative samples of the entire population. Surveillance activities of the CDC that focus on women and children do not provide representative samples because they generally select only low-income subjects. Even if larger numbers of infants, pregnant women, and lactating women were included in existing cross-sectional surveys, assessments would still be limited because the rapid changes undergone by these groups require analyses by narrow age groups or short time periods (such as trimesters) for appropriate analysis of status. Infants double their body weights in the first 3–4 months of life and experience many changes in the types of foods consumed over a short period of time: breast milk or formula in the first 3 months, some solid foods introduced during months 3–6, and table food in months 6–12. They represent a group at high risk because of the potential that long-term adverse developmental consequences may be the result of undernutrition early in life. Similarly, pregnant women undergo many physiological changes in a short period of time and undernutrition during pregnancy can have a profound influence on the development of the fetus and the health of the pregnant woman, while nutritional requirements and status differ greatly by trimester. High nutritional requirements are also imposed by lactation. These considerations convinced some of the EPONM that longitudinal studies of nutritional status in representative samples of these groups would be useful and advisable. Other members of the EPONM believed that such studies were more appropriate in a clinical setting than in the surveys of the NNMS.

- The elderly are also a group that may be at risk of malnutrition because of physiological changes, physical or mental impairments, or social factors. This group has not been adequately represented in all NNMS surveys, little is known about how their nutritional requirements may differ from younger adults, and their numbers are increasing rapidly. There has been no upper age limit in most of the dietary surveys conducted by USDA. The CSFII 1985–86 included no adults older than 50 years, but the current and future CSFII will include persons of all ages. In the past, HANES excluded persons older than 74 years, but NHANES III has no upper age limit. Elderly persons should be sampled in sufficient numbers to permit assessment of subgroups, for example, "elderly" (65–74 years), "aged" (75–84 years), and "very old" (85 years and over).

- Children aged 1–5 years also represent a group vulnerable to malnutrition and disorders related to diet and nutrition, such as dental caries and lead poisoning. One particular concern of the EPONM with respect to this group was the validity of proxy reports on dietary intake, especially in the case of parents reporting the intakes of children in day care or in school. Efforts should be made to test the validity of such reports or to find alternatives for obtaining intake information.

- Some members of the EPONM concluded that adolescents also represent a group at nutritional risk. Some of the factors related to concern about this group are the different levels of maturation, the nutritional requirements of the adolescent growth spurt, the frequency of eating away from home, the prevalence of dieting and eating disorders, and the nutritional demands of teenage pregnancy.

Dietary Data in the HANES

One–day dietary data, such as those collected in the HANES, do not provide information on the distribution of usual intakes; thus, a meaningful assessment of the cross–sectional association of dietary intake and health status cannot be made. Increasing the number of days of data collection would permit some assessment of intraindividual variation in intake and improve estimates of usual intake. Limitations would still exist in examining cross–sectional associations of diet and health status (see chapter 5); however, improved dietary intake data would be very helpful for planned followup studies of HANES populations.

Knowledge and Attitudes

Some members of the Panel recommended that questions on dietary and nutrition knowledge and attitudes be included in surveys that estimate usual dietary intake or dietary pattern. In the data available for this report, the EPONM found little information relating knowledge and attitudes to practices.

Vitamin and Mineral Supplements

The Panel could not evaluate total nutrient intake using the available data – none of the available surveys that assess nutrient intake from food include quantitative estimates of nutrient intake from supplements. The ability to examine excessive intakes, and possibly to assess consequences of nutrient toxicity, would be enhanced if such measures were included to provide more accurate assessments of total levels of nutrients consumed. Such information would also shed light on whether the dietary intakes of some nutrients are truly marginal.

Alcohol Consumption

Alcohol intake can influence dietary intake, nutritional status, and health status. The EPONM noted limitations in survey data on individual alcohol intake currently available. The HHANES included an extensive questionnaire on alcohol use, but data were not available to the Panel. The EPONM recommends that efforts be continued to improve the quantitative assessment of alcohol intake in NNMS surveys.

Nonresponse Analyses

In its analyses of the available data, the EPONM was concerned about the possibility of bias in national estimates because of nonresponse in the surveys. The Panel was reluctant to use some of the data in which response was less than 50 percent. Therefore, the Panel recommends that every effort be made to improve current response rates. Methods for improving response rates, such as monetary and other incentives, should be tested, especially in the USDA surveys in which such techniques have not been attempted. Current efforts to collect as much information as possible on nonrespondents by increasing the information collected in screening questionnaires, performing followup studies of nonrespondents, and conducting proxy interviews to obtain information on nonrespondents should be extended. The USDA and NCHS have conducted detailed analyses of nonresponse (discussed in the current report) in their recent surveys; such analyses should be made available to data users.

Education of Data Users

The EPONM noted that some of the published reports based on NNMS data, primarily those produced by investigators using public release data tapes or working under Agency contracts, failed to use appropriate procedures to account for sample weights and design effects inherent in these complex surveys. Thus, the EPONM strongly recommends that the Agencies continue and increase efforts to educate users on appropriate use of survey data. These efforts may take such forms as publications on statistical issues, workshops, and/or greater documentation for data tapes made available to investigators, and may require additional Agency staff with statistical expertise. In those situations where analyses are proposed as part of a contractual activity, it is incumbent on the funding Agency to ensure that the review of such proposals include an evaluation of the understanding and ability of the investigators to analyze data from a complex survey.

Responsiveness to Needs of State and Local Data Users

The Panel was aware of a desire by public health personnel in many States and localities to use NNMS data. The CDC surveillance activities are State-based, but the nationally representative surveys do not generate State- or local-level data. Nonetheless, policy makers in the States and localities need to know how to use national data, the implications of national data in terms of the State or locality, and how to "dovetail" State or local surveys more efficiently with national surveys. State and other officials who are responsible for implementation of the National Nutrition Objectives need ways to monitor status and progress in achieving these objectives. The Panel encourages more interaction of Federal and State data collection activities and research on the value and validity of synthetic estimates for States and other localities.

Research Needs

The EPONM noted many research needs in the course of reviewing the analyses included in this report, but wishes to highlight two issues:

- Development of methods for the assessment of dietary adequacy (and nutrient excess) to reduce reliance on the RDA as a standard for nutrient intake.

- Development of measures of status for food components identified as current public health concerns, such as calcium. Improved and/or validated measures of obesity, energy intake, and physical activity are also needed.

Future Reports on the NNMS

The integration of the currently available dietary and nutrition-related health status data from the two major surveys of the NNMS (the NFCS and the HANES) to assess the dietary and nutritional status of the U.S. population is a major contribution of reports such as this one and that of the JNMEC. Data from these surveys and other NNMS sources can also be used to provide a detailed analysis and summary of specific issues related to diet, nutrition, and health. The Panel's experiences, as amplified below, indicate that presentations of both updated information on status and detailed analyses are appropriate, valuable, and feasible objectives for such reports.

Content of Reports

The EPONM recommends that reports presenting updated information on dietary and nutritional status and reports presenting detailed analyses on special topics be prepared separately. In the Panel's experience, trying to accomplish both in the same report was overly ambitious.

- <u>Update reports</u> may take a variety of forms. One option is a relatively comprehensive discussion and analysis of available dietary and nutritional status data containing conclusions regarding public health significance and monitoring priority, such as the JNMEC report and chapters 3 and 4 in the current report. Another possibility is the tabulation of the most recent data, with limited interpretation, in a format similar to that used for *Health: United States*. These two alternatives are especially appropriate in view of the increasing trend for continuous data collection in the NNMS. Consideration might also be given to studying the development of a set of "leading indicators" (similar to leading economic indicators) that potentially could rapidly monitor changes in food consumption and nutritional status of the population. Such indicators need not be direct measures of food consumption or biochemical measures related to nutritional status, but might consist of data already collected for other purposes, such as food expenditures or participation in food and nutrition programs, that may reflect dietary and nutritional status.

- Reports of detailed analyses on special topics could alternate with update reports or could be prepared concurrently (but separately, as the need for such reports is identified and the data become available). For such reports, the assistance of consultants with a wide range of expertise within the specified subject area would be most helpful. The types and depth of expertise needed would differ for different topics. Some topics for consideration are listed below (not all of these topics could be undertaken with existing data).
  - The impact of supplement use on nutrient intake, nutritional status, and health status.
  - The nutritional and dietary status of the elderly.
  - The impact of consumption of food away from home on dietary status.
  - The impact of social changes such as single-parent and two-income households on dietary practices and nutritional status.
  - The impact of "dieting" behavior on dietary patterns and nutritional status.

Frequency of Reports

Difficulties in interpretation arise if update reports are prepared too frequently: little detectable change in dietary or nutritional status of the population would be expected in short time periods and appropriate data for desired analyses may not be available at short intervals. The latter was true of the EPONM's review; the major sources of data available for the update of dietary and nutritional status were limited in coverage of age and sex groups (CSFII 1985-86) and ethnic groups (HHANES). In addition, analyses of dietary intake data from HHANES were not completed for the EPONM review. These factors limited the ability of the Panel to meet the charge to update information on the nutritional status of the U.S. population and raised concerns about the timeliness of data release from some surveys. Planned schedules for release of data from current surveys will resolve concerns about the timeliness of data available, provided that the Agencies are allocated adequate staff and resources to meet the planned schedules. Reports intended to update information on the nutritional status of the U.S. population should be timed according to the availability of data from the two major components of the NNMS. Thus, the next major update report should be planned to incorporate data from the first half of NHANES III (1988-91), the NFCS 1987-88, and 1989-91 cycles of the CSFII (all of these data should be available in 1993). In addition, the most recent food supply data and data from other NNMS activities should be included. In intervening years in which reports on the NNMS are mandated, more limited update reports or reports on special topics should be prepared.

The NNMS of the Future

The recommendations above are predicated on the Panel's experiences in analyzing the NNMS data in this report, the recognition that most suggested changes cannot be made in ongoing surveys for several years, and the probability that the basic structure of the NNMS will remain the same. The EPONM believes that it is appropriate now to begin efforts to determine the most useful form of the NNMS in the future. The main considerations that should drive the introduction of changes to make the separate components function more effectively as a system are the needs of data users, especially policy makers. One obvious need is for data that permit the assessment of progress on implementing the National Nutrition Objectives for the Year 2000 at the midcourse review (1995) and at the end of the decade. Planning for the future of the NNMS should include a poll of data users to determine unmet needs and should proceed with cooperation between the Agencies from the highest to the lowest level. With such direction and cooperation, the best features of the existing NNMS can be retained and an even better system can be constructed.

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Appendix I

Description of NNMS Surveys

Descriptions are included for the following:

National Nutrient Data Bank

Sponsoring Agency: Human Nutrition Information Service, USDA

Conducted: Continuously.

Objective: To compile and summarize reliable data on the nutrient composition of foods through development and maintenance of a nutrient data bank. These data are made available in published tables of food composition and on public use data tapes, which include the nutrient data bases used for the NFCS 1977–78, CSFII 1985–86, and HHANES.

Data sources: Nutrient composition data are obtained from scientific publications, university and government laboratories, food processors and trade groups, and through Human Nutrition Information Service (HNIS)-funded contracts for purposes of generating needed food composition data. Most values released are supported by laboratory analyses. Nutrient values not available from laboratory analyses are imputed from data for other forms of the food or from data for similar foods.

Measures: Nutrient data bases for use with survey results are of two types: nutrient content of the edible parts of a pound of foods in forms as they enter the kitchen (household food use) and the nutrient content of 100 grams of food as ingested (individual intake). Currently, values are derived for food energy and 28 nutrients and other food components. Included are protein, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, total carbohydrate, dietary fiber, vitamin A as International Units, vitamin A as retinol equivalents, carotenes, thiamin, riboflavin, preformed niacin, vitamin B6, vitamin B12, folacin, vitamin C, vitamin E, calcium, phosphorus, magnesium, iron, zinc, copper, sodium, potassium, alcohol, and moisture (water).

Activity description: The HNIS maintains the National Nutrient Data Bank (NNDB). The Agency expands NNDB coverage of nutrients and foods as required to provide needed information on the nutrient composition of foods for use by Federal, State, and local food program administrators, researchers, health professionals, nutrition educators, the food industry, and consumers. The products of this NNDB activity are reference values for over 60 food components in thousands of foods Americans consume, presented in published and machine-readable forms.

Results from analyses conducted by industry, government, universities, and others are compiled, evaluated, and entered into the NNDB. Research to fill knowledge gaps is planned and sponsored. These studies fall into three general categories: (1) analyses of particular nutrients in foods known to be important sources; (2) analyses of particular foods for which data on many nutrients are lacking; and (3) analyses of new foods or new forms of foods of increasing popularity. Examples of the latter are tropical fruits and fish raised by aquaculture. Much of the research is planned in consultation with the Agricultural Research Service's (ARS) Nutrient Composition Laboratory at Beltsville, Maryland, and, as appropriate, with the National Institutes of Health, the Food Safety and Inspection Service, the Food and Drug Administration, the food industry, and others. Studies utilize national sampling plans appropriate to the national distribution of food types and employ validated analytical methods applied with proper laboratory quality control procedures. Food components believed to be important to health promotion and disease prevention receive emphasis in studies of the composition of foods. Current examples are selenium, lipids, carotenoids, tocopherols, and dietary fiber components.

With understanding of the effects of handling and processing on the nutrient content of foods, nutritive values of some foods can be estimated, thereby avoiding more extensive analyses. Examples of such studies are the distribution of nutrients in solid and liquid portions of canned foods, the effects of trimming of fat from meat and poultry prior to cooking on nutrient content of the cooked food, the absorption of cooking fat by fried foods, and the retention of nutrients after cooking and other preparation of mixed dishes.

Agricultural Handbook No. 8: The technical reference tables on the nutrient composition of foods, "Composition of Foods ... Raw, Processed, Prepared," *Agricultural Handbook No. 8* (AH-8), are being revised. Of the 22 sections, each showing values for a group of foods, five sections are yet to be published. They are lamb, veal, and game; baked products; snacks and sweets; cereal grains and pasta; and mixed dishes. Nutrient values in the 22 sections will be updated as necessary for either individual items or for complete food groups. The computerized USDA Nutrient Data Base for Standard Reference corresponds to AH-8 and is revised as the handbook is updated.

Special-use tables and data bases: Food composition tables and data bases for special uses are developed and kept up-to-date. For example, special tables are required by HNIS for estimating the nutrient content of U.S. food supplies each year. Also, consumers and many professionals require references that are smaller and less technical than AH-8. They may show the nutritive value of only foods most commonly eaten by Americans or for only selected food components such as calories, lipids, sodium, or dietary fiber. Special data bases will allow (1) school food service managers to assess the nutritional quality of school meals, and (2) Extension agents, other educators, and consumers to assess diets using interactive computer programs.

Data bases for assessing the nutrient content of diets: Large nutrient data bases for assessing diets reported in national food consumption surveys conducted by USDA, DHHS, and others are developed and documented in ways that facilitate improved comparability of assessments across surveys and with past surveys. Data bases involved are Nutrient Data Base for Individual Food Intake Surveys and Nutrient Data Base for Household Use Surveys. These data bases must contain values for all nutrients assessed in the survey in all foods reported. Until analytical data are available, best estimates are made by HNIS staff. Computerized files are developed and maintained (1) for linking the Nutrient Data Base for Standard Reference and the two survey data bases to facilitate updating through automatic calculation of values for specified recipes; (2) for converting quantities of foods as reported to weight in grams or pounds; (3) for linking food codes (and associated nutrient data) used in CSFII 1985 and NFCS 1987 with those used in NFCS 1977-78; and (4) for converting home-prepared and commercially prepared food mixtures reported in surveys to their basic ingredients.

Data bases for food industry use: The USDA cooperates with the food industry, the Food and Drug Administration, and other USDA Agencies in developing special data bases of the generic nutrient composition of fresh and processed foods for use in point-of-purchase labeling.

International data bases: The Department continues to cooperate internationally in the development and exchange of food composition data and technologies. Support of INFOODS involved a cooperative study of statistical methods for handling data and other assistance in development of standard procedures for handling food composition data. The Department also assisted the Food and Agriculture Organization (FAO) with the development and dissemination of data for foods eaten in developing countries.

Data user conferences: Annual Nutrient Data Bank Conferences provide USDA with an effective means of communicating with data users. The USDA helps develop uniform and concise guidelines to help nutrient data users to obtain accurate and consistent estimates of the nutritive value of foods and diets.

U.S. Food Supply Series

Sponsoring Agency: Economic Research Service, USDA

Conducted: Each year since 1909.

Target population: U.S. civilian population.

Design: The Economic Research Service of USDA provides annual estimates on amounts of about 350 foods that disappear into civilian food consumption at or before the retail level of distribution. This information is derived from data on production, imports and exports, military use, and beginning and year–end inventories.

Measures: Food that "disappears" into and is available for civilian consumption on a per capita basis. The nutrient content of these foods is estimated. Such food and nutrient supply estimates, available each year since 1909, are the only source of information on food and nutrient trends since the beginning of the century.

Background: The Nutrient Content of the U.S. Food Supply is a historical series providing data on amounts of nutrients per capita per day in food available for consumption each year beginning with 1909. Levels of nutrients per capita per day are rapidly and inexpensively derived indicators of diet quality. They are used to assess the potential of the U.S. food supply to satisfy the nutritional needs of the population. These data also have other uses such as in epidemiological studies on the relationship between diet and the prevalence of disease and in studies of the effects of technological, economic, and social changes on the U.S. diet and future food production.

Data on the nutrient content of the U.S. food supply are published annually in *Agricultural Statistics* (USDA, 1988), *Statistical Bulletins* on food consumption, prices and expenditures (USDA, 1989), and handbooks of agricultural charts in the *Agriculture Handbook* series (USDA, 1986), and *Statistical Abstract of the United States* (U.S. Bureau of the Census, 1987). Interpretive analyses of trends in nutrient levels in the food supply are reported annually in the *National Food Review* (USDA, 1987) and frequently in other publications (Welsh and Marston, 1982; Raper and Marston, 1986).

Design: Two sources of information within USDA are used to calculate the nutrient content of the U.S. food supply. The Economic Research Service provides estimates of quantities of food available for consumption per capita per year, and the Human Nutrition Information Service (HNIS) provides data on the nutrient content of food. The nutrient content of the U.S. food supply is calculated by multiplying the pounds of each food consumed per capita per year by the nutritive value of the edible portion per pound, totaling the results for all foods, and then converting the total to a per–day basis.

Food consumption estimates: The Economic Research Service estimates the quantities of approximately 300–400 foods that "disappear" into the U.S. food distribution system. The methods used have been described in detail previously (USDA, 1965). In brief, disappearance data are estimated by deducting data on exports, military use, year–end inventories, and nonfood use from data on production, imports, and beginning–of–the–year inventories. The methodology avoids double counting of any food. Data on per capita consumption of food are derived by dividing the weight of food available for use during the year by the population of the 50 States and the District of Columbia, as estimated by the U.S. Bureau of the Census.

Disappearance of all foods is not measured at the same point in the distribution system. Some foods are in a raw or primary form and others are retail products when their disappearance is measured. For example, the disappearance of meat, poultry, fish, flour, eggs, sugar, and fat is measured when they are in a primary state, that is, before they are processed into finished products such as bread, bakery products, soft drinks, and frozen casseroles. On the other hand, quantities of fruit, fruit juices, vegetables, and potatoes are measured in several forms--fresh, canned, frozen, or dehydrated. However, these products too may undergo further processing, for example, into pies and jellies. Losses that occur after food is initially measured, such as in further processing, marketing, or home use, are not considered in these estimates. Food disappearance estimates exclude some sources of nutrients: alcoholic beverages and the sugars and grains used in their manufacture; baking powder, baking soda, yeast, and certain vitamins and minerals added to foods for their functional or flavoring properties; and vitamin and/or mineral supplements in tablet, capsule, and liquid form.

Nutrient content of food: The HNIS data on the nutrient content of foods have been sufficient to derive estimates for the U.S. food supply series for the following nutrients and food components: energy; protein; total fat; saturated, monounsaturated, and polyunsaturated fatty acids; cholesterol; carbohydrate; calcium; phosphorus; magnesium; iron; zinc; copper; potassium; vitamin A (international units and retinol equivalents); carotenes; vitamin E; vitamin C; thiamin; riboflavin; niacin; vitamin B6; folacin; and vitamin B12. Because the food supply series requires food composition data for a relatively small number of foods and for the primary (uncombined) state of the foods, food composition data have been sufficient to make rough estimates for simple and complex carbohydrates.

Nutrients added to foods commercially through fortification and enrichment are included in the food supply estimates on the basis of periodic surveys of industry conducted for USDA by the U.S. Bureau of the Census. Therefore, data on the nutrient content of the U.S. food supply include quantities of iron, thiamin, riboflavin, and niacin added to flour and cereal products; vitamin A value added to margarine, milk, and milk extenders; vitamin B12 added to cereal; and ascorbic acid added to fruit juices and drinks, flavored beverages, dessert powders, milk extenders, and cereal.

Estimates of the nutrient content of the food supply exclude nutrients from the inedible parts of food, such as bones, rinds, and seeds, but include nutrients from portions of food that are edible but not always eaten and include all the separable fat that is left on retail cuts. For example, the nutrient values used for meat are for composite retail cuts. Nutrient estimates also include food and nutrients that may be lost after food disappearance is measured, as in processing, marketing, or cooking. Insofar as possible, nutrient estimates reflect changes in the composition of individual foods since 1909. For example, the ascorbic acid values applied to fresh potatoes consumed in recent years are higher than the values applied to potatoes consumed at the beginning of the century because of better storage conditions and use of different cultivars. The most recent composition data are used if earlier data are unavailable or considered unreliable.

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Nationwide Food Consumption Survey 1977–78

Sponsoring Agency: Human Nutrition Information Service, USDA

Conducted: April 1, 1977 to March 30, 1978.

Target populations: Private households in the 48 conterminous States and the individuals residing in those households. Special surveys targeted populations in Alaska, Hawaii, and Puerto Rico; low-income households; and households with elderly person(s) in the 48 States.

Design: Multistage stratified area probability samples of the defined population.

Sample size: 14,930 households; 30,770 individuals.

Measures: Food used from home supplies during one week by entire household and food ingested by individual household members at home and away from home for three consecutive days. Nutrients available from food used by the households and nutrients ingested by household members are derived using appropriate food composition data files developed from HNIS's nutrient data bank.

See JNMEC report for additional details on the survey.

Nonresponse analyses: For the Nationwide Food Consumption Survey (NFCS) 1977–78, household questionnaires were completed for about 72 percent of the households contacted. In the participating households, 94 percent of the eligible individuals completed the first-day dietary report, and 85 percent completed all three days of the dietary reports (DHHS/USDA, 1986). Hence the response rate for the group with three days of data is 61.1 percent (72 percent x 85 percent).

Comparisons between the NFCS 1977–78 and the March 1977 Current Population Survey of the U.S. Census were performed by Tuszynski and Roidt (1988). Variables examined included tenancy (owned or rented), race (white or nonwhite), urbanization (metropolitan or nonmetropolitan), ethnic origin (Hispanic or non–Hispanic), household size, region (Northwest, Midwest, South, or West), and household income (less than $10,000, $10,000– $19,000, or $20,000 or more). For these variables, most of the differences between the two surveys were small. The largest difference involved race, with the Current Population Survey estimating that 11.9 percent of the U.S. households were nonwhite compared to the estimate of 14.8 percent from the NFCS 1977–78, a difference of approximately 3 percentage points between the races.

An investigation of the nonrespondents was not conducted in 1977–78, and it is not reasonable to attempt such an investigation 10 years after the survey. Therefore, these were the only comparisons available on which to base a decision about nonresponse bias in the data. These comparisons were based on the one–day data; it would be useful to have a similar comparison for the three–day data. However, because there was not a large drop in the numbers from the one–to the three–day data, this comparison may not be necessary. The difference in the two racial estimates should not affect the results much unless there is a substantial difference in food or nutrient intake.

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Continuing Survey of Food Intakes by Individuals, 1985–86

Sponsoring Agency: Human Nutrition Information Service, USDA

Conducted: 1985 (April 1, 1985 to March 30, 1986) and 1986 (April 1, 1986 to March 30, 1987).

Target populations: Persons of selected sex and age residing in the 48 conterminous States in private households with income at any level (basic survey) and with income at or below 130 percent of the poverty guidelines (low-income survey). In 1985: women 19–50 years, their children 1–5 years, and men 19–50 years. In 1986: women 19–50 years and their children 1–5 years.

Design: Multistage stratified area probability samples drawn using a sampling frame organized using estimates of the U.S. population in 1985. Panel design: women and children were interviewed 6 times (waves) spread over the year.

	Response rate (wave 1)	
	Eligible households	Respondent[1] households
1985:		
Basic	1,893	1,341 (71%)
Low income	2,176	1,916 (88%)
1986:		
Basic	1,722	1,351 (79%)
Low income	1,386	1,223 (88%)

[1] In some households 2 or more women provided data. For example, in basic survey, Spring, 1985, 1,459 women in 1,341 households provided data.

Measures: Food intakes from six 24–hour recalls collected by interview at about 2–month intervals during the year. Nutrient intakes derived using food intakes and special food composition data files developed from HNIS's nutrient data bank. The food components assessed included food energy, protein, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, total carbohydrate, dietary fiber, vitamin A (IU and RE), carotenes, thiamin, riboflavin, preformed niacin, vitamin B6, vitamin B12, folacin, vitamin C, calcium, phosphorus, magnesium, iron, zinc, vitamin E, copper, sodium, alcohol, and water.

Description: The Continuing Surveys of Food Intakes by Individuals (CSFII) are part of USDA's system of Nationwide Food Consumption Surveys (NFCS). They are conducted between the larger decennial NFCS. The primary purpose of the CFSII 1985–86 was to provide timely information on U.S. diets and the diets of population groups of concern, and to indicate differences in information provided by previous surveys. Another purpose was to provide the basis for assessing "usual" diets as measured by several days' data spread over the year and for studying how diets vary over time for individuals and groups of individuals.

The CSFII 1985–86 focused on two groups considered at possible nutritional risk because earlier surveys had found them to have intakes of some nutrients well below recommended levels. Groups are women 19–50 years and children 1–5 years. (In Summer 1985, men 19–50 years were also surveyed.) Women and children contacted as part of the CSFII 1985–86 were asked to provide 6 days (waves) of dietary data over a 1–year period. Each wave of data was collected at about 2–month intervals using a 1–day dietary recall.

National Analysts (a division of Booz, Allen, and Hamilton, Inc.) a private firm in Philadelphia, conducted the CSFII 1985–86 under contract with the HNIS, USDA. National Analysts designed the sample; collected the information; edited, coded, and keyed the data; and prepared the data tape. The HNIS defined the target populations and the information to be collected; provided technical information such as food codes, gram weights of household measures, and the nutrient composition of foods; and monitored all aspects of the survey operation.

Sample design: The CSFII 1985–86 samples were drawn from all private households in the United States. The survey was designed to provide a multistage stratified area probability sample representative of the 48 conterminous States. (Alaska and Hawaii were not included because their diets and factors affecting them differ significantly from those in the mainland States and, therefore, require separate surveys.) The sampling frame was organized using estimates of the U.S. population in 1985. The stratification plan took into account geographic location, degree of urbanization, and socioeconomic considerations.

The 48 States were grouped into the 9 census geographic divisions; then all land areas within the divisions were divided into 3 urbanization classifications: central city, suburban, and nonmetropolitan. The stratification process resulted in a total of 60 strata--17 were central city, 28 suburban, and 15 nonmetropolitan--which correspond to the geographic distribution, urbanization, and density of the population within the 48 States as defined by the Bureau of the Census. Within each stratum two relatively homogeneous units--primary sampling units (PSU)--were randomly selected for a total of 120 PSU.

For the basic sample, each selected PSU was then divided geographically along census boundaries into smaller clusters, known as area segments, containing a minimum of 100 housing units. A total of 206 area segments was drawn into the sample. The number of area segments selected from each PSU varied, depending on the size of the PSU.

For the basic sample, within the 206 area segments, existing housing units were prelisted. The number of prelisted housing units in the area and census information were used to determine the number of housing units to be selected from that area. A sampling rate was derived from the expected occupancy rate, the expected eligibility rate (women 19–50 years living there), and the expected completion rate and applied to the target of 1,200 completed interviews by women 19–50 years.

Data collection: To contact individuals in housing units selected as part of the sample, trained interviewers made a minimum of three personal visits plus up to eight telephone calls to each household having a telephone. To contact households without telephones, interviewers made a minimum of six personal visits (five in rural areas). At each household, the interviewer conducted a screening interview to determine if the household was eligible to participate in the survey.

Eligible households contained at least one woman 19–50 years of age at the time of initial contact. In eligible households, all women within this age range and their children 1–5 years of age, if any, were invited to be interviewed and to participate in a year–long survey panel. A letter of introduction was provided, and respondents were informed that the full survey involved the collection of 6 individual days of intake data.

In each wave, the interviewing process included two major steps: (1) collection of information about the household and (2) collection of information on food intake. Separate intake records were used for each woman and for each child.

Interviewers were instructed to complete all interviews in a single household during the same visit or call, to complete the household schedule first and then the required intake records, and to obtain intake data about a woman and her children for the same 24–hour period. Interviewers were provided with instructions on what to do if deviation from this pattern was necessary.

Multiple contacts were made when needed to complete interviews in eligible households. Interviewing of a household was not considered complete until the household schedule and intake records for all eligible individuals who agreed to participate were obtained.

The first wave of data (wave 1) was collected by personal interview from 1,341 households for the basic sample; subsequent waves of data were collected by telephone, if possible. The proportion of households interviewed by telephone in waves 2 and 3 was 91 percent; in waves 4–6, it was 90 percent. In households without telephones or where the respondent requested to be interviewed in person, the information for waves 2–6 was collected in a personal interview.

Only households that contained a member who was interviewed in wave 1 were recontacted in subsequent waves. Within these households, only women and children who completed interviews in wave 1 were eligible for reinterview in waves 2–6. Respondents were retained in the survey even if they missed one or more waves. Respondents who moved out of their area during the survey were not followed. Individuals who became members of participating households after wave 1 were not eligible for participation regardless of their age.

In wave 1, information on the characteristics of the household was collected from the primary age–eligible woman in the household (the household informant). The female head of the household was always the household informant if she was age–eligible. In households where the female head did not participate in the survey, interviewers collected data on household characteristics from the participant who was the main meal planner/preparer or from the participant who could best answer questions about the household. Household characteristics included the previous month's household income by source; the previous year's household income before taxes; participation in food programs; age, education, occupation, and employment status of the male head of the household; household size; tenancy; usual amount of money spent on food; and each household member's sex, age, and relationship to the female head of the household.

In waves 2–6, interviewers were instructed to attempt a reinterview within 10 days of two month's time from the date of the last interview. At each interview in waves 2–6, the interviewer first obtained limited information on the household from the woman who provided the household information in wave 1. This included information on changes in household membership since the last interview, usual amount of money spent on food, program participation, and changes in monthly household income.

In all waves, each woman interviewed provided information on her own food intake as well as that of her eligible children. Information was collected on all food eaten either at home or away, the time of day food was eaten, what the eating occasion was called, and the use of salt at the table. The main meal planner/preparer was asked about the use of fat (including type) and salt in food preparation and about the form in which the food was brought into the home (commercially frozen, canned, or bottled, or in another form). Foods were designated as coming from the home food supply or as obtained and eaten away from home.

A Food Instruction Booklet, developed by National Analysts based on information provided by HNIS, was used by the interviewers to help respondents adequately describe foods and amounts eaten. The interviewers used standard household measuring cups and spoons and a ruler during the interview to help respondents estimate quantities of foods and beverages consumed. Respondents kept the cups, spoons, and ruler for use during subsequent interviews.

Each woman interviewed also provided information on her age, race, physiological status (pregnancy and lactation); employment, occupation, and education. Children were assigned the race of their mother/caretaker.

In wave 1, eligible households were scheduled for interviews in a manner designed to provide representativeness of intake data by day of the week over all households. In subsequent waves, interviewers were instructed to collect data for a household on different days of the week. For example, if the data for a household were collected for a Tuesday in wave 1 and for a Friday in wave 2, the household was asked to provide data for one of the other 5 days in wave 3, if possible.

For the basic sample, the largest proportion of dietary intakes was collected for Tuesday (18 percent) and the smallest proportion for Saturday (9 percent). Many participants were reluctant to be interviewed on a Sunday. Seventy–two percent of all respondents provided at least 1 day of intake data for Tuesday; 34 percent provided at least 1 day of intake for Saturday.

In wave 1 of CSFII 1985, a total of 1,459 women 19–50 years in 1,341 households completed the food intake interview. Of these women, 1,032 completed at least 3 of the 5 additional waves. Food and nutrient intakes by women reporting at least 4 or more days are presented in some tables. If a woman reported 4 days' data, all were used; if a women reported more than 4 days, the first day's data and three of the remaining days selected randomly were used. For more information about response over the six days, see CSFII Report No. 85–4 (USDA, 1987a).

Sample weights: The sample was designed to be self–weighting. That is, the proportion of eligible persons in the sample with a particular characteristic was designed to represent the same proportion of eligible persons in the population. However, adjustments to the sample were required because not all eligible households participated, not all eligible women and children in eligible households participated, not all interviews yielded complete information, and not all participants in wave 1 completed each subsequent wave. Weighting factors were applied to data from completed intake records to adjust for these sources of nonresponse. See CSFII reports for more information on weights and their derivation (USDA, 1985, 1986a,b, 1987a,b,c, 1988).

Data processing: Each food and beverage reported as ingested during the 24–hour survey period was assigned a code number, and amounts of foods were converted to their weight in grams. The amount of each of 30 nutrients and other food components was calculated using the gram weight of the food and the nutritional value of that food per 100 grams from a nutrient data base developed by HNIS for use with these survey data and with survey data from the Hispanic HANES. Amounts of each nutrient in all foods reported by an individual were summed to obtain the nutrient intake for the day.

Data were subjected to computer–assisted screening and checking by the contractor. Dietary intake records that were known to be incomplete were eliminated. The gram weight of each individual's total intake of food and intakes of food energy, protein, fat, carbohydrate, calcium, iron, and vitamin C were compared with the 2nd and 98th percentiles for individuals of the same age and sex in the NFCS 1977–78 as a check for reasonableness. Also, the gram weight of food reported was checked against reasonable maximums established by HNIS on a food group basis. Data that fell outside the limits set as reasonable were checked against the original questionnaire and were corrected if in error.

Data presentation: Data tapes provided by the contractor were further processed by HNIS to generate tables for the CSFII reports. Data from the basic surveys of CSFII 1985–86 were combined for this report (see appendix II).

Income levels: Tables present results by income. Households are classified by their income for the previous calendar year expressed as a percentage of the appropriate Federal Poverty Income guideline.

Food intakes: Data on food intakes in the tables are weighted means (averages) for the group of individuals identified in the stub. If no food from a group or subgroup was reported on the survey day(s), that individual's total was zero; the zero was included in the calculation of the group mean. The mean intakes presented in the tables, therefore, include intake values for both users and nonusers.

Nutrient intakes: The nutrient intakes in the table are weighted means for the group of individuals identified in the stub. Nutrient intakes do not include intakes from vitamin and mineral supplements for which information on only the frequency and type used were collected. Sodium intake does not include the amount of sodium from salt added at the table, for which quantity information was not collected.

Nutrient intakes at selected percentiles: (Presented only for averages of 4 days' intakes.) Intakes for 4 days by each individual were totaled and divided by four to obtain a mean intake per day for the individual. Values for individuals were arranged from lowest to highest and intakes were identified at specified weighted percentiles (10th, 25th, 50th, 75th, 90th).

Food energy from protein, total fat, fatty acids, and carbohydrate: For each individual, intakes of protein (in grams) were multiplied by 4, fat and fatty acids by 9, and carbohydrate by 4 to estimate the calorie contribution of each energy–providing nutrient. Values were divided by the individual's total food energy intake, then multiplied by 100 to obtain the percentage of an individual's total food energy provided by each nutrient. Weighted means were then determined for different groups of individuals. The general factors 4, 9, and 4 give estimates for a typical mixed diet. Alcohol is also an energy source and was included in determining total energy, but the percentage of food energy contributed by alcohol was not calculated.

Nonresponse analyses: For the CSFII 1985–86, at least four separate samples can be identified: the basic and low–income samples for the years 1985 and 1986. Overall CSFII response rates include the screening rate, rate of participation among eligible households, and rate of interviews among eligible women in participating households. The response rates for these samples ranged from a low of 57.5 percent (83.75 percent x 70.88 percent x 96.9 percent) for the basic sample in 1985 to a high of 77.3 percent (89.3 percent x 88.2 percent x 98.2 percent) for the low–income sample in 1986. These percentages are based on a one–day response; if the four–day data are considered, the response rate for the basic sample in 1985 is reduced from 57.5 percent to 39.2 percent (Basiotis and Pao, 1987). Individuals who moved from the area in which they were originally contacted were not followed up; this accounted for one–fifth of the dropouts between the first and sixth day of data collection.

Tuszynski and Roidt (1988) provided tables comparing the distribution of selected variables from the March 1986 Current Population Survey with distributions of those variables in the CSFII 1986 basic sample. Variables examined were urbanization, region, division (9 divisions ranging from New England to the Pacific), race, ethnic origin, proportion working, household size, tenure, household income, money spent on food, food stamp participation, and age. There was reasonable agreement between the Current Population Survey and the CSFII 1986 for most variables. The largest differences occurred with tenure, household income, and money spent on food. The CSFII 1986 had approximately 63.3 percent of households owning their residences whereas the Census had 56.7 percent (a difference of 7 percentage points), a mean income approximately $5,000 less ($28,179 versus $33,243), and approximately 28 percent more dollars spent on food at home per capita ($17.6 versus $13.8). Perhaps some of these differences can be accounted for by the lack of exact comparability between the target populations used for the comparison of the two surveys. For example, the CSFII 1986 sample was drawn only from households containing a woman 19–50 years of age and separate U.S. level census data for these households and for women aged 19–50 are not available. It is difficult to determine how much of the difference can be attributed to the lack of comparability and how much may be due to nonresponse.

Two studies examined the 1– and 4–day data from the basic group for the CSFII 1985. Basiotis and Pao (1987) did not consider the sample design and the sample weights in their analysis. This unweighted analysis could not assess whether reweighting for nonresponse adequately accounted for the observed differences between respondents and nonrespondents, but the results of Basiotis and Pao (1987) are nevertheless interesting. The 4–day group contains 995 respondents of the 1,459 1–day respondents. The likelihood that a respondent would complete 4 or more days of the CSFII 1985 was estimated to increase with the following characteristics:

- nonmetropolitan household.
- participation in Food Stamp Program.
- participation in WIC.
- household food supply reported not sufficient.
- older.
- Hispanic ethnic origin.
- a short initial interview.

The likelihood of a respondent completing 4 or more days decreased with the following characteristics:

- did not report an income for last year.
- one or more children 1–5 years of age.
- no male head present.
- physical activity at work reported as light.
- race other than white or black.
- smokes cigarettes.
- contacted in person any time after the first interview.

These results were based on a multivariate logistic regression analysis and, hence, could differ from results found when one explanatory variable at a time is examined in relation to the membership in the 1– or 4–day group. This second type of study was conducted by Kott (1988) who performed a weighted analysis and took the sample design into account in the analysis. Fewer variables were considered in this study and means or proportions were compared for each variable for the 1– and 4–day groups. When a weighted analysis was done and design effects were considered, the only significant difference was for the age variable, but this variable does not appear to be of practical importance. The mean intakes for 60 published food groups and 28 nutrients within six age groups were also examined, and very few differences were found between the 1– and 4–day groups in their first day intakes. The six statistically significant, but probably not practically significant, differences were:

Nutrient or food group	One–day sample (grams)	Four–day sample (grams)
Fat	68.9	70.9
Carbohydrates	191.1	195.9
Polyunsaturated fats	13.8	14.2

Nonalcoholic beverages	838.4	876.3
Carbonated beverages	286.7	311.5
Diet carbonated beverages	107.6	124.4

The results from the studies of Basiotis and Pao (1987) and Kott (1988) provide different perspectives on the issue of nonresponse bias. They both focused on the comparison of 1– and 4–day data. Basiotis and Pao (1987) suggested that the two groups differed on a number of variables whereas Kott (1988) found that these differences did not translate into many large differences in food or nutrient intake data. These results, complemented by the tables from Tuszynski and Roidt (1988), provide a more complete look at the representativeness of the CSFII 1985–86 for some of the four groups from the basic and low–income surveys of 1985 and 1986.

The final examination of the nonresponse issue by the USDA was a followup survey of the nonrespondents to the CFSII 1986, wave 1 (first day of data collection). In the followup survey described by Tuszynski and Roidt (1988), the USDA attempted to obtain information on the following:

- the number of persons in the household.
- the number of children 1–5 years of age.
- the number of women 19–50 years of age.
- race.
- origin.
- food stamp participation.
- WIC participation.
- money spent on food.
- a household assessment of food sufficiency.
- household income.

This survey was conducted during November and December 1986, approximately six months after wave 1 of the CFSII 1986 interviewing was done. Three different approaches were used to gather information from the nonrespondents. The overall response rate from the people who were nonrespondents in the CFSII 1986, wave 1 was 37 percent. This value of 37 percent includes some persons for whom other people, for example, a neighbor, provided information. This low response rate raises the question of whether the respondents to this followup survey are representative of the total group of nonrespondents. Based on the limited information available for comparison, the respondents to the followup survey did not differ substantially from the entire group of nonrespondents to the original survey. There were some differences for household composition variables, but these may be somewhat inflated owing to problems with recall.

Comparison of the nonrespondent followup survey participants with the participants in the CFSII 1986 showed little or no differences for most variables examined when the sampling weights were not used. However, there were differences for the proportion of metropolitan residents (greater for the followup group), for the proportion participating in food stamp programs (lower for the followup group), and for the proportion reporting having adequate quantities of the kinds of foods they like as determined from the food sufficiency question (greater for the followup group). There was also a suggestion of differences for the proportion of Hispanics (greater in the followup group) and for the proportion of WIC users (lower in the followup group). Lastly, a weighted analysis was conducted and comparisons were made to the results one would obtain from incorporating the information from the followup survey. These results suggest that adjusting the sampling weights for nonresponse may have dealt with the disparities mentioned above except for food stamp usage.

These investigations performed by the USDA have suggested the following:

- Some characteristics were related to whether 4–day data were available or only 1–day data were available.

- Even though there may be differences in the composition of the groups with 4–day data or only 1–day data, they did not translate into major differences in dietary intake.

- There were some differences between the nonrespondents and the participants in the CFSII 1986, but these differences, except for food stamp use, disappeared when the sampling weights were adjusted to account for the nonresponse.

These investigations have not uncovered major problems with the data, except possibly for the use of food stamps. What is the effect, if any, of too high an estimate of the use of food stamps on dietary intake? Although these studies have not found any major problem, nonresponse bias remains a potential problem. The followup survey of nonrespondents only had a response rate of 37 percent. Consequently, followup participants may not completely represent all nonrespondents, but that response rate is probably about what would be expected from a survey of nonrespondents. With the NFCS 1977–78 and the CSFII 1985–86 both having at least 40 percent nonresponse, there is a strong possibility of a bias in the data. The investigations performed have not discovered large differences between the respondents and nonrespondents except for the use of food stamps. However, even though no other differences were found, drawing conclusions from these data must be done with caution because of the large nonresponse. Although the examinations performed by the USDA do not guarantee a lack of bias, they do provide a basis for the use of the data from these surveys which provides some reassurance that nonresponse bias is not likely to have generated strongly misleading results.

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National Health and Nutrition Examination Survey

Sponsoring Agency: National Center for Health Statistics

Conducted: 1976–80.

Target population: The civilian noninstitutionalized population of the United States, 6 months through 74 years of age.

Design: Stratified, multistage, probability cluster of households throughout the United States.

Sample size/response rate (see also tables I–1 through I–4):

Sample size	Interviewed	Examined
27,801	25,286 (91%)	20,322 (73%)

Measures: Dietary interviews, body measurements, hematological tests, biochemical analyses of whole blood and serum, oral glucose tolerance tests, blood pressures, electrocardiograms; urine tests; X–rays of cervical and lumbar spine and chest (see information in tables I–5 and I–6).

See JNMEC report for additional details on the survey.

Nonresponse analyses: See discussion in section on HHANES.

Table I-1. Sample size and response rates for persons by race, age, and sex: second National Health and Nutrition Examination Survey, 1976-80

Race, age, and sex	Total sample size	Number interviewed	Percent interviewed	Number examined	Percent examined
ALL RACES					
Age					
Total	27,801	25,286	90.95	20,322	73.10
4-74 years	24,669	22,271	90.28	17,765	72.01
20-74 years	17,390	15,364	88.35	11,864	68.22
6 months-3 years	3,132	3,015	96.26	2,557	81.64
4-5 years	1,937	1,861	96.08	1,561	80.59
6-11 years	2,085	1,963	94.15	1,725	82.73
12-15 years	1,616	1,521	94.12	1,320	81.68
16-19 years	1,641	1,562	95.19	1,295	78.92
20-29 years	3,522	3,262	92.62	2,627	74.59
30-39 years	2,541	2,300	90.52	1,857	73.08
40-49 years	2,148	1,882	87.62	1,461	68.02
50-59 years	2,230	1,913	85.78	1,484	66.55
60-69 years	5,080	4,380	86.22	3,308	65.12
70-74 years	1,869	1,627	87.05	1,127	60.30
Sex					
Male	13,406	12,164	90.74	9,983	74.47
Female	14,395	13,122	91.16	10,339	71.82
Race					
White	23,537	21,350	90.71	17,105	72.67
Black	3,653	3,389	92.77	2,763	75.64
Other	611	547	89.53	454	74.30

Continued on page I-16

Table I-1. Sample size and response rates for persons by race, age, and sex: second National Health and Nutrition Examination Survey, 1976-80--continued

Race, age, and sex	Total sample size	Number interviewed	Percent interviewed	Number examined	Percent examined
Non-Hispanic white					
Total	22,050	19,912	90.30	15,921	72.20
4-74 years	19,802	17,754	89.66	14,109	71.25
20-74 years	14,434	12,678	87.83	9,794	67.85
6 months-3 years	2,248	2,158	96.00	1,812	80.60
4-5 years	1,348	1,289	95.62	1,070	79.38
6-11 years	1,547	1,451	93.79	1,271	82.16
12-15 years	1,203	1,125	93.52	976	81.13
16-19 years	1,270	1,211	95.35	998	78.58
20-29 years	2,803	2,587	92.29	2,077	74.10
30-39 years	2,061	1,855	90.00	1,505	73.02
40-49 years	1,734	1,520	87.66	1,187	68.45
50-59 years	1,844	1,572	85.25	1,224	66.38
60-69 years	4,373	3,746	85.66	2,841	64.97
70-74 years	1,619	1,398	86.35	960	59.30
Sex					
Male	10,626	9,562	89.99	7,797	73.38
Female	11,424	10,350	90.60	8,124	71.11
Non-Hispanic black					
Total	3,610	3,347	92.71	2,725	75.48
4-74 years	3,108	2,862	92.08	2,290	73.68
20-74 years	1,935	1,744	90.13	1,318	68.11
6 months-3 years	502	485	96.61	435	86.65
4-5 years	332	323	97.29	277	83.43
6-11 years	342	325	95.03	285	83.33
12-15 years	256	241	94.14	214	83.59
16-19 years	243	229	94.24	196	80.66
20-29 years	437	412	94.28	339	77.57
30-39 years	290	263	90.69	203	70.00
40-49 years	249	211	84.74	157	63.05
50-59 years	267	236	88.39	178	66.67
60-69 years	505	450	89.11	321	63.56
70-74 years	187	172	91.98	120	64.17
Sex					
Male	1,695	1,576	92.98	1,324	78.11
Female	1,915	1,771	92.48	1,401	73.16

Table I-2. Number examined and estimated population for non-Hispanic persons 6 months–74 years of age, by sex, age, race, and poverty status: second National Health and Nutrition Examination Survey, 1976–80

Sex and age	Non-Hispanic white				Non-Hispanic black			
	Below poverty		Above poverty		Below poverty		Above poverty	
	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands
Both sexes								
6 months-3 years	264	968	1,510	6,645	234	737	174	760
4-5 years	154	537	897	3,826	134	408	128	505
6-11 years	158	1,725	1,076	13,573	136	1,208	139	1,782
Male								
12-15 years	53	560	442	5,284	44	437	54	642
16-19 years	71	885	417	5,247	39	462	50	538
20-29 years	102	1,256	882	13,050	43	487	107	1,291
30-39 years	45	598	645	10,056	17	*	71	1,022
40-49 years	19	*	531	8,253	15	*	40	706
50-59 years	33	433	514	7,892	17	*	53	720
60-69 years	108	501	1,202	6,716	44	173	96	441
70-74 years	61	290	350	1,889	24	88	31	148
Female								
12-15 years	49	604	394	5,118	61	585	45	460
16-19 years	90	1,064	378	5,141	58	618	33	380
20-29 years	138	1,784	899	12,690	69	776	108	1,661
30-39 years	80	1,061	701	10,245	38	428	68	999
40-49 years	44	583	554	8,616	33	413	59	778
50-59 years	49	632	578	8,870	31	357	57	725
60-69 years	185	901	1,225	7,135	64	240	94	472
70-74 years	97	486	411	2,468	25	102	32	151

Table I-3. Percent of examined persons with missing blood assessments for non-Hispanic persons by age: second National Health and Nutrition Examination Survey, 1976-80

Race and age	Number of examined persons	Hemoglobin	Hematocrit	Red blood cell count	White blood cell count	Mean corpuscular hemoglobin	Mean hemoglobin concentration	Mean corpuscular hemoglobin concentration
Non-Hispanic white								
Total................	15,921	6.1	6.1	6.6	6.5	6.8	9.3	9.0
4-74 years..........	14,109	2.8	2.8	3.4	3.2	3.5	6.0	5.7
20-74 years.........	9,794	0.9	0.9	1.4	1.3	1.7	4.1	3.8
6 months-3 years....	1,812	31.2	31.2	31.7	31.7	31.9	34.4	34.2
4-5 years...........	1,070	15.1	15.1	15.6	15.4	15.6	17.9	17.6
6-11 years..........	1,271	7.7	7.7	8.3	8.0	8.3	11.3	10.9
12-15 years.........	976	3.1	3.1	3.7	3.6	3.8	6.6	6.1
16-19 years.........	998	1.8	1.8	2.5	2.4	2.5	5.4	4.8
20-29 years.........	2,077	1.2	1.2	1.8	1.7	2.0	4.7	4.3
30-39 years.........	1,505	1.1	1.1	1.3	1.3	1.5	3.9	3.9
40-49 years.........	1,187	0.6	0.6	1.3	1.3	1.3	3.8	3.3
50-59 years.........	1,224	0.6	0.6	1.3	1.2	1.5	4.1	3.6
60-69 years.........	2,841	0.9	0.9	1.3	1.2	1.6	3.9	3.9
70-74 years.........	960	1.0	1.0	1.7	1.5	2.0	3.7	3.4
Non-Hispanic black								
Total................	2,725	8.2	8.2	9.9	10.2	10.1	12.0	10.8
4-74 years..........	2,290	5.3	5.3	7.0	7.3	7.1	9.0	7.8
20-74 years.........	1,318	2.1	2.1	3.7	3.9	3.9	5.2	4.1
6 months-3 years....	435	23.7	23.7	25.5	25.7	25.5	28.0	26.4
4-5 years...........	277	13.4	13.4	15.2	15.5	15.2	17.7	16.2
6-11 years..........	285	10.9	10.9	13.7	14.7	13.7	15.8	13.7
12-15 years.........	214	7.5	7.5	8.9	9.3	9.3	12.1	11.7
16-19 years.........	196	4.6	4.6	5.6	5.6	5.6	8.2	7.7
20-29 years.........	339	1.8	1.8	3.5	3.8	3.5	5.9	4.4
30-39 years.........	203	2.0	2.0	3.0	3.0	3.4	4.4	4.4
40-49 years.........	157	1.3	1.3	3.2	3.2	3.2	4.5	3.2
50-59 years.........	178	2.2	2.2	3.9	3.4	3.9	5.6	3.9
60-69 years.........	321	2.8	2.8	4.7	5.0	5.0	5.3	4.0
70-74 years.........	120	2.5	2.5	3.3	4.2	3.3	5.0	4.2

Table I-3. Percent of examined persons with missing blood assessments for non-Hispanic persons by age: second National Health and Nutrition Examination Survey, 1976-80--continued

Race and age	Serum iron	Total iron-binding capacity	Transferrin saturation	Vitamin A	Erythrocyte protoporphyrin	Serum cholesterol
Non-Hispanic white						
Total...............	7.5	16.1	16.2	36.2	6.2	2.0
4-74 years..........	6.1	14.6	14.8	32.5	5.3	2.0
20-74 years.........	3.0	10.8	10.9	$	3.3	2.0
6 months-3 years....	40.9	51.7	51.7	51.5	28.6	$
4-5 years...........	27.5	35.2	35.2	38.9	20.1	$
6-11 years..........	14.2	23.7	23.8	27.1	10.6	$
12-15 years.........	5.5	16.4	16.5	$	4.5	$
16-19 years.........	4.3	17.2	17.6	$	3.4	$
20-29 years.........	3.0	10.0	10.2	$	3.5	2.0
30-39 years.........	3.5	10.6	10.8	$	3.5	2.7
40-49 years.........	2.4	10.4	10.5	$	2.9	1.7
50-59 years.........	2.6	10.5	10.6	$	2.7	1.5
60-69 years.........	2.9	11.6	11.8	$	3.2	2.0
70-74 years.........	3.9	11.1	11.2	$	3.9	2.3
Non-Hispanic black						
Total...............	12.2	24.7	24.9	45.9	8.7	3.9
4-74 years..........	10.2	23.0	23.2	42.9	7.2	3.9
20-74 years.........	3.9	17.1	17.3	$	3.3	3.9
6 months-3 years....	46.9	55.5	55.5	59.4	34.4	$
4-5 years...........	33.2	45.5	45.8	48.7	19.1	$
6-11 years..........	20.0	31.6	31.6	37.2	15.4	$
12-15 years.........	9.8	23.8	24.3	$	7.9	$
16-19 years.........	6.6	17.9	17.9	$	4.6	$
20-29 years.........	4.4	15.0	15.0	$	3.5	3.5
30-39 years.........	2.5	12.3	12.3	$	3.0	3.0
40-49 years.........	2.5	17.8	18.5	$	1.9	1.9
50-59 years.........	3.4	21.9	21.9	$	2.8	4.5
60-69 years.........	5.3	18.1	18.7	$	4.0	5.0
70-74 years.........	3.3	20.0	20.0	$	3.3	5.8

NOTE: $ Assessment not performed on this age group.

Table I-4. Number examined and estimated population for non-Hispanic persons 6 months-74 years of age, by sex, age, and race: second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Non-Hispanic white: Number of examined persons	Non-Hispanic white: Estimated population in thousands	Non-Hispanic black: Number of examined persons	Non-Hispanic black: Estimated population in thousands
Both sexes				
6 months-3 years	1,812	7,770	435	1,586
4-5 years	1,070	4,429	277	949
6-11 years	1,271	15,825	285	3,069
Male				
12-15 years	517	6,116	101	1,112
16-19 years	511	6,423	96	1,078
20-29 years	1,011	14,727	158	1,881
30-39 years	707	10,901	93	1,258
40-49 years	572	8,926	62	980
50-59 years	575	8,798	77	970
60-69 years	1,354	7,419	151	655
70-74 years	427	2,263	56	242
Female				
12-15 years	459	5,931	113	1,106
16-19 years	487	6,479	100	1,129
20-29 years	1,066	14,914	181	2,486
30-39 years	798	11,548	110	1,474
40-49 years	615	9,495	95	1,215
50-59 years	649	9,863	101	1,245
60-69 years	1,487	8,471	170	761
70-74 years	533	3,098	64	286

Table I–5. Examination components in the second National Health and Nutrition Examination Survey, 1976–80

6 months–2 years	3–11 years	12–19 years	20–74 years (bile acids test group)	20–74 years (glucose tolerance test group)
. . .	Urine: 6–11 yr only	Urine	Urine	Urine
Body measurements	Body measurements	Body measurements	Body measurements	Body measurements
Physician exam	Physician exam	Physician exam	Physician exam	Physician exam
Venipuncture	Venipuncture	Venipuncture	Venipuncture	Venipuncture
Dietary interview	Dietary interview	Dietary interview	Dietary interview	Dietary interview
. . .	Audiometry: 4–11 yr only	Audiometry	. . .	. . .
. . .	Speech test: 4–6 yr only	. . .	. . .	. . .
. . .	Allergy test: 6–11 yr only	Allergy test	Allergy test	Allergy test
. . .	Spirometry: 6–11 yr only	Spirometry	Spirometry: 20–24 yr only	Spirometry: 20–24 yr only
. . .	. . .	. . .	Electrocardiogram: 25–74 yr only	Electrocardiogram: 25–74 yr only
. . .	. . .	. . .	Chest and neck X-rays: 25–74 yr only	Chest and neck X-ray: 25–74 yr only
. . .	. . .	. . .	Back X-ray: 25–74 yr for men; 50–74 yr for women	Back X-ray: 25–74 yr for men; 50–74 yr for women
. . .	. . .	. . .	. . .	Glucose tolerance test
. . .	. . .	. . .	Bile acids test: 35–74 yr only	. . .

Table I-6. Blood and urine assessments in the second National Health and Nutrition Examination Survey, 1976-80

6 months-2 years	3-11 years	12-19 years	20-74 years (bile acids group)[1]	20-74 years (glucose tolerance test group)
		WHOLE BLOOD		
Lead: all examinees	Lead: all examinees 3-6 yr; odd-numbered examinees 7-11 yr	Lead: odd-numbered examinees	Lead: odd-numbered examinees	Lead: odd-numbered examinees
...	Carboxyhemoglobin: even-numbered examinees	Carboxyhemoglobin: even-numbered examinees	Carboxyhemoglobin: even-numbered examinees	Carboxyhemoglobin: even-numbered examinees
Protoporphyrin	Protoporphyrin	Protoporphyrin	Protoporphyrin	Protoporphyrin
Red blood cell folate[2]	Red blood cell folate[2]	Red blood cell folate[2]	Red blood cell folate[2]	Red blood cell folate[2]
		SERUM		
...	Ferritin[2]	Ferritin[2]	Ferritin[2]	Ferritin[2]
...	...	...	Bile acids: 35-74 yr only	...
...	...	...	Cholesterol	Cholesterol
...	...	...	...	Triglyceride
...	...	...	...	High density lipoprotein
...	...	Pesticides: even-numbered examinees	Pesticides: all examinees	...
...	...	Creatinine	Creatinine	Creatinine
...	...	Syphilis	Syphilis	Syphilis
Iron	Iron	Iron	Iron	Iron
Total iron binding capacity	Total iron binding capacity	Total iron binding capacity	Total iron binding capacity	Total iron binding capacity
Folate[2]	Folate[2]	Folate[2]	Folate[2]	Folate[2]
B12[2]	B12[2]	B12[2]	B12[2]	B12[2]
...	Vitamin A	...	...	...
...	Copper	Copper	Copper	Copper
...	Zinc	Zinc	Zinc	Zinc
...	Albumin	Albumin	Albumin	Albumin
...	...	...	...	Glucose tolerance: 75 gram load at 0-, 1-, and 2-hr intervals
...	Vitamin C	Vitamin C	Vitamin C	Vitamin C
		URINE		
...	N-Multistix: 6-11 yr only	N-Multistix	N-Multistix	N-Multistix
...	...	Gonorrhea	Gonorrhea: 20-40 yr only	Gonorrhea: 20-40 yr for men; 20-24 yr for women
...	...	...	...	Microscopy
...	...	...	...	Specific gravity
...	...	Pesticides	Pesticides	...

1 Bilirubin, SGOT, and alkaline phosphatase performed only on those samples with elevated bile acids.
2 Performed only on those samples with abnormal complete blood count, hemoglobin, hematocrit, or mean corpuscular volume.

Hispanic Health and Nutrition Examination Survey

Sponsoring Agency: National Center for Health Statistics, DHHS

Conducted: 1982–84.

Target population: Civilian noninstitutionalized "eligible" Hispanics; aged 6 months through 74 years; that is, Mexican Americans in five Southwestern States, Cubans in Dade County, Florida, and Puerto Ricans in New York, New Jersey, and Connecticut.

Design: Complex, multistage, stratified, clustered samples of the defined populations.

Sample size/response rate (see also tables I–7 through I–10):

	Sample size	Interviewed	Examined
Mexican–Americans	9,894	8,554 (87%)	7,462 (75%)
Cubans	2,244	1,766 (79%)	1,357 (61%)
Puerto Ricans	3,786	3,369 (89%)	2,834 (75%)

Measures: Dietary interviews, body measurements, hematological tests, biochemical analyses of whole blood and serum, oral glucose tolerance tests, blood pressures, electrocardiograms (see tables I–11 and I–12).

Survey description: The National Center for Health Statistics (NCHS) collects, analyzes, and disseminates data on the health status of Americans. The results of surveys, analyses, and studies are made known primarily through publications and the release of computer data tapes.

From 1960 through 1980 NCHS conducted five population–based, national health examination surveys. Each survey involved collecting data by direct physical examination, the taking of a medical history, and laboratory and clinical tests and measurements. Questionnaires and examination components have been designed to obtain and support analyses of data on certain targeted conditions such as diabetes, hypertension, and anemia. Beginning with the first National Health and Nutrition Examination Survey (NHANES I) a nutrition component was added to obtain information on nutritional status and dietary practices. The numbers of Hispanics in these samples were, however, insufficient to enable adequate estimation of their health conditions. From 1982 through 1984 a Hispanic Health and Nutrition Examination Survey (HHANES) was conducted to obtain data on the health and nutritional status of three Hispanic groups: Mexican Americans from Texas, Colorado, New Mexico, Arizona, and California; Cubans from Dade County, Florida; and Puerto Ricans from the New York City area, including parts of New Jersey and Connecticut.

The general structure of the HHANES sample design was similar to that of the previous National Health and Nutrition Examination Surveys. All of these studies have used complex, multistage, stratified, clustered samples of defined populations. The major difference between HHANES and the previous surveys is that HHANES was a survey of three special subgroups of the population in selected areas of the United States rather than a national probability sample. A detailed presentation of the design specifications is found in chapter 5 of "Plan and Operation of the Hispanic Health and Nutrition Examination Survey, 1982–84" (NCHS, 1985).

Table I-7. Sample size and response rates for persons of specified Hispanic origin, by age and sex: Hispanic Health and Nutrition Examination Survey, 1982-84

Hispanic origin, age, and sex	Total sample size	Number interviewed	Percent interviewed	Number examined	Percent examined
Mexican American					
Total	9,455	8,222	86.96	7,197	76.12
4-74 years	8,482	7,327	86.38	6,386	75.29
20-74 years	4,735	3,935	83.10	3,326	70.24
6 months-3 years	973	895	91.98	811	83.35
4-5 years	519	482	92.87	439	84.59
6-11 years	1,508	1,384	91.78	1,287	85.34
12-15 years	896	807	90.07	732	81.70
16-19 years	824	719	87.26	602	73.06
20-29 years	1,407	1,207	85.79	1,003	71.29
30-39 years	1,093	957	87.56	837	76.58
40-49 years	822	661	80.41	558	67.88
50-59 years	847	653	77.10	561	66.23
60-69 years	420	338	80.48	266	63.33
70-74 years	146	119	81.51	101	69.18
Male	4,589	3,926	85.55	3,385	73.76
Female	4,866	4,296	88.29	3,812	78.34
Cuban					
Total	2,125	1,677	78.92	1,291	60.75
4-74 years	2,012	1,582	78.63	1,225	60.88
20-74 years	1,481	1,134	76.57	865	58.41
6 months-3 years	113	95	84.07	66	58.41
4-5 years	52	44	84.62	29	55.77
6-11 years	178	152	85.39	126	70.79
12-15 years	145	123	84.83	104	71.72
16-19 years	156	129	82.69	101	64.74
20-29 years	244	173	70.90	127	52.05
30-39 years	247	196	79.35	152	61.54
40-49 years	311	237	76.21	186	59.81
50-59 years	356	286	80.34	223	62.64
60-69 years	226	167	73.89	117	51.77
70-74 years	97	75	77.32	60	61.86
Male	999	786	78.68	608	60.86
Female	1,126	891	79.13	683	60.66
Puerto Rican					
Total	3,525	3,137	88.99	2,645	75.04
4-74 years	3,195	2,835	88.73	2,387	74.71
20-74 years	1,764	1,519	86.11	1,220	69.16
6 months-3 years	330	302	91.52	258	78.18
4-5 years	166	149	89.76	131	78.92
6-11 years	501	463	92.42	420	83.83
12-15 years	382	358	93.72	316	82.72
16-19 years	382	346	90.58	300	78.53
20-29 years	454	394	86.78	317	69.82
30-39 years	370	317	85.68	266	71.89
40-49 years	365	310	84.93	259	70.96
50-59 years	337	295	87.54	234	69.44
60-69 years	186	157	84.41	119	63.98
70-74 years	52	46	88.46	25	48.08
Male	1,575	1,385	87.94	1,155	73.33
Female	1,950	1,752	89.85	1,490	76.41

Table I-8. Number examined and estimated population for Mexican-American persons 6 months-74 years of age, by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty: Number of examined persons	Below poverty: Estimated population in thousands	Above poverty: Number of examined persons	Above poverty: Estimated population in thousands
Both sexes				
6 months-3 years	287	268	475	481
4-5 years	147	134	261	252
6-11 years	467	414	720	686
Male				
12-15 years	121	128	216	246
16-19 years	85	110	156	204
20-29 years	101	225	306	682
30-39 years	70	131	284	577
40-49 years	49	64	173	262
50-59 years	53	55	161	192
60-69 years	41	54	71	89
70-74 years	14	*	21	*
Female				
12-15 years	140	145	183	202
16-19 years	127	141	175	194
20-29 years	160	256	358	586
30-39 years	134	188	296	445
40-49 years	93	106	189	233
50-59 years	98	101	190	201
60-69 years	46	56	77	92
70-74 years	37	45	18	*

Table I-9. Percent of examined persons with missing blood assessments, by specified Hispanic origin and age: Hispanic Health and Nutrition Examination Survey, 1982-84

Hispanic origin and age	Number of examined persons	Hemoglobin	Hematocrit	Red blood cell count	White blood cell count	Mean corpuscular hemoglobin	Mean hemoglobin concentration	Mean corpuscular hemoglobin concentration
Mexican American								
Total...............	7,197	8.5	7.5	9.1	8.6	9.1	9.2	8.5
4-74 years..........	6,386	6.8	5.9	7.4	7.0	7.4	7.5	6.8
20-74 years.........	3,326	2.8	2.0	3.4	2.9	3.4	3.5	2.8
6 months-3 years....	811	21.9	20.2	22.4	21.6	22.7	23.2	22.1
4-5 years...........	439	31.0	29.8	31.2	31.2	31.2	31.2	31.0
6-11 years..........	1,287	11.0	9.6	11.7	11.2	11.7	11.7	11.0
12-15 years.........	732	5.3	4.4	5.9	5.6	5.9	5.9	5.3
16-19 years.........	602	3.8	3.7	5.1	4.0	5.1	5.1	3.8
20-29 years.........	1,003	2.8	2.3	3.2	3.0	3.2	3.2	2.8
30-39 years.........	837	3.0	2.2	3.7	3.2	3.7	3.7	3.0
40-49 years.........	558	3.8	2.2	3.8	3.6	3.8	3.9	3.8
50-59 years.........	561	2.5	2.0	3.6	2.7	3.6	3.7	2.5
60-69 years.........	266	1.1	0.8	2.6	1.5	2.6	2.6	1.1
70-74 years.........	101	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Cuban								
Total...............	1,291	7.4	7.4	7.7	7.7	7.7	7.7	7.4
4-74 years..........	1,225	6.3	6.2	6.5	6.5	6.5	6.5	6.3
20-74 years.........	865	2.3	2.2	2.5	2.5	2.5	2.5	2.3
6 months-3 years....	66	28.8	28.8	28.8	28.8	28.8	28.8	28.8
4-5 years...........	29	34.5	34.5	34.5	34.5	34.5	34.5	34.5
6-11 years..........	126	22.2	22.2	22.2	22.2	22.2	22.2	22.2
12-15 years.........	104	11.5	11.5	12.5	12.5	12.5	12.5	11.5
16-19 years.........	101	6.9	6.9	6.9	6.9	6.9	6.9	6.9
20-29 years.........	127	5.5	5.5	5.5	5.5	5.5	5.5	5.5
30-39 years.........	152	4.6	3.9	4.6	4.6	4.6	4.6	4.6
40-49 years.........	186	1.1	1.1	1.1	1.1	1.1	1.1	1.1
50-59 years.........	223	.0	0.0	0.4	0.4	0.4	0.4	0.0
60-69 years.........	117	2.6	2.6	2.6	2.6	2.6	2.6	2.6
70-74 years.........	60	1.7	1.7	3.3	3.3	3.3	3.3	1.7

Table I-9. Percent of examined persons with missing blood assessments, by specified Hispanic origin and age: Hispanic Health and Nutrition Examination Survey, 1982-84 - continued

Hispanic origin and age	Number of examined persons	Hemoglobin	Hematocrit	Red blood cell count	White blood cell count	Mean corpuscular hemoglobin	Mean hemoglobin concentration	Mean corpuscular hemoglobin concentration
Puerto Rican								
Total	2,645	12.6	12.4	14.6	14.6	14.7	14.7	12.7
4-74 years	2,387	11.4	11.2	13.5	13.5	13.5	13.5	11.4
20-74 years	1,220	4.8	4.8	7.4	7.4	7.4	7.5	4.9
6 months-3 years	258	24.0	23.6	25.2	24.4	26.0	25.2	24.8
4-5 years	131	43.5	43.5	44.3	44.3	44.3	44.3	43.5
6-11 years	420	21.2	21.0	23.3	23.3	23.3	23.3	21.2
12-15 years	316	11.7	11.1	13.6	13.6	13.6	13.6	11.7
16-19 years	300	10.0	9.7	11.0	11.0	11.0	11.0	10.0
20-29 years	317	5.0	4.7	7.9	7.9	7.9	7.9	5.0
30-39 years	266	5.6	5.6	7.9	7.9	7.9	7.9	5.6
40-49 years	259	5.0	5.0	7.7	7.7	7.7	7.7	5.0
50-59 years	234	2.6	2.6	5.6	5.6	5.6	6.0	3.0
60-69 years	119	6.7	6.7	7.6	7.6	7.6	7.6	6.7
70-74 years	25	4.0	4.0	8.0	8.0	8.0	8.0	4.0

Table I-9. Percent of examined persons with missing blood assessments, by specified Hispanic origin and age: Hispanic Health and Nutrition Examination Survey, 1982-84 - continued

Hispanic origin and age	Serum iron	Total iron-binding capacity	Transferrin saturation	Vitamin A	Vitamin E	Erythrocyte protoporphyrin	Serum cholesterol
Mexican American							
Total	12.6	9.3	12.6	11.0	11.0	6.8	3.7
4-74 years	12.6	9.3	12.6	11.0	11.0	6.8	3.7
20-74 years	6.4	3.4	6.4	4.5	4.6	3.2	3.7
6 months-3 years	$	$	$	$	$	$	$
4-5 years	47.2	42.6	47.4	46.7	46.9	30.5	$
6-11 years	19.7	17.3	19.7	20.1	20.0	9.8	$
12-15 years	10.2	5.5	10.2	6.7	6.7	4.8	$
16-19 years	9.3	5.5	9.3	6.3	6.3	5.0	$
20-29 years	6.3	3.7	6.3	5.1	5.1	3.6	4.0
30-39 years	6.7	3.2	6.7	4.4	4.4	3.1	3.6
40-49 years	5.9	3.4	5.9	4.7	4.7	3.0	3.8
50-59 years	6.2	3.2	6.2	4.1	4.1	3.2	3.7
60-69 years	6.8	2.6	6.8	3.0	3.4	2.3	2.3
70-74 years	8.9	5.0	8.9	5.0	5.9	5.0	4.0
Cuban							
Total	6.2	6.2	7.6	6.2	6.2	7.8	4.5
4-74 years	6.2	6.2	7.6	6.2	6.2	7.8	4.5
20-74 years	2.2	2.2	3.1	2.2	2.2	4.4	4.5
6 months-3 years	$	$	$	$	$	$	$
4-5 years	34.5	34.5	51.7	34.5	34.5	34.5	$
6-11 years	22.2	22.2	23.0	22.2	22.2	22.2	$
12-15 years	11.5	11.5	14.4	11.5	11.5	11.5	$
16-19 years	6.9	6.9	6.9	6.9	6.9	6.9	$
20-29 years	5.5	5.5	7.9	5.5	5.5	7.1	10.2
30-39 years	3.9	3.9	4.6	3.9	3.9	5.9	5.3
40-49 years	1.1	1.1	1.6	1.1	1.1	2.2	2.2
50-59 years	0.0	0.0	0.9	0.0	0.0	3.1	2.7
60-69 years	2.6	2.6	3.4	2.6	2.6	4.3	5.1
70-74 years	1.7	1.7	1.7	1.7	1.7	6.7	3.3

NOTE: $ Assessment not performed on this age group.

Table I-9. Percent of examined persons with missing blood assessments, by specified Hispanic origin and age: Hispanic Health and Nutrition Examination Survey, 1982-84 - continued

Hispanic origin and age	Serum iron	Total iron-binding capacity	Transferrin saturation	Vitamin A	Vitamin E	Erythrocyte protoporphyrin	Serum cholesterol
Puerto Rican							
Total	11.1	11.1	13.4	11.1	11.1	11.1	6.7
4-74 years	11.1	11.1	13.4	11.1	11.1	11.1	6.7
20-74 years	4.8	4.8	6.4	4.8	4.8	4.8	6.7
6 months-3 years	$	$	$	$	$	$	$
4-5 years	42.7	42.7	53.4	42.7	42.7	42.7	$
6-11 years	21.0	21.0	23.1	21.0	21.0	21.0	$
12-15 years	11.1	11.1	12.7	11.1	11.1	11.1	$
16-19 years	9.7	9.7	12.0	9.7	9.7	9.7	$
20-29 years	4.7	4.7	7.9	4.7	4.7	4.7	8.2
30-39 years	5.6	5.6	6.8	5.6	5.6	5.6	6.4
40-49 years	5.0	5.0	5.4	5.0	5.0	5.0	6.6
50-59 years	2.6	2.6	4.7	2.6	2.6	2.6	4.3
60-69 years	6.7	6.7	7.6	6.7	6.7	6.7	9.2
70-74 years	4.0	4.0	4.0	4.0	4.0	4.0	4.0

NOTE: $ Assessment not performed on this age group.

Table I-10. Number examined and estimated population for Hispanic persons 6 months-74 years of age, by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American		Cuban		Puerto Rican	
	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands
Both sexes						
6 months-3 years	811	795	66	18	258	96
4-5 years	439	412	29	8	131	49
6-11 years	1,287	1,187	126	38	420	157
Male						
12-15 years	379	418	58	16	154	60
16-19 years	275	356	56	16	147	57
20-29 years	444	991	57	30	114	76
30-39 years	376	750	56	28	90	61
40-49 years	243	358	82	32	88	46
50-59 years	235	270	109	34	101	35
60-69 years	124	159	45	14	41	15
70-74 years	39	56	28	9	11	*
Female						
12-15 years	353	375	46	14	162	60
16-19 years	327	360	45	13	153	58
20-29 years	559	903	70	32	203	130
30-39 years	461	680	96	44	176	111
40-49 years	315	378	104	39	171	81
50-59 years	326	344	114	36	133	44
60-69 years	142	169	72	22	78	24
70-74 years	62	76	32	10	14	*

Table I-11. Examination components in the Hispanic Health and Nutrition Examination Survey, 1982-84

6 months-5 years	6-11 years	12-19 years	20-74 years *(nonfasting)*	20-74 years *(fasting)*
Physician exam	Physician exam	Physician exam	Physician exam	Physician exam
Dental exam	Dental exam	Dental exam	Dental exam	Dental exam
Dietary interview	Dietary interview	Dietary interview	Dietary interview	Dietary interview
Body measurements	Body measurements	Body measurements	Body measurements	Body measurements
TB skin test[1]	TB skin test[1]	TB skin test[1]	TB skin test[1]	TB skin test[1]
Tympanic impedance	Tympanic impedance	Tympanic impedance	Tympanic impedance	Tympanic impedance
...	Audiometry	Audiometry	Audiometry	...
...	Vision test	Vision test	Vision test	...
Venipuncture[2]	Venipuncture	Venipuncture	Venipuncture	Venipuncture
...	Urine	Urine	Urine	Urine
...	...	Hair collection	...	Hair collection
...	...	...	Posterior-anterior chest X-ray	Posterior-anterior chest X-ray
...	...	...	Lateral chest X-ray[3]	Lateral chest X-ray[3]
...	...	...	Electrocardiogram	Electrocardiogram
...	...	...	...	Oral glucose tolerance test
...	...	...	...	Ultrasound examination

[1] Conducted under special arrangements in the California and Dade County, Florida sites.
[2] Fingerstick only for 6 months-3 years of age.
[3] For persons 45-74 years of age.
NOTE: ... = Category not applicable.

Table I-12. Blood and urine assessments in the Hispanic Health and Nutrition Examination Survey, 1982-84

Test	Age				
	6 months-5 years[1]	6-11 years	12-19 years	20-74 years (nonfasting)	20-74 years (fasting)
			Whole blood		
Lead	X	X	X	X	X
Protoporphyrin	X	X	X	X	X
Red blood cell folate[2]	X	X	X	X	X
Complete blood counts[3]	X	X	X	X	X
			Serum		
Iron	X[4]	X	X	X	X
Total iron binding capacity	X[4]	X	X	X	X
Ferritin	X[4]	X	X	X	X
Folate[2]	X[4]	X	X	X	X
Differential count[2]	X[4]	X	X	X	X
Vitamins A and E	X[4]	X	X	X	X
Glucose	...	...	...	X	X
Cholesterol	...	...	...	X	X
Triglycerides	...	...	...	...	X
High density lipoprotein	...	...	...	X	X
Pesticides (organic)	...	...	X	X	...
Syphilis serology	...	...	X	X	X
Albumin	...	...	...	X	X
Total protein	...	...	...	X	...
Alkaline phosphatase	...	...	...	X	X
LDH	...	...	...	X	X
SGOT	...	...	...	X	X
Phosphorus	...	...	...	X	X
Uric acid	...	...	...	X	X
Total bilirubin	...	...	...	X	X
Calcium	...	...	...	X	X
Urea Nitrogen	...	...	...	X	X
Creatinine	...	...	...	X	X
Total CO[2]	...	...	...	X	X
Chloride	...	...	...	X	X
Sodium	...	...	...	X	X
Potassium	...	...	...	X	X
SGPT	...	...	...	X	X
Tetanus	X[4]	X	...	...	...
			Serum and hair samples		
Selected trace metals[5]	...	...	X	...	X
			Plasma		
Oral glucose tolerance test	...	...	...	...	X
			Urine		
N-Multistix	...	X	X	X	X
Pesticides	...	...	X	X	...

[1] Fingerstick only for persons 6 months-3 years of age.
[2] Special hematological subsample only.
[3] Includes hematocrit, hemoglobin, red and white cell counts, mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration.
[4] 4-5 years of age.
[5] Performed on a subset of the samples collected as a pilot test only.
NOTE: X = category applicable; ... = category not applicable.

Data collection began with a household interview. Several questionnaires were administered:

- A Household Screener Questionnaire (HSQ), administered at each selected address, for determining household eligibility and for selecting sample persons.

- A Family Questionnaire (FQ), administered once for each family containing sample persons, which included sections on family relationships, basic demographic information for sample persons and head of family, Medicare and health insurance coverage, participation in income assistance programs, and housing characteristics.

- An Adult Sample Person Questionnaire (ASPQ), for persons 12 through 74 years which, depending on age, included sections on health status measures, health services utilization, smoking (20 through 74 years), meal program participation, and acculturation. Information on the use of medicines and vitamins in the past two weeks was also obtained.

- A Child Sample Person Questionnaire (CSPQ), for sample persons 6 months through 11 years which included sections on a number of health status issues, health care utilization, infant feeding practices, participation in meal programs, school attendance, and language use. Information on the use of medicines and vitamins in the past two weeks was also obtained.

At the Mobile Examination Center two questionnaires were administered and an examination performed:

- An Adult Sample Person Supplement (ASPS), for sample persons 12 through 74 years, which included sections on alcohol consumption, drug abuse, depression, smoking (12 through 19 years), pesticide exposure, and reproductive history.

- A Dietary Questionnaire (DQ), for persons 6 months through 74 years, by which trained dietary interviewers collected information about "usual" consumption habits and dietary practices, and recorded foods consumed 24-hours prior to midnight of the interview.

- An examination which included a variety of tests and procedures was performed. Age at interview and other factors determined which procedures were administered to which examinees. A dentist performed a dental examination and a vision test. Technicians took blood and urine specimens and administered a glucose tolerance test, X-rays, electrocardiograms, and ultrasonographs of the gallbladder. Technicians also performed hearing tests and took a variety of body measurements. A physician performed a medical examination focusing especially on the cardiovascular, gastrointestinal, neurological, and musculoskeletal systems. The physician's impression of overall health, nutritional and weight status, and health care needs were also recorded. Some blood and urine specimen analyses were performed by technicians in the examination center; others were conducted under contract at various laboratories.

Descriptions of the special clinical procedures and tests follow:

<u>Ultrasound examination of the gallbladder</u>: For the purpose of estimating the prevalence of gallstones, an ultrasound examination was conducted on a specified subsample of examinees 20 through 74 years of age.

<u>Dental examination</u>: All examined persons received an examination that included the following measures of dental health: (1) a decayed, missing, filled (DMF) surface index, (2) a dental restorative treatment needs index, (3) a simplified oral hygiene index, (4) a periodontal index, (5) an assessment of need for and quality of full dentures, and (6) an assessment of malocclusion.

<u>Vision screening</u>: Examined persons 6 through 74 years of age were tested for visual acuity. The near vision and distance vision tests involved reading test cards with Sloan letters or Landolt rings set at standard distances from the eyes. Binocularity of vision was tested by using the Random Dot E (RDE) test.

<u>Tympanic impedance</u>: For the purpose of assessing levels of effusive and noneffusive middle ear disease, impedance tympanometry was performed on all examined persons. In this procedure, the mobility of the tympanic membrane is induced and recorded electronically under varied air pressures in the ear canal.

<u>Puretone audiometry</u>: This test, conducted on examined persons between the ages of 6 and 74 years, permitted determination of threshold levels of hearing for frequencies of 500, 1000, 2000, and 4000 hertz for each ear.

Electrocardiograms: Electrocardiographic signals, for examined persons 20 through 74 years of age, were digitized and recorded on magnetic tape. This provided normative data on amplitude, duration, interval and axis measurements, and permitted interpretations of heart disease according to the Minnesota classification code.

Body measurements: Measurements were made on all examinees and included standing height and/or recumbent length, depending on age; body weight; triceps and subscapular skinfolds; and various other measurements.

Hair collection: A small sample of hair was collected from each examined person 12 through 74 years of age and analyzed for selected trace elements. These data, which were collected for the Centers for Disease Control for methodological purposes, can be related to body burdens or stores of the elements and to overall nutritional and health status.

Tuberculin skin test: In the California and Dade County, Florida PSUs, examinees were injected with 5 tuberculin units of purified protein derivative (PPD) to test for exposure to tuberculosis. Examinees were examined at the examination center or at home 2 to 3 days later by a trained nurse who read and recorded the test results.

X-rays: Two chest X-rays were made, as follows:

- Posterior-anterior (PA) – This X-ray of persons 20 through 74 years of age was used for the determination of heart size and diagnosis of cardiovascular conditions, lung and chest conditions, and structural deformities.

- Lateral – Taken of persons 45 through 74 years of age, this X-ray provided an additional parameter for the determination of heart size. No X-rays were taken of pregnant women.

Urine tests: The following tests were performed on casual samples of urine:

- N-Multistix tests – These urinary dipstick tests for qualitative protein, glucose, ketones, bilirubin, blood, urobilinogen, pH, and bacteriuria (nitrite test) were done for examined persons 6 through 74 years of age.

- Urinary sediments – Sediments including red cells, white cells, and casts were measured for persons 6 through 74 years of age.

- Analysis for pesticide levels – Urine samples from a half sample of examined persons 12 through 74 years of age were tested for the presence of alkyl phosphate residues and metabolites, carbamate residues, phenolic compound residues, and malathion metabolites.

Tests on blood samples: Tests on blood samples provide a broad range of information related to health and nutrition. The particular tests performed varied with the specific target condition and age group.

- Oral glucose tolerance test (OGTT) – This test involved the collection of blood specimens from examined persons while they were in a fasting state as well as at 1 and 2 hours after the glucose challenge. The test was performed on a specified half sample of examined adults 20 through 74 years of age to provide estimates of the prevalence of diabetes and impaired glucose tolerance.

- Liver function tests – Biochemical liver tests, performed on examined persons 20 through 74 years of age, included bilirubin, SGOT, SGPT, and alkaline phosphatase.

- Anemia-related laboratory tests – For the diagnosis of anemia, tests on blood samples included protoporphyrin, iron, total iron-binding capacity, red cell folates, serum folates, serum ferritin, and abnormal hematological indices.

- Other biochemical nutritional tests – These tests included alpha-tocopherol and retinol.

- Serum lipids – Because of their relevance to cardiovascular disease, determinations were made of serum cholesterol, triglycerides, and high density lipoprotein (HDL).

- Biochemical tests for body burden from environmental exposures – Levels of lead (all persons) and organochlorine pesticide residues and metabolites (half sample of persons 12 through 74 years of age) were determined. Tests for carboxyhemoglobin and thiocyanate were performed on a half sample of persons 3 through 74 years of age for the first 12 examination sites only.

- Hematology – The hematological determinations included hemoglobin, hematocrit, red blood cell count, white blood cell count and differential analysis, and red blood cell morphology.

- Kidney function – The serum creatinine test for kidney function was performed on blood samples.

- Syphilis serology – The serology determinations for syphilis for examined persons 12 through 74 years of age included qualitative and quantitative ART, a FTA–ABS, and MHA–TP.

Because the HHANES sample is not a simple random one, it is necessary to incorporate sample weights for proper analysis of the data. These sample weights are a composite of individual selection probabilities, adjustments for noncoverage and nonresponse, and poststratification adjustments. Because of the complex sample design and the ratio adjustments used to produce the sample weights, commonly used methods of point and variance estimation and hypothesis testing which assume simple random sampling may give misleading results.

Nonresponse analyses: The response–nonresponse situation for NHANES and HHANES was somewhat different from the surveys conducted for the USDA. The NHANES and HHANES consisted of a screening component, an interview component, and an examination component. In NHANES II and HHANES, the screening rates ranged from 99.5 to 99.9 percent. Unlike CSFII 1985–86, proxy responses were accepted for the screening questionnaire which determines if an eligible respondent resides in the household. The extremely small nonresponse to the screeners is taken into account in the post–stratification adjustments in which ratio adjustments were made within each age–sex–race/ethnicity cell to independent estimates provided by the U.S. Bureau of the Census for the population as of the midpoint of the survey. Because screening is completed in virtually the entire sample and the extremely small nonresponse to the screener is built into the post–stratification adjustment calculations, NCHS has not found it necessary to show screening rates in the response rate calculations.

The interview response rate was calculated by dividing the number of sample persons completing the interview by the total sample size. Similarly, the examination response rate was calculated by dividing the number of sample persons completing the examination by the total sample size.

The nonresponse bias analyses considered in this report covered both NHANES II and HHANES. In both surveys, the first stage of nonresponse (refusal of the screener) constituted less than 0.5 percent of the target sample, and therefore is not an important problem. For the NHANES II analysis, the second stage of nonresponse (nonresponse to the interview) was addressed through comparison of identical questions in the National Health Interview Survey which at that time had a response rate in the high 90s. For HHANES, information from the screeners was used to assess bias in the interviewed sample. After demonstrating that there did not appear to be significant bias in the interviewed sample, the third stage of nonresponse (nonresponse to the examination) was assessed in both surveys by comparing the characteristics of the examined and interviewed samples. For each of the specific analyses presented in this report, an additional nonresponse bias analysis was performed to determine if the analytical subsamples differed from the examined sample. The NHANES II had an overall interview rate of 91 percent and an examination rate of 73 percent. The examination rate is of most interest, and it ranged from a low of 62 percent for persons aged 65–74 years to a high of 82.7 percent for children 6–11 years old (DHHS/USDA, 1986). The existence of these components made it possible to use information from those interviewed but not examined to address the nonresponse bias issue. Additionally, the National Health Interview Survey that was conducted at approximately the same time as NHANES II had a response rate of 97 percent and included many of the same questions as NHANES II, thereby facilitating the investigation of nonresponse bias in NHANES II. Results of this investigation were published by Forthofer (1983). There was little indication of bias due to nonresponse for the variables examined. The HHANES 1982–84 consisted of three separate surveys. For the Mexican Americans, the response rate for those examined was 75 percent compared to rates of 61 percent for the Cubans and 75 percent for the Puerto Ricans.

Clearly, there was substantial nonresponse for these households surveys, consequently raising the possibility of nonresponse bias. Therefore, it was necessary to compare the samples to the target populations based on whatever information was available. Even if differences between the samples and the populations were absent, nonresponse bias could be present in the data. If differences were found, it may be possible to adjust the data for the differences that were identified. The NCHS conducted an examination of the potential for nonresponse bias in HHANES. The investigation consisted of several components:

- Comparison of those who provided only limited demographic data (age, sex, household size, and language of the screener) with those who provided a medical history.
- Comparison of the total selected sample with only those who provided the medical history.
- Comparison of those who provided only limited demographic data with those who were examined.
- Comparison of the weighted interviewed and examined samples:
    - for those 6 months–74 years of age based on the eight variables: birthplace, marital status of the head of household, education of the head of household, health insurance coverage, perceived health status, report of never having had a routine physical, report of ever having vision problems, and report of ever having hearing problems;
    - for those 12–74 years of age based on five variables: previous diagnosis of high blood pressure or hypertension, report of previous physician diagnosis of anemia, report of previous physician diagnosis of diabetes, report of previous physician diagnosis of bronchitis, and self–perception of overweight;
    - for those 20–74 years of age based on the variables of report of previous physician diagnosis of gallstones and current smoking status; and
    - for those 6 months–11 years of age based on three variables: previous physician diagnosis of anemia, perception of overweight, and previous physician diagnosis of asthma.

Interviewed and examined persons tended to be younger than those not interviewed or examined. For the Mexican Americans and Puerto Ricans, females were more likely than males to be interviewed and examined. Household size was positively associated with participation, and if the language of the interview was Spanish, the household was more likely to participate.

In the comparison of the interviewed and examined, Cubans who were examined were more likely to have a family income below $10,000 than those who were interviewed. Cuban females who were examined were more likely to have no health insurance, not to have had a routine exam, and to have hearing problems. The Cubans examined were more likely to state that they had fair or poor health status than the interviewed persons. Cuban males aged 45–74 years who were examined were more likely to report a previous diagnosis of hypertension and examined Cuban females were more likely to be current smokers than those in the interviewed group. For children aged 6 months–11 years, Mexican–American girls in the examined sample were more likely to be called overweight than those in the interviewed sample, and Puerto Ricans in the examined sample were more likely to have a previous physician diagnosis of anemia than those in the interviewed group.

The adjustment of the sample weights for nonresponse and the poststratification done for the Mexican–American sample corrected for differences in the marginal distributions of age, sex, income, and household size. There is no guarantee that because the marginal distributions have been made to agree, bias no longer exists; however, it is a reasonable approach. These adjustments have not dealt with the differences that were found in the Cuban sample between the examined and interviewed groups. These differences are of concern, suggesting the data from the Cuban sample should be interpreted with caution.

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NHANES I Epidemiologic Followup Study

Sponsoring Agency: National Center for Health Statistics, DHHS

Conducted: 1982–84, 1986.

Target population: 14,407 persons examined in NHANES I who were 25 through 74 years old at baseline.

Sample size/response rate:

Total subjects in cohort	Traced (1982–84)	Interviewed 1982–84)
14,407	13,380 (92.9%)	12,220 (84.8%)

Measures: Personal interview for survivors and proxy interviews for decedents and incapacited persons including medical history, history of hospitalization, functional status, medications usage, smoking history, alcohol history, psychological status, food frequency, and physical activity; physical measurements of pulse, blood pressure, and weight; death certificates; hospital and nursing home records for overnight stays.

Background: NHANES I was carried out in 1971–75 and was designed to collect extensive health-related information on a probability sample of the U.S. civilian noninstitutionalized population. To increase sample size in selected population subgroups, there was oversampling of the elderly, of women of childbearing age, and of persons living in poverty areas.

The NHANES I Epidemiologic Followup Study (NHEFS) builds on the baseline data collected in NHANES I. The objectives of the followup are to study (a) mortality, morbidity, and institutionalization associated with suspected risk factors; (b) changes in the participants' characteristics between NHANES I and the followup survey; and (c) the progression of chronic disease and functional impairments. The study population comprised the 14,407 examinees in NHANES I who were 25–74 years old at the time of that survey. An attempt was made to trace all these examinees to their current addresses. Personal interviews, which included weight, blood pressure, and pulse measurements, were conducted with survivors. Personal interviews were also conducted with suitable proxies for deceased or incapacitated participants.

In order to be accepted as a proxy respondent, the individual had to answer correctly the verification questions which were used to establish the identity of the deceased NHANES I participant. Persons who had lived with the subject were the preferred proxies. Thirty-seven percent of the proxy respondents were spouses of the subject, 39 percent were children, 10 percent were siblings, and the remaining 14 percent had various connections with the subject such as friend, neighbor, or other relative.

Death certificates for deceased persons were also obtained. Records of hospitalizations and nursing home stays were collected for both surviving and deceased participants.

The results of data collection activities in the NHEFS are summarized in the diagram (figure I–1). Ninety-three percent of the cohort was successfully traced--11,358 were alive at followup, and 2,022 were deceased. Interviews were successfully completed for 93 percent of the traced examinees who were alive at followup. Interviews with proxy respondents were completed for 84 percent of those deceased. Death certificates were obtained for 96 percent of decedents. Both a death certificate and a proxy interview were available for 1,610 participants (80 percent of all decedents). A proxy interview only was available for 87 decedents (4 percent), and a death certificate only was available for the remaining 325 decedents (16 percent).

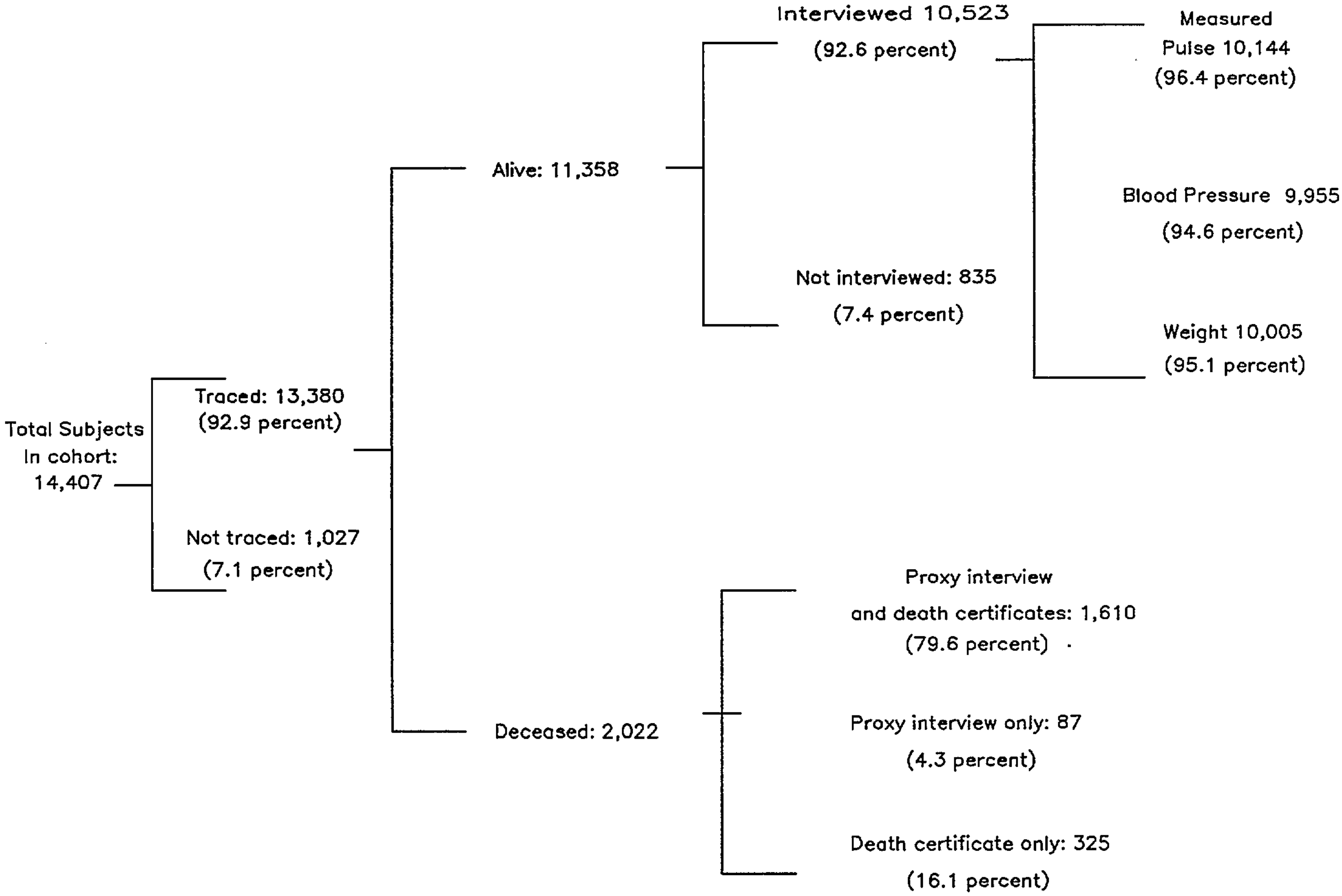

Figure I-1. Summary of data collection procedures, NHANES I Epidemiologic Followup Study.

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National Health Interview Survey

Sponsoring Agency: National Center for Health Statistics, DHHS

Specific survey name: National Health Interview Survey on Health Promotion and Disease Prevention

Conducted: January–December 1985.

Target population: Civilian noninstitutionalized population aged 18 years and over in the United States.

Design: Complex, multistage, stratified, clustered sample.

Sample size/response rate:

Sample size	Interviewed	Response rate
38,000	34,000	90%

Survey description: This survey was designed to measure progress toward the 1990 Health Objectives for the Nation and was collaboratively designed, sponsored, and analyzed by the Agencies in the Public Health Service which have responsibility for monitoring progress toward the Objectives. It is planned to repeat this survey in 1990, and to include new questions as baseline measures for the Year 2000 Health Objectives for the Nation.

Detailed list of variables:

Topical areas

Pregnancy and smoking	Occupational safety and health
Injury control	Child safety and health
High blood pressure	Stress
Exercise	Smoking
Alcohol use	Dental care
General health habits	

Nutrition-related items

Breakfast regularity	Snacking
Doctor's advice on diet	Height and weight
Weight loss knowledge	Weight loss practice
Perceived relative weight	Breastfeeding
Diet to reduce hypertension	Fluoride use

Specific survey name: National Health Interview Survey on Vitamin and Mineral Supplements

Conducted: January–June 1986.

Target population: Civilian noninstitutionalized children aged 2–6 years and adults aged 18 years and over in the United States.

Design: Complex, multistage, stratified, clustered sample.

Sample size/response rate (provisional estimates):

	Sample size	Interviewed	Examined
Children, 2–6 years	4,000	3,600	90%
Adults, 18 years and over	12,500	11,250	90%

Measures: Self–reports (for adults) and proxy–reports (for children) of vitamin or mineral supplements to the diet used during the two weeks before interview, including product name and manufacturer, nutrient information from product label, and dosage.

Survey description: Questions were designed to determine the prevalence and quantitative level of vitamin and mineral supplement intake among adults and young children in the United States. The project was initiated by the Food and Drug Administration's Division of Consumer Studies, Center for Food Safety and Applied Nutrition. The data obtained will provide baseline data aimed at meeting several priority objectives of the 1990 Health Objectives for the Nation.

Detailed list of variables: For each sample person it was determined how many vitamin or mineral supplement products were taken in the 2 weeks before interview. For each product, the interviewer obtained the product name and manufacturer, the number of days during the 2 weeks on which the product was taken, the form in which it was taken, the number of doses taken, the duration for which the product had been taken, and whether or not it was prescribed by a doctor. If the product container was available at the time of interview, the interviewer also recorded from the label each nutrient and its dosage; however, FDA later matched product information to its data files on product nutrient content, and those nutrient data were written onto the data tape. The pregnancy status and lactation status of sample women 18–44 years of age were also determined.

General description

Background: The National Health Interview Survey (NHIS) is the principal source of information on the health of the civilian noninstitutionalized population of the United States. The NHIS is one of the major data collection programs of the National Center for Health Statistics (NCHS). The National Health Survey Act of 1956 provided for a continuing survey and special studies to secure accurate and current statistical information on the amount, distribution, and effects of illness and disability in the United States and the services rendered for or because of such conditions. The survey referred to in the Act, now called the National Health Interview Survey, was initiated in July 1957. Since 1960, the survey has been conducted by NCHS, which was formed when the National Health Survey and the National Vital Statistics Division were combined.

Purpose and scope: The objective of the survey is to address major current health issues through the collection and analysis of data on the civilian noninstitutionalized population of the United States. National data on the incidence of acute illness and injuries, the prevalence of chronic conditions and impairments, the extent of disability, the utilization of health care services, and other health–related topics are provided by the survey. A major strength of this survey lies in the ability to display these health characteristics by many demographic and socioeconomic characteristics.

The NHIS data are obtained through personal interviews with household members. Interviews are conducted each week throughout the year in a probability sample of households. The interviewing is performed by a permanent staff of interviewers employed by the U.S. Bureau of the Census. Data collected over the period of a year form the basis for the development of annual estimates of the health characteristics of the population and for the analysis of trends in those characteristics.

The survey covers the civilian noninstitutionalized population of the United States living at the time of the interview. Because of technical and logistical problems, several segments of the population are not included in the sample or in the estimates from the survey. Persons excluded are: patients in long–term care facilities, persons on active duty with the Armed Forces (though their dependents are included), and U.S. nationals living in foreign countries.

Sample design: The NHIS is a cross–sectional household interview survey. Sampling and interviewing are continuous through each year. The sampling plan follows a multistage area probability design that permits the representative sampling of households. The first stage consists of a sample of about 200 primary sampling units (PSU) drawn from approximately 1,900 geographically defined PSU that cover the 50 States and the District of Columbia. A PSU consists of a county, a small group of contiguous counties, or a Metropolitan Statistical Area. Within PSU, intermediate stage units called segments are defined in such a manner that each segment contains approximately 40 households. Within these segments, a systematic sample of eight households is selected for the NHIS sample.

The NHIS sample implemented with the 1985 data collection year was a complete redesign from previous years. A feature that was added for the 1985 design is the formation of panels of PSU. The total NHIS sample of PSU is subdivided into four separate panels such that each panel is a representative sample of the U.S. population. This design feature has a number of advantages, including flexibility for the total sample size. The 1985 NHIS sample included three of the four panels and the 1986 NHIS sample included two panels.

Another design feature implemented in 1985 was the oversampling of black persons to improve the precision of estimates for that population. This resulted in an increase in the number of black persons in the NHIS sample by approximately 75 percent and an increase in the precision of most related statistics by more than 20 percent. The new sample design also facilitates followup studies of respondents and linkage with other national health-related data sets such as the National Death Index.

The households selected for interview each week are a probability sample representative of the target population. With four sample panels, data are collected from approximately 50,000 households including about 135,000 persons in a calendar year. Participation is voluntary and confidentiality of responses is guaranteed. The annual response rate of NHIS is over 95 percent of the eligible households in the sample. The nonresponse is divided equally between refusals and households where no eligible respondent could be found at home after repeated calls.

<u>Data collection procedures</u>: Data are collected through a personal household interview conducted by interviewers employed and trained by the U.S. Bureau of the Census according to procedures specified by the National Center for Health Statistics.

All adult members of the household 17 years of age and over who are at home at the time of the interview are invited to participate and to respond for themselves. For children and for adults not at home during the interview, information is provided by a responsible adult family member (19 years of age and over) residing in the household. Between 65 and 70 percent of the adults 17 years of age and over are self-respondents. Generally, a random subsample of adult household members is selected to respond for themselves to questions on current health topics that are added each year.

Nationally, there are approximately 150 interviewers, trained and directed by health survey supervisors in each of the 12 Census Bureau Regional Offices. The supervisors are career Civil Service employees whose primary responsibility is the NHIS. The interviewers are part-time employees, selected through an examination and testing process. Interviewers receive thorough training in basic interviewing procedures and in the concepts and procedures unique to the NHIS.

Depending on the family size and the nature and extent of health conditions of family members, the length of interview ranges between 20 and 90 minutes. On the average, the interviews require about 50 minutes in the household.

<u>Content of the questionnaire</u>: The questionnaire consists of two basic parts: (1) a set of basic health and demographic items, and (2) one or more sets of questions on current health topics. The basic items constitute approximately 50 percent of the questionnaire and are repeated each year. These items provide continuous information on basic health variables. Questions on current health topics facilitate a response to changing needs for data and coverage of a wide variety of issues. This combination yields a unique national health data base.

The questionnaire includes the following types of basic health and demographic questions:

- Demographic characteristics of household members, including age, sex, race, education, and family income.
- Disability days, including restricted-activity and bed-disability days, and work- and school-loss days occurring during the 2-week period prior to the week of interview, as well as 12-month bed days.
- Physician visits occurring during the same 2-week period, interval since the last physician visit, and the number of visits in the last 12 months.
- Acute and chronic conditions responsible for these days and visits.

- Long-term limitation of activity resulting from chronic disease or impairment and the chronic conditions associated with the disability.
- Short-stay hospitalization data, including the number of hospital episodes during the past year and the number of days for each stay.

In addition, each of six representative subsamples is asked to respond to questions about one of six lists of selected chronic conditions.

Questions on special health topics change in response to current interest and need for data. The 1983 questionnaire contained questions on alcohol, dental care, physician services, and health insurance. The 1984 current health topic questionnaire was devoted entirely to issues of aging, 1985 covered health promotion and disease prevention, and 1986 included questions on health insurance, dental health, vitamin and mineral intake, longest job worked, and functional limitations. The 1987 NHIS included an extensive questionnaire on cancer risk factors and questions on child adoption.

Suggestions and requests for special health topics are solicited and received from many sources. These include university-based researchers, administrators of national organizations and programs in the private and public health sectors, and other parts of the U.S. Department of Health and Human Services (for example, the National Institutes of Health and the Centers for Disease Control). Topics are selected after consultation with Agencies within the Public Health Service and after an assessment of priority health issues and the related need for population-based data. A lead time of at least 18 months is required to develop and pretest questions for new topics.

Reference:

National Center for Health Statistics, C. A. Schoenborn. 1988. Health Promotion and Disease Prevention, United States, 1985. *Vital and Health Statistics.* Series 10, No. 163. DHHS Pub. No. (PHS) 88-1591. Public Health Service. Washington: U.S. Government Printing Office.

Food Label and Package Survey

Sponsoring Agency: Food and Drug Administration, DHHS

Purpose of survey: The survey is conducted to monitor labeling practices of U.S. food manufacturers. Excluded from the survey are fresh fruit and vegetables and USDA regulated meat products. The survey also includes a surveillance program to identify levels of accuracy of selected nutrient declarations compared with values obtained from nutrient analysis of products.

Last survey conducted: 1986. (Previous surveys conducted in 1978, 1980, 1982, 1983, and 1984.)

Design:

- Biennial probability survey of retail packaged foods using commercial market research data bases (A. C. Nielsen Co.). The survey involves about 1,500 individual food brands representing about 44 percent of the packaged food supply in retail dollar terms. Label observations are interpreted on a share-of-the-market sales basis.

- Biennial analysis of a representative sample of the 55 percent of packaged foods which bear nutrition labels. Approximately 300 foods are analyzed for an average of eight nutrients.

Measures: Prevalence of nutrition labeling in general as well as declaration of selected nutrients/ingredients (for example, cholesterol and sodium content, fats and oils, food additives).

Sampling methodology: Represented in the 1986 survey were 143 packaged food classes chosen to account for a minimum of 75 percent of the annual retail sales of each of the 51 major supermarket food groups regulated by FDA. In addition, another 40 product classes were selected at random without regard to sales importance, bringing the total number of product classes included in the survey to 183. Excluded from the sample were fresh fruit and vegetables and fresh meat.

For each product class selected for the survey, the three leading brands (on the basis of share of market) were predesignated for inclusion in the product sample, using sales information contained in the A. C. Nielsen Company syndicated data base NEIS. An additional three brands (depending on total number of brands available) were sampled at random from each product class. A third set of three brands per category was selected at random and designated as substitutable replacements for selected products not available after reasonable search at retail. In total, 948 preselected brands were included in the sample.

In addition to prior specified brands, convenience samples of off-premises-baked bread, milk and ice cream were picked up in three major markets, one in the East, one in the West, and one in the Midwest. Field agents visited one chain and two independent stores in each market and purchased all brands available in each store. A total of 541 unduplicated products were obtained in this manner.

Field agents of the A. C. Nielsen Company purchased sample products at retail between February and July 1986.

Total Diet Study

Sponsoring Agency: Food and Drug Administration, DHHS

Purpose: The Total Diet Study (TDS) is conducted yearly to assess the levels of various nutritional elements and organic and elemental contaminants in the U.S. food supply and in representative diets of specific age-sex groups, and to monitor trends in the levels and consumption of these substances over time. The Selected Minerals in Foods Survey is the component of the TDS that estimates levels of 11 essential minerals in representative diets of specific age-sex groups.

Last survey conducted: 1987. (The TDS has been conducted annually since 1961. Collection of nutritional elements began in 1974.)

Target population: Eight age-sex groups: infants, young children, male and female teenagers, male and female adults, and male and female older persons. (Between 1975 and 1982, diets were collected for 3 groups: 6-month-old infants, 2-year-old toddlers, and teenaged males. Prior to 1975, only the teenaged male diet was used.)

Design: Two hundred and thirty-four foods are collected from retail markets in urban areas, prepared for consumption, and analyzed for nutritional elements and contaminants 4 times each year. The representative diets of specific age-sex groups which are used to estimate intake levels of nutrients and contaminants are based on the food consumption patterns indicated by NFCS 1977-78 and NHANES II. (Prior to 1982, food lists and diets were based on the 1965 and 1955 USDA Household Food Consumption Surveys. Also prior to 1982, foods were prepared for consumption and composited into 11 or 12 food groups before analysis for nutrients and contaminants.)

Sample size/response rate: Not applicable.

Measures: Assessment of food composition and dietary intake.

List of variables: Variables are listed only for the Selected Minerals in Foods Survey component of the TDS.

Calcium
Phosphorus
Magnesium
Sodium
Potassium
Iron
Zinc
Copper
Manganese
Selenium
Iodine

References:

Food and Drug Administration, J. A. T. Pennington and E. L. Gunderson. 1986. History of the Food and Drug Administration's Total Diet Study--1961 to 1987. *J. Assoc. Off. Anal. Chem.* 70:772-782.

Pennington, J. A. T. 1983. Revision of the Total Diet Study Food List and Diets. *J. Am. Diet Assoc.* 82:166-173.

Vitamin/Mineral Supplement Intake Survey

Sponsoring Agency: Food and Drug Administration, DHHS

Purpose of survey: The survey was conducted to quantitatively assess nutrient intake from vitamin/mineral supplements in the United States and to examine characteristics of supplement users by supplement intake patterns.

Last survey conducted: 1980.

Target population: Civilian noninstitutionalized adults, aged 16 years and over.

Design: Telephone interviews with a national probability age-stratified sample selected by a random digit dialing method. One person 16 years or older from each household contacted was randomly selected to participate in the survey.

Design limitation: Sample excludes households without telephones.

Sample size/response rate:

Residential telephone sample size	Number screened for vitamin/mineral supplement use
7,986	6,409 (80%)

Number vitamin/mineral supplement users interviewed	Interview completion rate
2,991 (47%)	(95%)

Measures: Assessment of supplement intake, attitudes, and behaviors among supplement users.

Sample selection and subjects: Between August and December 1980, a random digit dialing method was used for telephone interviews of a national probability sample of 2,991 individuals. Up to four attempts were made for each telephone number at different times of the day and evening. On contacting a residence, the interviewer explained the purpose of the survey, stated that it was being done under the auspices of the FDA, and asked the age and the sex of all members of the household 16 years old and older. One person 16 years old or older was then randomly selected to participate in the survey. Respondents were selected until 1,000 individuals in each age group (16–24 years, 25–64 years, and 65 years and older) had been interviewed. No control over gender of respondent was attempted.

A total of 12,577 telephone numbers was dialed; 7,986 resulted in contacts with residences. Of the contacted individuals, 6,409 (80.3 percent) agreed to participate in the screening questionnaire. Among the 2,991 individuals who met the sampling requirements, the interview completion rate was 95 percent.

Estimates of general supplement usage are based on 2,866 (96 percent) of the 2,991 respondents; 77 otherwise acceptable respondents were excluded because of special supplementation needs owing to pregnancy/lactation, and 48 were excluded because the interview ended before the questions on vitamin/mineral supplement use were asked. Incomplete interviews that did determine general supplement use were included. The more specific analyses (for example, type of supplement and amount of nutrient consumed) are based on 2,751 respondents (92 percent); the 115 additional respondents were excluded because of later interview termination or lack of quantitative information regarding supplement content. The further respondent elimination was necessary because the more definitive tabulations required specific information about the supplement type and its complete nutrient profile. The 2,751 respondents who provided full information included 1,012 men (16–24 years = 433, 25–64 years = 315, and 65 years and older = 264) and 1,739 women (16–24 years = 502, 25–64 years = 604, and 65 years and older = 633).

Data collection: The screening and survey questionnaires were pretested to ensure respondent comprehension. The survey questionnaire determined whether the selected respondent was currently taking a vitamin, mineral, or other type of nutritional supplement (excluding fortified, ready-to-eat cereals). Respondents answering "yes" were asked a series of questions to establish the brand name, manufacturer, and retail source of each supplement; the form of the product; frequency of use per week; quantity per day; and other information related to the source of influence in the purchase of the product. Each respondent was asked to bring all supplement bottles to the telephone and to read the potency of individual nutrients from the labels. Respondents unable or unwilling to do that were requested to complete and return a mail questionnaire for each supplement. In addition, respondents were asked for demographic information (for example, income, education, race). State of residence was determined from area code.

Interviewers were dietitians trained in telephone interview techniques. The average interview length was approximately 19 minutes for vitamin/mineral supplement users and 11 minutes for all others.

Data analyses: "Supplement" denotes the product purchased by the respondent (for example, multiple vitamins); "nutrient" refers to each of the constituents of a product (for example, vitamin A, thiamin). Various analyses were conducted:

1. Examination of bias owing to noncooperation (terminated interviews or incomplete quantitative information for nutrients) using the Mann-Whitney U Test for each of the six groups formed by the factorial combination of two levels of sex (male, female) and three age levels (16-24 years, 25-64 years, and 65 years and over).

2. Evaluation of sex-age group differences in prevalence of use for each of nine mutually exclusive supplement types with the chi-square test used for the 6-cell contingency table derived from the factorial combination of sex and age levels: single vitamins/miscellaneous dietary components, single minerals, vitamin combinations, mineral combinations, vitamin/mineral combinations, multivitamins, multiminerals, multivitamin/multimineral combinations, and multivitamins plus iron.

3. Evaluation of differences in prevalence of use by census region, education, income, and race, with the chi-square test used as in No. 2.

4. Evaluation of sex-age group differences in prevalence of use for individual nutrients, with the chi-square test used as in No. 2.

5. Calculation of statistics on central tendency and variability of quantitative intake for selected nutrients.

To make possible reporting of combined sex-age group estimates in Nos. 2 through 5, the data were weighted according to the 1979 population census (U.S. Bureau of the Census, 1980).

Noncooperative bias: Of those respondents identified as vitamin/mineral supplement users, 10.6 percent were classified as noncooperators (that is, the interview was prematurely terminated or the respondent did not sufficiently identify supplements for quantitative analysis). Only 2 percent of nonusers were noncooperators.

The number of supplements consumed was significantly higher ($p<.05$) for cooperating than for noncooperating supplement users for two of the six sex-age groups (males 25-64 years and females 65 years and older). Mean daily intake among cooperating supplement users was 2.3 and 2.1 supplements for males 25-64 years and females 65 years and older, respectively; mean daily intake among noncooperating supplement users was 1.5 and 1.4 supplements, respectively. Therefore, estimates of number of supplements taken may slightly overestimate true values for those two sex-age groups.

References:

Levy, A. S., and R. E. Schucker. 1987. Patterns of Nutrient Intake Among Dietary Supplement Users: Attitudinal and Behavioral Correlates. *J. Am. Diet. Assoc.* 87:754-760.

Stewart, M. L., J. T. McDonald, R. E. Schucker, and D. P. Henderson. 1985. Vitamin/Mineral Supplement Use. A Telephone Survey of Adults in the United States. *J. Am. Diet. Assoc.* 85:1585-1590.

U.S. Bureau of the Census. 1980. *Statistical Abstract of the United States, 1980.* Washington: U.S. Department of Commerce.

Health and Diet Survey

Sponsoring Agency: Food and Drug Administration (Cosponsored by National Institutes of Health/National Heart, Lung and Blood Institute), DHHS

Purpose of survey: The survey is conducted to assess public knowledge, attitudes, and practices about food and nutrition, particularly as they relate to such health problems as hypertension, hypercholesterolemia, coronary heart disease, and cancer. The survey also assesses the public's use of information on food labels including the use of ingredient lists to avoid or limit food substances.

Last survey conducted: 1986. (Previous surveys conducted in 1982 and 1984.)

Target population: Civilian noninstitutionalized adults aged 18 years and over.

Design: Telephone interviews with a national probability Waksberg sample selected by a random-digit dialing method. One adult from each household contacted was randomly selected to participate in the survey.

Design limitation: Sample excludes households without telephones.

Sample size/response rate: 4,000 (comprising 4 replicate samples of 1,000 each); response rates are 70 to 75 percent.

Measures: Awareness (perceptions), attitudes (concerns), knowledge, and behaviors regarding food and nutrition; height, weight, and household health status and history (as reported by household members).

- List of Variables:

- Awareness (perceptions)
  causes of coronary heart disease
  causes of cancer
  causes of breast cancer
  causes of colorectal cancer
  causes of lung cancer
  diet links with coronary heart disease
  diet links with hypertension
  diet links with cancer (beneficial and detrimental)
  diseases related to sodium
  diseases related to fat
  diseases related to fiber
  diseases related to calcium

- Concerns (attitudes)
  sodium intake
  blood cholesterol levels

- Knowledge
  dietary control of coronary heart disease
  cause(s) of hypercholesterolemia
  control of hypercholesterolemia
  outcome(s) of hypercholesterolemia
  early detection of breast, colorectal, and cervical cancer
  fatty acids and cholesterol
  fiber

- <u>Behavior (for some variables, information is collected on households, as well as individuals)</u>

  overall dietary change to reduce cancer or coronary heart disease
  barriers to dietary change
  weight loss diets
  sodium–modified diets
  blood cholesterol reducing diets
  tobacco use
  exercise
  food label use
  purchase of sodium–modified products

- <u>Health status (as reported by household member. Information is collected on households as well as individuals)</u>

  blood cholesterol checks/level
  hypercholesterolemia
  hypertension
  heart disease
  stroke
  cancer

Pediatric Nutrition Surveillance System

Sponsoring Agency: Division of Nutrition, Centers for Disease Control, DHHS

Conducted: Continuous data collection.

Target population: Low-income, high-risk children 0-17 years, especially those 0-5 years.

Design: Simple, key indicators of nutritional status are continuously monitored using readily available clinic data from participating States. The data are collected on a convenience population of low-income children who participate in publicly funded health, nutrition, and food assistance programs. These data are rapidly analyzed, with reports available to States monthly, quarterly, and annually.

Sample size/response rate: Sample size and response rates do not apply in the Pediatric Nutrition Surveillance System (PedNSS). The coverage of PedNSS reflects the count of clinic visits in participating programs and can be separated by initial and followup visits. Over 2.4 million records from 36 States including the District of Columbia and Puerto Rico were submitted for analysis during FY 1987.

Measures: Anthropometry (height, weight), birthweight (below 2,500 grams), hematology (hemoglobin, hematocrit, erythrocyte protoporphyrin) are measured.

Description: The PedNSS is designed to monitor continuously the status of major nutrition problems among high-risk infants and children 0-17 years of age.

The system is based on information collected routinely in health, nutrition, and food assistance programs such as the Special Supplemental Food Program for Women, Infants, and Children (WIC), Early and Periodic Screening, Diagnosis and Treatment (EPSDT) and Maternal and Child Health (MCH). The data consist primarily of measurements such as height, weight, birthweight, and hemoglobin and/or hematocrit. This information is rapidly analyzed and comparisons are made with reference population data. In this way, the nutritional status of the surveillance population can be characterized by the prevalence of short stature (low height for age), underweight (low weight for height), overweight (high weight for height), anemia (low hematocrit, low hemoglobin), and low birthweight. Trends in the prevalence of these nutrition status indicators are also monitored. The linkage of Pregnancy Nutrition Surveillance System (PNSS) data to birth certificates has been explored in one State and was found to be a potentially useful method for assessing program coverage and targeting and the evaluation of program impact.

The PedNSS reports are returned to States monthly, quarterly, and annually for use in patient followup, program planning, management, and the evaluation of health resource allocation at the State and local level. Prevalent nutrition-related problems are identified by age and ethnic groups for the targeting of high-risk groups for intervention. The data are available by individual clinic, county, region, or the State as a whole, thus, various State needs are met for geographic-specific nutrition surveillance data. States may also incorporate the CDC PedNSS software into their own computer system to independently produce these reports. Technical assistance, consultation, and training are available for States from CDC for the collection, processing, analysis, interpretation, and application of PedNSS data.

Demographic:

- Basic identification
- Date of birth
- Ethnic group
- Sex

Nutrition risk indicators:

- Height
- Weight
- Hemoglobin
- Hematocrit
- Protoporphyrin
- Birthweight

Pregnancy Nutrition Surveillance System

Sponsoring Agency: Division of Nutrition, Centers for Disease Control, DHHS

Conducted: Continuous data collection.

Target population: Low-income, high-risk pregnant women.

Design: Simple, key indicators of pregnancy nutritional status, behavioral risk factors, and birth outcome are monitored using readily available clinic data. The data are collected on a convenience population of low income women who participate in publicly funded health, nutrition, and food assistance programs. These data are analyzed and made available to participating States quarterly and annually. The Pregnancy Nutrition Surveillance System will be enhanced to collect additional behavioral risk factor data which relate to low birthweight during FY 1988. Cooperative agreement funding was awarded to nine States during September 1987 to implement this enhanced PNSS.

Sample size/response rate: Sample size and response rates do not apply in PNSS. The coverage of PNSS reflects the number of pregnant women who participate in the programs contributing to the surveillance system. During FY 1986, approximately 70,000 records were received from 12 States including the District of Columbia. Including the nine cooperative agreement States, 18 or more States will be participating in FY 1988.

Measures: Pregravid weight status, anemia (hemoglobin, hematocrit), pregnancy behavioral risk factors (smoking), low birthweight (<2,500 grams) and other indicators are currently monitored. With enhancement of the PNSS, additional behavioral risk factor data (quantity and frequency of smoking, drinking alcohol, other) will be collected.

Description: The PNSS is designed to monitor the prevalence of nutrition-related problems and behavioral risk factors among high-risk prenatal populations.

The PNSS is based on data collected from health, nutrition, and food assistance programs for pregnant women such as the Special Supplemental Food Program For Women, Infants, and Children (WIC) and prenatal clinics, including such programs as the Maternal and Infant Care Project (MIC) and Improved Pregnancy Outcome Project (IPO). Nutrition-related problems currently monitored include pregravid underweight or overweight and anemia (low hemoglobin, low hematocrit). The primary behavioral risk factor currently monitored is the rate of smoking among pregnant women and its association to low birthweight. Low birthweight is also examined relative to pregravid weight and smoking status as well as to weight gain during pregnancy. With the enhancement to the PNSS, additional behavioral risk factor data will be collected such as the quantity and frequency of smoking and drinking alcohol. The emphasis is to quantify prevalent preventable nutrition-related problems and behavioral risk factors among low-income pregnant women for targeting low birthweight intervention efforts. Trends in the prevalence of these nutrition status indicators and behavioral risk factors can also be monitored. The future linkage of PNSS data to birth certificates may also allow for the assessment of program coverage and targeting and the evaluation of program impact.

The PNSS reports are returned to States quarterly and annually for use in program planning, management, and the evaluation of health resource allocation at the State and local level. Prevalent nutrition-related and behavioral risk factor problems are identified by age and ethnic groups for targeting high-risk women for intervention. The PNSS data can be available by geographic sub-areas (for example, region, county); however, routine reports summarize the data Statewide. In the future, CDC will develop exportable software so that States will be able to produce their PNSS reports independently. Technical assistance, consultation, and training are available to States for the collection, processing, analysis, interpretation, and application of PNSS data.

Behavioral Risk Factors Surveillance System

Sponsoring Agency: Division of Nutrition, Centers for Disease Control, DHHS

Conducted: Continuous data collection.

Target population: Adults (≥18 years) residing in participating States (35 in 1987) in households with telephone.

Design: The Behavioral Risk Factors Surveillance System (BRFSS) uses a multistage cluster telephone survey design based on the Waksberg method. Respondents are selected randomly from adult civilian residents with telephones. After a household is contacted, an adult aged 18 years or older is randomly selected from among the adults residing in the household and interviewed. If the adult selected is not available, the interview is done during a followup telephone call. To improve efficiency in contacting eligible respondents, the interviews are conducted primarily weekday evenings, but also during the day and on weekends. Beginning in 1985, most States began using computer assisted telephone interviewing (CATI) to facilitate the interview, data coding and entry, and quality control procedures.

Sample size/response rate:

Year(s)	Average State sample size	Number of States	Total sample size	Average response rate
1981–83	797	29	23,113	86%
1984	675	17	11,480	83%
1985	1,174	22	25,830	83%
1986	1,182	26	30,730	86%

Measures: Height, weight, dieting practices, table salt use, cigarette smoking, smokeless tobacco use, alcohol use, and cholesterol screening practices, awareness, and treatment.

Description: The State–based behavioral risk factor surveillance system uses standard telephone survey methods and questionnaires to assess the prevalence of personal health practices. These behaviors are related to the leading causes of death and include cigarette smoking, alcohol use, drinking and driving and seatbelt use, physical activity, weight control, high blood pressure, and preventive health practices, such as cholesterol and breast cancer screening. Between 1981 and 1983, the Centers for Disease Control (CDC) collaborated with 29 State health departments (including the District of Columbia) to conduct one–time random–digit dialed telephone surveys of adults. Beginning in 1984, most States began collecting data continuously throughout the year, completing approximately 100 interviews per month (range 50–250), with an average of 1,200 completed interviews per year (range 600–3,000). In 1987, 35 States were collecting data on an ongoing basis––bringing to 46 the number of States which have participated in behavioral risk factor surveillance since 1981. This system has proven to be flexible––by providing data on emerging public health problems such as smokeless tobacco use and AIDS, timely––by providing data within months of the completion of data collection, and affordable––by operating at a fraction of the cost of comparable Statewide in–person surveys. Behavioral risk factor surveillance has been used by State health departments to plan, initiate, and guide Statewide health promotion and disease prevention programs, and to monitor their progress over time.

Background: During the 1960s and 1970s, the role of personal behaviors––such as smoking, alcohol abuse, obesity, and physical inactivity––as risk factors for disease became recognized. Accordingly, many State health departments launched health education and risk reduction programs directed towards reducing the prevalence of these "behavioral risk factors" in the population. However, data on which to plan or guide these efforts were either unavailable, or obtained by conducting household surveys or by using synthetic estimates based on the prevalence of behaviors at the national level. Because of the expense of conducting household surveys and the uncertainty of applying national prevalence estimates at the State level, an alternate method was sought.

By 1980, telephone surveys had emerged as both a reliable and affordable alternative method for determining the prevalence of behavioral risk factors in the population. Accordingly, the CDC began working with State health departments to develop a system for the surveillance of behavioral risk factors in the population using random–digit dialed telephone techniques. The goal of the system was to collect, analyze, and interpret behavioral risk factor data, in order to plan, implement, and monitor public health programs.

Between April 1981 and October 1983, random–digit dialed telephone surveys were conducted in 29 States (including the District of Columbia) over a 1–6 week period by State health department personnel. These surveys were supported, in part, through funds provided in the Health Education and Risk Reduction Grants and through training, coordination, and standard methods provided by the CDC. Beginning in 1984, the surveys were conducted during a 1–week period every month continuously throughout the year. The CDC continued to provide training, coordination, and standard methods but, in addition, provided funds directly to the participating State health departments through cooperative agreements. Several State health departments have conducted the surveys using the standard telephone survey methods and questionnaires, but without CDC funds. Since 1981, 43 States have participated with the CDC in the BRFSS.

In the BRFSS, respondents are selected randomly from adult civilian residents with telephones. The telephone number is selected using a multistage cluster design procedure based on the Waksberg method. After a household is contacted, an adult aged 18 years or older is randomly selected from among the adults residing in the household and interviewed. If the adult selected is not available, the interview is done during a followup telephone call. To improve efficiency in contacting eligible respondents, the interviews are conducted primarily weekday evenings, but also during the day and on weekends. Beginning in 1985, most States began using computer assisted telephone interviewing (CATI) to facilitate the interview, data coding and entry, and quality control procedures.

The questionnaire used in the BRFSS has two components. One is "core" of questions developed jointly by the CDC and the participating States and asked by all States. For comparability, the questions in the core are selected from national surveys, such as the National Health and Nutrition Examination Surveys and the National Health Interview Surveys. States which have interest in subject areas not covered by the core questionnaire add specific questions. These "modules" are added at the end of the questionnaire in order to maintain the comparability of the core between States and over time.

Upon completing the interviewing cycle each month, the data are keyed and sent to CDC for editing. After editing, the data are weighted to provide representative population–based estimates of risk factor prevalence (accounting for telephone noncoverage, nonresponse, refusals, and the cluster survey design). The weighted and unweighted tabulations are provided to the States within two months of completion of the last December interview. In addition, the CDC publishes the annual summary and selected risk–factor specific reports in the *Morbidity and Mortality Weekly Report* throughout the year.

The information gathered under the BRFSS is expected to be of use to State health departments to support risk reduction and disease prevention activities. Because comparable methods are used from State to State and from year to year, States can compare risk factor prevalence with other States and monitor the effects of interventions over time. Also, the use of consistent methods in a large group of States permits the assessment of geographic patterns of risk factor prevalence. These telephone survey techniques can also be applied at the community level to guide local efforts in reducing risk factor prevalence. Taken together, the behavioral risk factor survey and surveillance data provide a new resource to guide State and local disease prevention efforts.

Appendix II

Summary Data on Food Components

Explanatory Notes

Table Notes for Data from the Continuing Survey of Food Intakes by Individuals (CSFII) 1985-86, 4 Nonconsecutive Days

- N represents number of individuals who provided at least 4 days of dietary data.

- The number of children excludes 2 breastfed children.

- The mean nutrient intake estimates for women were adjusted to reflect a specified proportion of individuals in the ten-year age groups 20-29, 30-39, and 40-49. The adjustment was done to the means for all 20- to 49-year-old women and the means for each category of race, poverty status, education, region, and urbanization. The standard errors were computed for these adjusted means.

  The specified proportions were derived from the 1980 Census counts for all races, both sexes in the United States population. Thus, both males and females were adjusted to the same standard proportions. These counts are:

Age	1980 Census count	Percent of 20- to 49-year-olds
20-29	40,839,623	42.93
30-39	31,526,222	33.14
40-49	22,759,163	23.93
20-49	95,125,008	100.00

- The sample was designed to be self-weighting. That is, the proportion of eligible households in the population with a particular characteristic was designed to represent the same proportion of eligible households in the population. However, adjustments to the sample were required because not all eligible households agreed to participate, not all eligible women and children in eligible households agreed to participate, not all interviews yielded complete information, and not all participants in wave I completed each subsequent wave. Weighting factors were applied to data from completed intake records to adjust for these sources of nonresponse. For more information on how the weighting factors were derived, see NFCS, CSFII Report No. 85-4.

- Estimated coefficients of variation of the mean were less than 20 percent for all cells for the women and most cells for the children. Exceptions are shown with an asterisk and should be interpreted with caution.

- The following minimum cell sizes were used in presentation of various percentile values:

  5th & 95th percentiles: $N \geq 140$
  10th & 90th percentiles: $N \geq 80$
  25th & 75th percentiles: $N \geq 40$

  Where cell sizes are below this minimum, the fields are left blank.

- Individuals are classified into age and poverty status based on the responses provided on the first day of the survey.

- Education status and race of a child are that of the mother/caretaker (that is, the mother or guardian of a child respondent or the person most responsible for that child). For race, poverty status, and education, the number of persons does not add to the number of all children because some individuals had missing values.

- For race, poverty status, and education, the number of women does not add to the number of all women because some individuals had missing values.

- The nutrient intakes represent the nutrient content of all foods and beverages (except water) reported to be ingested by the respondent and do not include intakes from vitamin and mineral supplements, for which information on only the frequency and type used was collected. Sodium intake does not include sodium from salt added at the table, for which information was not collected.

- To estimate the mean nutrient intakes for each dietary component, the intakes calculated for each individual over the 4 days of observation were totaled and divided by 4 to obtain a mean intake per day for the individual. Individual mean intakes were then totaled and divided by the number of individuals in the group to obtain the mean intake per individual per day for that group.

- To estimate nutrient intakes at selected percentiles for each dietary component, the intakes calculated for each individual over the 4 days of observation were totaled and divided by 4 to obtain a mean intake per day for the individual. Values for each individual were then arrayed from lowest to highest, and intakes were identified at specified population (weighted) percentiles (5th, 10th, 25th, 50th, 75th, 90th, 95th).

- To estimate the percent of calories from various components, each individual's intakes of protein, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, and carbohydrate were summed over 4 days. Intakes of protein were multiplied by 4 kilocalories per gram; fat, by 9 kilocalories per gram; and carbohydrate, by 4 kilocalories per gram. Those values were divided by the sum of the individual's energy from reported food intakes over 4 days then multiplied by 100 to obtain the percentage of an individual's total food energy intake provided by each nutrient. Individual percentages were totaled and divided by the number of individuals in the group to obtain the mean percentage per individual for that group. Alcohol is also an energy source and was included in determining total energy, but the percentage of food energy contributed by alcohol was not calculated.

- To estimate the nutrient densities at selected percentiles for each dietary component, nutrient density values for each individual were arrayed from lowest to highest, and intakes were identified at specified population (weighted) percentiles (5th, 10th, 25th, 50th, 75th, 90th, 95th).

Definitions:

Age--Calculated from date of birth as reported by the household informant.

Carotenes--Beta-carotene and other provitamin A carotenoids (see Vitamin A).

Dietary fiber--Total dietary fiber including both the insoluble fraction (neutral detergent fiber) and the soluble fraction (for example, gums in cereal grains and pectin in fruits and vegetables).

Educational level--Adult respondents were categorized according to the highest grade of formal schooling they completed. High school refers to 4 years or high school equivalency. Formal schooling does not include trade or vocational schooling or company training unless credit is given which would be accepted at a regular school or college.

Folacin--Total folate activity.

Niacin--Nicotinic acid and nicotinamide present in foods. Does not include niacin converted from dietary tryptophan, a niacin precursor.

Poverty status--Tables presenting results by income level use household income for the previous calendar year expressed as a percentage of the Federal Poverty Income guidelines. Each household's income before taxes was expressed as a proportion of the poverty guideline for households of the appropriate size. Individuals were then grouped according to their household income as a percentage of the poverty guidelines. The poverty guidelines, provided by the U.S. Department of Health and Human Services, are adapted from the poverty thresholds published by the Bureau of the Census. They are used by many Federal Agencies to determine whether a person or family is financially eligible for assistance under a particular Federal program. The guidelines (which are based on the previous calendar year's income) are as follows:

Household size	Poverty guidelines 1985	1986
1	$ 5,250	$ 5,360
2	7,050	7,240
3	8,850	9,120
4	10,650	11,000
5	12,450	12,880
6	14,250	14,760
7	16,050	16,640
8	17,850	18,520

For households with more than eight members, $1,800 was added for each additional member in 1985 and $1,880 was added for each additional member in 1986.

Several major Federal food assistance programs use 130 percent of poverty to determine eligibility for benefits. These include the Food Stamp Program, the National School Lunch Program, the School Breakfast Program, the Child Care Food Program, the Special Milk Program, the Temporary Emergency Feeding Program, and the Food Distribution Program to Indian Reservations.

Race--Race of women was self-reported as white, black, Asian/Pacific Islander, or Aleut/Eskimo/American Indian. Children were assigned the race of their mother/caretaker (that is, the mother or guardian of a child respondent or the person most responsible for taking care of the child).

Region--An area of the conterminous United States as defined by the U.S. Department of Commerce for the 1980 Census of Population. The four census regions and their States are as follows:

Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont.

Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.

South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.

West: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

Urbanization--Based on metropolitan statistical areas (MSA) defined by the U.S. Department of Commerce for the 1980 Census of Population. The degrees of urbanization used in this report are as follows:

Central city: A city which has a population of 50,000 or more and is the main city within an MSA.

Suburban area: Generally within the boundaries of an MSA but not within the legal limits of the central city; includes some farms and rural areas.

Nonmetropolitan area: Any area not within an MSA; includes some towns and urban areas.

Vitamin A--Vitamin A activity derived from both preformed vitamin A (retinol) and provitamin A carotenoids. Values in tables are expressed as retinol equivalents (RE). One RE equals 1 microgram of retinol, 6 micrograms of beta-carotene, or 12 micrograms of other provitamin A carotenoids.

Vitamin E--Vitamin E activity derived from alpha-, beta-, and gamma-tocopherol and alpha-tocotrienol. Values in tables are expressed as alpha-tocopherol equivalents. One alpha-tocopherol equivalent equals 1 milligram of alpha-tocopherol, 2 milligrams of beta-tocopherol, 10 milligrams of gamma-tocopherol, or 3.3 milligrams of alpha-tocotrienol.

Table Notes for Data from the Nationwide Food Consumption Survey (NFCS) 1977-78 and the Continuing Survey of Food Intakes by Individuals (CSFII) 1985-86, 1 Day

- Number of respondents by sex and age

Sex and age (years)	NFCS 1977-78	CSFII 1985-86
Males and females		
1-2	1,113	363
3-5	1,838	633
6-11	4,107	---
Males		
12-15	1,613	---
16-19	1,284	---
20-29	1,752	222
30-39	1,338	249
40-49	1,082	164
50-59	1,166	---
60-69	941	---
70+	684	---
Females		
12-15	1,596	---
16-19	1,397	---
20-29	2,282	1,000
30-39	1,901	1,049
40-49	1,496	735
50-59	1,698	---
60-69	1,412	---
70+	1,192	---

- Data for children aged 1-2 years exclude 12 breastfed infants in 1977 and 2 breastfed infants in 1985-86.

- Data for NFCS 1977-78 were obtained throughout all seasons of the year; data for CSFII 1985-86 were obtained in the spring of each year.

- Data for men from CSFII were collected in 1985 only.

- Data for males in CSFII 1985 include men from both an all-income sample and a low-income sample. The all-income and the low-income samples were drawn independently. The data from both samples were merged and additional weights were computed for the purpose of treating the two samples as one combined sample. The weights were designed to keep the distribution of low-income households across strata in the combined sample the same as that of low-income households in the all-income sample and to keep the proportion of non-low-income households within strata in the combined sample to be the same as that of non-low-income households in the all-income sample.

- The NFCS 1977–78 and CSFII 1985–86 samples were designed to be self-weighting. That is, strata, primary sampling units, area segments, and housing units were selected to be representative of the population. Thus, the number of eligible households in each of these divisions or cells in the sample was designed to represent the same proportion as the respective number of households in each cell in the population. However, adjustments to the sample were required because not all eligible households agreed to participate, not all eligible individuals in eligible households agreed to participate, and not all interviews yielded complete information. Weighting factors were applied to data from completed intake records to adjust for these sources of nonresponse. For more information on how the weighting factors were derived, see NFCS, CSFII Report Nos. 85–1 and 85–3 and NFCS 1977–78 Report No. I–2.

- Dashes indicate data are not available. In NFCS 1977–78 food composition data were not available for fatty acids, cholesterol, dietary fiber, vitamin A in retinol equivalents, folacin, vitamin E, zinc, sodium, copper, or potassium. In CSFII 1985–86, age groups other than 1– to 5–year–olds and 19– to 50–year–olds were not sampled.

- Estimated coefficients of variation of the mean were less that 20 percent for most cells. Exceptions are shown with an asterisk and should be interpreted with caution.

- The nutrient intakes represent the nutrient content of all foods and beverages (except water) reported to be ingested by the respondent and do not include intakes from vitamin and mineral supplements, for which information on only the frequency and type used was collected. Sodium intake does not include sodium from salt added at the table, for which information was not collected.

- To estimate the percent of calories from various components, intakes of protein were multiplied by 4 kilocalories per gram; fat, by 9 kilocalories per gram; and carbohydrate, by 4 kilocalories per gram. Those values were divided by the individual's food energy intake then multiplied by 100 to obtain the percentage of an individual's total food energy intake provided by each nutrient. Individual percentages were totaled and divided by the number of individuals in the group to obtain the mean percentage per individual for that group. Alcohol is also an energy source and was included in determining total energy, but the percentage of food energy contributed by alcohol was not calculated.

Definitions:

Carotenes--Beta–carotene and other provitamin A carotenoids (see Vitamin A).

Dietary fiber--Total dietary fiber including both the insoluble fraction (neutral detergent fiber) and the soluble fraction (for example, gums in cereal grains and pectin in fruits and vegetables).

Folacin--Total folate activity.

Niacin--Nicotinic acid and nicotinamide present in foods. Does not include niacin converted from dietary tryptophan, a niacin precursor.

Vitamin A--Vitamin A activity derived from both preformed vitamin A (retinol) and provitamin A carotenoids. Values in tables are expressed as international units (IU) and as retinol equivalents (RE). One IU equals 0.3 micrograms of retinol, 0.6 micrograms of beta–carotene, or 1.2 micrograms of other carotenoids having vitamin A activity. One RE equals 1 microgram of retinol, 6 micrograms of beta–carotene, or 12 micrograms of other provitamin A carotenoids.

Vitamin E--Vitamin E activity derived from alpha–, beta–, and gamma–tocopherol and alpha–tocotrienol. Values in tables are expressed as alpha–tocopherol equivalents. One alpha–tocopherol equivalent equals 1 milligram of alpha–tocopherol, 2 milligrams of beta–tocopherol, 10 milligrams of gamma–tocopherol, or 3.3 milligrams of alpha–tocotrienol.

Table Notes for Data from the Second National Health and Nutrition Examination Survey (NHANES II) and the Hispanic Health and Nutrition Examination Survey (HHANES)

- The number of examined persons is given in the tables; for the number of persons represented in the population, see tables in appendix I.
- Sample weights, which incorporate the selection probabilities, a nonresponse adjustment, and poststratification, were used to produce the population estimates included in the tables..
- If the sample size is less than 25, the mean or percent (prevalence estimate) is not presented and an asterisk is placed in the cell. If the sample size is 25–44, the mean or percent is presented but with an asterisk. If the sample size is 45 or more, the estimated mean or percent is presented without caveat.
- Age–adjustment was calculated by the direct method using the 1980 census population 20–74 years of age for both sexes and all races.
- Body mass index (BMI) is the ratio of body weight in kilograms to height in meters squared.
- Non–Hispanic whites were persons whose race was observed and recorded as "white" and whose self–reported family ancestry or national origin was not Chicano, Mexicano, Mexican American, other Spanish, countries of Central or South America, Puerto Rican, or Cuban.
- Non–Hispanic blacks were persons whose race was observed and recorded as "black" and whose self–reported family ancestry or national origin was not Chicano, Mexicano, Mexican American, other Spanish, countries of Central or South America, Puerto Rican, or Cuban.
- Mexican American includes persons residing in Southwest primary sampling unit areas who specified their national origin or ancestry as Mexican/Mexicano, Mexican American or Chicano/Hispano/Spanish–American/Spanish.
- Cuban includes persons residing in Dade County, Florida, primary sampling unit areas who reported their national origin or ancestry as Cuban or Cuban American.
- Puerto Rican includes persons residing in New York, New Jersey, and Connecticut primary sampling unit areas who reported their national origin or ancestry as Puerto Rican or Boricuan.
- Poverty status is defined by poverty income ratio (PIR), a measure of income relative to a poverty index. A PIR less than 1.0 can be described as "below poverty level", while a ratio equal to or greater than 1.0 describes a status that is "at or above the poverty level."
- Poverty Income Ratio formulas vary by survey. For the National Health and Nutrition Examination Survey II, 1976–80, PIR was calculated as follows:

$$\text{PIR} = \frac{\text{Family income}}{\text{Weighted average poverty threshold}}$$

  where family income equaled the median for the income group for incomes of $7,000 or more or the sum of the component parts of the income questions for incomes less than $7,000, and poverty threshold equaled the value for the year of the interview published by the U.S. Bureau of the Census.

  For the Hispanic Health and Nutrition Examination Survey, 1982–84, PIR was calculated as follows:

$$\text{PIR} = \frac{\text{Family income}}{\text{Adjusted poverty threshold}}$$

  where family income equaled the median for the income group, with $50,000 assigned to the highest income category; and poverty threshold was calculated from the full threshold matrix value for the calendar year preceding the interview, updated by the rate of inflation that prevailed between the calendar year and the 12–month income reference period prior to the date of the interview.

- Overweight is defined as a sex-specific BMI equal to or higher than the BMI of the 85th percentile for men and nonpregnant women 20–29 years of age examined in the NHANES II. Severely overweight is defined as a BMI equal to or greater than the 95th percentile for the same reference population. (For men, a BMI of 27.8 or greater and 31.1 or greater defines overweight and severely overweight, respectively. For women, overweight and severely overweight are defined by BMI values of 27.3 and 32.2, respectively.)

- Serum cholesterol status is indicated by both mean serum cholesterol level (in mmol/L) and the percent with "high-risk" serum cholesterol. "High-risk" serum cholesterol is defined as a level of more than 5.69 mmol/L (220 mg/dl) for persons 20–29 years of age, more than 6.21 mmol/L (240 mg/dl) for persons 30–39 years of age, and more than 6.72 mmol/L (260 mg/dl) for persons 40 years of age or older.

- Serum vitamin A status is indicated by both mean serum retinol levels (in µmol/L) and the percent with serum retinol level less than 0.7 µmol/L (20 µg/dl).

- Serum vitamin E status is indicated by mean serum alpha-tocopherol levels (in µmol/L).

- Mean corpuscular volume (MCV) equals $\dfrac{\text{hematocrit (in percent)}}{\text{red blood cells/L x 100}}$

- Iron deficiency is assessed by means of the MCV model. The MCV model uses mean corpuscular volume, transferrin saturation, and erythrocyte protoporphyrin as indicators of iron deficiency, and requires that at least two of three values for these indicators be abnormal. See chapter 6 for the cutoff values used and a detailed description of the model.

- Hypertension is defined as a condition in which a person examined had a systolic blood pressure equal to or higher than 140 mm mercury or a diastolic blood pressure equal to or higher than 90 mm mercury or was taking antihypertensive medication.

Notes for Data from the U.S. Food Supply Series

- Nutrient estimates are based on Economic Research Service (ERS) estimates of per capita quantities of food available for consumption (retail weight), on imputed consumption data for foods no longer reported by ERS, and on Human Nutrition Information Service estimates of quantities of produce from home gardens. No deduction is made in food supply estimates for loss of food or nutrients in further processing, in marketing, or in the home. Data include iron, thiamin, riboflavin, niacin, vitamin A, vitamin B6, vitamin B12, and ascorbic acid added by enrichment and fortification.

- Data are given for the following food groups: meat, poultry, and fish; dairy products; eggs; fats and oils; fruits; vegetables; legumes, nuts, and soy; grain products; sugars and sweeteners; and miscellaneous foods.

- Percentages are based on unrounded data. Components may not add to 100 because of rounding.

- <u>Meat</u>: Reported as fresh retail cut equivalent. Includes game, edible offal, and fat cuts of pork.

- <u>Poultry</u>: Reported on ready-to-cook basis. Excludes game birds.

- <u>Fish</u>: Reported on edible-weight basis. Includes game fish.

- <u>Eggs</u>: Reported on shell basis.

- <u>Dairy products</u>: Includes fluid milk (whole and lowfat), cheese, and other. Reported as calcium equivalent.

- <u>Fluid milk</u>: Reported as calcium equivalent.

- <u>Other milk products</u>: Reported as calcium equivalent. Includes cream; canned, evaporated, and dry milk; whey; yogurt; and ice cream and frozen desserts.

- Fats and oils: Includes butter and margarine; shortening; lard and beef tallow; salad, cooking, and other edible oils.
- Lard and beef tallow: Excludes use in margarine and shortening.
- Total fruits: Includes citrus and noncitrus fruits. Reported as product weight except for concentrated juices, which are on a single--strength basis.
- Total vegetables: Includes white potatoes; dark green and deep yellow vegetables; and others.
- Miscellaneous: Includes coffee, tea, chocolate liquor equivalent of cocoa beans, spices, and fortification not assigned to a specific food group.
- Coffee, tea, and cocoa: Includes instant and regular coffee reported on roasted basis; tea reported as leaf equivalent; cocoa reported as chocolate liquor equivalent of cocoa beans.

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Vitamin/Mineral Supplement Use

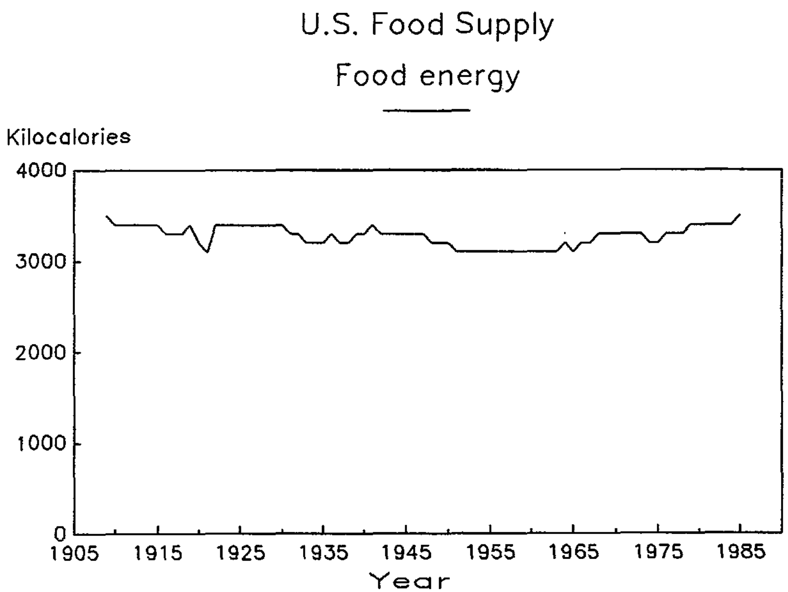


Figure II–1. Food energy: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

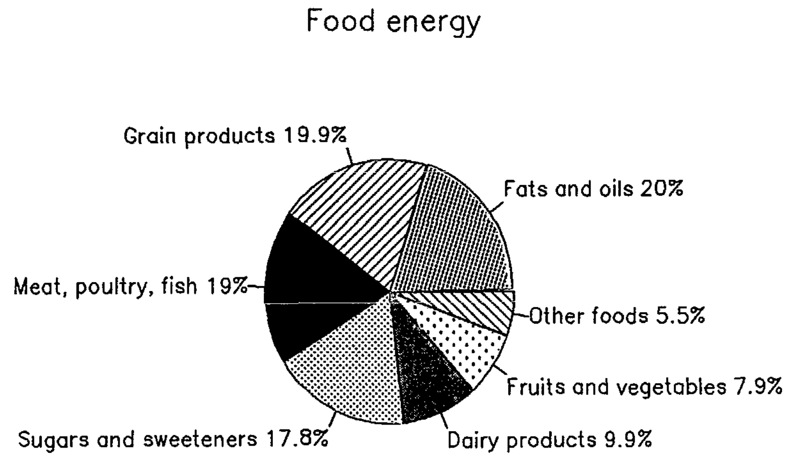


Figure II–2. Food energy: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; legumes, nuts, and soy; and miscellaneous foods)

Table II-1. Food energy: mean intake in kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	1517	16	783	904	1157	1454	1814	2173	2431
Age										
20-29 years	661	1572	25	788	955	1207	1503	1886	2314	2488
30-39 years	812	1503	22	791	891	1138	1445	1810	2177	2337
40-49 years	583	1438	26	713	895	1120	1400	1702	2048	2243
Race 1/										
White	1775	1538	16	804	940	1181	1477	1827	2201	2441
Black	167	1376	57	576	724	959	1295	1753	2087	2271
Other	76	1405	51	*	*	1141	1413	1745	*	*
Poverty status 1/										
< 100	315	1420	38	670	758	1034	1314	1746	2099	2434
≥ 100	1575	1542	15	806	939	1191	1488	1834	2182	2392
< 131	414	1431	39	661	758	1059	1350	1771	2087	2377
≥ 131	1476	1547	15	821	946	1191	1493	1834	2184	2399
Education 1/										
< High school	305	1309	33	654	715	968	1241	1591	1943	2171
High school	854	1507	20	788	909	1172	1451	1802	2120	2337
> High school	891	1589	20	838	994	1229	1548	1885	2254	2489
Region										
Northeast	448	1447	29	824	885	1109	1406	1731	2025	2303
Midwest	564	1577	32	794	926	1205	1528	1924	2284	2488
South	660	1497	25	713	870	1127	1428	1810	2130	2403
West	384	1542	39	824	948	1219	1490	1834	2177	2441
Urbanization										
Central city	499	1536	35	783	905	1154	1476	1859	2287	2489
Suburban	1039	1515	22	786	900	1158	1462	1809	2168	2396
Nonmetropolitan	518	1488	23	737	905	1148	1432	1796	2084	2301

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-2. Food energy: mean intake in kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1426	22	920	1005	1178	1374	1620	1909	2064
Age										
1-2 years	224	1305	31	867	916	1105	1266	1506	1687	1827
3-5 years	423	1492	26	990	1047	1216	1462	1719	2013	2145
Race 2/										
White	559	1440	23	938	1025	1185	1395	1635	1914	2082
Black	53	1397	67	*	*	1178	1381	1601	*	*
Other	26	1222	61	*	*	*	1216	*	*	*
Poverty status 2/										
< 100	140	1396	45	878	960	1156	1352	1601	1829	2038
≥ 100	471	1437	26	931	1021	1189	1372	1631	1914	2120
< 131	192	1387	40	888	961	1150	1312	1597	1900	2048
≥ 131	419	1446	27	938	1021	1193	1391	1635	1914	2120
Education 2/										
< High school	99	1421	46	*	980	1158	1331	1659	2029	*
High school	252	1421	31	920	988	1166	1364	1634	1914	2052
> High school	295	1431	30	940	1030	1200	1400	1616	1836	2067
Region										
Northeast	111	1444	44	*	1023	1200	1433	1683	1914	*
Midwest	199	1433	44	963	1033	1218	1369	1622	1983	2073
South	187	1399	43	920	980	1142	1316	1609	1889	2120
West	150	1438	43	934	1021	1209	1409	1635	1836	2022
Urbanization										
Central city	171	1478	51	931	1036	1234	1435	1708	1960	2145
Suburban	310	1395	28	920	1010	1166	1336	1588	1836	2029
Nonmetropolitan	166	1434	45	920	960	1150	1413	1683	1938	2149

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-3. Food energy: mean intake in kilocalories, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971–74; Nationwide Food Consumption Survey (NFCS), 1977–78; Second National Health and Nutrition Examination Survey (NHANES II), 1976–80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985–86

Sex and age (years)	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	1,350	15	1,196	14	1,287	11	1,309	36
3-5	1,676	14	1,454	17	1,569	9	1,527	29
6-11	2,045	22	1,876	16	1,960	22	-	-
Male								
12-15	2,625	51	2,431	32	2,490	55	-	-
16-19	3,010	77	2,629	39	3,048	83	-	-
20-29[1]	2,850	60	2,501	34	2,899	64	2,806	96
30-39[1]	2,668	67	2,382	32	2,554	56	2,484	88
40-49[1]	2,428	56	2,341	37	2,421	65	2,384	91
50-59	2,157	55	2,240	30	2,203	55	-	-
60-69	1,967	23	2,041	33	1,961	19	-	-
70+[2]	1,747	19	1,875	36	1,734	29	-	-
Female								
12-15	1,910	40	1,870	25	1,821	40	-	-
16-19	1,735	45	1,721	27	1,687	46	-	-
20-29	1,681	18	1,634	18	1,675	30	1,674	31
30-39	1,610	19	1,571	19	1,596	36	1,648	27
40-49	1,552	23	1,562	19	1,531	35	1,541	31
50-59	1,466	33	1,548	20	1,417	36	-	-
60-69	1,352	15	1,475	20	1,340	12	-	-
70+[2]	1,239	14	1,386	17	1,270	18	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-4. Percent of overweight persons 20-74 years of age, number examined, and standard error of the percent by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American			Cuban			Puerto Rican		
	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent
Male									
20-74 years	1,454	29.6	1.4	376	29.4	2.4	443	25.2	2.1
20-74 years, age adjusted	...	30.9	...	...	27.6	...	...	25.6	...
20-29 years	441	20.4	2.6	57	23.5	6.7	113	15.6	3.9
30-39 years	376	34.6	3.1	56	19.9	6.1	90	24.8	5.2
40-49 years	243	38.2	3.4	82	38.3	5.5	87	35.6	5.2
50-59 years	234	36.0	3.0	109	33.1	4.1	101	33.1	3.8
60-69 years	122	34.0	4.4	44	*25.9	6.1	41	*23.5	5.7
70-74 years	38	*26.8	7.9	28	*38.4	8.5	11	*	*
Female 2/									
20-74 years	1,797	39.1	1.2	484	34.1	2.1	758	37.3	1.7
20-74 years, age adjusted	...	41.6	...	...	31.6	...	...	40.2	...
20-29 years	514	24.4	2.2	67	16.2	5.0	192	22.5	3.4
30-39 years	442	39.5	2.6	95	26.4	5.0	172	36.2	4.1
40-49 years	314	47.9	2.8	104	41.3	4.8	171	46.4	3.7
50-59 years	324	53.4	2.6	114	41.5	4.2	132	50.2	3.5
60-69 years	141	59.9	4.1	72	46.8	5.3	77	59.3	4.3
70-74 years	62	43.0	6.3	32	*40.0	7.9	14	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Excludes pregnant women.

Table II-5. Percent of overweight Mexican-American persons 20-74 years of age, number examined, and standard error of the percent by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent
Male						
20-74 years..................	324	29.9	3.1	1,013	29.6	1.7
20-74 years, age adjusted ...	...	31.8	...	...	31.1	...
20-29 years	100	20.2	5.6	304	20.6	3.1
30-39 years..................	70	38.0	7.4	284	33.3	3.6
40-49 years..................	49	46.2	7.6	173	36.7	4.1
50-59 years..................	52	35.0	6.3	161	37.0	3.8
60-69 years..................	40	*31.8	7.9	70	36.3	5.9
70-74 years..................	13	*	*	21	*	*
Female 2/						
20-74 years..................	549	44.0	2.3	1,084	36.8	1.6
20-74 years, age adjusted ...	...	46.1	...	...	40.1	...
20-29 years	152	26.0	4.2	326	23.9	2.7
30-39 years..................	125	45.1	4.9	286	37.3	3.2
40-49 years..................	92	57.8	5.1	189	45.1	3.6
50-59 years..................	98	61.9	4.6	188	49.4	3.4
60-69 years..................	45	59.4	7.5	77	57.4	5.6
70-74 years..................	37	*46.1	8.6	18	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Excludes pregnant women.

Table II-6. Percent of severely overweight persons 20-74 years of age, number examined, and standard error of the percent by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American			Cuban			Puerto Rican		
	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent
Male									
20-74 years	1,454	10.3	0.9	376	10.6	1.6	443	7.7	1.3
20-74 years, age adjusted	...	10.8	...	...	10.7	...	...	8.0	...
20-29 years	441	7.4	1.5	57	14.9	5.6	113	4.4	2.2
30-39 years	376	11.9	1.9	56	5.6	3.5	90	7.6	3.2
40-49 years	243	10.6	1.9	82	9.4	3.3	87	8.2	3.0
50-59 years	234	15.3	2.0	109	12.7	2.9	101	12.2	2.7
60-69 years	122	12.9	2.8	44	+10.5	4.3	41	+13.8	4.7
70-74 years	38	+5.0	3.5	28	+7.4	4.6	11	*	*
Female 2/									
20-74 years	1,797	15.6	0.8	484	7.7	1.2	758	14.4	1.3
20-74 years, age adjusted	...	16.9	...	...	6.6	...	...	15.7	...
20-29 years	514	9.4	1.3	67	1.5	1.6	192	8.2	2.2
30-39 years	442	14.9	1.7	95	7.1	2.9	172	16.6	3.1
40-49 years	314	20.5	2.0	104	9.3	2.8	171	15.4	2.7
50-59 years	324	22.7	1.9	114	13.9	3.0	132	17.2	2.6
60-69 years	141	23.4	3.1	72	4.1	2.1	77	24.1	3.8
70-74 years	62	17.0	4.3	32	+9.1	4.6	14	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Excludes pregnant women.

Table II-7. Percent of overweight non-Hispanic persons 20-74 years of age, number examined, and standard error of the percent by sex, age, and race: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Non-Hispanic white			Non-Hispanic black		
	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent
Male						
20-74 years..................	4,646	24.4	0.7	597	25.6	2.0
20-74 years, age adjusted....	...	24.2	...	...	26.0	...
20-29 years	1,011	15.1	1.4	158	12.4	3.2
30-39 years..................	707	24.5	2.1	93	24.3	5.8
40-49 years..................	572	31.7	2.6	62	46.0	8.9
50-59 years..................	575	28.9	2.5	77	30.5	6.6
60-69 years..................	1,354	28.1	1.0	151	29.2	2.7
70-74 years..................	427	24.7	1.6	56	24.3	4.2
Female 2/						
20-74 years..................	5,069	24.8	0.7	711	43.5	2.1
20-74 years, age adjusted....	...	23.9	...	711	44.4	...
20-29 years	1,007	12.2	1.3	173	27.5	4.4
30-39 years..................	779	20.6	1.8	108	36.4	6.0
40-49 years..................	614	27.4	2.4	95	50.1	6.5
50-59 years..................	649	32.7	2.4	101	62.6	6.0
60-69 years..................	1,487	35.6	1.0	170	61.4	2.8
70-74 years..................	533	34.9	1.7	64	54.0	4.7

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Excludes pregnant women.

Table II-8. Percent of overweight non-Hispanic persons 20-74 years of age, number examined, and standard error of the percent by sex, age, and poverty status: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Percent	Standard error of the percent	Number of examined persons 1/	Percent	Standard error of the percent
Male						
20-74 years..................	528	19.4	1.7	4,522	24.8	0.7
20-74 years, age adjusted....	...	21.5	...	...	24.6	...
20-29 years	145	9.6	2.8	989	15.3	1.5
30-39 years..................	62	22.2	6.3	716	24.8	2.1
40-49 years..................	34	*35.5	10.3	571	33.6	2.6
50-59 years..................	50	24.4	7.0	567	28.7	2.5
60-69 years..................	152	27.4	2.6	1,298	28.2	1.0
70-74 years..................	85	17.2	2.9	381	25.2	1.7
Female 2/						
20-74 years..................	845	36.9	1.7	4,707	25.3	0.7
20-74 years, age adjusted....	...	38.5	...	4,707	24.6	...
20-29 years	201	15.5	3.0	948	13.9	1.4
30-39 years..................	117	40.8	5.4	749	20.2	1.9
40-49 years..................	76	53.4	6.9	613	27.5	2.4
50-59 years..................	80	54.2	6.6	635	33.7	2.4
60-69 years..................	249	42.6	2.3	1,319	37.0	1.1
70-74 years..................	122	50.3	3.3	443	33.0	1.8

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Excludes pregnant women.

Table II-9. Percent of severely overweight non-Hispanic persons 20-74 years of age, number examined, and standard error of the percent by sex, age, and race: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Non-Hispanic white: Number of examined persons 1/	Non-Hispanic white: Percent	Non-Hispanic white: Standard error of the percent	Non-Hispanic black: Number of examined persons 1/	Non-Hispanic black: Percent	Non-Hispanic black: Standard error of the percent
Male						
20-74 years..................	4,646	7.7	0.4	597	9.9	1.4
20-74 years, age adjusted....	...	7.7	...	...	10.0	...
20-29 years	1,011	4.7	0.8	158	5.7	2.2
30-39 years..................	707	8.2	1.4	93	10.0	4.0
40-49 years..................	572	9.1	1.6	62	15.8	6.5
50-59 years..................	575	10.1	1.6	77	12.3	4.7
60-69 years..................	1,354	8.1	0.6	151	9.7	1.8
70-74 years..................	427	9.5	1.1	56	10.1	3.0
Female 2/						
20-74 years..................	5,069	9.7	0.5	711	19.2	1.7
20-74 years, age adjusted....	...	9.4	...	...	19.8	...
20-29 years	1,007	4.5	0.8	173	9.0	2.8
30-39 years..................	779	9.1	1.3	108	23.7	5.3
40-49 years..................	614	11.6	1.7	95	22.9	5.4
50-59 years..................	649	12.8	1.7	101	24.5	5.3
60-69 years..................	1,487	12.8	0.7	170	30.0	2.6
70-74 years..................	533	11.0	1.1	64	12.7	3.1

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Excludes pregnant women.

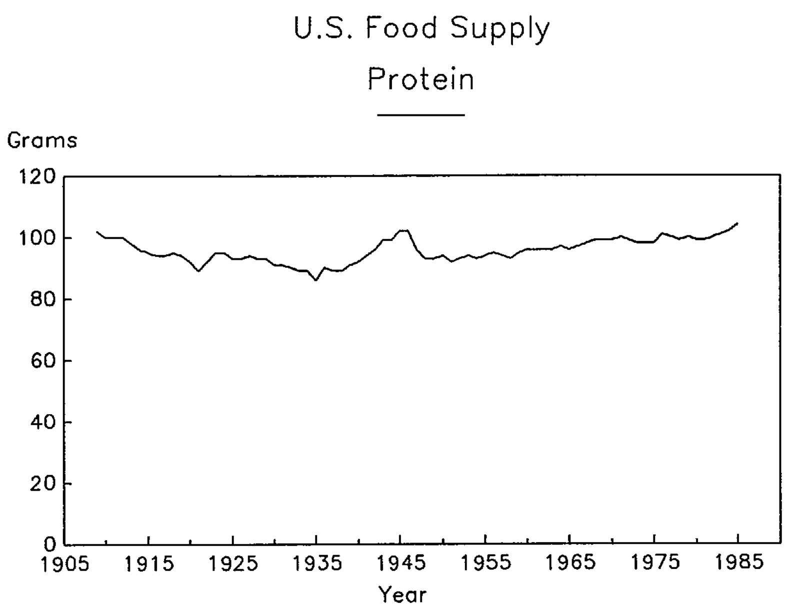


Figure II-3. Protein: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

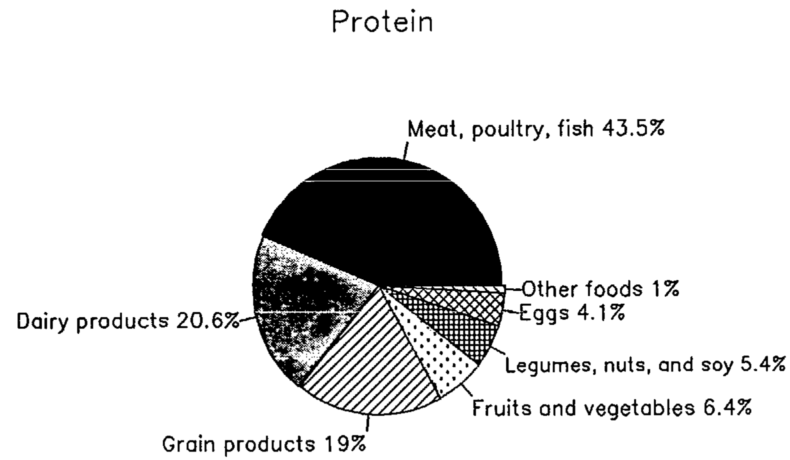


Figure II-4. Protein: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fats and oils; sugars and sweeteners; and miscellaneous foods)

Table II-10. Protein: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	61	.7	30	36	47	59	72	87	97
Age										
20-29 years	661	62	1.0	30	36	47	59	74	91	104
30-39 years	812	60	.9	30	36	47	59	71	85	96
40-49 years	583	60	1.0	30	36	47	58	71	83	92
Race 1/										
White	1775	61	.8	31	36	48	60	73	86	97
Black	167	56	2.1	24	28	41	54	67	84	98
Other	76	61	3.5	*	*	44	60	76	*	*
Poverty status 1/										
< 100	315	58	1.5	25	30	42	55	70	83	94
≥ 100	1575	62	.7	31	37	49	60	73	87	97
< 131	414	58	1.4	25	31	43	56	71	82	93
≥ 131	1476	62	.7	32	38	49	60	73	88	98
Education 1/										
< High school	305	53	1.5	25	30	37	52	67	79	93
High school	854	60	.8	30	36	46	58	71	86	96
> High school	891	64	.9	34	39	50	62	75	90	101
Region										
Northeast	448	61	1.4	31	37	48	59	73	85	93
Midwest	564	62	1.5	33	38	48	59	73	91	104
South	660	59	1.1	27	33	45	57	71	86	96
West	384	62	1.4	30	36	48	61	73	86	96
Urbanization										
Central city	499	63	1.5	30	37	46	59	75	92	106
Suburban	1039	60	.9	30	36	48	59	72	86	95
Nonmetropolitan	518	59	1.2	30	34	46	59	71	83	95

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-11. Protein: mean percent of calories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	16	.1	11	12	14	16	19	21	23
Age										
20-29 years	661	16	.2	11	12	14	16	18	20	22
30-39 years	812	16	.1	11	12	14	16	19	21	23
40-49 years	583	17	.2	12	12	14	17	19	22	23
Race 1/										
White	1775	16	.1	11	12	14	16	18	21	23
Black	167	17	.4	11	12	14	17	19	23	25
Other	76	18	.8	*	*	14	17	20	*	*
Poverty status 1/										
< 100	315	17	.3	11	12	14	17	19	22	23
≥ 100	1575	16	.1	11	12	14	16	18	21	23
< 131	414	16	.2	11	12	14	16	19	21	23
≥ 131	1476	16	.1	11	12	14	16	19	21	23
Education 1/										
< High school	305	17	.3	11	12	14	17	19	22	23
High school	854	16	.2	11	12	14	16	19	21	23
> High school	891	16	.1	11	12	14	16	19	21	23
Region										
Northeast	448	17	.2	12	13	15	17	19	21	23
Midwest	564	16	.2	11	12	14	16	18	20	23
South	660	16	.2	11	12	13	16	18	21	23
West	384	16	.2	11	12	14	16	18	21	23
Urbanization										
Central city	499	17	.2	11	12	14	17	19	21	23
Suburban	1039	16	.1	11	12	14	16	19	21	23
Nonmetropolitan	518	16	.3	11	12	14	16	18	20	22

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-12. Protein: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	54	.9	32	37	43	52	61	73	83
Age										
1-2 years	224	50	1.2	31	35	41	49	58	66	70
3-5 years	423	56	1.1	32	39	45	53	64	78	86
Race 2/										
White	559	54	.8	32	37	43	52	61	73	82
Black	53	56	3.8	*	*	44	54	69	*	*
Other	26	51	1.6	*	*	*	51	*	*	*
Poverty status 2/										
< 100	140	55	2.0	32	37	45	53	64	80	86
≥ 100	471	53	1.0	33	37	43	52	60	72	81
< 131	192	54	1.8	33	37	44	52	61	80	86
≥ 131	419	53	.9	33	37	43	52	61	72	80
Education 2/										
< High school	99	56	2.0	*	35	45	53	65	80	*
High school	252	55	1.3	33	36	43	52	64	74	87
> High school	295	52	1.1	32	38	43	51	59	70	77
Region										
Northeast	111	55	2.5	*	34	41	53	66	79	*
Midwest	199	54	1.3	35	39	45	52	61	73	85
South	187	51	1.3	29	34	43	50	57	71	80
West	150	55	2.0	37	40	46	53	63	71	82
Urbanization										
Central city	171	56	2.2	34	39	46	53	65	78	86
Suburban	310	52	.9	32	36	43	51	59	69	79
Nonmetropolitan	166	56	1.6	32	35	45	54	64	77	83

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-13. Protein: mean percent of calories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	15	.1	11	12	13	15	17	18	19
Age										
1-2 years	224	15	.2	11	13	13	15	17	19	20
3-5 years	423	15	.2	12	12	13	15	16	18	19
Race 2/										
White	559	15	.1	11	12	13	15	16	18	19
Black	53	16	.5	*	*	14	16	18	*	*
Other	26	17	.7	*	*	*	17	*	*	*
Poverty status 2/										
< 100	140	16	.3	12	13	14	16	17	19	20
≥ 100	471	15	.2	11	12	13	15	17	18	19
< 131	192	16	.2	12	13	14	16	17	19	20
≥ 131	419	15	.2	11	12	13	15	16	18	19
Education 2/										
< High school	99	16	.4	*	13	14	15	18	20	*
High school	252	15	.2	12	13	14	15	17	19	20
> High school	295	15	.2	11	12	13	15	16	18	19
Region										
Northeast	111	15	.4	*	12	13	15	17	19	*
Midwest	199	15	.3	12	12	14	15	17	18	20
South	187	15	.3	11	12	13	15	16	18	19
West	150	15	.2	12	13	14	15	17	19	19
Urbanization										
Central city	171	15	.3	12	13	13	15	16	18	19
Suburban	310	15	.2	11	12	13	15	17	18	19
Nonmetropolitan	166	16	.2	11	12	14	16	17	19	20

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-14. Protein: mean intake in grams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	53	0.7	48	0.6	48	0.5	51	1.4
3-5	61	0.6	56	0.8	56	0.4	60	1.5
6-11	76	0.9	72	0.7	71	1.0	-	-
Male								
12-15	97	2.2	94	1.2	92	2.3	-	-
16-19	118	3.5	106	1.6	122	3.9	-	-
20-29[1]	112	2.7	102	1.4	113	2.9	105	4.1
30-39[1]	107	3.3	96	1.4	99	2.7	96	4.6
40-49[1]	100	2.8	95	1.5	95	2.8	95	3.8
50-59	89	2.4	93	1.2	89	2.5	-	-
60-69	80	1.1	84	1.3	79	0.9	-	-
70+[2]	69	0.9	76	1.5	69	1.3	-	-
Female								
12-15	73	1.8	72	1.0	66	1.6	-	-
16-19	67	2.1	69	1.2	63	2.1	-	-
20-29	67	0.8	67	0.9	64	1.3	65	1.3
30-39	65	0.9	65	0.9	63	1.7	66	1.1
40-49	65	1.2	66	0.9	62	1.8	63	1.2
50-59	63	1.8	66	1.0	56	1.7	-	-
60-69	57	0.8	62	0.9	54	0.6	-	-
70+[2]	51	0.7	57	0.8	49	0.9	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-15. Protein: mean percent of kilocalories, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	16	0.1	16	0.1	15	0.1	16	0.3
3-5	15	0.1	16	0.1	14	0.1	16	0.2
6-11	15	0.1	16	0.1	15	0.1	-	-
Male								
12-15	15	0.2	16	0.1	15	0.2	-	-
16-19	16	0.3	16	0.1	16	0.3	-	-
20-29[1]	16	0.3	16	0.1	15	0.2	15	0.5
30-39[1]	16	0.4	16	0.2	15	0.3	16	0.4
40-49[1]	16	0.3	17	0.2	16	0.3	17	0.6
50-59	16	0.3	17	0.2	16	0.3	-	-
60-69	16	0.1	17	0.2	16	0.1	-	-
70+[2]	16	0.1	17	0.2	16	0.2	-	-
Female								
12-15	15	0.2	16	0.1	14	0.3	-	-
16-19	15	0.3	16	0.2	15	0.3	-	-
20-29	16	0.1	17	0.1	15	0.2	16	0.3
30-39	16	0.2	17	0.1	15	0.3	17	0.2
40-49	17	0.2	17	0.2	16	0.3	17	0.2
50-59	17	0.3	17	0.2	16	0.3	-	-
60-69	17	0.2	17	0.2	16	0.1	-	-
70+[2]	16	0.2	17	0.2	15	0.2	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

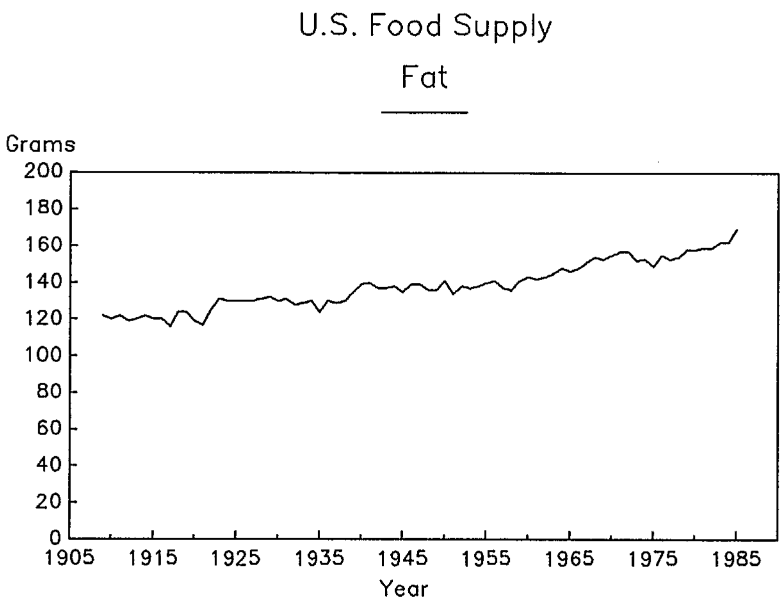


Figure II–5. Fat: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

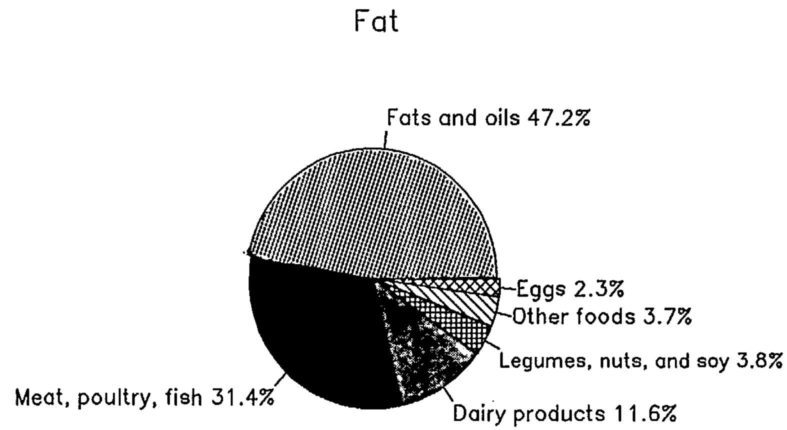


Figure II–6. Fat: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fruits; vegetables; grain products; and miscellaneous foods)

Table II-16. Fat: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	62	.7	27	33	45	59	75	96	107
Age										
20-29 years	661	64	1.0	27	34	47	60	79	98	113
30-39 years	812	62	1.0	28	33	44	59	76	96	107
40-49 years	583	60	1.3	27	32	44	58	72	90	105
Race 1/										
White	1775	64	.7	29	34	46	60	77	96	108
Black	167	56	2.9	24	26	37	52	70	91	98
Other	76	53	2.4	*	*	38	50	62	*	*
Poverty status 1/										
< 100	315	58	1.8	25	28	38	53	72	91	101
≥ 100	1575	63	.7	28	35	47	60	77	96	107
< 131	414	58	1.9	25	29	39	55	73	94	103
≥ 131	1476	64	.7	29	35	47	60	77	96	108
Education 1/										
< High school	305	52	1.6	22	27	35	48	64	86	95
High school	854	62	1.0	28	34	46	60	74	93	105
> High school	891	65	.9	29	38	48	62	79	99	111
Region										
Northeast	448	59	1.4	26	32	43	57	71	89	99
Midwest	564	67	1.4	28	34	48	63	81	102	113
South	660	60	1.2	26	31	42	58	74	93	106
West	384	65	1.3	29	37	47	61	77	97	112
Urbanization										
Central city	499	63	1.7	25	33	44	58	76	101	115
Suburban	1039	62	.8	28	33	46	60	75	94	107
Nonmetropolitan	518	62	1.5	28	32	44	59	75	90	102

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-17. Fat: mean percent of calories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	37	.2	26	29	33	37	41	44	47
Age										
20-29 years	661	36	.2	26	29	32	37	41	43	45
30-39 years	812	37	.3	26	28	33	37	41	45	48
40-49 years	583	37	.3	27	29	33	37	41	45	47
Race 1/										
White	1775	37	.2	27	29	33	37	41	45	47
Black	167	36	.7	26	29	33	36	40	44	45
Other	76	33	.7	*	*	30	34	36	*	*
Poverty status 1/										
< 100	315	36	.5	26	29	33	37	41	44	46
≥ 100	1575	37	.2	26	29	33	37	41	45	47
< 131	414	36	.4	25	29	32	37	41	44	46
≥ 131	1476	37	.2	27	29	33	37	41	45	47
Education 1/										
< High school	305	35	.4	24	27	31	36	40	43	45
High school	854	37	.3	27	29	33	37	41	45	47
> High school	891	37	.2	27	29	33	37	41	44	47
Region										
Northeast	448	36	.4	26	29	33	36	40	44	45
Midwest	564	38	.2	27	30	34	38	42	45	47
South	660	36	.3	26	28	32	36	40	44	47
West	384	37	.5	27	29	33	37	42	45	48
Urbanization										
Central city	499	36	.4	25	27	32	36	41	44	47
Suburban	1039	37	.2	27	29	33	37	41	45	47
Nonmetropolitan	518	37	.4	26	29	33	37	41	44	46

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-18. Fat: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	55	1.2	33	36	43	53	66	77	87
Age										
1-2 years	224	51	1.7	29	33	40	48	61	71	76
3-5 years	423	58	1.3	33	38	45	56	68	82	90
Race 2/										
White	559	56	1.2	33	35	43	53	67	77	87
Black	53	57	3.4	*	*	44	56	66	*	*
Other	26	47	2.4	*	*	*	47	*	*	*
Poverty status 2/										
< 100	140	57	1.7	33	38	44	55	66	77	83
≥ 100	471	55	1.4	32	36	43	52	67	76	89
< 131	192	56	1.8	33	37	44	53	66	78	85
≥ 131	419	56	1.4	32	36	43	53	68	76	89
Education 2/										
< High school	99	58	2.4	*	38	44	54	70	83	*
High school	252	56	1.5	33	36	44	55	67	78	90
> High school	295	54	1.6	32	35	42	51	64	74	85
Region										
Northeast	111	55	2.4	*	33	42	51	66	77	*
Midwest	199	56	2.3	32	37	45	54	64	78	87
South	187	55	2.1	32	37	43	52	65	78	89
West	150	56	2.5	33	35	44	55	68	76	82
Urbanization										
Central city	171	58	2.6	34	39	47	56	70	78	89
Suburban	310	53	1.4	33	35	41	50	63	74	85
Nonmetropolitan	166	58	2.5	32	36	44	57	67	83	95

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-19. Fat: mean percent of calories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	35	.3	27	29	31	35	38	41	43
Age										
1-2 years	224	35	.5	26	29	31	34	39	42	43
3-5 years	423	35	.4	27	28	31	35	38	41	43
Race 2/										
White	559	35	.4	27	28	31	34	38	41	42
Black	53	36	.6	*	*	33	35	38	*	*
Other	26	35	1.3	*	*	*	34	*	*	*
Poverty status 2/										
< 100	140	36	.6	29	31	34	36	39	42	44
≥ 100	471	34	.4	26	28	31	34	38	41	43
< 131	192	36	.6	28	30	33	36	39	42	44
≥ 131	419	34	.4	26	28	31	34	38	41	43
Education 2/										
< High school	99	37	.7	*	31	33	36	40	44	*
High school	252	35	.5	28	29	32	35	39	42	43
> High school	295	34	.4	26	28	31	34	37	39	42
Region										
Northeast	111	34	.8	*	28	31	34	36	40	*
Midwest	199	35	.5	28	29	32	35	38	41	43
South	187	35	.6	27	29	32	35	39	41	42
West	150	35	.7	28	29	31	35	38	42	43
Urbanization										
Central city	171	35	.6	28	30	32	35	38	41	42
Suburban	310	34	.4	26	28	31	34	37	41	42
Nonmetropolitan	166	36	.9	27	28	34	36	39	43	44

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-20. Fat: mean intake in grams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	56	0.8	50	0.7	51	0.6	51	1.6
3-5	68	0.7	62	1.0	62	0.5	60	1.4
6-11	83	1.1	81	0.8	79	1.1	-	-
Male								
12-15	108	2.6	108	1.7	102	2.8	-	-
16-19	127	4.0	120	2.1	126	4.0	-	-
20-29[1]	119	3.1	115	1.9	118	3.2	115	4.5
30-39[1]	111	3.6	112	1.8	105	3.0	103	5.5
40-49[1]	101	3.1	111	2.0	103	3.5	101	4.6
50-59	91	3.3	107	1.7	91	2.8	-	-
60-69	81	1.3	96	2.0	82	1.0	-	-
70+[2]	71	1.0	86	2.2	71	1.6	-	-
Female								
12-15	80	2.1	83	1.5	76	2.1	-	-
16-19	72	2.4	77	1.5	69	2.3	-	-
20-29	68	0.9	75	1.1	67	1.5	68	1.4
30-39	67	1.0	73	1.0	66	1.9	68	1.4
40-49	65	1.2	74	1.1	64	2.1	65	1.5
50-59	59	1.8	72	1.2	58	1.9	-	-
60-69	53	0.8	67	1.2	53	0.7	-	-
70+[2]	49	0.8	60	0.9	48	0.9	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-21. Fat: mean percent of kilocalories, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	37	0.2	37	0.3	36	0.2	35	0.4
3-5	36	0.2	37	0.3	36	0.1	35	0.4
6-11	37	0.2	38	0.2	36	0.2	-	-
Male								
12-15	37	0.4	39	0.2	37	0.4	-	-
16-19	38	0.5	40	0.2	38	0.5	-	-
20-29[1]	37	0.5	41	0.3	36	0.4	36	0.7
30-39[1]	37	0.6	42	0.3	37	0.5	36	0.8
40-49[1]	37	0.6	42	0.3	38	0.5	37	0.8
50-59	38	0.6	42	0.3	37	0.5	-	-
60-69	37	0.3	42	0.4	38	0.2	-	-
70+[2]	37	0.3	41	0.5	37	0.4	-	-
Female								
12-15	38	0.4	39	0.3	37	0.5	-	-
16-19	37	0.5	40	0.3	37	0.5	-	-
20-29	37	0.2	40	0.3	36	0.4	36	0.4
30-39	37	0.2	41	0.3	37	0.5	37	0.3
40-49	37	0.3	42	0.3	38	0.5	37	0.4
50-59	36	0.5	41	0.3	37	0.5	-	-
60-69	36	0.3	40	0.3	36	0.2	-	-
70+[2]	36	0.3	38	0.4	35	0.4	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

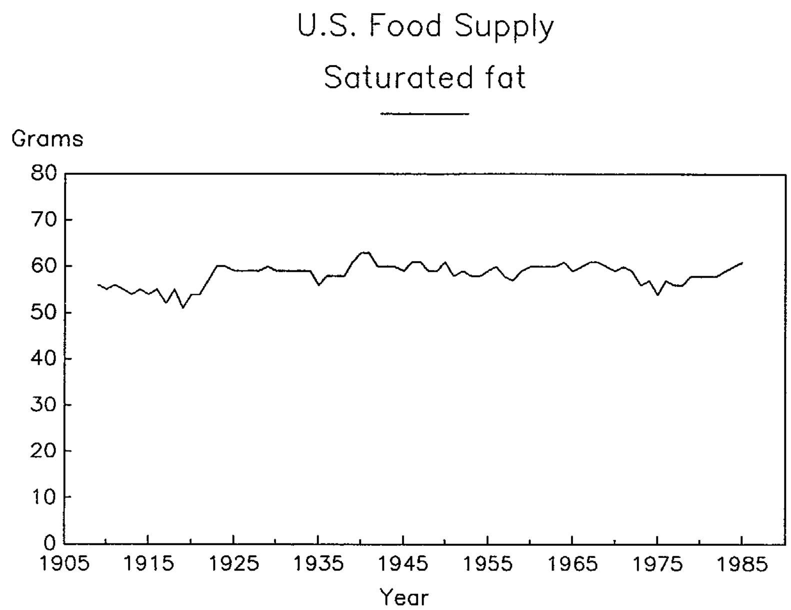


Figure II–7. Saturated fat: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

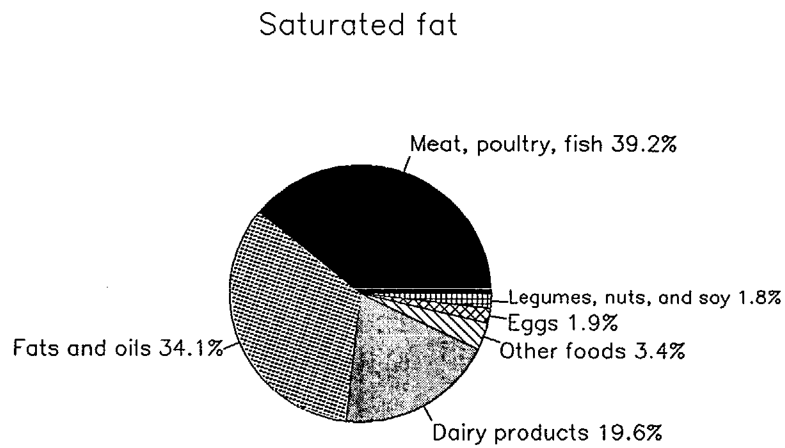


Figure II–8. Saturated fat: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fruits; vegetables; grain products; and miscellaneous foods)

Table II-22. Saturated fat: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	23	.3	9	11	16	21	28	36	41
Age										
20-29 years	661	24	.5	9	12	17	22	30	38	44
30-39 years	812	23	.4	9	11	16	21	28	36	40
40-49 years	583	22	.5	9	11	15	20	27	33	39
Race 1/										
White	1775	24	.3	10	12	16	22	29	37	42
Black	167	19	1.1	8	9	11	19	24	33	40
Other	76	19	.9	*	*	14	19	22	*	*
Poverty status 1/										
< 100	315	21	.7	8	10	13	20	27	33	39
≥ 100	1575	23	.3	9	12	16	22	29	36	41
< 131	414	21	.7	7	10	14	20	27	34	39
≥ 131	1476	23	.3	9	12	16	22	29	36	41
Education 1/										
< High school	305	19	.6	7	9	12	17	23	32	36
High school	854	23	.5	9	11	16	21	28	36	40
> High school	891	24	.4	10	12	17	23	30	37	44
Region										
Northeast	448	22	.6	9	11	15	20	27	33	40
Midwest	564	25	.6	10	12	17	23	31	38	44
South	660	22	.6	9	10	14	20	28	34	40
West	384	24	.5	10	12	17	22	28	37	42
Urbanization										
Central city	499	23	.6	9	11	15	21	28	39	44
Suburban	1039	23	.4	10	11	16	22	29	36	41
Nonmetropolitan	518	23	.6	10	11	15	21	28	35	38

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-23. Saturated fat: mean percent of calories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	13	.1	9	10	11	13	15	17	18
Age										
20-29 years	661	13	.2	9	10	11	13	15	18	19
30-39 years	812	13	.1	8	9	11	13	15	17	18
40-49 years	583	13	.2	9	10	11	13	15	17	18
Race 1/										
White	1775	14	.1	9	10	12	14	15	17	19
Black	167	13	.3	9	9	11	12	15	16	17
Other	76	12	.4	*	*	10	12	15	*	*
Poverty status 1/										
< 100	315	13	.2	8	9	11	13	15	17	18
≥ 100	1575	13	.1	9	10	11	13	15	17	18
< 131	414	13	.2	9	9	11	13	15	17	18
≥ 131	1476	13	.1	9	10	11	13	15	17	18
Education 1/										
< High school	305	13	.2	8	9	11	13	15	16	17
High school	854	13	.2	9	10	11	13	15	17	19
> High school	891	13	.1	9	10	11	14	15	17	18
Region										
Northeast	448	13	.2	9	9	11	13	15	17	18
Midwest	564	14	.1	9	10	12	14	16	17	19
South	660	13	.2	8	9	11	13	15	17	18
West	384	14	.3	9	9	12	14	16	18	19
Urbanization										
Central city	499	13	.2	8	9	11	13	15	18	19
Suburban	1039	13	.1	9	10	11	13	15	17	18
Nonmetropolitan	518	13	.2	9	10	11	13	15	17	18

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-24. Saturated fat: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	22	.5	12	14	17	21	26	31	35
Age										
1-2 years	224	21	.7	10	13	16	20	25	30	32
3-5 years	423	23	.5	13	14	17	22	27	32	36
Race 2/										
White	559	22	.5	12	14	17	21	27	31	36
Black	53	21	1.2	*	*	17	20	24	*	*
Other	26	19	.9	*	*	*	19	*	*	*
Poverty status 2/										
< 100	140	22	.6	13	14	18	23	26	30	34
≥ 100	471	22	.6	12	13	17	21	26	32	36
< 131	192	22	.6	13	14	17	22	26	31	35
≥ 131	419	22	.6	12	13	17	21	27	31	36
Education 2/										
< High school	99	23	.9	*	15	18	22	28	32	*
High school	252	22	.6	12	13	16	22	26	31	36
> High school	295	22	.6	12	14	17	21	25	30	34
Region										
Northeast	111	22	.9	*	14	17	21	27	32	*
Midwest	199	23	1.0	13	15	18	22	26	32	38
South	187	22	.9	11	12	17	21	25	31	34
West	150	22	1.1	13	14	17	20	27	30	33
Urbanization										
Central city	171	23	1.0	14	15	18	22	26	31	34
Suburban	310	21	.6	12	13	16	20	25	30	34
Nonmetropolitan	166	23	1.1	12	14	17	23	28	33	37

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-25. Saturated fat: mean percent of calories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	14	.2	10	11	12	14	16	17	18
Age										
1-2 years	224	14	.2	9	10	12	14	16	18	18
3-5 years	423	14	.2	10	11	12	14	15	17	18
Race 2/										
White	559	14	.2	10	10	12	14	16	17	18
Black	53	14	.2	*	*	13	14	15	*	*
Other	26	15	.7	*	*	*	13	*	*	*
Poverty status 2/										
< 100	140	14	.3	11	11	13	14	16	18	18
≥ 100	471	14	.2	10	10	12	14	16	17	18
< 131	192	14	.3	11	11	13	14	16	18	18
≥ 131	419	14	.2	9	10	12	13	16	17	18
Education 2/										
< High school	99	15	.3	*	12	13	14	16	18	*
High school	252	14	.2	10	11	12	14	16	17	18
> High school	295	14	.2	9	10	12	13	15	17	18
Region										
Northeast	111	14	.4	*	10	12	13	16	17	*
Midwest	199	14	.2	10	11	13	14	16	17	18
South	187	14	.3	9	10	12	14	16	17	18
West	150	14	.3	10	10	12	13	15	17	18
Urbanization										
Central city	171	14	.3	10	11	12	14	15	17	18
Suburban	310	14	.2	9	10	12	13	16	17	18
Nonmetropolitan	166	15	.4	10	11	13	14	16	18	19

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II–26. Saturated fat: mean intake in grams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971–74; Nationwide Food Consumption Survey (NFCS), 1977–78; Second National Health and Nutrition Examination Survey (NHANES II), 1976–80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985–86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	22	0.3	-	-	19	0.2	21	0.7
3-5	26	0.3	-	-	23	0.2	24	0.6
6-11	32	0.5	-	-	29	0.4	-	-
Male								
12-15	40	1.1	-	-	38	1.1	-	-
16-19	46	1.6	-	-	48	1.6	-	-
20-29[1]	43	1.3	-	-	43	1.2	42	1.8
30-39[1]	40	1.4	-	-	38	1.1	37	2.0
40-49[1]	37	1.3	-	-	38	1.3	37	2.2
50-59	33	1.3	-	-	33	1.0	-	-
60-69	30	0.5	-	-	29	0.4	-	-
70+[2]	26	0.4	-	-	25	0.6	-	-
Female								
12-15	30	0.9	-	-	27	0.8	-	-
16-19	26	1.0	-	-	25	0.8	-	-
20-29	25	0.4	-	-	24	0.5	25	0.6
30-39	24	0.4	-	-	23	0.7	25	0.5
40-49	23	0.5	-	-	23	0.7	23	0.6
50-59	22	0.8	-	-	20	0.7	-	-
60-69	19	0.3	-	-	18	0.2	-	-
70+[2]	18	0.3	-	-	16	0.3	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Monounsaturated Fat

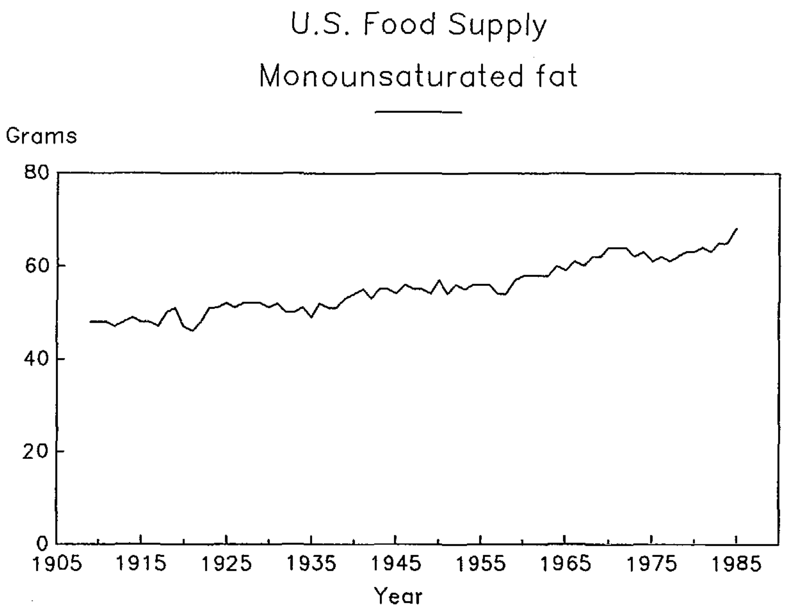


Figure II–9. Monounsaturated fat: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

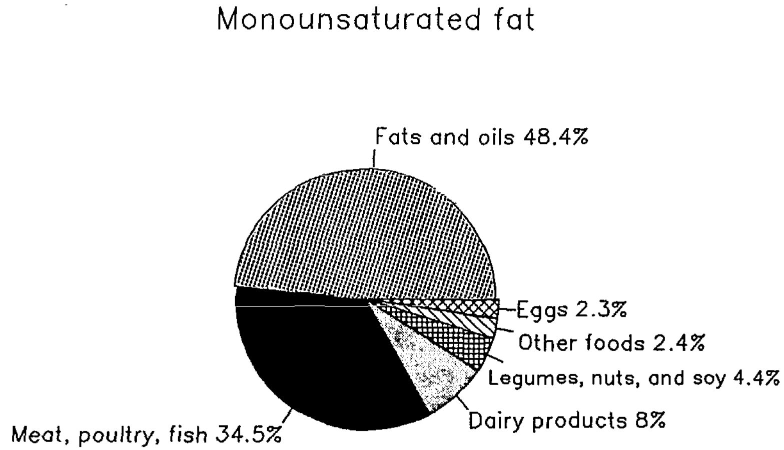


Figure II–10. Monounsaturated fat: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fruits; vegetables; grain products; and miscellaneous foods)

Table II-27. Monounsaturated fat: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	23	.3	10	12	16	22	28	35	40
Age										
20-29 years	661	23	.4	10	12	17	22	29	37	41
30-39 years	812	23	.4	10	12	16	21	28	35	39
40-49 years	583	22	.5	10	12	16	21	27	34	38
Race 1/										
White	1775	23	.2	10	12	17	22	28	36	40
Black	167	21	1.1	8	10	14	19	27	33	38
Other	76	20	1.0	*	*	13	19	23	*	*
Poverty status 1/										
< 100	315	22	.8	9	10	14	21	27	35	39
≥ 100	1575	23	.3	10	12	17	22	28	36	40
< 131	414	22	.8	9	11	15	21	27	35	40
≥ 131	1476	23	.3	10	13	17	22	28	35	40
Education 1/										
< High school	305	20	.7	8	10	13	18	24	33	37
High school	854	23	.4	10	12	17	22	28	35	38
> High school	891	24	.3	10	13	17	23	29	37	41
Region										
Northeast	448	21	.5	10	12	16	20	26	33	37
Midwest	564	24	.5	10	12	18	23	30	37	41
South	660	22	.4	9	12	16	22	27	34	40
West	384	24	.6	10	13	17	22	28	37	41
Urbanization										
Central city	499	23	.6	9	12	16	21	28	37	41
Suburban	1039	23	.3	10	12	16	22	28	35	39
Nonmetropolitan	518	23	.6	10	12	16	22	28	34	37

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-28. Monounsaturated fat: mean percent of calories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	13	.1	9	10	12	13	15	17	18
Age										
20-29 years	661	13	.1	9	10	12	13	15	16	17
30-39 years	812	13	.1	9	10	12	13	15	17	18
40-49 years	583	14	.1	10	11	12	14	16	17	18
Race 1/										
White	1775	14	.1	10	10	12	14	15	17	18
Black	167	14	.4	9	10	12	13	15	17	18
Other	76	13	.3	*	*	10	13	14	*	*
Poverty status 1/										
< 100	315	14	.2	9	10	12	14	16	17	18
≥ 100	1575	13	.1	10	10	12	13	15	17	18
< 131	414	14	.2	9	10	12	14	16	17	18
≥ 131	1476	13	.1	10	10	12	13	15	17	18
Education 1/										
< High school	305	13	.2	9	10	12	13	15	17	18
High school	854	14	.1	10	11	12	14	15	17	18
> High school	891	13	.1	9	10	12	13	15	17	17
Region										
Northeast	448	13	.2	9	10	12	13	15	16	17
Midwest	564	14	.1	10	11	12	14	15	17	18
South	660	13	.1	9	10	12	13	15	17	18
West	384	14	.2	10	10	12	14	15	17	18
Urbanization										
Central city	499	13	.2	9	10	12	13	15	17	17
Suburban	1039	13	.1	10	10	12	13	15	17	18
Nonmetropolitan	518	14	.2	9	11	12	14	15	17	18

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-29. Monounsaturated fat: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	20	.4	11	13	16	19	24	28	33
Age										
1-2 years	224	18	.6	11	12	14	18	22	26	27
3-5 years	423	21	.5	12	14	16	20	25	31	33
Race 2/										
White	559	20	.5	12	13	16	19	24	28	33
Black	53	22	1.4	*	*	16	22	26	*	*
Other	26	17	1.0	*	*	*	18	*	*	*
Poverty status 2/										
< 100	140	21	.7	12	13	16	20	25	29	32
≥ 100	471	20	.5	11	13	15	19	24	28	33
< 131	192	21	.7	12	13	16	20	24	29	32
≥ 131	419	20	.5	11	13	16	19	24	28	33
Education 2/										
< High school	99	22	.9	*	13	16	20	27	31	*
High school	252	21	.6	11	13	16	20	25	28	33
> High school	295	20	.6	11	12	15	18	23	27	31
Region										
Northeast	111	20	1.0	*	12	15	18	24	28	*
Midwest	199	20	.9	11	13	16	19	24	29	32
South	187	20	.8	12	13	16	19	24	28	34
West	150	20	.9	11	12	15	20	26	28	32
Urbanization										
Central city	171	21	1.1	11	13	16	20	26	29	34
Suburban	310	19	.6	12	12	15	18	24	28	31
Nonmetropolitan	166	21	.9	11	12	16	21	25	31	34

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-30. Monounsaturated fat: mean percent of calories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	13	.1	9	10	11	13	14	15	16
Age										
1-2 years	224	13	.2	9	10	11	13	14	15	16
3-5 years	423	13	.1	10	10	11	13	14	15	16
Race 2/										
White	559	13	.2	9	10	11	13	14	15	16
Black	53	14	.3	*	*	12	14	15	*	*
Other	26	12	.5	*	*	*	13	*	*	*
Poverty status 2/										
< 100	140	14	.3	11	11	12	14	15	16	16
≥ 100	471	12	.1	9	10	11	13	14	15	16
< 131	192	13	.3	10	11	12	13	15	16	16
≥ 131	419	12	.2	9	10	11	12	14	15	16
Education 2/										
< High school	99	14	.3	*	11	12	14	15	16	*
High school	252	13	.2	10	10	11	13	15	15	16
> High school	295	12	.2	9	10	11	12	13	15	15
Region										
Northeast	111	12	.4	*	10	11	12	14	15	*
Midwest	199	13	.2	10	10	11	13	14	15	16
South	187	13	.3	9	10	11	13	15	16	16
West	150	13	.3	9	10	11	13	14	15	15
Urbanization										
Central city	171	13	.2	10	11	12	13	14	15	15
Suburban	310	12	.2	9	10	11	12	14	15	16
Nonmetropolitan	166	13	.3	9	10	12	13	15	16	16

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-31. Monounsaturated fat[1]: mean intake in grams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	20	0.3	-	-	18	0.2	18	0.7
3-5	25	0.3	-	-	22	0.2	22	0.5
6-11	30	0.4	-	-	28	0.4	-	-
Male								
12-15	39	1.1	-	-	37	1.0	-	-
16-19	46	1.5	-	-	47	1.4	-	-
20-29[2]	44	1.2	-	-	44	1.1	44	1.7
30-39[2]	42	1.4	-	-	39	1.1	40	2.5
40-49[2]	39	1.3	-	-	39	1.3	38	1.8
50-59	35	1.3	-	-	34	1.0	-	-
60-69	32	0.5	-	-	31	0.4	-	-
70+[3]	28	0.4	-	-	26	0.6	-	-
Female								
12-15	30	0.8	-	-	27	0.8	-	-
16-19	26	1.0	-	-	25	0.8	-	-
20-29	26	0.4	-	-	24	0.5	25	0.5
30-39	26	0.4	-	-	24	0.7	25	0.5
40-49	25	0.5	-	-	24	0.7	24	0.6
50-59	23	0.7	-	-	21	0.7	-	-
60-69	21	0.3	-	-	20	0.2	-	-
70+[3]	19	0.3	-	-	17	0.4	-	-

[1] Oleic acid measured in NHANES I and NHANES II.

[2] CSFII data for 1985 only.

[3] Ages 70-74 years only for NHANES I and NHANES II.

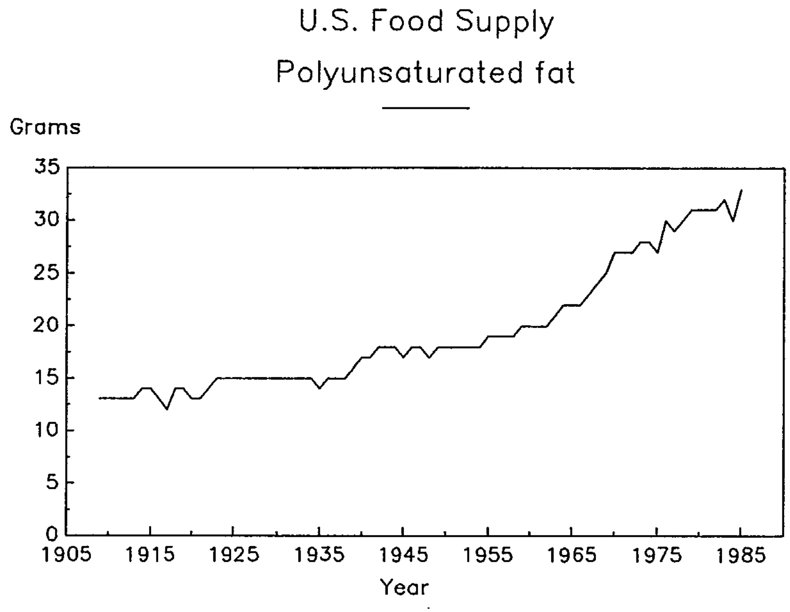


Figure II–11. Polyunsaturated fat: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

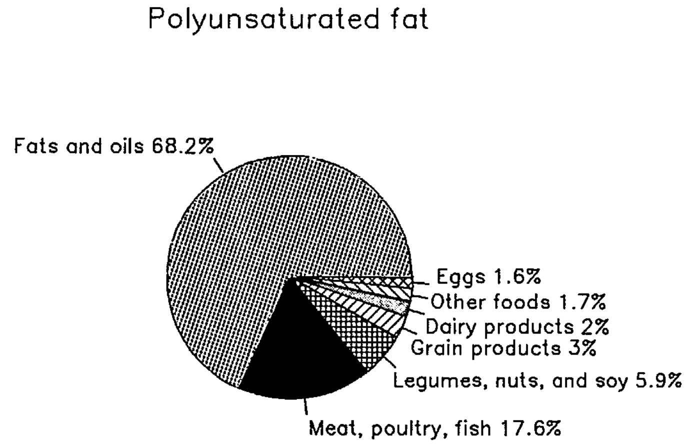


Figure II–12. Polyunsaturated fat: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fruits; vegetables; and miscellaneous foods)

Table II-32. Polyunsaturated fat: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	12	.1	5	6	8	11	15	19	23
Age										
20-29 years	661	12	.3	5	6	8	11	15	19	23
30-39 years	812	12	.2	5	6	8	11	15	19	23
40-49 years	583	12	.3	5	6	8	11	15	19	23
Race 1/										
White	1775	12	.2	5	6	9	12	16	19	23
Black	167	11	.6	4	5	7	10	13	18	22
Other	76	10	.7	*	*	6	9	13	*	*
Poverty status 1/										
< 100	315	11	.3	4	5	7	9	13	17	20
≥ 100	1575	13	.2	5	6	9	12	16	20	23
< 131	414	11	.4	4	5	7	10	14	17	22
≥ 131	1476	13	.2	5	6	9	12	16	20	23
Education 1/										
< High school	305	10	.4	3	4	6	9	12	17	20
High school	854	12	.2	5	6	9	11	15	19	22
> High school	891	13	.2	6	7	9	12	16	20	24
Region										
Northeast	448	11	.2	5	6	8	11	14	18	20
Midwest	564	13	.3	5	6	9	12	16	21	24
South	660	12	.3	5	6	8	11	15	18	21
West	384	13	.3	5	6	8	13	16	20	24
Urbanization										
Central city	499	12	.4	4	6	8	11	15	19	24
Suburban	1039	12	.2	5	6	9	12	15	19	23
Nonmetropolitan	518	12	.3	5	6	8	11	15	19	21

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-33. Polyunsaturated fat: mean percent of calories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	7	.1	4	5	6	7	9	10	11
Age										
20-29 years	661	7	.1	4	5	6	7	8	10	11
30-39 years	812	7	.1	4	5	6	7	9	10	12
40-49 years	583	7	.1	4	5	6	7	9	10	11
Race 1/										
White	1775	7	.1	4	5	6	7	9	10	11
Black	167	7	.2	4	5	6	7	9	10	11
Other	76	6	.3	*	*	5	6	7	*	*
Poverty status 1/										
< 100	315	7	.2	4	4	5	6	8	9	11
≥ 100	1575	7	.1	4	5	6	7	9	10	11
< 131	414	7	.2	4	4	5	7	8	10	11
≥ 131	1476	7	.1	4	5	6	7	9	10	11
Education 1/										
< High school	305	7	.2	4	4	5	6	8	9	11
High school	854	7	.1	4	5	6	7	8	10	11
> High school	891	7	.1	4	5	6	7	9	10	12
Region										
Northeast	448	7	.1	4	5	6	7	8	10	11
Midwest	564	7	.1	4	5	6	7	9	10	11
South	660	7	.2	4	5	6	7	8	10	11
West	384	7	.1	4	5	6	7	9	11	12
Urbanization										
Central city	499	7	.1	4	5	6	7	8	10	11
Suburban	1039	7	.1	4	5	6	7	9	10	12
Nonmetropolitan	518	7	.1	4	5	6	7	8	10	11

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-34. Polyunsaturated fat: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	9	.2	5	5	7	9	11	14	16
Age										
1-2 years	224	8	.4	4	5	6	8	11	12	14
3-5 years	423	10	.2	5	6	7	9	12	15	16
Race 2/										
White	559	9	.2	5	5	7	9	11	14	16
Black	53	10	.7	*	*	7	9	11	*	*
Other	26	7	.4	*	*	*	7	*	*	*
Poverty status 2/										
< 100	140	9	.4	5	6	7	8	11	13	15
≥ 100	471	9	.2	4	5	7	9	11	14	16
< 131	192	9	.4	4	5	6	8	11	13	15
≥ 131	419	10	.3	4	5	7	9	12	14	16
Education 2/										
< High school	99	9	.4	*	5	7	8	11	14	*
High school	252	10	.3	5	5	7	9	11	15	16
> High school	295	9	.3	4	5	7	9	11	14	15
Region										
Northeast	111	9	.5	*	5	6	9	11	13	*
Midwest	199	9	.3	4	5	7	9	11	13	15
South	187	9	.4	5	5	7	8	11	15	16
West	150	10	.4	5	5	7	10	12	15	16
Urbanization										
Central city	171	10	.5	4	5	7	10	12	16	16
Suburban	310	9	.2	5	5	6	9	11	13	14
Nonmetropolitan	166	9	.5	4	5	7	8	11	15	17

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-35. Polyunsaturated fat: mean percent of calories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	6	.1	4	4	5	6	7	8	9
Age										
1-2 years	224	6	.1	3	4	5	6	6	8	9
3-5 years	423	6	.1	4	4	5	6	7	8	8
Race 2/										
White	559	6	.1	4	4	5	6	7	8	9
Black	53	6	.2	*	*	5	6	7	*	*
Other	26	5	.2	*	*	*	5	*	*	*
Poverty status 2/										
< 100	140	6	.1	4	4	5	6	6	7	8
≥ 100	471	6	.1	4	4	5	6	7	8	9
< 131	192	6	.1	4	4	5	6	6	7	8
≥ 131	419	6	.1	4	4	5	6	7	8	9
Education 2/										
< High school	99	6	.2	*	4	5	6	6	7	*
High school	252	6	.1	4	4	5	6	7	8	9
> High school	295	6	.1	4	4	5	6	6	7	8
Region										
Northeast	111	5	.2	*	4	5	5	6	7	*
Midwest	199	6	.1	4	4	5	6	6	7	8
South	187	6	.1	4	4	5	6	7	7	8
West	150	6	.1	4	4	5	6	7	8	9
Urbanization										
Central city	171	6	.1	4	4	5	6	7	8	9
Suburban	310	6	.1	4	4	5	6	6	7	8
Nonmetropolitan	166	6	.2	4	4	5	6	7	7	8

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-36. Polyunsaturated fat[1]: mean intake in grams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	4	0.1	-	-	6	0.1	8	0.3
3-5	6	0.1	-	-	8	0.1	10	0.3
6-11	8	0.2	-	-	10	0.2	-	-
Male								
12-15	10	0.4	-	-	14	0.5	-	-
16-19	13	0.7	-	-	16	0.6	-	-
20-29[2]	13	0.6	-	-	16	0.5	21	1.1
30-39[2]	12	0.7	-	-	15	0.5	19	1.0
40-49[2]	10	0.5	-	-	14	0.5	18	0.9
50-59	10	0.6	-	-	12	0.5	-	-
60-69	8	0.2	-	-	11	0.2	-	-
70+[3]	7	0.2	-	-	10	0.3	-	-
Female								
12-15	8	0.3	-	-	11	0.4	-	-
16-19	8	0.5	-	-	10	0.4	-	-
20-29	8	0.2	-	-	10	0.3	13	0.3
30-39	8	0.2	-	-	10	0.4	13	0.4
40-49	7	0.2	-	-	10	0.5	13	0.4
50-59	6	0.3	-	-	8	0.3	-	-
60-69	6	0.1	-	-	8	0.1	-	-
70+[3]	5	0.1	-	-	7	0.2	-	-

[1] Linoleic acid measured in NHANES I and NHANES II.

[2] CSFII data for 1985 only.

[3] Ages 70-74 years only for NHANES I and NHANES II.

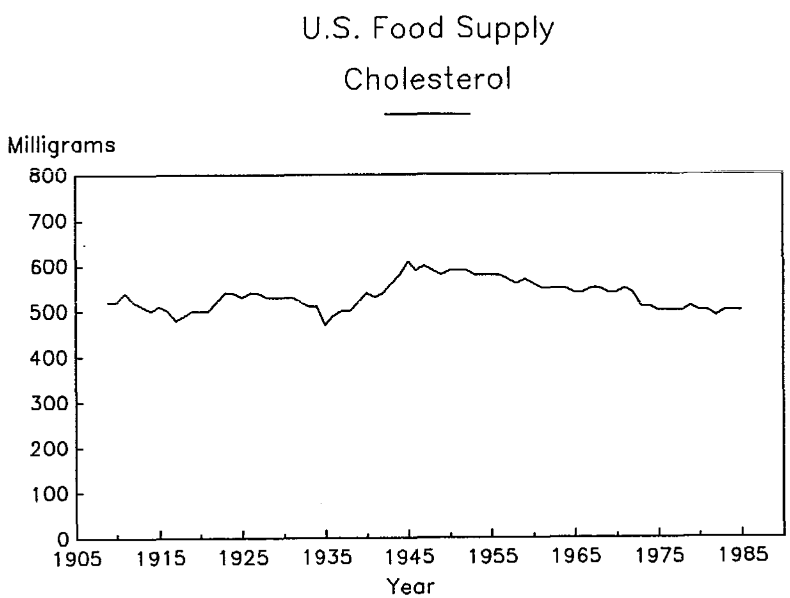


Figure II–13. Cholesterol: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

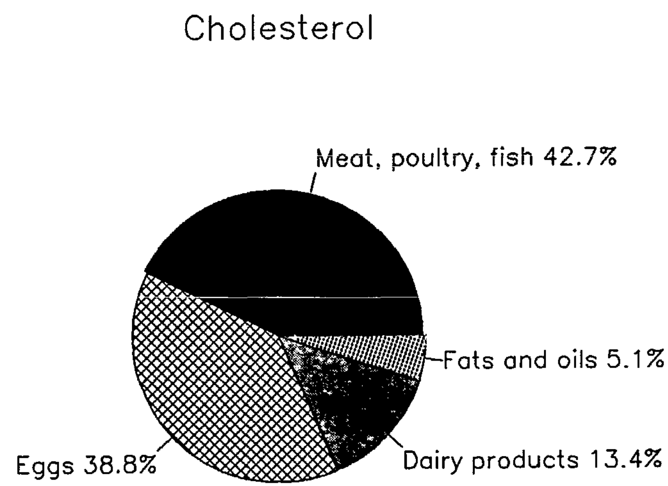


Figure II–14. Cholesterol: food sources in the U.S. food supply, 1985: U.S. Food Supply Series

Table II-37. Cholesterol: mean intake in milligrams, women aged 20–49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985–86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	277	4.3	97	122	174	251	354	467	544
Age										
20-29 years	661	277	6.7	90	118	168	245	363	470	550
30-39 years	812	276	6.7	102	126	176	251	346	463	542
40-49 years	583	279	6.5	99	123	178	255	359	462	528
Race 1/										
White	1775	271	4.5	95	122	173	247	345	455	542
Black	167	315	18.2	102	122	175	303	431	514	614
Other	76	277	14.9	*	*	175	259	377	*	*
Poverty status 1/										
< 100	315	297	13.4	86	119	172	257	391	518	592
≥ 100	1575	274	4.6	99	122	176	251	347	455	533
< 131	414	287	10.8	83	111	171	250	364	503	575
≥ 131	1476	275	4.5	100	125	176	253	349	460	532
Education 1/										
< High school	305	262	11.0	81	101	155	231	368	508	582
High school	854	285	7.1	95	122	176	253	362	475	550
> High school	891	275	5.8	107	130	177	253	347	457	532
Region										
Northeast	448	285	7.2	106	127	171	253	382	471	550
Midwest	564	278	10.0	99	120	174	251	351	453	556
South	660	270	7.4	84	118	173	243	337	465	537
West	384	279	8.2	100	127	185	262	349	468	534
Urbanization										
Central city	499	305	10.3	100	129	180	277	385	503	563
Suburban	1039	267	5.7	97	122	171	238	345	454	541
Nonmetropolitan	518	266	7.8	87	112	171	233	337	451	528

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-38. Cholesterol: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	228	5.7	87	108	147	201	292	378	445
Age										
1-2 years	224	219	8.9	75	100	143	195	276	364	429
3-5 years	423	233	6.4	94	114	148	204	300	382	449
Race 2/										
White	559	222	6.2	86	103	145	195	292	365	426
Black	53	260	20.6	*	*	179	236	285	*	*
Other	26	296	36.5	*	*	*	295	*	*	*
Poverty status 2/										
< 100	140	269	15.2	105	124	169	236	330	458	564
≥ 100	471	220	6.5	94	106	145	194	285	358	419
< 131	192	257	12.2	103	124	168	229	318	415	533
≥ 131	419	219	6.9	90	103	143	194	285	358	422
Education 2/										
< High school	99	273	18.6	*	140	180	243	328	523	*
High school	252	234	7.9	95	115	165	211	299	382	426
> High school	295	211	7.6	87	100	137	183	266	350	418
Region										
Northeast	111	238	15.6	*	94	131	205	313	429	*
Midwest	199	215	11.3	89	100	140	199	268	342	380
South	187	225	9.3	98	114	154	194	287	365	416
West	150	238	9.9	94	117	151	206	303	415	477
Urbanization										
Central city	171	239	12.4	108	124	165	217	292	416	458
Suburban	310	214	8.0	87	99	138	188	264	358	414
Nonmetropolitan	166	249	8.9	94	114	173	228	307	407	445

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-39. Cholesterol: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971–74; Nationwide Food Consumption Survey (NFCS), 1977–78; Second National Health and Nutrition Examination Survey (NHANES II), 1976–80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985–86

Sex and age (years)	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	284	6.3	-	-	227	4.2	247	12.6
3-5	290	4.9	-	-	245	3.2	261	10.6
6-11	314	6.8	-	-	278	7.0	-	-
Male								
12-15	379	13.6	-	-	359	15.4	-	-
16-19	518	23.8	-	-	493	21.4	-	-
20-29[1]	513	19.6	-	-	453	16.7	466	30.8
30-39[1]	517	22.8	-	-	453	18.5	423	24.9
40-49[1]	497	20.0	-	-	442	19.5	435	26.1
50-59	470	18.9	-	-	437	17.8	-	-
60-69	424	8.6	-	-	415	7.2	-	-
70+[2]	424	10.7	-	-	365	11.1	-	-
Female								
12-15	305	11.3	-	-	256	11.2	-	-
16-19	297	14.2	-	-	255	12.4	-	-
20-29	304	5.9	-	-	270	9.1	302	10.6
30-39	312	6.5	-	-	289	11.6	304	8.6
40-49	340	10.0	-	-	305	14.7	298	8.8
50-59	317	14.4	-	-	263	12.1	-	-
60-69	298	6.6	-	-	262	4.9	-	-
70+[2]	256	5.7	-	-	216	7.3	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-40. Serum cholesterol status of persons 20-74 years of age by sex, specified Hispanic origin, and age: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex, Hispanic origin, and age	Number of examined persons 1/	Mean serum cholesterol (mmol/L) 2/	Standard error of the mean	Percent with high-risk serum cholesterol	Standard error of the percent
MALE					
Mexican American					
20-74 years	1,407	5.26	0.03	16.2	1.1
20-74 years, age adjusted	...	5.35	...	15.5	...
20-29 years	429	4.87	0.06	18.0	2.3
30-39 years	358	5.33	0.06	16.6	2.3
40-49 years	232	5.70	0.07	13.1	2.2
50-59 years	229	5.68	0.06	14.5	2.1
60-69 years	121	5.58	0.08	12.6	2.8
70-74 years	38	*5.41	0.19	*15.8	5.9
Cuban					
20-74 years	366	5.40	0.06	14.6	1.9
20-74 years, age adjusted	...	5.28	...	13.7	...
20-29 years	52	4.73	0.16	12.2	5.5
30-39 years	53	5.12	0.17	12.2	5.3
40-49 years	81	5.70	0.12	14.8	4.1
50-59 years	107	5.65	0.09	18.4	3.5
60-69 years	45	5.55	0.14	8.4	3.9
70-74 years	28	*5.95	0.16	*24.1	7.6
Puerto Rican					
20-74 years	422	5.19	0.07	13.3	2.1
20-74 years, age adjusted	...	5.26	...	13.5	...
20-29 years	110	4.63	0.12	9.5	4.0
30-39 years	85	5.10	0.16	11.8	5.0
40-49 years	83	5.55	0.16	16.3	5.1
50-59 years	97	5.82	0.12	20.6	4.2
60-69 years	37	*5.73	0.16	*11.3	5.6
70-74 years	10	*	*	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ mmol/L = mg/dl*0.02586.

Table II-40. Serum cholesterol status of persons 20-74 years of age by sex, specified Hispanic origin, and age: Hispanic Health and Nutrition Examination Survey, 1982-84--continued

Sex, Hispanic origin, and age	Number of examined persons 1/	Mean serum cholesterol (mmol/L) 2/	Standard error of the mean	Percent with high-risk serum cholesterol	Standard error of the percent
FEMALE					
Mexican American					
20-74 years..................	1,797	5.23	0.03	14.6	0.8
20-74 years, age adjusted....	...	5.35	...	15.5	...
20-29 years..................	534	4.85	0.05	16.7	1.7
30-39 years..................	449	5.02	0.05	10.1	1.4
40-49 years..................	305	5.45	0.06	9.1	1.5
50-59 years..................	311	5.81	0.06	15.8	1.7
60-69 years..................	139	6.00	0.09	23.1	3.2
70-74 years..................	59	6.19	0.14	33.4	5.6
Cuban					
20-74 years..................	460	5.23	0.05	11.3	1.5
20-74 years, age adjusted....	...	5.16	...	11.2	...
20-29 years..................	62	4.60	0.10	8.7	4.1
30-39 years..................	91	4.67	0.09	5.9	2.8
40-49 years..................	101	5.13	0.07	4.1	2.0
50-59 years..................	110	5.98	0.10	20.4	3.6
60-69 years..................	66	5.94	0.11	18.9	4.4
70-74 years..................	30	*5.82	0.20	*22.9	7.2
Puerto Rican					
20-74 years..................	716	5.25	0.06	15.4	1.7
20-74 years, age adjusted....	...	5.39	...	17.5	...
20-29 years..................	181	4.84	0.13	16.2	3.8
30-39 years..................	164	4.97	0.11	10.8	3.3
40-49 years..................	159	5.53	0.11	13.7	3.2
50-59 years..................	127	5.96	0.09	19.2	3.5
60-69 years..................	71	6.13	0.12	21.6	4.7
70-74 years..................	14	*	*	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ mmol/L = mg/dl*0.02586.

Table II-41. Serum cholesterol status of Mexican-American persons 20-74 years of age by sex, poverty status, and age: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex, poverty status, and age	Number of examined persons 1/	Mean serum cholesterol (mmol/L) 2/	Standard error of the mean	Percent with high-risk serum cholesterol	Standard error of the percent
MALE					
Below poverty					
20-74 years	310	5.14	0.06	12.2	2.0
20-74 years, age adjusted	...	5.27	...	12.1	...
20-29 years	98	4.71	0.11	11.2	4.0
30-39 years	65	5.28	0.13	15.3	5.2
40-49 years	46	5.59	0.13	9.9	4.3
50-59 years	47	5.59	0.15	11.0	4.0
60-69 years	40	*5.62	0.13	*12.2	5.0
70-74 years	14	*	*	*	*
Above poverty					
20-74 years	981	5.30	0.04	17.5	1.3
20-74 years, age adjusted	...	5.39	...	16.9	...
20-29 years	294	4.93	0.07	20.2	2.8
30-39 years	272	5.36	0.07	17.4	2.7
40-49 years	166	5.75	0.08	14.4	2.7
50-59 years	158	5.67	0.07	13.7	2.4
60-69 years	70	5.69	0.11	14.8	3.9
70-74 years	21	*	*	*	*
FEMALE					
Below poverty					
20-74 years	550	5.18	0.04	12.2	1.4
20-74 years, age adjusted	...	5.25	...	12.6	...
20-29 years	154	4.72	0.08	10.7	2.7
30-39 years	131	5.05	0.08	9.1	2.5
40-49 years	88	5.31	0.11	8.9	2.8
50-59 years	96	5.59	0.09	13.6	3.0
60-69 years	46	5.85	0.14	20.1	5.6
70-74 years	35	*6.27	0.19	*28.6	7.2
Above poverty					
20-74 years	1,078	5.25	0.03	15.7	1.1
20-74 years, age adjusted	...	5.42	...	17.5	...
20-29 years	339	4.94	0.06	19.5	2.2
30-39 years	285	4.99	0.06	10.1	1.8
40-49 years	183	5.54	0.08	9.0	1.9
50-59 years	180	5.92	0.08	17.8	2.4
60-69 years	74	6.09	0.14	25.1	4.5
70-74 years	17	*	*	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ mmol/L = mg/dl*0.02586.

Table II-42. Serum cholesterol status of non-Hispanic persons 20-74 years of age by sex, race, and age: Second National Health and Nutrition Examination Survey, 1976-80

Sex, race, and age	Number of examined persons 1/	Mean serum cholesterol (mmol/L) 2/	Standard error of the mean	Percent with high-risk serum cholesterol	Standard error of the percent
MALE					
Non-Hispanic white					
20-74 years................	4,646	5.47	0.02	19.1	0.7
20-74 years, age adjusted..	...	5.45	...	19.0	...
20-29 years................	1,011	4.85	0.04	17.1	1.6
30-39 years................	707	5.41	0.06	20.1	2.1
40-49 years................	572	5.78	0.07	18.1	2.3
50-59 years................	575	5.92	0.07	21.9	2.4
60-69 years................	1,354	5.85	0.03	21.0	0.9
70-74 years................	427	5.58	0.04	13.7	1.4
Non-Hispanic black					
20-74 years................	597	5.37	0.07	20.5	2.0
20-74 years, age adjusted..	...	5.39	...	20.5	...
20-29 years................	158	4.79	0.13	17.1	3.9
30-39 years................	93	5.36	0.20	20.8	5.8
40-49 years................	62	5.63	0.28	19.7	7.6
50-59 years................	77	5.96	0.19	30.3	7.0
60-69 years................	151	5.77	0.07	18.4	2.5
70-74 years................	56	5.48	0.13	14.7	3.7
FEMALE					
Non-Hispanic white					
20-74 years................	5,148	5.59	0.02	22.4	0.7
20-74 years, age adjusted..	...	5.54	...	21.7	...
20-29 years................	1,066	4.83	0.04	17.0	1.5
30-39 years................	798	5.09	0.05	14.5	1.7
40-49 years................	615	5.65	0.07	13.6	1.9
50-59 years................	649	6.30	0.07	31.4	2.5
60-69 years................	1,487	6.44	0.03	36.4	1.1
70-74 years................	533	6.42	0.05	37.4	1.8
Non-Hispanic black					
20-74 years................	721	5.48	0.06	19.9	1.8
20-74 years, age adjusted..	...	5.52	...	20.2	...
20-29 years................	181	4.88	0.11	17.4	3.9
30-39 years................	110	5.11	0.13	11.1	4.1
40-49 years................	95	5.61	0.19	17.9	5.3
50-59 years................	101	6.28	0.20	30.0	6.0
60-69 years................	170	6.22	0.08	27.2	2.7
70-74 years................	64	6.46	0.14	33.4	4.7

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ mmol/L = mg/dl*0.02586.

Table II-43. Serum cholesterol status of non-Hispanic persons 20-74 years of age by sex, poverty status, and age: Second National Health and Nutrition Examination Survey, 1982-84

Sex, poverty status, and age	Number of examined persons 1/	Mean serum cholesterol (mmol/L) 2/	Standard error of the mean	Percent with high-risk serum cholesterol	Standard error of the percent
MALE					
Below poverty					
20-74 years................	541	5.28	0.06	15.0	1.8
20-74 years, age adjusted..	...	5.34	...	14.7	...
20-29 years................	147	4.85	0.13	16.9	4.3
30-39 years................	67	5.31	0.20	16.0	6.4
40-49 years................	35	*5.34	0.29	*8.8	7.3
50-59 years................	50	5.96	0.22	15.5	7.1
60-69 years................	156	5.70	0.07	15.8	2.5
70-74 years................	86	5.34	0.10	9.9	2.7
Above poverty					
20-74 years................	4,595	5.48	0.02	19.7	0.7
20-74 years, age adjusted..	...	5.47	...	19.7	...
20-29 years................	1,008	4.85	0.04	17.5	1.6
30-39 years................	728	5.42	0.06	21.1	2.1
40-49 years................	580	5.79	0.07	18.6	2.3
50-59 years................	576	5.93	0.07	22.7	2.4
60-69 years................	1,317	5.86	0.03	21.3	0.9
70-74 years................	386	5.63	0.05	14.8	1.5
FEMALE					
Below poverty					
20-74 years................	865	5.45	0.05	20.8	1.7
20-74 years, age adjusted..	...	5.47	...	20.3	...
20-29 years................	213	4.80	0.09	16.9	3.6
30-39 years................	120	5.11	0.14	12.2	4.3
40-49 years................	77	5.54	0.22	13.1	5.6
50-59 years................	81	6.17	0.21	31.1	7.3
60-69 years................	252	6.29	0.07	31.4	2.5
70-74 years................	122	6.28	0.11	34.7	3.8
Above poverty					
20-74 years................	4,861	5.58	0.02	22.1	0.7
20-74 years, age adjusted..	...	5.54	...	21.8	...
20-29 years................	1,034	4.84	0.04	17.1	1.6
30-39 years................	779	5.11	0.05	14.5	1.7
40-49 years................	621	5.64	0.07	14.3	1.9
50-59 years................	644	6.30	0.07	31.1	2.5
60-69 years................	1,336	6.42	0.03	35.9	1.1
70-74 years................	447	6.46	0.05	37.8	2.0

1/ Includes persons for whom usable measurements for criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ mmol/L = mg/dl*0.02586.

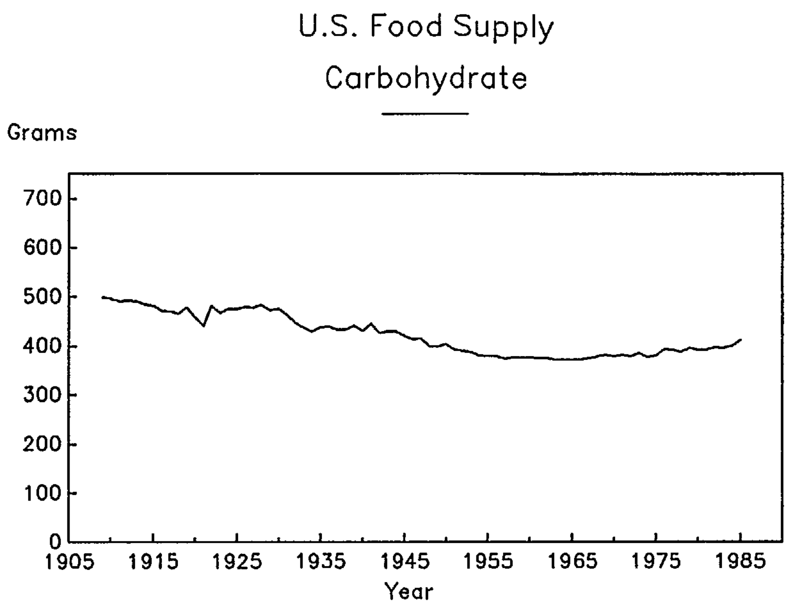


Figure II-15. Carbohydrate: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

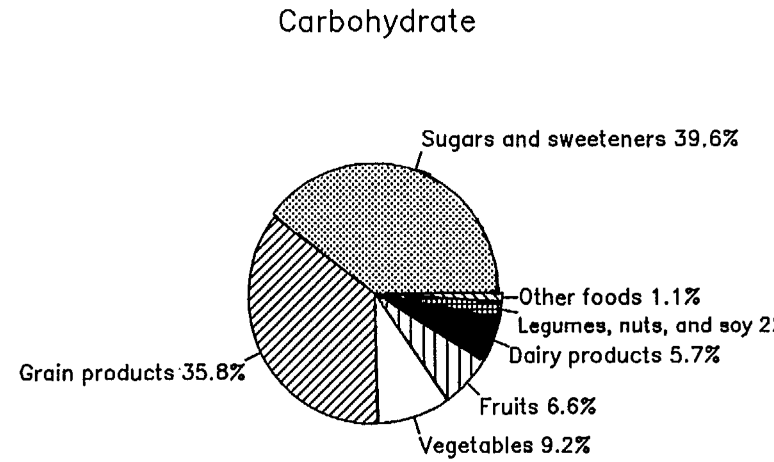


Figure II-16. Carbohydrate: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include meat, poultry, and fish; eggs; fats and oils; and miscellaneous foods)

Table II-44. Carbohydrate: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	175	2.2	79	98	127	168	212	262	290
Age										
20-29 years	661	184	3.7	86	105	135	179	225	274	296
30-39 years	812	173	3.0	75	94	122	167	214	260	287
40-49 years	583	162	3.4	78	91	123	157	195	238	272
Race 1/										
White	1775	177	2.3	84	99	130	169	214	262	292
Black	167	157	7.4	63	72	110	145	197	260	274
Other	76	172	6.5	*	*	135	175	209	*	*
Poverty status 1/										
< 100	315	165	4.8	68	86	117	148	207	260	289
≥ 100	1575	178	2.2	83	100	131	170	215	264	292
< 131	414	168	4.6	71	87	118	156	210	260	290
≥ 131	1476	178	2.2	84	100	131	170	215	264	294
Education 1/										
< High school	305	154	3.8	68	80	110	144	193	242	264
High school	854	173	2.5	81	101	126	165	209	255	288
> High school	891	184	3.0	85	101	135	178	225	270	296
Region										
Northeast	448	163	3.7	79	97	120	158	193	236	265
Midwest	564	180	3.7	80	100	132	171	223	265	292
South	660	178	3.2	80	92	128	167	220	271	302
West	384	176	7.3	78	100	132	171	212	259	283
Urbanization										
Central city	499	176	5.0	75	100	127	168	213	264	292
Suburban	1039	175	3.2	81	98	126	166	212	262	290
Nonmetropolitan	518	175	3.0	79	94	131	169	210	257	284

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-45. Carbohydrate: mean percent of calories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	46	.3	33	36	41	46	51	56	59
Age										
20-29 years	661	47	.4	34	37	42	47	52	56	59
30-39 years	812	46	.3	32	35	41	46	51	56	60
40-49 years	583	45	.4	33	36	40	45	51	55	59
Race 1/										
White	1775	46	.3	33	36	41	46	51	56	59
Black	167	46	.9	32	34	41	47	51	54	56
Other	76	49	1.2	*	*	44	49	56	*	*
Poverty status 1/										
< 100	315	47	.6	34	35	42	47	52	56	61
≥ 100	1575	46	.3	33	36	41	46	51	56	59
< 131	414	47	.5	34	36	42	47	52	58	61
≥ 131	1476	46	.3	33	36	41	46	51	56	59
Education 1/										
< High school	305	47	.5	34	36	41	47	52	58	61
High school	854	46	.4	33	36	41	46	51	55	58
> High school	891	46	.4	33	36	41	46	51	56	60
Region										
Northeast	448	45	.4	31	35	40	46	50	54	57
Midwest	564	46	.3	34	36	41	45	50	55	58
South	660	47	.5	33	36	42	47	53	58	61
West	384	46	.8	34	35	41	46	50	56	59
Urbanization										
Central city	499	46	.6	32	35	41	46	51	56	60
Suburban	1039	46	.4	33	36	41	46	51	56	59
Nonmetropolitan	518	47	.4	34	37	42	47	52	56	61

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-46. Carbohydrate: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	184	3.0	114	124	149	179	214	251	267
Age										
1-2 years	224	167	3.9	108	116	136	165	190	221	254
3-5 years	423	192	3.4	122	131	154	187	226	259	275
Race 2/										
White	559	187	3.1	117	127	151	181	218	254	271
Black	53	170	6.7	*	*	138	169	196	*	*
Other	26	151	11.2	*	*	*	154	*	*	*
Poverty status 2/										
< 100	140	171	6.9	94	118	131	165	207	233	251
≥ 100	471	187	3.3	114	127	153	181	218	259	275
< 131	192	171	5.8	96	116	136	167	206	233	253
≥ 131	419	189	3.5	117	129	154	183	220	259	276
Education 2/										
< High school	99	173	6.3	*	114	140	161	208	239	*
High school	252	179	4.5	114	122	146	176	207	254	262
> High school	295	190	3.6	117	134	159	184	220	251	271
Region										
Northeast	111	188	6.0	*	129	153	184	221	254	*
Midwest	199	184	5.6	113	126	148	177	214	244	275
South	187	180	6.2	113	118	141	169	213	261	275
West	150	185	5.1	119	128	154	181	213	240	255
Urbanization										
Central city	171	189	5.9	119	129	155	185	220	261	268
Suburban	310	183	3.9	116	126	151	177	214	252	265
Nonmetropolitan	166	178	6.6	98	114	136	174	209	245	269

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-47. Carbohydrate: mean percent of calories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	52	.4	41	44	47	52	56	59	61
Age										
1-2 years	224	51	.6	41	42	47	52	56	59	61
3-5 years	423	52	.4	42	44	47	52	56	59	61
Race 2/										
White	559	52	.4	42	44	48	52	56	60	62
Black	53	49	1.0	*	*	46	49	53	*	*
Other	26	49	1.8	*	*	*	50	*	*	*
Poverty status 2/										
< 100	140	49	.8	38	42	45	49	53	57	58
≥ 100	471	52	.4	42	44	48	53	56	60	63
< 131	192	49	.8	39	41	45	49	54	57	59
≥ 131	419	52	.4	42	45	48	53	56	60	63
Education 2/										
< High school	99	49	1.0	*	40	44	49	53	58	*
High school	252	51	.6	41	44	47	50	55	58	61
> High school	295	53	.4	43	46	50	54	57	60	62
Region										
Northeast	111	52	1.1	*	43	48	53	57	60	*
Midwest	199	51	.6	42	44	47	52	56	58	59
South	187	51	.8	41	44	47	51	55	60	62
West	150	52	.8	42	44	47	52	56	59	61
Urbanization										
Central city	171	51	.7	42	44	47	51	55	57	61
Suburban	310	53	.5	42	44	48	53	57	60	62
Nonmetropolitan	166	50	1.0	40	41	45	49	54	58	61

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-48. Carbohydrate: mean intake in grams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	161	2.1	140	2.1	162	1.6	166	4.9
3-5	209	2.0	172	2.2	200	1.2	192	3.8
6-11	252	3.0	219	2.1	246	3.0	-	-
Male								
12-15	319	6.6	276	4.0	304	7.0	-	-
16-19	341	8.9	282	4.3	340	9.6	-	-
20-29[1]	301	7.1	252	3.5	305	6.6	317	12.9
30-39[1]	271	7.7	233	3.4	272	6.5	279	9.3
40-49[1]	245	6.6	225	4.0	245	6.8	263	10.7
50-59	222	5.7	218	3.7	229	7.0	-	-
60-69	214	2.7	205	3.6	211	2.2	-	-
70+[2]	199	2.7	199	4.1	198	3.5	-	-
Female								
12-15	228	5.0	213	2.9	223	5.2	-	-
16-19	205	5.4	190	3.1	198	5.7	-	-
20-29	193	2.2	170	2.0	195	3.9	198	4.2
30-39	178	2.2	160	2.3	177	4.5	188	3.9
40-49	168	2.9	154	2.1	168	4.3	173	4.0
50-59	163	4.1	156	2.3	158	4.3	-	-
60-69	156	2.1	158	2.2	158	1.6	-	-
70+[2]	148	1.8	156	2.6	159	2.6	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-49. Carbohydrate: mean percent of kilocalories, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	48	0.3	47	0.3	50	0.2	51	0.5
3-5	50	0.2	48	0.3	51	0.2	51	0.6
6-11	49	0.3	47	0.2	50	0.3	-	-
Male								
12-15	49	0.5	46	0.3	49	0.5	-	-
16-19	46	0.6	43	0.3	45	0.6	-	-
20-29[1]	42	0.6	41	0.3	42	0.4	46	0.9
30-39[1]	41	0.7	40	0.3	43	0.6	46	1.1
40-49[1]	41	0.7	39	0.4	41	0.6	44	1.0
50-59	41	0.6	40	0.3	41	0.6	-	-
60-69	44	0.3	41	0.4	43	0.3	-	-
70+[2]	45	0.3	43	0.5	46	0.5	-	-
Female								
12-15	48	0.5	46	0.3	49	0.6	-	-
16-19	47	0.7	45	0.4	47	0.6	-	-
20-29	46	0.3	42	0.3	47	0.5	48	0.5
30-39	44	0.3	41	0.3	45	0.6	46	0.4
40-49	44	0.4	40	0.4	44	0.7	45	0.5
50-59	45	0.7	41	0.3	45	0.6	-	-
60-69	47	0.3	44	0.4	47	0.3	-	-
70+[2]	48	0.3	45	0.5	50	0.4	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-50. Dietary fiber: mean intake in grams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	11	.2	4	5	7	10	14	17	20
Age										
20-29 years	661	11	.3	4	5	7	10	13	17	19
30-39 years	812	11	.2	4	5	7	10	14	18	21
40-49 years	583	11	.2	4	6	7	10	13	17	18
Race 1/										
White	1775	11	.2	4	6	8	11	14	17	20
Black	167	9	.5	3	4	5	8	10	15	17
Other	76	10	.5	*	*	7	10	13	*	*
Poverty status 1/										
< 100	315	9	.3	3	4	6	8	11	15	17
≥ 100	1575	11	.2	5	6	8	11	14	18	20
< 131	414	9	.3	3	4	6	8	11	15	17
≥ 131	1476	11	.2	5	6	8	11	14	18	20
Education 1/										
< High school	305	8	.3	2	3	6	7	11	15	18
High school	854	10	.2	4	5	7	10	13	16	18
> High school	891	12	.2	5	6	9	12	15	18	22
Region										
Northeast	448	10	.3	4	5	7	9	13	16	19
Midwest	564	11	.4	4	6	8	11	14	17	21
South	660	10	.3	4	5	7	10	13	17	19
West	384	12	.4	5	6	8	11	15	18	20
Urbanization										
Central city	499	11	.4	4	5	7	10	13	17	22
Suburban	1039	11	.2	4	5	8	10	14	17	19
Nonmetropolitan	518	11	.3	4	5	7	10	13	17	19

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-51. Dietary fiber: mean intake in grams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	10	.2	4	5	7	10	12	15	17
Age										
1-2 years	224	9	.3	4	5	7	9	11	13	14
3-5 years	423	10	.3	4	6	7	10	13	15	17
Race 2/										
White	559	10	.2	5	6	7	10	12	15	17
Black	53	10	1.1	*	*	6	9	11	*	*
Other	26	7	.7	*	*	*	7	*	*	*
Poverty status 2/										
< 100	140	9	.9	3	4	6	9	11	15	17
≥ 100	471	10	.2	5	6	7	10	12	15	17
< 131	192	9	.7	3	4	6	9	11	16	17
≥ 131	419	10	.2	5	6	8	10	12	15	17
Education 2/										
< High school	99	9	.4	*	4	6	9	11	14	*
High school	252	10	.5	4	5	7	9	12	15	18
> High school	295	10	.2	5	6	8	10	13	15	17
Region										
Northeast	111	9	.6	*	6	6	8	11	15	*
Midwest	199	10	.3	4	6	7	9	11	14	17
South	187	9	.4	4	5	7	9	12	14	15
West	150	11	.6	5	6	8	10	13	16	18
Urbanization										
Central city	171	11	.6	5	6	8	10	13	17	20
Suburban	310	10	.2	5	6	7	9	12	14	15
Nonmetropolitan	166	9	.5	3	4	7	9	11	14	15

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

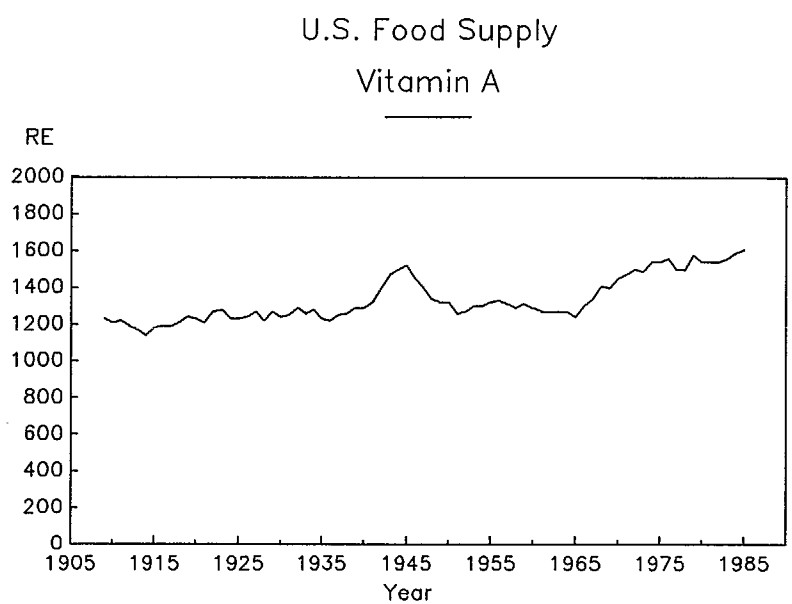


Figure II-17. Vitamin A: per capita amount (in retinol equivalents) per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

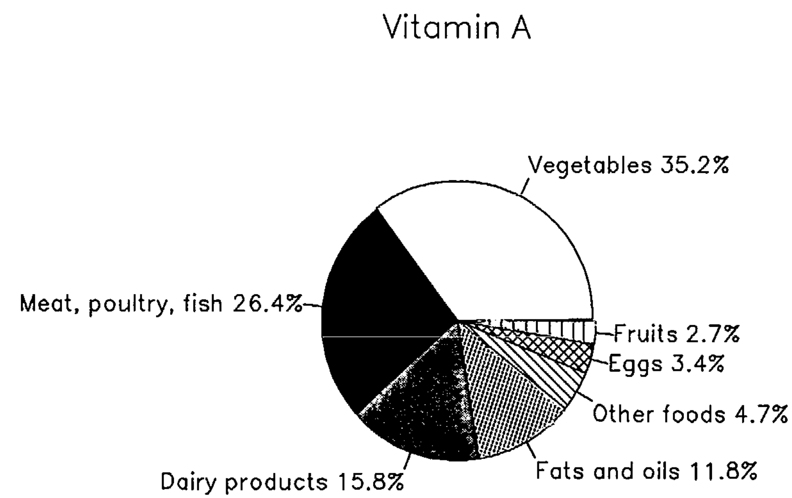


Figure II-18. Vitamin A: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include legumes, nuts, and soy; grain products; and miscellaneous foods)

Table II-52. Vitamin A: mean intake in retinol equivalents, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	832	26	170	248	386	614	1000	1515	1959
Age										
20-29 years	661	832	50	171	250	381	593	1000	1546	1892
30-39 years	812	814	32	162	246	392	645	999	1486	1920
40-49 years	583	857	57	182	249	379	611	1005	1512	2124
Race 1/										
White	1775	842	26	191	260	408	651	1042	1546	1959
Black	167	818	110	145	171	318	407	627	1014	2162
Other	76	591	64	*	*	292	550	785	*	*
Poverty status 1/										
< 100	315	855	98	121	161	291	448	725	1314	2095
≥ 100	1575	811	21	198	271	408	643	1013	1477	1921
< 131	414	800	73	121	168	314	484	769	1300	1866
≥ 131	1476	821	21	207	278	413	647	1015	1512	1958
Education 1/										
< High school	305	685	61	104	150	248	397	699	1199	2221
High school	854	755	45	150	209	369	559	882	1307	1679
> High school	891	950	23	289	340	481	744	1169	1738	2145
Region										
Northeast	448	853	53	166	248	365	558	942	1552	2145
Midwest	564	892	53	191	245	391	674	1064	1546	2047
South	660	765	50	143	212	354	544	875	1437	2054
West	384	846	49	245	332	479	725	1089	1546	1762
Urbanization										
Central city	499	867	41	161	248	379	601	966	1524	1879
Suburban	1039	802	31	194	270	414	643	1027	1515	2019
Nonmetropolitan	518	855	73	147	207	327	548	983	1487	2054

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-53. Vitamin A: mean intake in retinol equivalents, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	816	21	323	400	545	729	965	1297	1628
Age										
1-2 years	224	811	31	335	359	545	729	892	1273	1676
3-5 years	423	818	26	323	420	545	719	1003	1301	1587
Race 2/										
White	559	816	20	337	421	552	731	970	1285	1562
Black	53	851	97	*	*	430	577	877	*	*
Other	26	778	105	*	*	*	681	*	*	*
Poverty status 2/										
< 100	140	808	70	302	385	479	697	874	1281	1677
≥ 100	471	816	20	331	397	550	731	985	1299	1587
< 131	192	819	58	331	368	483	720	877	1390	1677
≥ 131	419	812	21	323	420	552	730	988	1285	1587
Education 2/										
< High school	99	743	51	*	375	476	631	812	1221	*
High school	252	821	38	321	358	530	720	944	1393	1671
> High school	295	832	22	350	452	574	747	1010	1292	1551
Region										
Northeast	111	846	52	*	518	567	772	997	1407	*
Midwest	199	859	41	354	460	589	732	970	1380	1667
South	187	765	42	300	337	457	602	944	1345	1686
West	150	814	34	358	439	577	744	940	1264	1498
Urbanization										
Central city	171	870	49	359	467	604	746	1024	1403	1587
Suburban	310	784	24	321	415	534	712	944	1273	1667
Nonmetropolitan	166	825	47	321	349	493	663	970	1345	1676

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-54. Vitamin A: mean intake in International Units, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971–74; Nationwide Food Consumption Survey (NFCS), 1977–78; Second National Health and Nutrition Examination Survey (NHANES II), 1976–80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985–86

Sex and age (years)	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	3,427	88	3,511	138	3,618	54	4,489	332
3-5	3,753	132	3,958	158	4,008	45	4,411	338
6-11	4,319	156	4,936	144	4,989	130	-	-
Male								
12-15	4,951	266	5,946	211	5,663	341	-	-
16-19	5,272	393	6,101	367	6,295	584	-	-
20-29[1]	5,510	401	5,823	324	5,437	220	5,711	669
30-39[1]	5,092	574	5,799	207	5,917	511	5,933	612
40-49[1]	5,058	387	6,578	417	6,036	460	7,114	716
50-59	5,628	439	6,953	350	6,020	350	-	-
60-69	5,684	287	6,889	440	6,163	191	-	-
70+[2]	5,830	294	6,441	319	6,731	376	-	-
Female								
12-15	3,899	296	4,449	189	4,018	210	-	-
16-19	3,725	288	4,369	242	3,777	223	-	-
20-29	3,891	133	4,462	153	4,207	189	5,241	250
30-39	4,403	190	4,836	217	4,691	364	5,573	384
40-49	4,950	353	5,090	251	5,250	438	5,442	314
50-59	5,337	496	5,990	295	5,331	365	-	-
60-69	6,030	483	6,722	327	5,400	139	-	-
70+[2]	4,527	186	5,942	279	5,469	258	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-55. **Serum vitamin A status of children 4-19 years of age by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84**

Sex, Hispanic origin, and age	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
BOTH SEXES					
Mexican American					
4-5 years	234	1.00	0.02	4.6	1.2
6-11 years	1,028	1.11	0.01	2.7	0.4
Cuban					
4-5 years	12	*	*	*	*
6-11 years	96	1.19	0.02	3.3	1.7
Puerto Rican					
4-5 years	62	1.02	0.03	8.8	3.4
6-11 years	322	1.14	0.01	1.4	0.6
MALE					
Mexican American					
12-15 years	351	1.32	0.02	0.0	0.0
16-19 years	253	1.53	0.03	0.0	0.0
Cuban					
12-15 years	48	1.32	0.04	0.0	0.0
16-19 years	51	1.58	0.04	0.0	0.0
Puerto Rican					
12-15 years	138	1.41	0.02	0.0	0.0
16-19 years	137	1.58	0.03	0.0	0.0
FEMALE 4/					
Mexican American					
12-15 years	328	1.26	0.02	0.3	0.3
16-19 years	291	1.37	0.03	0.4	0.3
Cuban					
12-15 years	38	*1.29	0.04	*0.0	0.0
16-19 years	41	*1.28	0.04	*0.0	0.0
Puerto Rican					
12-15 years	140	1.33	0.02	0.0	0.0
16-19 years	123	1.43	0.04	0.0	0.0

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl*0.03491.

3/ 0.7 umol/L = 20 ug/dl.

4/ Excludes pregnant women.

Table II-56. Serum vitamin A status of persons 20-74 years of age by sex, specified Hispanic origin, and age: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex, Hispanic origin, and age	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
MALE					
Mexican American					
20-74 years....................	1,392	1.84	0.02	0.3	0.2
20-74 years, age adjusted.....	...	1.85	...	0.5	...
20-29 years....................	421	1.74	0.04	0.0	0.0
30-39 years....................	354	1.89	0.05	0.0	0.0
40-49 years....................	230	1.96	0.05	0.3	0.4
50-59 years....................	229	1.88	0.04	0.0	0.0
60-69 years....................	122	1.84	0.07	2.6	1.4
70-74 years....................	36	*1.84	0.13	*2.4	2.7
Cuban					
20-74 years....................	372	2.02	0.03	0.0	0.0
20-74 years, age adjusted.....	...	1.86	...	0.0	...
20-29 years....................	55	1.82	0.06	0.0	0.0
30-39 years....................	53	1.99	0.05	0.0	0.0
40-49 years....................	82	2.13	0.06	0.0	0.0
50-59 years....................	109	2.07	0.04	0.0	0.0
60-69 years....................	45	2.14	0.08	0.0	0.0
70-74 years....................	28	*1.90	0.10	*0.0	0.0
Puerto Rican					
20-74 years....................	423	1.86	0.03	0.0	0.0
20-74 years, age adjusted.....	...	1.99	...	0.0	...
20-29 years....................	109	1.76	0.05	0.0	0.0
30-39 years....................	86	1.88	0.06	0.0	0.0
40-49 years....................	84	1.96	0.07	0.0	0.0
50-59 years....................	97	1.89	0.05	0.0	0.0
60-69 years....................	37	*1.96	0.06	*0.0	0.0
70-74 years....................	10	*	*	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl*0.03491.

3/ 0.7 umol/L = 20 ug/dl.

Table II-56. Serum vitamin A status of persons 20-74 years of age by sex, specified Hispanic origin, and age: Hispanic Health and Nutrition Examination Survey, 1982-84--continued

Sex, Hispanic origin, and age	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
FEMALE 4/					
Mexican American					
20-74 years	1,784	1.53	0.02	0.6	0.2
20-74 years, age adjusted	...	1.57	...	0.5	...
20-29 years	531	1.46	0.03	0.9	0.5
30-39 years	446	1.48	0.03	0.2	0.2
40-49 years	302	1.53	0.03	0.0	0.0
50-59 years	309	1.62	0.03	0.9	0.5
60-69 years	136	1.76	0.05	0.7	0.7
70-74 years	60	1.93	0.11	0.0	0.0
Cuban					
20-74 years	467	1.64	0.02	0.0	0.0
20-74 years, age adjusted	....	1.63	...	...	...
20-29 years	63	1.52	0.05	0.0	0.0
30-39 years	92	1.50	0.03	0.0	0.0
40-49 years	101	1.55	0.03	0.0	0.0
50-59 years	112	1.79	0.04	0.0	0.0
60-69 years	68	1.88	0.05	0.0	0.0
70-74 years	31	*1.91	0.09	*0.0	0.0
Puerto Rican					
20-74 years	721	1.56	0.02	0.4	0.3
20-74 years, age adjusted	...	1.61	...	...	...
20-29 years	184	1.49	0.04	0.0	0.0
30-39 years	164	1.52	0.04	1.0	1.0
40-49 years	161	1.56	0.03	0.6	0.6
50-59 years	126	1.71	0.03	0.0	0.0
60-69 years	72	1.87	0.05	0.0	0.0
70-74 years	14	*	*	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl*0.03491.

3/ 0.7 umol/L = 20 ug/dl.

4/ Excludes pregnant women.

Table II-57. Serum vitamin A status of Mexican-American children 4-19 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty				
	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
Both sexes					
4-5 years...........	87	0.97	0.04	10.1	2.7
6-11 years..........	378	1.10	0.02	2.6	0.7
Male					
12-15 years.........	115	1.32	0.03	0.0	0.0
16-19 years.........	80	1.48	0.05	0.0	0.0
Female 4/					
12-15 years.........	124	1.25	0.03	0.8	0.7
16-19 years.........	107	1.35	0.04	0.0	0.0

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl+0.03491.

3/ 0.7 umol/L = 20 ug/dl.

4/ Excludes pregnant women.

Table II-57. Serum vitamin A status of Mexican-American children 4-19 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84--continued

Sex and age	Above poverty				
	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
Both sexes					
4-5 years...........	134	1.02	0.02	1.8	1.0
6-11 years..........	569	1.12	0.01	2.7	0.6
Male					
12-15 years.........	200	1.33	0.03	0.0	0.0
16-19 years.........	142	1.56	0.04	0.0	0.0
Female 4/					
12-15 years.........	175	1.27	0.03	0.0	0.0
16-19 years.........	160	1.40	0.04	0.7	0.6

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl*0.03491.

3/ 0.7 umol/L = 20 ug/dl.

4/ Excludes pregnant women.

Table II-58. Serum vitamin A status of Mexican-American persons 20-74 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty				
	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
Male					
20-74 years..................	307	1.75	0.04	0.7	0.5
20-74 years, age adjusted.....	...	1.76	...	0.8	...
20-29 years..................	96	1.72	0.07	0.0	0.0
30-39 years..................	64	1.78	0.09	0.0	0.0
40-49 years..................	45	1.92	0.11	1.5	1.8
50-59 years..................	48	1.69	0.07	0.0	0.0
60-69 years..................	40	*1.67	0.12	*5.0	3.4
70-74 years..................	14	*	*	*	*
Female 4/					
20-74 years..................	520	1.53	0.03	1.1	0.5
20-74 years, age adjusted.....	...	1.54	...	1.1	...
20-29 years..................	141	1.38	0.05	1.6	1.2
30-39 years..................	118	1.55	0.06	0.9	0.9
40-49 years..................	86	1.49	0.06	0.0	0.0
50-59 years..................	94	1.57	0.06	1.2	1.0
60-69 years..................	45	1.73	0.10	2.2	2.1
70-74 years..................	36	*2.01	0.16	*0.0	0.0

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl*0.03491.

3/ 0.7 umol/L = 20 ug/dl.

4/ Excludes pregnant women.

Table II-58. Serum vitamin A status of Mexican-American persons 20-74 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84--continued

Sex and age	Above poverty				
	Number of examined persons 1/	Mean vitamin A level umol/L 2/	Standard error of the mean	Percent with vitamin A < 0.7 umol/L 3/	Standard error of the percent
Male					
20-74 years..................	966	1.87	0.03	0.2	0.1
20-74 years, age adjusted.....	...	1.88	...	0.4	...
20-29 years..................	287	1.75	0.05	0.0	0.0
30-39 years..................	269	1.91	0.05	0.0	0.0
40-49 years..................	164	1.97	0.06	0.0	0.0
50-59 years..................	157	1.94	0.05	0.0	0.0
60-69 years..................	70	1.98	0.09	1.7	1.5
70-74 years..................	19	*	*	*	*
Female 4/					
20-74 years..................	1,029	1.56	0.02	0.2	0.1
20-74 years, age adjusted.....	...	1.59	...	0.1	...
20-29 years..................	303	1.54	0.04	0.4	0.4
30-39 years..................	276	1.47	0.04	0.0	0.0
40-49 years..................	182	1.56	0.04	0.0	0.0
50-59 years..................	179	1.65	0.04	0.0	0.0
60-69 years..................	72	1.78	0.07	0.0	0.0
70-74 years..................	17	*	*	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ umol/L = ug/dl*0.03491.

3/ 0.7 umol/L = 20 ug/dl.

4/ Excludes pregnant women.

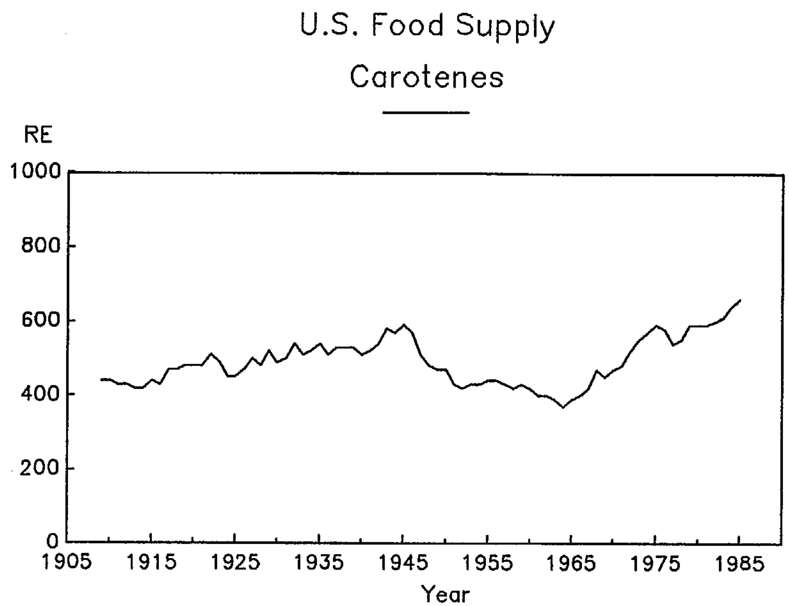


Figure II–19. Carotenes: per capita amount (in retinol equivalents) per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

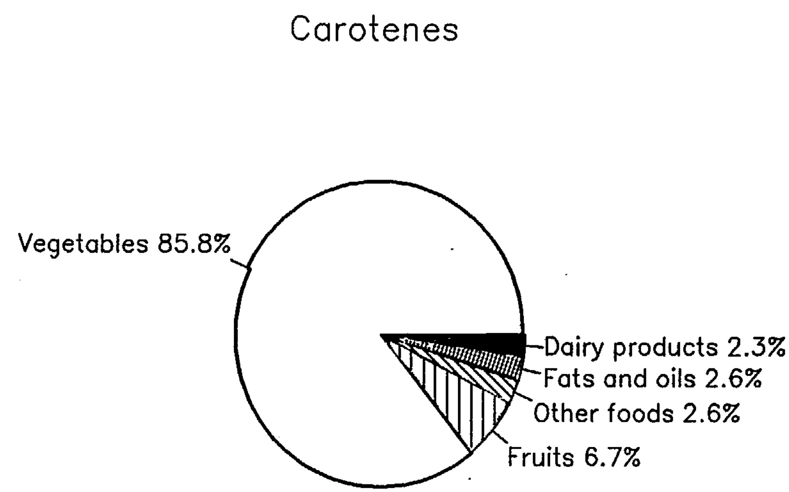


Figure II–20. Carotenes: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include meat, poultry, and fish; eggs; legumes, nuts, and soy; grain products; and miscellaneous foods)

Table II-59. Carotenes: mean intake in retinol equivalents, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	353	12	44	63	118	227	459	773	1116
Age										
20-29 years	661	330	17	44	61	111	208	422	734	1057
30-39 years	812	368	17	40	62	119	230	490	832	1163
40-49 years	583	372	19	53	68	122	256	472	772	1103
Race 1/										
White	1775	366	13	48	69	123	239	479	811	1129
Black	167	235	17	35	45	91	171	262	533	668
Other	76	321	51	*	*	86	289	514	*	*
Poverty status 1/										
< 100	315	246	17	27	37	73	151	292	570	741
≥ 100	1575	371	13	53	74	131	251	484	800	1126
< 131	414	258	17	27	40	80	167	333	571	741
≥ 131	1476	376	13	53	75	132	252	487	843	1149
Education 1/										
< High school	305	233	21	17	34	66	137	259	563	783
High school	854	306	13	44	57	103	204	399	674	915
> High school	891	434	16	74	96	164	298	561	979	1267
Region										
Northeast	448	351	23	51	62	122	214	422	757	1191
Midwest	564	341	27	43	56	108	213	440	747	1126
South	660	310	17	42	63	104	207	411	699	977
West	384	430	22	44	81	159	321	593	938	1331
Urbanization										
Central city	499	346	24	44	63	113	214	433	741	1129
Suburban	1039	377	17	49	71	136	255	500	803	1152
Nonmetropolitan	518	295	17	33	53	94	182	371	703	944

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-60. Carotenes: mean intake in retinol equivalents, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake: n	Mean	SEM	Intakes at selected percentiles: 5	10	25	50	75	90	95
All children 1/	647	252	13	41	54	84	141	314	589	808
Age										
1-2 years	224	230	15	52	59	85	133	289	530	678
3-5 years	423	264	20	36	48	84	150	334	662	851
Race 2/										
White	559	263	14	45	55	86	148	337	615	820
Black	53	148	19	*	*	65	126	194	*	*
Other	26	*313	*92	*	*	*	163	*	*	*
Poverty status 2/										
< 100	140	216	21	39	46	74	139	284	547	595
≥ 100	471	264	16	49	60	87	141	330	662	847
< 131	192	207	17	39	46	79	129	238	530	595
≥ 131	419	273	18	52	60	89	148	352	677	855
Education 2/										
< High school	99	183	20	*	52	87	126	212	372	*
High school	252	242	22	36	46	73	134	314	582	808
> High school	295	281	20	48	62	90	162	358	669	855
Region										
Northeast	111	246	34	*	36	87	139	298	585	*
Midwest	199	200	14	43	53	80	128	251	402	615
South	187	279	30	43	51	73	141	352	751	1002
West	150	276	23	59	67	93	185	383	581	736
Urbanization										
Central city	171	260	27	43	60	90	174	352	562	836
Suburban	310	260	19	40	55	87	139	314	590	808
Nonmetropolitan	166	220	21	39	46	68	126	290	581	710

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Vitamin E

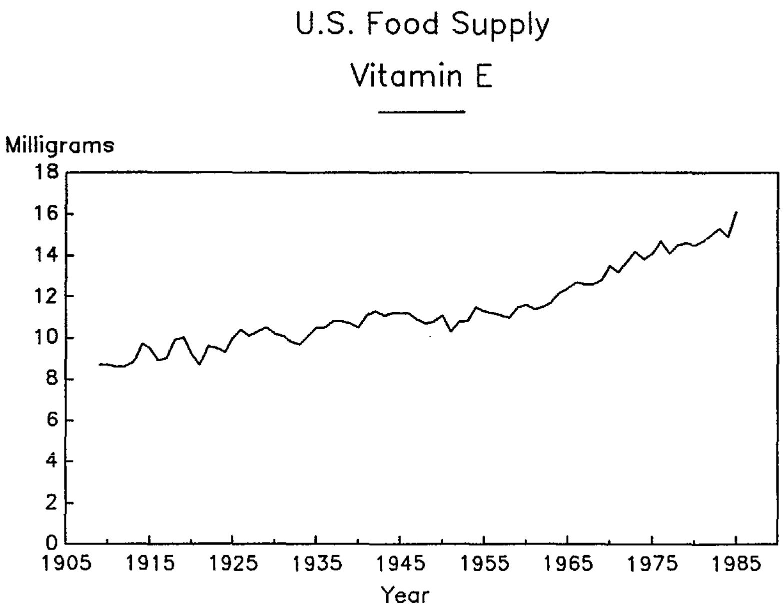


Figure II–21. Vitamin E: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

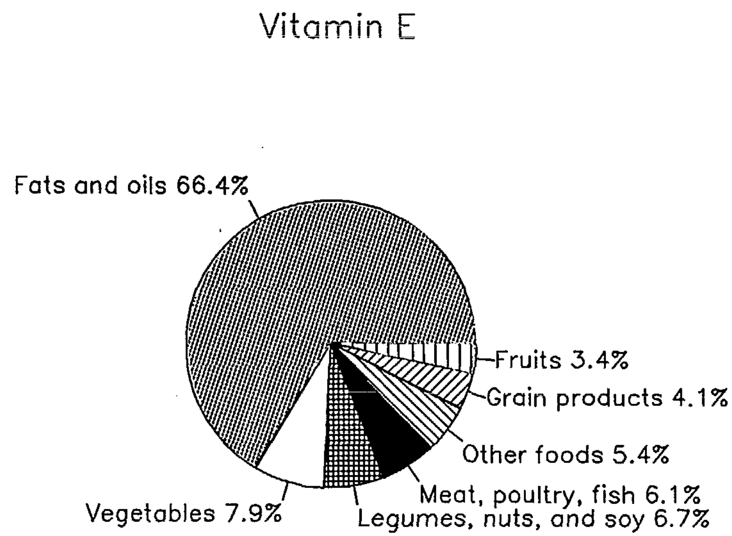


Figure II–22. Vitamin E: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include dairy products; eggs; sugars and sweeteners; and miscellaneous foods)

Table II-61. Vitamin E: mean intake in milligrams alpha tocopherol equivalents, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	7.0	.14	2.5	3.0	4.3	6.1	8.2	11.2	13.8
Age										
20-29 years	661	7.0	.25	2.6	2.9	4.2	6.0	8.2	11.7	15.5
30-39 years	812	7.0	.23	2.5	3.0	4.3	6.1	8.4	11.1	13.2
40-49 years	583	6.9	.24	2.4	3.3	4.3	6.1	8.0	11.1	13.8
Race 1/										
White	1775	7.2	.17	2.6	3.2	4.4	6.3	8.4	11.4	14.2
Black	167	5.6	.31	1.7	2.3	3.4	4.9	7.1	9.3	11.9
Other	76	5.6	.46	*	*	3.0	5.0	7.1	*	*
Poverty status 1/										
< 100	315	5.6	.22	2.1	2.5	3.5	4.8	6.7	9.4	11.6
≥ 100	1575	7.2	.14	2.7	3.3	4.6	6.3	8.5	11.3	14.0
< 131	414	5.7	.23	2.0	2.5	3.6	4.9	6.9	9.4	11.7
≥ 131	1476	7.2	.15	2.8	3.3	4.6	6.4	8.5	11.3	14.2
Education 1/										
< High school	305	5.3	.36	1.5	2.1	2.9	4.3	6.0	8.3	10.3
High school	854	6.5	.16	2.6	3.1	4.2	5.9	7.8	10.1	12.8
> High school	891	7.9	.22	3.1	3.6	5.0	6.9	9.0	12.4	16.1
Region										
Northeast	448	6.5	.23	2.4	2.9	4.0	5.6	7.6	10.2	13.0
Midwest	564	7.1	.26	2.5	3.1	4.4	6.2	8.4	11.5	13.8
South	660	6.9	.31	2.3	2.9	4.1	5.8	8.0	10.6	14.0
West	384	7.6	.28	2.9	3.4	4.9	6.8	8.7	11.6	14.3
Urbanization										
Central city	499	7.0	.29	2.4	3.1	4.2	5.9	8.2	11.5	14.5
Suburban	1039	7.0	.20	2.6	3.2	4.5	6.3	8.3	11.1	13.6
Nonmetropolitan	518	6.7	.19	2.2	2.8	4.0	5.6	7.7	10.7	13.2

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-62. Vitamin E: mean intake in milligrams alpha tocopherol equivalents, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	5.5	.22	2.4	2.9	3.5	4.7	6.2	8.2	10.2
Age										
1-2 years	224	5.4	.41	2.3	2.6	3.3	4.3	5.9	8.5	11.7
3-5 years	423	5.6	.22	2.6	3.0	3.8	4.8	6.4	8.0	10.1
Race 2/										
White	559	5.3	.18	2.5	2.9	3.5	4.7	6.3	7.9	9.2
Black	53	*6.8	*1.41	*	*	3.6	4.4	6.1	*	*
Other	26	6.0	1.13	*	*	*	4.9	*	*	*
Poverty status 2/										
< 100	140	6.4	.76	2.4	2.9	3.4	4.7	6.5	9.2	16.8
≥ 100	471	5.3	.17	2.5	2.9	3.6	4.7	6.2	7.9	8.9
< 131	192	6.1	.60	2.3	2.6	3.3	4.6	6.1	9.2	16.5
≥ 131	419	5.3	.18	2.5	3.0	3.6	4.7	6.3	7.8	8.7
Education 2/										
< High school	99	6.5	1.00	*	2.4	3.4	4.6	6.5	10.6	*
High school	252	5.5	.25	2.3	2.9	3.4	4.4	6.2	8.5	14.2
> High school	295	5.2	.24	2.7	2.9	3.6	4.8	6.2	7.6	8.6
Region										
Northeast	111	5.3	.35	*	2.7	3.3	4.5	5.9	8.1	*
Midwest	199	5.9	.65	2.3	2.8	3.5	4.6	6.0	8.9	15.9
South	187	4.7	.16	2.3	2.8	3.3	4.4	5.8	7.1	7.6
West	150	6.2	.41	2.5	3.2	4.2	5.4	7.3	8.6	10.6
Urbanization										
Central city	171	6.5	.53	2.5	3.2	4.1	5.5	6.9	8.9	16.5
Suburban	310	4.9	.20	2.5	2.7	3.4	4.5	5.8	7.4	8.1
Nonmetropolitan	166	5.6	.49	2.3	2.7	3.4	4.6	6.3	8.9	11.6

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-63. Serum vitamin E status of children 4-19 years of age by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American			Cuban			Puerto Rican		
	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean
Both sexes									
4-5 years...........	233	18	0.4	12	*	*	62	15	0.6
6-11 years..........	1,029	17	0.2	96	17	0.5	322	15	0.3
Male									
12-15 years.........	351	15	0.3	48	15	0.5	138	15	0.4
16-19 years.........	253	16	0.4	51	16	0.7	137	15	0.5
Female 3/									
12-15 years.........	328	16	0.3	38	+15	0.7	140	14	0.4
16-19 years.........	291	17	0.4	41	+17	0.7	123	15	0.6

1/ Includes persons for whom usable measurements for the criteria variable were obtained.

2/ umol/L = mg/dl*23.22.

3/ Excludes pregnant women.

Table II-64. Serum vitamin E status of persons 20-74 years of age by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American			Cuban			Puerto Rican		
	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean
Male									
20-74 years................	1,390	24	0.5	372	26	0.6	423	21	0.6
20-74 years, age adjusted..	...	25	...	...	25	...	...	22	...
20-29 years................	421	20	0.6	55	20	1.1	109	17	0.7
30-39 years................	354	25	1.1	53	25	1.7	86	21	1.5
40-49 years................	230	28	1.3	82	26	1.6	84	25	1.7
50-59 years................	229	29	1.1	109	28	0.9	97	27	1.5
60-69 years................	121	26	1.2	45	29	1.6	37	*24	1.4
70-74 years................	35	*27	2.8	28	*29	1.9	10	*	*
Female 3/									
20-74 years................	1,711	25	0.4	463	25	0.5	705	21	0.4
20-74 years, age adjusted..	...	22	...	...	24	...	...	22	...
20-29 years................	479	20	0.5	62	20	0.9	172	18	0.7
30-39 years................	427	23	0.7	90	21	0.8	160	20	0.8
40-49 years................	300	28	1.1	100	23	0.7	161	23	1.0
50-59 years................	309	30	1.0	112	30	1.0	126	26	1.1
60-69 years................	136	30	1.4	68	30	1.3	72	26	1.1
70-74 years................	60	31	1.9	31	*28	2.0	14	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained.

2/ umol/L = mg/dl*23.22.

3/ Excludes pregnant women.

Table II-65. Serum vitamin E status of Mexican-American children 4-19 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean
Both sexes						
4-5 years...........	87	18	0.8	133	18	0.5
6-11 years..........	378	17	0.3	570	17	0.3
Male						
12-15 years.........	115	15	0.5	200	15	0.3
16-19 years.........	80	16	0.6	142	16	0.6
Female 3/						
12-15 years.........	124	16	0.4	175	16	0.4
16-19 years.........	107	17	0.5	160	17	0.6

1/ Includes persons for whom usable measurements for the criteria variable were obtained.

2/ umol/L = mg/dl*23.22.

3/ Excludes pregnant women.

Table II-66. Serum vitamin E status of Mexican-American persons 20-74 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean	Number of examined persons 1/	Mean vitamin E level umol/L 2/	Standard error of the mean
Male						
20-74 years..................	307	22	0.7	964	25	0.6
20-74 years, age adjusted.....	...	23	...	...	26	...
20-29 years..................	96	19	0.9	287	20	0.8
30-39 years..................	64	23	1.3	269	26	1.3
40-49 years..................	45	27	2.2	164	28	1.7
50-59 years..................	48	24	1.3	157	30	1.4
60-69 years..................	40	*26	1.9	69	28	1.7
70-74 years..................	14	*	*	18	*	*
Female 3/						
20-74 years..................	520	24	0.6	1,029	25	0.5
20-74 years, age adjusted.....	...	24	...	...	26	...
20-29 years..................	141	20	0.9	303	20	0.6
30-39 years..................	118	23	1.3	276	23	0.8
40-49 years..................	86	26	1.8	182	29	1.5
50-59 years..................	94	27	1.4	179	32	1.5
60-69 years..................	45	29	1.7	72	32	2.3
70-74 years..................	36	*33	2.5	17	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained.

2/ umol/L = mg/dl*23.22.

3/ Excludes pregnant women.

Thiamin

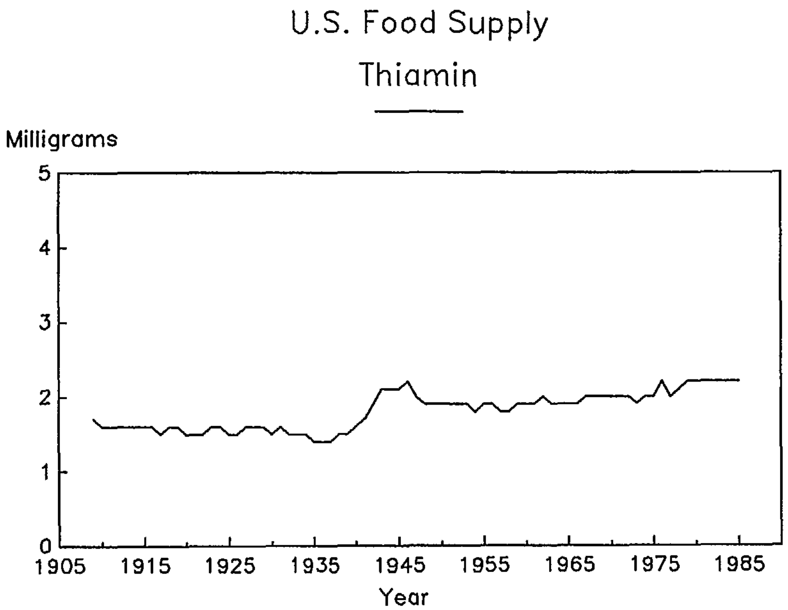


Figure II–23. Thiamin: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

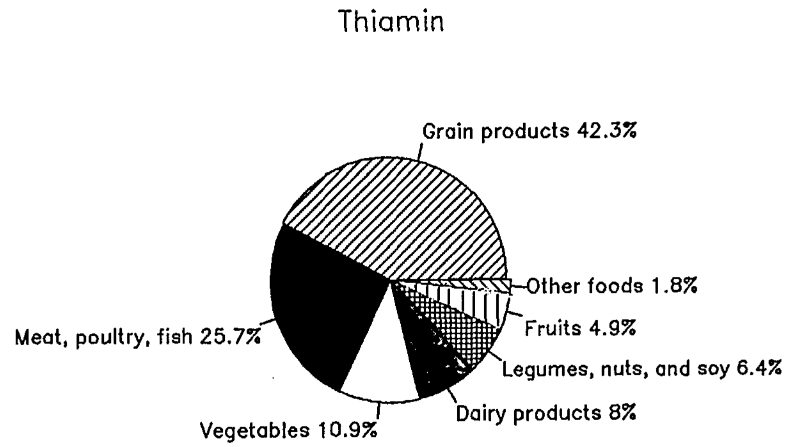


Figure II–24. Thiamin: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; fats and oils; sugars and sweeteners; and miscellaneous foods)

Table II-67. Thiamin: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake n	Mean	SEM	Intakes at selected percentiles 5	10	25	50	75	90	95
All women	2056	1.05	.02	.48	.56	.76	.98	1.29	1.61	1.81
Age										
20-29 years	661	1.09	.02	.48	.56	.78	1.02	1.35	1.69	1.90
30-39 years	812	1.05	.02	.48	.55	.76	.98	1.29	1.60	1.77
40-49 years	583	1.00	.02	.50	.58	.73	.94	1.21	1.51	1.70
Race 1/										
White	1775	1.07	.02	.50	.58	.76	1.00	1.30	1.62	1.81
Black	167	.93	.04	.38	.47	.66	.88	1.14	1.44	1.68
Other	76	1.05	.05	*	*	.79	.94	1.43	*	*
Poverty status 1/										
< 100	315	.99	.03	.42	.50	.65	.92	1.24	1.51	1.72
≥ 100	1575	1.07	.02	.50	.59	.77	1.00	1.30	1.64	1.84
< 131	414	1.00	.03	.44	.52	.67	.93	1.24	1.51	1.72
≥ 131	1476	1.07	.02	.50	.59	.77	1.00	1.30	1.64	1.87
Education 1/										
< High school	305	.93	.03	.37	.48	.60	.86	1.21	1.49	1.76
High school	854	1.03	.02	.48	.58	.76	.96	1.23	1.54	1.74
> High school	891	1.11	.02	.53	.63	.81	1.04	1.38	1.66	1.85
Region										
Northeast	448	1.03	.03	.49	.55	.73	.95	1.25	1.54	1.79
Midwest	564	1.11	.03	.50	.61	.78	1.05	1.36	1.68	1.87
South	660	1.03	.02	.46	.54	.73	.95	1.24	1.60	1.88
West	384	1.06	.04	.50	.58	.78	.99	1.30	1.57	1.69
Urbanization										
Central city	499	1.06	.03	.48	.58	.76	.98	1.34	1.63	1.80
Suburban	1039	1.05	.02	.50	.57	.76	.99	1.27	1.56	1.75
Nonmetropolitan	518	1.06	.02	.45	.55	.75	.98	1.28	1.67	1.88

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-68. Thiamin: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles					
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1.13	.02	.64	.71	.90	1.09	1.31	1.59	1.74
Age										
1-2 years	224	1.04	.03	.61	.69	.81	.99	1.19	1.39	1.59
3-5 years	423	1.18	.02	.65	.76	.94	1.12	1.36	1.67	1.80
Race 2/										
White	559	1.12	.02	.65	.73	.90	1.08	1.31	1.58	1.73
Black	53	1.23	.07	*	*	.98	1.11	1.47	*	*
Other	26	1.00	.08	*	*	*	.97	*	*	*
Poverty status 2/										
< 100	140	1.11	.05	.58	.65	.87	1.07	1.32	1.68	1.75
≥ 100	471	1.13	.02	.66	.74	.90	1.08	1.31	1.59	1.74
< 131	192	1.13	.05	.59	.68	.87	1.08	1.33	1.65	1.76
≥ 131	419	1.12	.02	.66	.73	.90	1.07	1.30	1.59	1.74
Education 2/										
< High school	99	1.18	.05	*	.65	.91	1.11	1.37	1.74	*
High school	252	1.14	.03	.66	.71	.88	1.07	1.34	1.70	1.80
> High school	295	1.10	.02	.64	.76	.91	1.08	1.25	1.47	1.65
Region										
Northeast	111	1.19	.05	*	.71	.98	1.17	1.37	1.68	*
Midwest	199	1.16	.04	.65	.73	.86	1.08	1.35	1.69	2.05
South	187	1.07	.03	.60	.67	.84	1.03	1.21	1.48	1.74
West	150	1.12	.04	.67	.72	.91	1.11	1.31	1.58	1.65
Urbanization										
Central city	171	1.21	.05	.66	.76	.94	1.17	1.41	1.70	1.79
Suburban	310	1.09	.02	.63	.71	.84	1.05	1.25	1.45	1.71
Nonmetropolitan	166	1.13	.04	.61	.77	.90	1.06	1.31	1.55	1.80

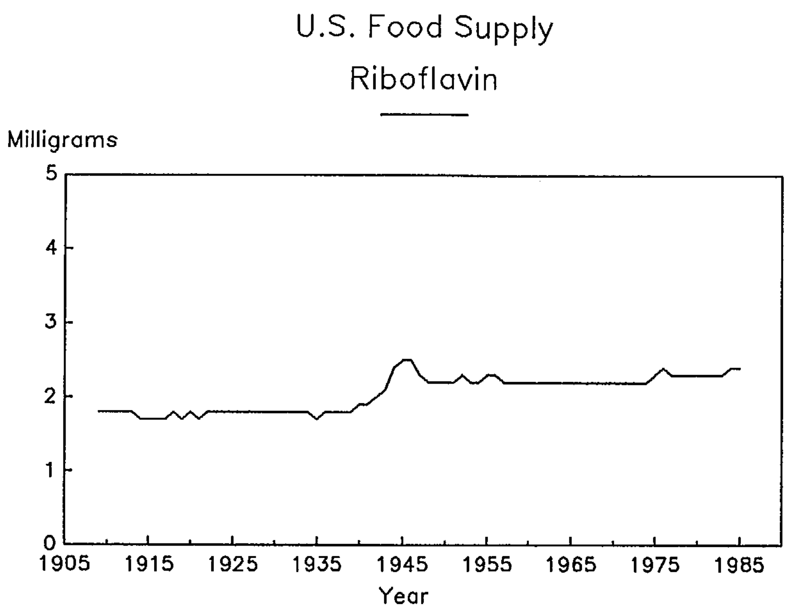
1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-69. Thiamin: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	0.80	0.01	0.90	0.02	0.92	0.01	1.08	0.04
3-5	0.97	0.01	1.10	0.02	1.14	0.01	1.23	0.03
6-11	1.16	0.02	1.39	0.01	1.40	0.02	-	-
Male								
12-15	1.48	0.04	1.75	0.03	1.77	0.05	-	-
16-19	1.64	0.06	1.78	0.03	1.97	0.07	-	-
20-29[1]	1.53	0.05	1.57	0.03	1.73	0.05	1.81	0.08
30-39[1]	1.40	0.05	1.52	0.03	1.60	0.06	1.72	0.09
40-49[1]	1.31	0.06	1.51	0.03	1.56	0.05	1.77	0.12
50-59	1.19	0.04	1.50	0.03	1.41	0.04	-	-
60-69	1.16	0.02	1.43	0.03	1.40	0.02	-	-
70+[2]	1.04	0.02	1.39	0.03	1.28	0.03	-	-
Female								
12-15	1.10	0.03	1.31	0.02	1.16	0.03	-	-
16-19	0.92	0.04	1.15	0.02	1.05	0.04	-	-
20-29	0.94	0.02	1.05	0.02	1.09	0.03	1.17	0.03
30-39	0.87	0.02	1.03	0.02	1.05	0.05	1.13	0.03
40-49	0.87	0.02	1.01	0.02	1.02	0.03	1.07	0.03
50-59	0.85	0.03	1.04	0.02	0.98	0.03	-	-
60-69	0.82	0.01	1.04	0.02	1.01	0.02	-	-
70+[2]	0.77	0.01	1.03	0.02	0.95	0.02	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.



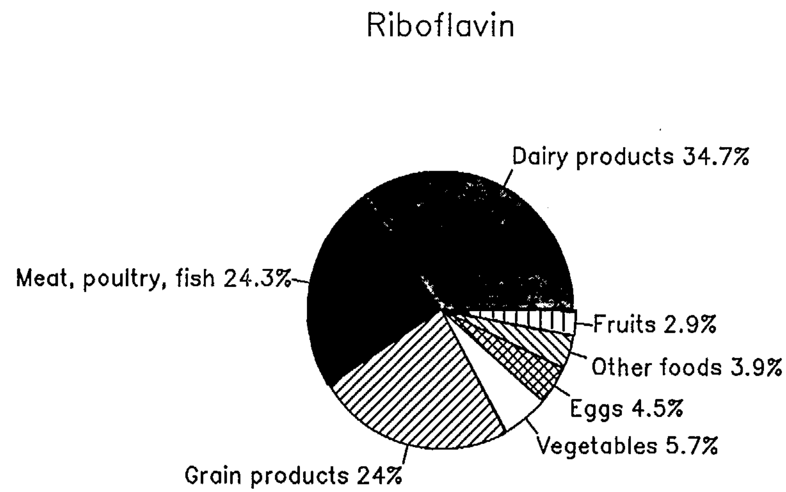


Figure II–25. Riboflavin: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

Figure II–26. Riboflavin: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fats and oils; legumes, nuts, and soy; sugars and sweeteners; and miscellaneous foods)

Table II-70. Riboflavin: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	1.35	.02	.56	.68	.90	1.20	1.63	2.14	2.55
Age										
20-29 years	661	1.42	.03	.59	.69	.93	1.27	1.78	2.31	2.79
30-39 years	812	1.32	.03	.53	.65	.90	1.21	1.64	2.07	2.48
40-49 years	583	1.26	.03	.56	.67	.87	1.14	1.50	1.94	2.46
Race 1/										
White	1775	1.38	.02	.59	.71	.93	1.25	1.67	2.21	2.62
Black	167	1.15	.04	.44	.53	.74	.97	1.38	1.90	2.22
Other	76	1.13	.08	*	*	.70	1.04	1.59	*	*
Poverty status 1/										
< 100	315	1.26	.04	.47	.56	.81	1.09	1.57	2.02	2.35
≥ 100	1575	1.37	.02	.58	.69	.92	1.22	1.65	2.16	2.62
< 131	414	1.25	.04	.47	.54	.82	1.12	1.56	2.04	2.37
≥ 131	1476	1.38	.02	.60	.71	.92	1.24	1.67	2.15	2.65
Education 1/										
< High school	305	1.14	.04	.45	.53	.76	.96	1.37	1.85	2.47
High school	854	1.31	.03	.55	.64	.87	1.16	1.59	2.01	2.45
> High school	891	1.45	.03	.65	.79	1.01	1.35	1.74	2.32	2.70
Region										
Northeast	448	1.32	.05	.56	.68	.90	1.17	1.61	2.06	2.62
Midwest	564	1.43	.04	.60	.71	.94	1.31	1.78	2.29	2.55
South	660	1.28	.04	.50	.64	.85	1.13	1.54	2.04	2.48
West	384	1.39	.05	.59	.73	.94	1.30	1.69	2.22	2.53
Urbanization										
Central city	499	1.38	.04	.55	.69	.92	1.22	1.74	2.16	2.68
Suburban	1039	1.33	.03	.56	.68	.92	1.23	1.60	2.06	2.49
Nonmetropolitan	518	1.34	.03	.53	.63	.86	1.15	1.63	2.25	2.70

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-71. Riboflavin: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1.61	.03	.90	1.05	1.29	1.54	1.88	2.20	2.50
Age										
1-2 years	224	1.56	.04	.90	1.02	1.29	1.53	1.78	1.99	2.41
3-5 years	423	1.64	.03	.94	1.06	1.30	1.58	1.92	2.27	2.50
Race 2/										
White	559	1.63	.03	.94	1.06	1.30	1.55	1.90	2.23	2.53
Black	53	1.54	.08	*	*	1.23	1.50	1.82	*	*
Other	26	1.43	.09	*	*	*	1.48	*	*	*
Poverty status 2/										
< 100	140	1.58	.07	.92	1.07	1.27	1.50	1.79	2.32	2.61
≥ 100	471	1.61	.03	.90	1.06	1.30	1.57	1.90	2.19	2.44
< 131	192	1.59	.06	.92	1.08	1.29	1.50	1.82	2.32	2.60
≥ 131	419	1.61	.03	.90	1.04	1.30	1.57	1.90	2.19	2.44
Education 2/										
< High school	99	1.62	.06	*	1.07	1.34	1.48	1.79	2.46	*
High school	252	1.58	.04	.90	1.02	1.23	1.50	1.84	2.27	2.53
> High school	295	1.63	.03	.94	1.07	1.34	1.62	1.90	2.12	2.37
Region										
Northeast	111	1.66	.05	*	1.09	1.36	1.65	1.85	2.10	*
Midwest	199	1.73	.05	1.00	1.14	1.37	1.65	1.97	2.47	2.72
South	187	1.46	.04	.78	.91	1.16	1.41	1.71	2.01	2.19
West	150	1.63	.06	.98	1.09	1.34	1.60	1.85	2.27	2.48
Urbanization										
Central city	171	1.67	.06	1.07	1.24	1.37	1.60	1.92	2.19	2.42
Suburban	310	1.56	.03	.88	1.00	1.23	1.50	1.83	2.09	2.34
Nonmetropolitan	166	1.66	.05	.90	1.06	1.29	1.62	1.90	2.49	2.56

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-72. Riboflavin: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	1.56	0.02	1.48	0.02	1.54	0.02	1.65	0.05
3-5	1.70	0.02	1.64	0.02	1.74	0.01	1.71	0.04
6-11	2.02	0.03	2.02	0.02	2.18	0.04	-	-
Male								
12-15	2.49	0.07	2.51	0.04	2.63	0.08	-	-
16-19	2.62	0.10	2.51	0.05	3.08	0.13	-	-
20-29[1]	2.39	0.08	2.13	0.04	2.53	0.08	2.29	0.12
30-39[1]	2.06	0.08	1.93	0.03	2.21	0.10	1.97	0.09
40-49[1]	1.98	0.07	1.92	0.05	2.05	0.08	2.01	0.13
50-59	1.79	0.06	1.92	0.04	2.00	0.07	-	-
60-69	1.76	0.04	1.86	0.04	1.90	0.03	-	-
70+[2]	1.57	0.03	1.77	0.04	1.77	0.06	-	-
Female								
12-15	1.78	0.05	1.85	0.03	1.73	0.05	-	-
16-19	1.45	0.05	1.59	0.03	1.59	0.06	-	-
20-29	1.40	0.02	1.39	0.02	1.49	0.04	1.51	0.04
30-39	1.31	0.02	1.34	0.02	1.44	0.07	1.42	0.04
40-49	1.33	0.04	1.30	0.03	1.44	0.08	1.34	0.04
50-59	1.31	0.05	1.40	0.03	1.35	0.06	-	-
60-69	1.32	0.04	1.40	0.03	1.36	0.02	-	-
70+[2]	1.11	0.02	1.35	0.03	1.33	0.04	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

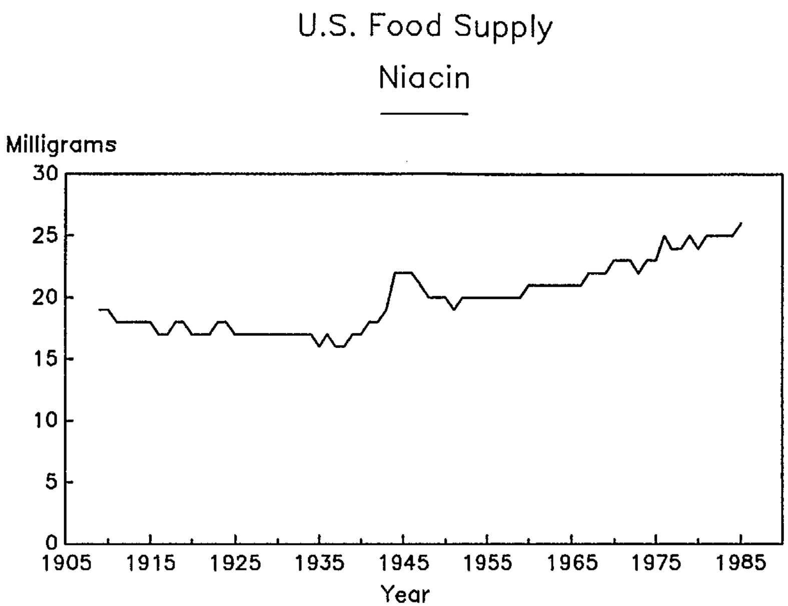


Figure II-27. Niacin: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

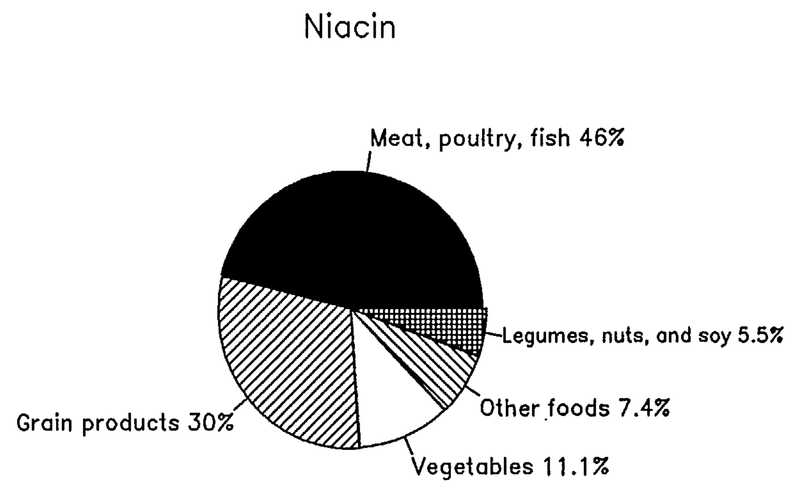


Figure II-28. Niacin: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include dairy products; eggs; fats and oils; fruits; sugars and sweeteners; and miscellaneous foods)

Table II-73. Niacin: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	16.0	.18	7.8	9.2	11.9	15.4	19.1	23.9	26.4
Age										
20-29 years	661	16.0	.31	7.7	9.6	11.7	15.0	19.9	24.3	26.4
30-39 years	812	15.8	.27	8.0	9.2	11.8	15.4	19.0	23.1	26.1
40-49 years	583	16.0	.24	7.6	9.2	12.3	15.6	19.0	23.2	26.4
Race 1/										
White	1775	16.2	.21	8.2	9.7	12.1	15.5	19.6	24.0	26.4
Black	167	14.6	.37	6.1	7.2	10.5	14.8	17.2	20.9	25.7
Other	76	15.3	.90	*	*	11.3	15.1	18.7	*	*
Poverty status 1/										
< 100	315	15.0	.36	6.5	8.0	10.9	14.5	18.1	23.1	25.6
≥ 100	1575	16.2	.19	8.2	9.8	12.0	15.6	19.4	23.7	26.6
< 131	414	15.0	.35	6.5	8.0	11.0	14.6	18.1	22.7	25.6
≥ 131	1476	16.2	.18	8.3	9.9	12.1	15.6	19.6	23.8	26.6
Education 1/										
< High school	305	14.3	.41	6.5	7.4	9.6	13.8	17.5	21.6	26.8
High school	854	15.6	.24	8.0	9.5	11.9	14.8	18.7	23.2	25.2
> High school	891	16.9	.22	8.5	10.2	12.7	16.1	20.6	24.4	26.8
Region										
Northeast	448	16.1	.32	8.1	9.6	12.1	15.5	19.4	24.0	26.2
Midwest	564	16.5	.36	8.1	9.9	12.5	15.5	20.0	24.4	26.7
South	660	15.8	.29	7.4	8.7	11.7	15.2	18.7	24.0	26.9
West	384	15.5	.52	7.8	9.1	11.4	15.3	19.0	23.0	24.8
Urbanization										
Central city	499	16.0	.38	7.6	8.8	11.7	15.2	19.5	24.4	26.4
Suburban	1039	15.9	.26	8.2	9.6	12.0	15.6	19.2	23.5	26.2
Nonmetropolitan	518	15.9	.24	7.4	9.6	11.9	15.1	18.7	23.2	26.3

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-74. Niacin: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles					
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	13.8	.27	7.1	8.5	10.6	13.1	16.4	19.5	22.7
Age										
1-2 years	224	12.5	.44	6.6	7.3	9.7	12.2	14.0	17.6	21.1
3-5 years	423	14.5	.30	7.9	9.5	11.2	13.9	17.1	19.9	23.3
Race 2/										
White	559	13.6	.25	7.1	8.8	10.7	13.0	16.1	19.3	22.5
Black	53	15.9	1.17	*	*	11.5	14.9	19.5	*	*
Other	26	11.8	.81	*	*	*	11.3	*	*	*
Poverty status 2/										
< 100	140	13.7	.61	7.3	8.6	10.2	13.0	15.9	19.5	22.4
≥ 100	471	13.8	.30	7.1	8.8	10.7	13.1	16.3	19.4	23.3
< 131	192	13.9	.61	7.2	8.2	10.2	12.9	16.5	20.2	23.8
≥ 131	419	13.7	.26	7.2	9.1	10.7	13.1	16.1	19.3	22.7
Education 2/										
< High school	99	14.4	.68	*	8.0	11.2	13.5	16.7	21.3	*
High school	252	14.4	.44	7.8	9.2	10.9	13.5	17.6	20.4	23.8
> High school	295	13.1	.33	7.1	7.8	10.3	12.7	15.1	18.2	20.0
Region										
Northeast	111	14.9	.75	*	8.9	10.8	13.9	19.1	21.1	*
Midwest	199	14.0	.51	6.6	8.4	10.3	13.2	16.3	21.6	24.9
South	187	13.3	.39	7.4	8.6	10.3	12.8	16.0	18.2	19.5
West	150	13.3	.52	7.1	9.2	10.8	12.6	15.1	18.5	21.4
Urbanization										
Central city	171	14.8	.70	6.9	8.8	11.5	13.8	17.9	22.4	24.4
Suburban	310	13.1	.31	7.1	8.2	10.2	12.7	15.7	17.9	19.5
Nonmetropolitan	166	14.0	.48	7.6	8.8	11.0	12.8	16.7	19.9	23.3

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-75. Niacin: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	8.82	0.15	10.3	0.18	10.82	0.14	12.4	0.53
3-5	11.20	0.14	13.5	0.20	13.92	0.11	15.6	0.52
6-11	14.37	0.24	17.5	0.18	17.52	0.27	-	-
Male								
12-15	18.89	0.51	22.3	0.33	23.00	0.61	-	-
16-19	23.85	0.83	24.4	0.40	29.55	1.02	-	-
20-29[1]	25.21	0.70	24.6	0.37	29.42	0.70	28.0	1.09
30-39[1]	24.94	0.80	23.6	0.39	26.12	0.72	26.2	1.37
40-49[1]	23.52	0.71	23.8	0.42	25.90	0.76	25.3	1.05
50-59	20.52	0.61	23.5	0.35	23.15	0.63	-	-
60-69	18.54	0.30	21.6	0.36	21.23	0.26	-	-
70+[2]	15.82	0.28	19.4	0.42	18.78	0.41	-	-
Female								
12-15	14.01	0.38	17.0	0.31	15.34	0.42	-	-
16-19	13.65	0.49	16.4	0.32	15.04	0.50	-	-
20-29	14.36	0.20	15.7	0.26	16.17	0.34	17.3	0.43
30-39	15.14	0.25	16.1	0.24	16.81	0.45	17.1	0.32
40-49	15.05	0.30	16.4	0.24	16.50	0.47	16.6	0.36
50-59	14.41	0.45	17.0	0.27	15.10	0.40	-	-
60-69	13.45	0.24	16.0	0.26	14.83	0.18	-	-
70+[2]	11.33	0.18	14.8	0.26	14.14	0.28	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

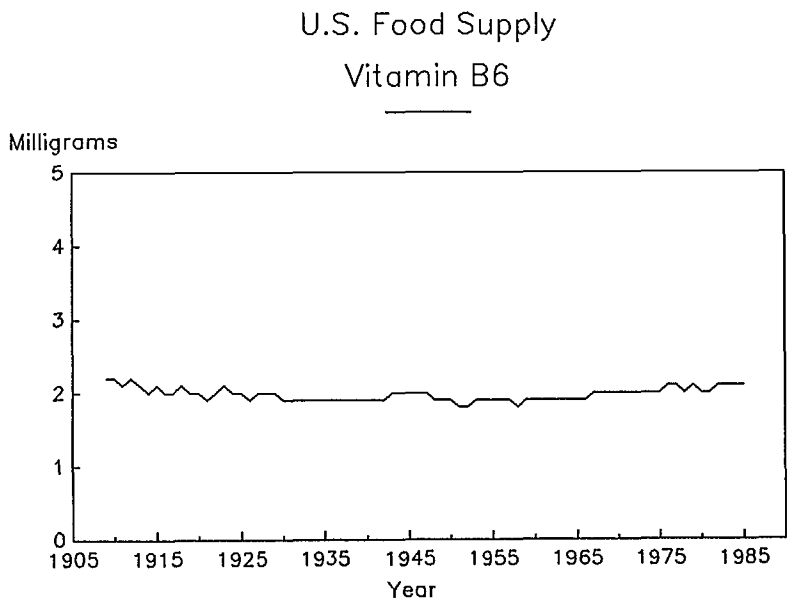


Figure II–29. Vitamin B6: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

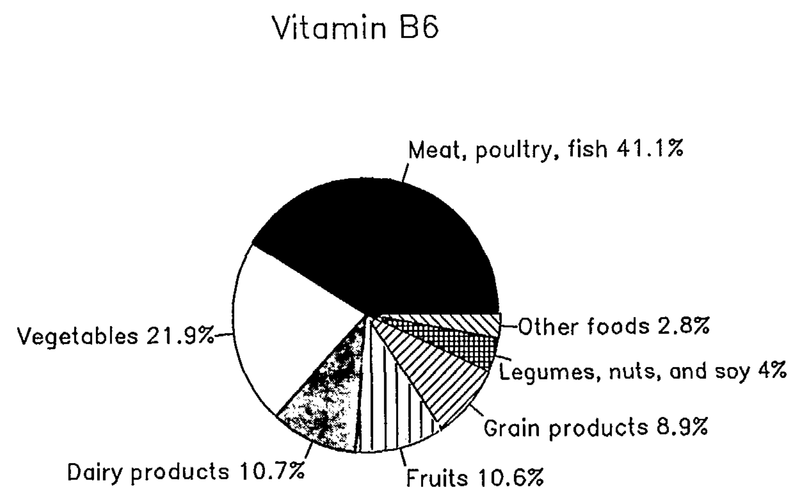


Figure II–30. Vitamin B6: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; fats and oils; sugars and sweeteners; and miscellaneous foods)

Table II-76. Vitamin B6: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	1.17	.02	.50	.62	.82	1.07	1.44	1.83	2.12
Age										
20-29 years	661	1.20	.02	.54	.64	.81	1.07	1.48	1.91	2.17
30-39 years	812	1.17	.03	.48	.59	.83	1.07	1.45	1.81	2.13
40-49 years	583	1.13	.02	.51	.64	.81	1.06	1.39	1.72	1.97
Race 1/										
White	1775	1.20	.02	.54	.64	.84	1.09	1.46	1.86	2.15
Black	167	1.00	.03	.40	.49	.75	.95	1.25	1.59	1.76
Other	76	1.07	.06	*	*	.76	1.00	1.40	*	*
Poverty status 1/										
< 100	315	1.05	.03	.40	.47	.70	.96	1.28	1.73	1.92
≥ 100	1575	1.20	.02	.55	.65	.83	1.09	1.46	1.83	2.15
< 131	414	1.05	.03	.40	.49	.72	.98	1.28	1.76	1.92
≥ 131	1476	1.21	.02	.55	.65	.84	1.11	1.47	1.86	2.18
Education 1/										
< High school	305	.98	.03	.40	.47	.67	.91	1.13	1.56	1.88
High school	854	1.12	.02	.49	.61	.79	1.01	1.35	1.75	1.99
> High school	891	1.28	.02	.61	.72	.91	1.19	1.57	1.94	2.26
Region										
Northeast	448	1.15	.03	.53	.62	.81	1.05	1.36	1.86	2.10
Midwest	564	1.22	.04	.51	.64	.84	1.11	1.54	1.91	2.12
South	660	1.14	.03	.47	.58	.78	1.03	1.39	1.78	2.21
West	384	1.20	.04	.55	.69	.87	1.12	1.48	1.76	2.04
Urbanization										
Central city	499	1.20	.03	.49	.63	.81	1.09	1.48	1.92	2.18
Suburban	1039	1.17	.03	.52	.63	.84	1.07	1.42	1.78	2.05
Nonmetropolitan	518	1.15	.03	.50	.59	.77	1.02	1.41	1.84	2.10

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-77. Vitamin B6: mean intake in milligrams per 1000 kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	.79	.01	.46	.52	.61	.74	.90	1.12	1.28
Age										
20-29 years	661	.77	.01	.46	.51	.60	.73	.87	1.11	1.26
30-39 years	812	.79	.01	.45	.50	.60	.75	.92	1.12	1.29
40-49 years	583	.81	.01	.49	.53	.63	.75	.92	1.14	1.33
Race 1/										
White	1775	.79	.01	.46	.52	.61	.74	.91	1.14	1.30
Black	167	.76	.02	.41	.47	.59	.71	.88	1.09	1.20
Other	76	.77	.03	*	*	.64	.73	.88	*	*
Poverty status 1/										
< 100	315	.76	.02	.44	.48	.59	.71	.86	1.05	1.21
≥ 100	1575	.79	.01	.46	.52	.61	.74	.92	1.13	1.28
< 131	414	.75	.02	.46	.50	.59	.71	.85	1.02	1.20
≥ 131	1476	.79	.01	.46	.52	.62	.75	.92	1.14	1.29
Education 1/										
< High school	305	.77	.03	.44	.50	.58	.70	.85	1.09	1.29
High school	854	.75	.01	.45	.51	.59	.71	.87	1.04	1.21
> High school	891	.83	.01	.48	.52	.64	.78	.94	1.18	1.33
Region										
Northeast	448	.80	.01	.48	.53	.64	.77	.92	1.15	1.29
Midwest	564	.78	.02	.45	.51	.61	.73	.91	1.09	1.31
South	660	.78	.02	.42	.49	.59	.73	.90	1.10	1.27
West	384	.79	.01	.49	.54	.62	.74	.90	1.17	1.26
Urbanization										
Central city	499	.80	.01	.47	.53	.62	.74	.91	1.17	1.30
Suburban	1039	.79	.01	.46	.52	.61	.75	.91	1.13	1.28
Nonmetropolitan	518	.77	.02	.45	.50	.60	.71	.90	1.08	1.23

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-78. Vitamin B6: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1.24	.02	.65	.76	.94	1.19	1.45	1.78	2.00
Age										
1-2 years	224	1.19	.04	.63	.76	.92	1.13	1.40	1.76	1.86
3-5 years	423	1.26	.03	.66	.76	.96	1.22	1.48	1.80	2.03
Race 2/										
White	559	1.24	.02	.68	.78	.95	1.20	1.45	1.76	1.97
Black	53	1.28	.09	*	*	.88	1.19	1.57	*	*
Other	26	1.10	.09	*	*	*	1.07	*	*	*
Poverty status 2/										
< 100	140	1.20	.07	.61	.69	.82	1.18	1.46	1.74	1.97
≥ 100	471	1.25	.02	.70	.80	.98	1.20	1.45	1.79	2.03
< 131	192	1.22	.06	.64	.71	.82	1.20	1.47	1.78	2.07
≥ 131	419	1.25	.02	.69	.81	.98	1.20	1.45	1.78	1.97
Education 2/										
< High school	99	1.25	.06	*	.73	.92	1.22	1.45	1.78	*
High school	252	1.24	.04	.65	.74	.94	1.16	1.46	1.86	2.12
> High school	295	1.22	.03	.65	.78	.94	1.20	1.44	1.76	1.84
Region										
Northeast	111	1.28	.06	*	.64	.96	1.28	1.58	1.87	*
Midwest	199	1.26	.04	.73	.78	.95	1.21	1.46	1.79	2.23
South	187	1.17	.04	.63	.74	.90	1.14	1.38	1.75	1.79
West	150	1.26	.06	.70	.81	.97	1.24	1.47	1.80	1.97
Urbanization										
Central city	171	1.33	.06	.73	.81	.99	1.30	1.57	1.97	2.18
Suburban	310	1.20	.02	.63	.75	.92	1.14	1.40	1.76	1.88
Nonmetropolitan	166	1.22	.04	.64	.74	.91	1.21	1.45	1.76	1.87

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-79. Vitamin B6: mean intake in milligrams per 1000 kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	.88	.01	.55	.61	.72	.85	1.01	1.13	1.29
Age										
1-2 years	224	.92	.02	.57	.63	.74	.88	1.04	1.20	1.35
3-5 years	423	.85	.01	.53	.61	.71	.83	.98	1.11	1.25
Race 2/										
White	559	.87	.01	.57	.62	.71	.84	1.01	1.13	1.29
Black	53	.91	.06	*	*	.73	.92	1.08	*	*
Other	26	.91	.06	*	*	*	.88	*	*	*
Poverty status 2/										
< 100	140	.86	.03	.46	.58	.68	.86	.99	1.14	1.31
≥ 100	471	.88	.01	.57	.63	.73	.86	1.01	1.13	1.29
< 131	192	.89	.03	.49	.62	.71	.88	1.00	1.14	1.31
≥ 131	419	.87	.01	.55	.63	.72	.85	1.01	1.13	1.29
Education 2/										
< High school	99	.89	.04	*	.62	.70	.87	1.04	1.23	*
High school	252	.88	.02	.54	.61	.71	.87	1.00	1.13	1.28
> High school	295	.87	.02	.57	.62	.72	.83	1.00	1.11	1.27
Region										
Northeast	111	.89	.03	*	.61	.74	.87	1.03	1.13	*
Midwest	199	.89	.02	.57	.62	.73	.86	1.00	1.19	1.30
South	187	.85	.02	.58	.63	.70	.78	.98	1.11	1.25
West	150	.89	.03	.51	.59	.74	.89	1.01	1.14	1.30
Urbanization										
Central city	171	.90	.02	.61	.64	.77	.87	1.01	1.14	1.30
Suburban	310	.87	.02	.53	.60	.70	.85	1.01	1.12	1.28
Nonmetropolitan	166	.87	.02	.56	.63	.71	.82	.99	1.19	1.30

1/ Excludes two breastfed children.

2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Vitamin B12

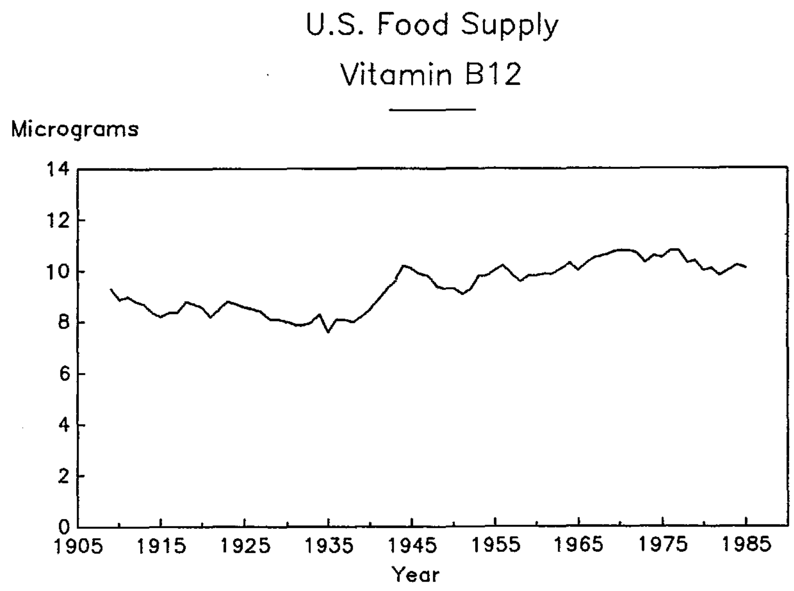


Figure II-31. Vitamin B12: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

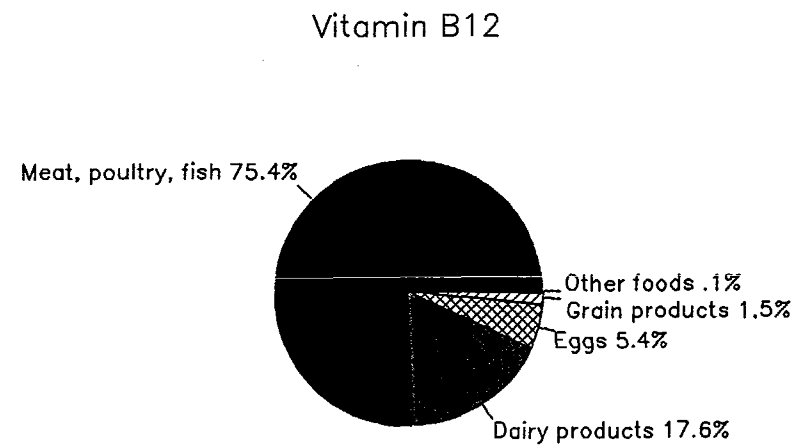


Figure II-32. Vitamin B12: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fats and oils)

Table II-80 Vitamin B12: mean intake in micrograms, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	4.6	.15	1.3	1.7	2.4	3.4	4.9	7.0	10.2
Age										
20-29 years	661	4.5	.32	1.4	1.8	2.4	3.4	4.9	7.0	8.7
30-39 years	812	4.4	.20	1.2	1.5	2.5	3.4	4.8	6.9	10.3
40-49 years	583	5.1	.32	1.3	1.7	2.3	3.4	4.8	7.1	12.6
Race 1/										
White	1775	4.5	.14	1.3	1.7	2.5	3.5	4.9	7.0	10.1
Black	167	6.0	.84	.9	1.4	2.0	3.1	4.7	6.9	12.6
Other	76	4.4	.46	*	*	2.1	3.2	5.3	*	*
Poverty status 1/										
< 100	315	5.5	.75	1.0	1.4	2.0	3.1	4.4	7.0	10.9
≥ 100	1575	4.4	.11	1.3	1.7	2.5	3.4	4.9	7.1	10.1
< 131	414	5.0	.58	1.0	1.4	2.0	3.2	4.6	6.6	8.7
≥ 131	1476	4.5	.11	1.3	1.7	2.5	3.5	5.0	7.1	10.5
Education 1/										
< High school	305	4.6	.46	.9	1.5	2.0	3.1	4.1	6.0	11.8
High school	854	4.5	.31	1.3	1.7	2.4	3.4	4.8	6.8	8.6
> High school	891	4.8	.14	1.4	1.8	2.5	3.5	5.1	7.6	11.2
Region										
Northeast	448	5.0	.24	1.4	1.8	2.6	3.4	4.9	7.7	11.7
Midwest	564	4.7	.36	1.3	1.7	2.6	3.5	4.9	6.9	8.9
South	660	4.5	.30	1.2	1.5	2.2	3.2	4.7	6.9	10.1
West	384	4.4	.17	1.3	1.7	2.5	3.7	5.0	7.1	8.6
Urbanization										
Central city	499	5.0	.29	1.3	1.7	2.5	3.7	5.1	7.3	10.3
Suburban	1039	4.3	.13	1.3	1.7	2.5	3.3	4.7	6.9	10.1
Nonmetropolitan	518	4.9	.46	1.2	1.6	2.2	3.3	4.8	6.9	11.2

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-81. Vitamin B12: mean intake in micrograms, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	4.0	.13	1.8	2.2	2.8	3.5	4.4	5.5	6.8
Age										
1-2 years	224	4.0	.17	1.8	2.2	2.8	3.5	4.1	5.5	6.8
3-5 years	423	4.0	.15	1.8	2.3	2.8	3.5	4.6	5.6	6.9
Race 2/										
White	559	3.9	.11	1.8	2.3	2.8	3.5	4.4	5.5	6.8
Black	53	4.8	.62	*	*	2.9	3.6	4.8	*	*
Other	26	3.4	.18	*	*	*	3.5	*	*	*
Poverty status 2/										
< 100	140	4.4	.50	1.9	2.2	2.9	3.5	4.7	6.1	7.9
≥ 100	471	3.8	.12	1.9	2.3	2.8	3.5	4.3	5.5	6.4
< 131	192	4.3	.38	2.0	2.3	2.9	3.5	4.7	5.9	7.7
≥ 131	419	3.8	.12	1.8	2.3	2.8	3.5	4.3	5.4	6.5
Education 2/										
< High school	99	4.1	.23	*	2.5	3.2	3.7	4.7	5.9	*
High school	252	4.2	.27	1.8	2.1	2.8	3.5	4.7	6.3	7.3
> High school	295	3.8	.14	1.8	2.3	2.8	3.5	4.1	5.4	6.0
Region										
Northeast	111	4.0	.38	*	1.8	2.7	3.6	4.7	5.6	*
Midwest	199	4.4	.27	2.2	2.6	3.3	3.9	4.7	6.0	7.2
South	187	3.7	.21	1.6	2.0	2.7	3.2	3.8	5.1	5.9
West	150	3.8	.14	2.1	2.4	2.9	3.5	4.3	5.8	6.5
Urbanization										
Central city	171	4.2	.33	2.1	2.5	2.9	3.7	4.6	5.7	6.7
Suburban	310	3.6	.10	1.7	2.0	2.7	3.3	4.2	5.1	6.8
Nonmetropolitan	166	4.5	.27	1.9	2.3	2.9	3.7	5.1	6.1	7.6

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Vitamin C

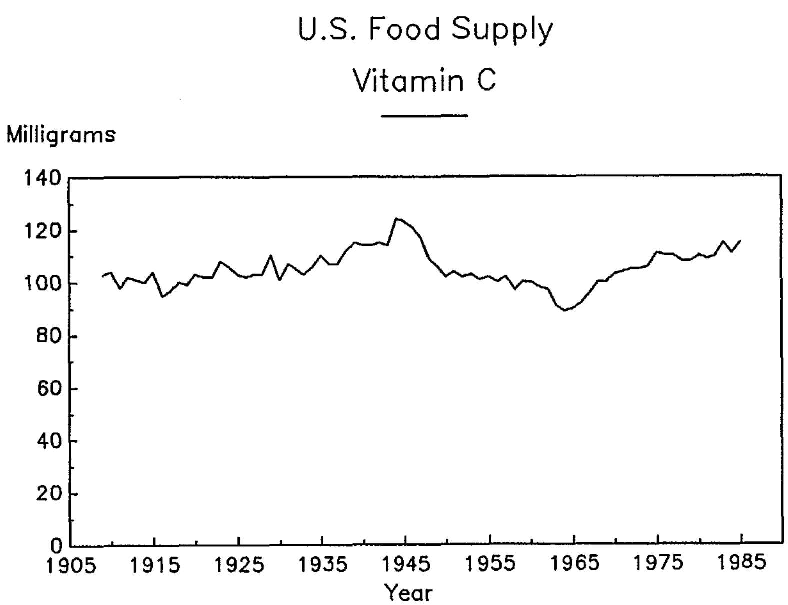


Figure II–33. Vitamin C: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

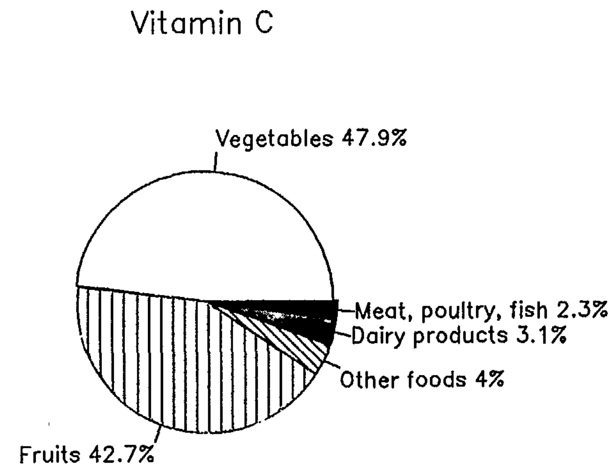


Figure II–34. Vitamin C: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include legumes, nuts, and soy; sugars and sweeteners; and miscellaneous foods)

Table II-82. Vitamin C: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	78	2.1	18	25	40	67	105	148	177
Age										
20-29 years	661	79	3.6	20	26	40	65	107	153	187
30-39 years	812	78	2.6	17	23	38	67	105	147	171
40-49 years	583	78	2.6	19	26	43	68	102	141	170
Race 1/										
White	1775	78	2.4	20	26	40	67	104	146	176
Black	167	78	6.2	16	22	39	70	109	156	178
Other	76	79	6.9	*	*	35	68	109	*	*
Poverty status 1/										
< 100	315	61	3.6	13	17	28	48	79	123	140
≥ 100	1575	83	2.3	20	26	43	70	109	153	186
< 131	414	64	3.3	14	18	32	51	83	123	143
≥ 131	1476	83	2.4	20	26	43	70	109	155	188
Education 1/										
< High school	305	57	3.3	13	16	27	47	70	109	150
High school	854	72	2.5	17	23	37	59	97	132	165
> High school	891	90	2.5	26	31	50	80	115	162	194
Region										
Northeast	448	80	3.4	18	25	46	71	108	151	178
Midwest	564	79	5.5	18	23	40	67	102	146	189
South	660	74	3.0	16	23	37	63	101	144	165
West	384	83	4.7	23	29	43	70	109	149	176
Urbanization										
Central city	499	81	3.8	18	24	41	68	113	153	170
Suburban	1039	81	3.3	20	26	42	70	106	149	187
Nonmetropolitan	518	69	3.2	15	23	35	55	90	126	156

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-83. Vitamin C: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	83	2.75	26	32	49	69	107	146	168
Age										
1-2 years	224	84	4.04	26	33	49	70	106	150	175
3-5 years	423	82	2.95	26	32	49	69	108	143	164
Race 2/										
White	559	84	2.93	26	34	49	69	110	150	175
Black	53	75	6.82	*	*	49	69	97	*	*
Other	26	85	11.23	*	*	*	79	*	*	*
Poverty status 2/										
< 100	140	67	4.76	23	29	41	59	87	114	138
≥ 100	471	88	2.77	28	36	52	78	116	151	175
< 131	192	71	4.14	24	30	43	63	91	121	146
≥ 131	419	88	3.08	28	36	52	79	117	153	176
Education 2/										
< High school	99	65	5.39	*	26	36	54	85	119	*
High school	252	78	4.02	26	32	49	66	98	132	157
> High school	295	92	3.62	26	39	54	85	124	156	176
Region										
Northeast	111	93	7.97	*	29	54	72	125	157	*
Midwest	199	83	3.79	29	35	52	76	111	140	165
South	187	75	5.26	23	29	41	59	100	143	157
West	150	84	4.68	34	40	54	71	105	150	164
Urbanization										
Central city	171	89	4.92	27	34	52	75	116	155	167
Suburban	310	82	4.24	25	31	48	68	109	146	176
Nonmetropolitan	166	75	4.18	27	33	47	66	93	124	147

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-84. Vitamin C: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	71	2.4	66	2.1	88	1.8	81	3.8
3-5	82	2.2	71	2.2	100	1.6	81	3.1
6-11	81	2.5	87	2.0	107	3.3	-	-
Male								
12-15	91	5.1	95	3.1	117	6.3	-	-
16-19	109	7.4	100	3.2	125	7.7	-	-
20-29[1]	102	6.0	89	2.7	118	5.7	107	8.6
30-39[1]	78	5.3	84	2.3	102	5.8	104	7.1
40-49[1]	84	5.1	86	3.1	98	5.2	124	13.4
50-59	91	5.4	95	2.8	105	5.6	-	-
60-69	93	2.4	90	2.8	101	2.0	-	-
70+[2]	91	2.6	89	3.3	102	3.3	-	-
Female								
12-15	79	4.2	79	2.2	82	4.5	-	-
16-19	82	5.6	77	2.1	79	4.9	-	-
20-29	80	2.3	74	2.2	95	4.1	86	4.1
30-39	76	2.2	73	2.0	86	4.7	86	4.1
40-49	79	2.9	78	2.1	91	4.9	81	3.2
50-59	90	4.6	86	2.3	102	5.0	-	-
60-69	96	2.5	92	2.4	102	1.8	-	-
70+[2]	83	2.3	85	2.2	112	3.2	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

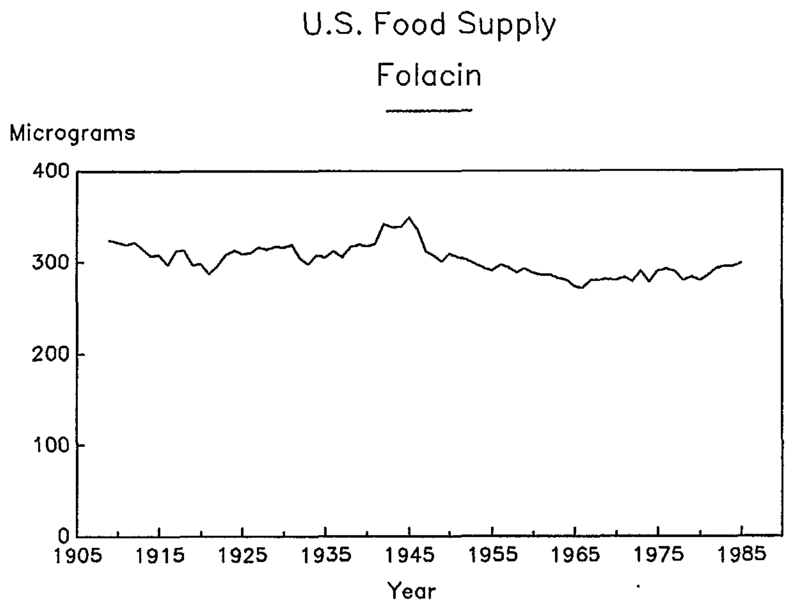


Figure II-35. Folacin: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

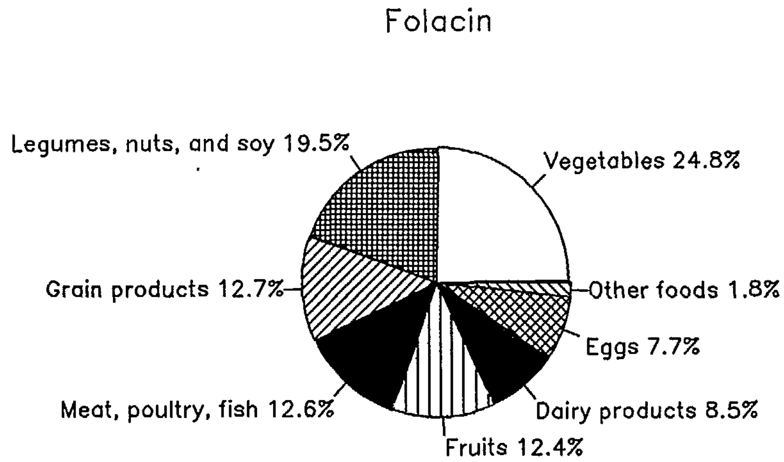


Figure II-36. Folacin: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fats and oils; and miscellaneous foods)

Table II-85. Folacin: mean intake in micrograms, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	193	3.1	78	93	127	176	236	310	359
Age										
20-29 years	661	197	4.9	79	93	130	182	239	325	379
30-39 years	812	193	4.6	75	91	126	179	242	311	355
40-49 years	583	183	4.3	78	99	127	166	218	287	337
Race 1/										
White	1775	196	3.7	82	99	132	179	239	311	363
Black	167	165	6.5	56	70	106	153	199	292	330
Other	76	179	12.7	*	*	104	170	237	*	*
Poverty status 1/										
< 100	315	166	6.1	59	75	100	139	199	302	334
≥ 100	1575	198	3.3	83	100	134	182	238	308	367
< 131	414	168	6.1	59	78	105	148	201	294	331
≥ 131	1476	199	3.3	83	101	136	183	239	311	370
Education 1/										
< High school	305	157	6.0	58	69	95	137	190	269	332
High school	854	181	4.0	75	90	120	161	222	292	328
> High school	891	214	3.5	96	116	147	196	260	328	387
Region										
Northeast	448	188	6.1	75	98	126	171	224	309	363
Midwest	564	193	7.7	75	89	127	176	240	310	348
South	660	190	5.0	76	89	124	168	233	300	374
West	384	200	6.1	89	100	138	189	245	313	346
Urbanization										
Central city	499	197	4.9	78	97	126	182	244	319	388
Suburban	1039	193	5.1	81	96	134	179	233	306	343
Nonmetropolitan	518	186	5.1	74	85	118	161	228	305	351

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-86. Folacin: mean intake in micrograms per 1000 kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	130	1.4	67	75	94	121	153	197	231
Age										
20-29 years	661	129	2.3	64	73	92	118	150	196	217
30-39 years	812	131	2.4	66	73	95	121	155	199	241
40-49 years	583	131	2.0	70	77	95	121	153	199	232
Race 1/										
White	1775	131	1.6	69	76	96	121	153	198	231
Black	167	126	4.0	56	66	87	112	158	197	220
Other	76	128	8.2	*	*	86	120	161	*	*
Poverty status 1/										
< 100	315	119	2.8	58	67	80	104	147	183	205
≥ 100	1575	132	1.7	69	78	96	122	153	198	231
< 131	414	120	2.4	61	69	83	110	147	182	205
≥ 131	1476	132	1.8	69	78	96	122	154	198	233
Education 1/										
< High school	305	123	4.1	62	67	85	110	145	198	213
High school	854	123	1.9	66	73	88	113	145	184	210
> High school	891	139	2.0	72	84	102	126	164	209	241
Region										
Northeast	448	132	3.0	67	76	96	124	161	196	214
Midwest	564	125	3.4	64	72	89	119	146	187	220
South	660	132	2.4	66	72	92	118	152	199	243
West	384	133	1.9	74	81	98	122	159	197	231
Urbanization										
Central city	499	134	2.1	67	75	94	119	156	204	241
Suburban	1039	130	2.1	67	75	96	122	155	197	222
Nonmetropolitan	518	126	3.2	68	72	89	114	145	190	231

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-87. Folacin: mean intake in micrograms, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	191	4.8	92	108	137	177	229	287	350
Age										
1-2 years	224	180	6.6	90	104	120	164	216	274	335
3-5 years	423	197	5.3	93	111	146	185	242	295	352
Race 2/										
White	559	189	4.6	95	109	137	177	228	276	340
Black	53	221	22.1	*	*	148	226	295	*	*
Other	26	177	18.6	*	*	*	158	*	*	*
Poverty status 2/										
< 100	140	188	12.8	91	103	120	164	231	295	363
≥ 100	471	192	4.8	97	111	141	180	230	286	345
< 131	192	191	10.8	92	103	124	173	231	318	363
≥ 131	419	192	4.5	95	111	141	181	229	280	340
Education 2/										
< High school	99	196	11.0	*	110	143	174	232	321	*
High school	252	194	8.3	93	103	130	174	230	318	372
> High school	295	187	4.9	93	110	138	180	229	271	313
Region										
Northeast	111	205	13.6	*	104	141	195	247	335	*
Midwest	199	193	9.1	93	108	128	177	230	313	376
South	187	178	7.0	92	103	124	164	228	268	307
West	150	196	9.6	103	124	149	184	230	283	318
Urbanization										
Central city	171	206	10.6	107	116	146	187	257	325	372
Suburban	310	184	6.2	91	103	127	175	228	272	328
Nonmetropolitan	166	188	8.9	89	109	136	169	226	286	356

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-88. Folacin: mean intake in micrograms per 1000 kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	135	2.7	79	86	102	127	159	193	217
Age										
1-2 years	224	138	3.9	77	87	102	134	161	203	221
3-5 years	423	134	2.8	79	84	100	124	159	190	212
Race 2/										
White	559	132	2.5	79	86	101	123	155	187	212
Black	53	160	15.8	*	*	106	155	192	*	*
Other	26	145	12.7	*	*	*	126	*	*	*
Poverty status 2/										
< 100	140	136	7.0	70	82	94	121	160	210	230
≥ 100	471	135	2.6	79	87	103	128	159	188	212
< 131	192	140	5.8	71	82	100	125	168	208	230
≥ 131	419	133	2.6	79	87	102	127	155	187	212
Education 2/										
< High school	99	142	7.9	*	77	103	130	176	217	*
High school	252	137	4.5	79	83	100	130	161	207	213
> High school	295	131	2.4	82	87	102	123	152	185	206
Region										
Northeast	111	142	7.0	*	87	106	137	174	201	*
Midwest	199	135	4.4	74	84	100	125	162	193	213
South	187	130	5.4	79	86	100	117	149	186	221
West	150	138	4.0	80	85	109	134	160	188	210
Urbanization										
Central city	171	141	4.6	82	88	104	134	163	202	228
Suburban	310	133	3.9	77	85	102	123	157	187	212
Nonmetropolitan	166	135	5.0	75	82	99	123	159	196	221

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

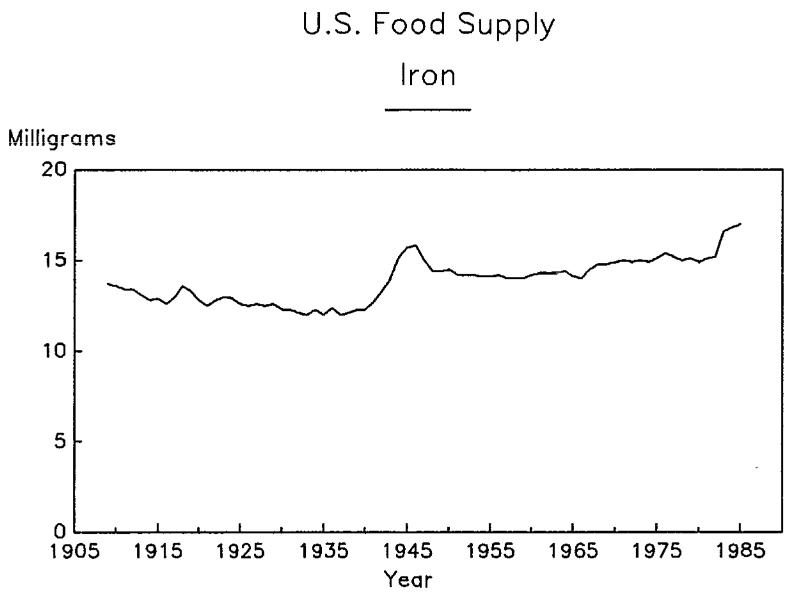


Figure II–37. Iron: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

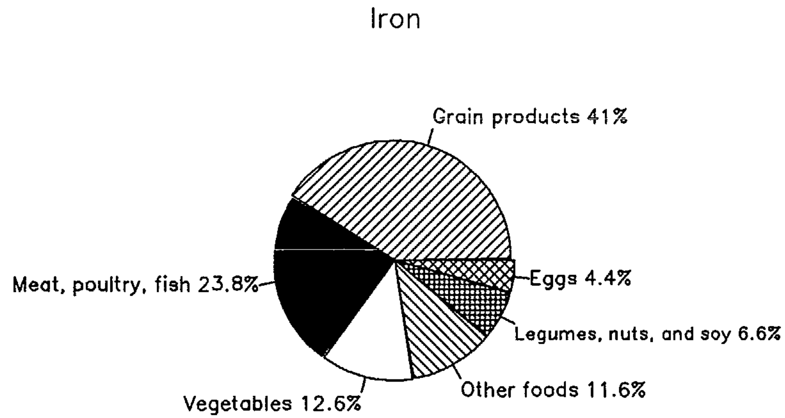


Figure II–38. Iron: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include dairy products; fats and oils; fruits; sugars and sweeteners; and miscellaneous foods)

Table II-89. Iron: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	10.1	.14	4.9	5.9	7.5	9.6	11.9	15.2	17.5
Age										
20-29 years	661	10.2	.23	4.9	5.8	7.3	9.6	12.1	16.2	18.7
30-39 years	812	10.2	.19	4.9	5.9	7.5	9.8	12.0	15.2	16.9
40-49 years	583	9.9	.17	5.4	6.1	7.7	9.3	11.4	14.5	16.0
Race 1/										
White	1775	10.2	.15	5.2	6.1	7.6	9.6	12.0	15.1	17.1
Black	167	9.1	.37	4.0	4.5	6.2	8.8	11.0	14.1	16.4
Other	76	10.7	.71	*	*	7.3	10.3	13.6	*	*
Poverty status 1/										
< 100	315	9.5	.24	4.3	4.9	6.8	8.9	11.3	14.8	16.5
≥ 100	1575	10.3	.14	5.3	6.2	7.7	9.7	12.1	15.2	17.1
< 131	414	9.6	.26	4.3	5.1	6.9	9.1	11.4	14.8	17.5
> 131	1476	10.3	.13	5.3	6.2	7.7	9.7	12.1	15.2	16.9
Education 1/										
< High school	305	8.9	.27	4.0	4.7	6.1	8.4	10.9	14.5	16.3
High school	854	9.8	.18	4.9	5.8	7.3	9.3	11.4	14.5	16.5
> High school	891	10.8	.16	5.9	6.7	8.1	10.3	12.7	16.0	18.7
Region										
Northeast	448	10.1	.31	5.1	5.9	7.4	9.8	11.5	14.6	18.4
Midwest	564	10.4	.28	5.1	6.1	7.7	9.6	12.7	15.6	18.4
South	660	9.8	.20	4.6	5.8	7.2	9.2	11.5	14.6	16.9
West	384	10.3	.33	5.3	6.4	7.9	9.9	12.5	15.3	16.6
Urbanization										
Central city	499	10.3	.29	5.2	6.0	7.5	9.6	12.3	16.2	18.3
Suburban	1039	10.0	.20	5.0	6.0	7.6	9.7	11.9	14.4	16.5
Nonmetropolitan	518	10.1	.20	4.9	5.8	7.4	9.3	11.8	15.5	17.8

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-90. Iron: mean intake in milligrams per 1000 kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	6.8	.06	4.5	5.0	5.6	6.5	7.7	9.1	10.0
Age										
20-29 years	661	6.6	.10	4.3	4.8	5.4	6.3	7.5	8.8	9.8
30-39 years	812	6.9	.08	4.6	5.0	5.7	6.6	7.8	9.1	9.9
40-49 years	583	7.1	.07	4.8	5.1	5.8	6.8	7.9	9.6	10.3
Race 1/										
White	1775	6.8	.06	4.6	4.9	5.6	6.5	7.6	9.0	10.0
Black	167	6.8	.19	4.5	4.9	5.4	6.5	8.0	9.1	10.0
Other	76	7.6	.37	*	*	6.4	7.9	8.6	*	*
Poverty status 1/										
< 100	315	6.8	.12	4.6	5.1	5.7	6.6	8.0	8.9	9.4
≥ 100	1575	6.8	.06	4.6	5.0	5.6	6.5	7.6	9.2	10.0
< 131	414	6.9	.12	4.6	5.1	5.6	6.7	7.9	9.0	10.0
≥ 131	1476	6.8	.07	4.6	4.9	5.6	6.4	7.6	9.1	9.9
Education 1/										
< High school	305	6.9	.15	4.5	4.8	5.8	6.7	7.9	9.3	10.3
High school	854	6.6	.09	4.4	4.8	5.5	6.4	7.5	8.9	9.8
> High school	891	6.9	.07	4.7	5.1	5.7	6.6	7.9	9.2	10.2
Region										
Northeast	448	7.1	.13	4.7	5.2	5.9	6.8	8.0	9.3	10.0
Midwest	564	6.7	.12	4.6	4.9	5.5	6.3	7.5	9.1	10.0
South	660	6.7	.10	4.5	4.8	5.4	6.4	7.5	8.8	9.9
West	384	6.8	.11	4.4	5.0	5.7	6.6	7.8	9.2	10.2
Urbanization										
Central city	499	6.9	.09	4.5	4.9	5.7	6.6	7.8	9.3	10.2
Suburban	1039	6.7	.08	4.6	5.0	5.6	6.5	7.6	9.0	9.9
Nonmetropolitan	518	6.9	.15	4.5	5.0	5.6	6.6	7.8	9.2	10.5

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-91. Iron: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	9.8	.21	5.7	6.3	7.5	9.3	11.1	14.0	15.9
Age										
1-2 years	224	9.2	.29	5.4	5.8	6.9	8.6	10.4	13.3	15.6
3-5 years	423	10.2	.23	6.1	6.7	8.0	9.7	11.5	14.3	16.1
Race 2/										
White	559	9.7	.17	5.8	6.4	7.5	9.2	11.0	13.7	15.4
Black	53	11.3	1.10	*	*	8.2	10.1	13.1	*	*
Other	26	9.2	.80	*	*	*	9.2	*	*	*
Poverty status 2/										
< 100	140	10.0	,58	5.1	5.8	7.1	9.2	11.7	15.1	17.5
≥ 100	471	9.8	.21	5.9	6.4	7.7	9.3	11.0	13.6	15.4
< 131	192	10.1	.56	5.2	5.8	7.1	9.2	12.0	15.1	18.3
≥ 131	419	9.7	.15	5.9	6.5	7.8	9.3	10.9	13.4	15.3
Education 2/										
< High school	99	10.4	.52	*	5.8	7.5	10.2	12.3	14.9	*
High school	252	10.1	.37	5.6	6.4	7.6	9.4	11.5	15.3	16.8
> High school	295	9.5	.20	5.9	6.4	7.5	9.2	10.6	12.7	14.5
Region										
Northeast	111	10.9	.64	*	6.2	8.0	10.4	12.6	15.4	*
Midwest	199	10.2	.39	5.9	6.4	7.5	9.2	11.6	15.3	18.2
South	187	9.0	.23	5.2	5.9	7.1	8.9	10.2	12.0	13.7
West	150	9.7	.36	5.8	6.5	8.0	9.2	10.6	13.7	16.4
Urbanization										
Central city	171	10.5	.54	5.8	6.5	8.0	9.6	11.5	15.6	17.5
Suburban	310	9.5	.24	5.6	6.2	7.5	9.2	10.7	13.4	15.3
Nonmetropolitan	166	9.7	.28	5.4	6.3	7.2	9.2	11.2	14.1	16.3

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-92. Iron: mean intake in milligrams per 1000 kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	7.0	.10	4.7	5.1	5.6	6.5	7.9	9.2	10.5
Age										
1-2 years	224	7.1	.17	4.7	5.1	5.6	6.5	8.2	9.8	11.5
3-5 years	423	6.9	.12	4.8	5.1	5.7	6.5	7.7	8.9	10.1
Race 2/										
White	559	6.8	.10	4.7	5.1	5.6	6.4	7.8	8.9	10.0
Black	53	8.1	.58	*	*	6.4	7.1	8.9	*	*
Other	26	7.5	.49	*	*	*	7.5	*	*	*
Poverty status 2/										
< 100	140	7.1	.30	5.0	5.1	5.7	6.5	8.0	9.9	11.6
≥ 100	471	6.9	.11	4.6	5.0	5.6	6.5	7.9	9.0	10.2
< 131	192	7.3	.27	4.9	5.0	5.6	6.5	8.2	9.9	11.8
≥ 131	419	6.9	.10	4.6	5.1	5.6	6.5	7.8	8.8	10.0
Education 2/										
< High school	99	7.4	.36	*	5.1	5.8	6.7	8.5	10.5	*
High school	252	7.1	.17	5.0	5.2	5.7	6.5	8.2	9.3	10.5
> High school	295	6.7	.12	4.6	5.0	5.6	6.2	7.6	8.7	10.2
Region										
Northeast	111	7.6	.23	*	5.8	6.4	7.1	8.4	9.9	*
Midwest	199	7.2	.20	4.7	5.1	5.6	6.7	8.0	9.3	11.6
South	187	6.6	.18	4.7	5.0	5.3	6.0	7.6	8.8	9.8
West	150	6.9	.15	4.6	5.2	5.7	6.4	7.7	8.9	11.1
Urbanization										
Central city	171	7.2	.25	4.8	5.2	5.6	6.5	8.0	10.0	11.6
Suburban	310	6.9	.12	4.7	5.1	5.7	6.5	7.9	8.9	10.0
Nonmetropolitan	166	6.9	.17	4.7	5.0	5.6	6.5	7.7	9.1	10.4

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-93. Iron: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

Sex and age (years)	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	7.35	0.16	8.1	0.16	8.57	0.13	10.2	0.51
3-5	8.58	0.11	9.5	0.12	10.02	0.09	11.0	0.34
6-11	10.81	0.17	12.2	0.12	12.34	0.21	-	-
Male								
12-15	14.13	0.42	15.6	0.20	16.01	0.45	-	-
16-19	16.70	0.51	16.9	0.26	18.15	0.60	-	-
20-29[1]	16.55	0.40	16.2	0.23	17.59	0.45	16.7	0.79
30-39[1]	16.54	0.48	15.9	0.21	16.48	0.49	15.6	0.70
40-49[1]	15.26	0.42	16.1	0.24	16.58	0.53	15.6	0.81
50-59	13.85	0.38	15.9	0.23	15.21	0.43	-	-
60-69	13.08	0.18	14.9	0.25	14.73	0.20	-	-
70+[2]	11.68	0.16	14.2	0.28	13.24	0.29	-	-
Female								
12-15	10.44	0.28	11.9	0.21	10.71	0.32	-	-
16-19	9.54	0.30	11.2	0.20	10.04	0.34	-	-
20-29	10.06	0.13	10.7	0.17	10.67	0.23	11.1	0.27
30-39	10.36	0.14	11.1	0.15	11.08	0.31	11.1	0.26
40-49	10.40	0.18	11.0	0.14	11.10	0.34	10.6	0.22
50-59	10.15	0.28	11.5	0.17	10.30	0.30	-	-
60-69	9.53	0.14	11.0	0.15	10.53	0.13	-	-
70+[2]	8.63	0.13	10.4	0.16	10.18	0.22	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-94. Iron deficiency determined by the MCV model of children 4-19 years of age by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American			Cuban			Puerto Rican		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Both sexes									
4-5 years...........	225	3.9	1.1	14	*	*	60	7.0	3.2
6-11 years..........	1,012	3.4	0.5	97	3.1	1.7	313	2.5	0.8
Male									
12-15 years.........	339	3.5	1.0	50	6.7	3.3	134	2.6	1.4
16-19 years.........	242	0.4	0.4	51	0.0	0.0	133	1.2	0.9
Female 3/									
12-15 years.........	307	5.9	1.3	39	*0.0	0.0	134	6.5	2.1
16-19 years.........	277	7.9	1.6	42	*0.0	4.6	117	7.9	2.4

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-95. Iron deficiency determined by the MCV model of persons 20-74 years of age by sex, age, and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Mexican American			Cuban			Puerto Rican		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Male									
20-74 years..............	1,344	0.9	0.3	363	0.5	0.4	415	0.4	0.4
20-74 years, age adjusted	...	0.9	...	...	0.6	...	...	0.3	...
20-29 years..............	413	0.7	0.5	54	1.5	2.1	107	0.0	0.0
30-39 years..............	343	1.3	0.8	52	0.0	0.0	83	1.1	1.5
40-49 years..............	226	1.0	0.7	80	0.0	0.0	83	0.6	1.0
50-59 years..............	216	0.9	0.6	104	0.0	0.0	95	0.0	0.0
60-69 years..............	111	0.0	0.0	45	0.0	0.0	37	*0.0	0.0
70-74 years..............	35	*2.9	3.2	28	*3.8	3.6	10	*	*
Female 3/									
20-74 years..............	1,653	9.0	0.8	449	5.8	1.2	677	6.9	1.1
20-74 years, age adjusted	...	8.5	...	...	5.2	...	...	6.2	...
20-29 years..............	468	8.2	1.5	60	2.8	2.5	162	7.2	2.5
30-39 years..............	407	11.7	1.8	87	7.2	3.3	155	7.9	2.7
40-49 years..............	288	12.9	2.0	100	10.2	3.3	155	8.3	2.4
50-59 years..............	301	4.0	1.1	109	4.0	1.9	120	3.9	1.6
60-69 years..............	132	4.2	1.8	66	1.7	1.5	72	3.8	2.0
70-74 years..............	57	8.4	3.8	27	*7.0	4.9	13	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-96. Iron deficiency determined by the MCV model of Mexican-American children 4-19 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Both sexes						
4-5 years...........	84	3.3	1.7	128	3.8	1.6
6-11 years..........	372	4.1	0.9	559	2.8	0.6
Male						
12-15 years.........	111	5.0	1.9	193	2.0	1.0
16-19 years.........	76	1.2	1.3	136	0.0	0.0
Female 3/						
12-15 years.........	116	4.3	1.8	163	5.9	1.8
16-19 years.........	103	9.2	2.8	151	6.3	1.9

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-97. Iron deficiency determined by the MCV model of Mexican-American persons 20-74 years of age by sex, age, and poverty status: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Male						
20-74 years..................	298	0.2	0.3	930	1.2	0.4
20-74 years, age adjusted.....	...	0.3	...	...	1.2	...
20-29 years..................	95	0.0	0.0	280	1.0	0.8
30-39 years..................	64	0.0	0.0	259	1.6	1.0
40-49 years..................	45	0.0	0.0	161	1.1	0.9
50-59 years..................	46	1.8	1.9	147	0.8	0.7
60-69 years..................	34	*0.0	0.0	65	0.0	0.0
70-74 years..................	14	*	*	18	*	*
Female 3/						
20-74 years..................	505	10.6	1.4	994	7.9	0.9
20-74 years, age adjusted.....	...	10.1	...	...	7.2	...
20-29 years..................	140	9.6	2.9	296	7.7	1.8
30-39 years..................	112	14.6	3.6	265	9.8	2.0
40-49 years..................	84	19.2	4.2	172	9.8	2.3
50-59 years..................	92	3.1	1.7	174	4.1	1.4
60-69 years..................	42	*2.6	2.5	71	5.5	2.7
70-74 years..................	35	*7.6	4.6	16	*	*

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-98. Iron deficiency determined by the MCV model of children 4-19 years of age by sex, age, and race: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Non-Hispanic white			Non-Hispanic black		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Both sexes						
4-5 years...........	771	3.8	0.5	180	9.3	1.4
6-11 years..........	1,085	3.2	0.6	219	4.0	1.5
Male						
12-15 years.........	492	1.8	0.7	87	2.2	1.8
16-19 years.........	480	0.8	0.5	91	0.9	1.1
Female 3/						
12-15 years.........	418	2.1	0.8	101	8.0	2.9
16-19 years.........	456	3.8	1.1	83	13.8	4.4

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-99. Iron deficiency determined by the MCV model of persons 20-74 years of age by sex, age, and race: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Non-Hispanic white			Non-Hispanic black		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Male						
20-74 years	4,464	1.3	0.2	565	2.6	0.7
20-74 years, age adjusted	...	1.3	...	...	2.7	...
20-29 years	977	0.8	0.4	146	0.0	0.0
30-39 years	677	0.7	0.4	88	3.1	2.3
40-49 years	551	1.4	0.7	60	2.4	2.7
50-59 years	551	1.1	0.6	72	5.9	3.4
60-69 years	1,301	2.4	0.3	144	3.0	1.0
70-74 years	407	3.5	0.7	55	6.1	2.3
Female 3/						
20-74 years	4,832	4.2	0.3	666	6.0	1.0
20-74 years, age adjusted	...	4.2	...	...	6.1	...
20-29 years	956	2.4	0.6	163	3.5	1.8
30-39 years	741	6.5	1.2	104	5.9	2.9
40-49 years	587	6.5	1.4	90	14.0	4.4
50-59 years	623	3.5	1.0	96	2.4	1.9
60-69 years	1,424	3.1	0.4	153	7.9	1.6
70-74 years	501	2.7	0.6	60	4.2	1.9

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-100. Iron deficiency determined by the MCV model of children 4-19 years of age by sex, age, and poverty status: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Both sexes						
4-5 years...........	192	6.4	1.1	737	4.2	0.5
6-11 years..........	235	3.8	1.3	1,034	3.3	0.7
Male						
12-15 years.........	89	1.1	1.2	466	1.9	0.8
16-19 years.........	101	0.9	1.1	445	0.9	0.5
Female 3/						
12-15 years.........	102	5.1	2.4	397	2.5	0.9
16-19 years.........	132	8.7	2.8	384	3.6	1.2

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Table II-101. Iron deficiency determined by the MCV model of persons 20-74 years of age by sex, age, and poverty status: Second National Health and Nutrition Examination Survey, 1976-80

Sex and age	Below poverty			Above poverty		
	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent	Number of examined persons 1/	Percent with iron deficiency 2/	Standard error of the percent
Male						
20-74 years..................	505	3.1	0.8	4,343	1.3	0.2
20-74 years, age adjusted.....	...	3.2	...	...	1.2	...
20-29 years..................	139	0.8	0.9	952	0.7	0.3
30-39 years..................	59	4.1	3.1	684	0.6	0.4
40-49 years..................	32	*2.1	3.2	551	1.6	0.7
50-59 years..................	46	4.0	3.4	544	1.6	0.7
60-69 years..................	147	6.0	1.4	1,249	2.1	0.3
70-74 years..................	82	5.6	1.8	363	3.4	0.8
Female 3/						
20-74 years..................	804	6.3	0.9	4,476	4.2	0.3
20-74 years, age adjusted.....	...	6.6	...	...	4.2	...
20-29 years..................	189	3.7	1.7	901	2.5	0.7
30-39 years..................	111	10.7	3.6	714	5.8	1.1
40-49 years..................	72	10.1	4.4	585	7.1	1.4
50-59 years..................	76	5.3	3.1	609	3.4	1.0
60-69 years..................	240	4.4	1.0	1,251	3.4	0.4
70-74 years..................	116	4.8	1.5	416	2.5	0.6

1/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

2/ Iron deficiency assessed by MCV model.

3/ Excludes pregnant women.

Calcium

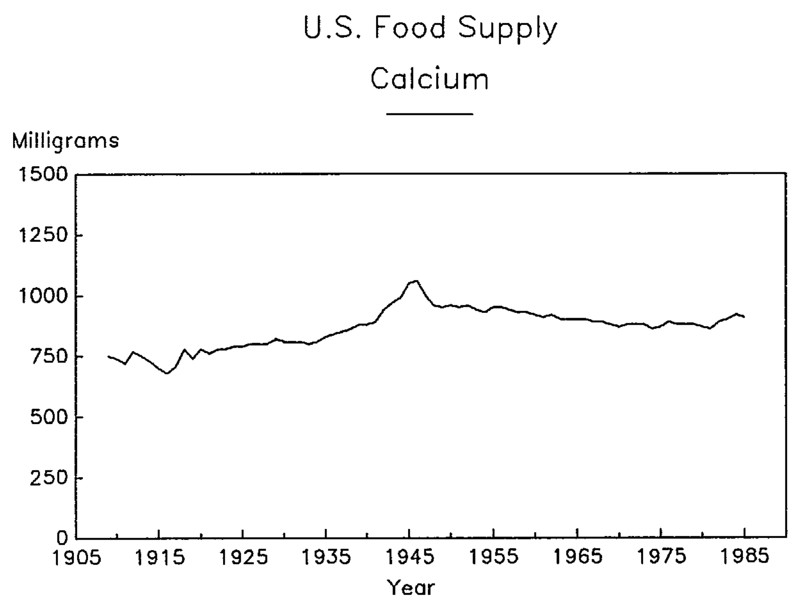


Figure II-39. Calcium: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

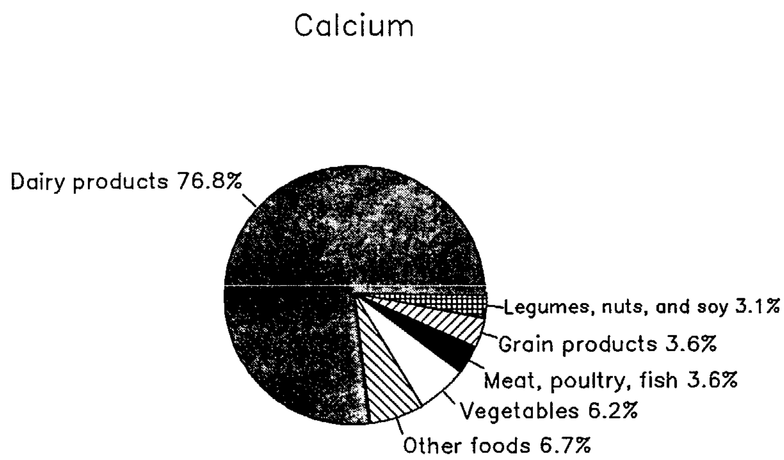


Figure II-40. Calcium: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; fats and oils; fruits; sugars and sweeteners; and miscellaneous foods)

Table II-102. Calcium: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	630	12	213	273	387	558	783	1062	1280
Age										
20-29 years	661	678	17	232	300	408	596	841	1239	1480
30-39 years	812	617	17	199	262	383	568	799	1032	1197
40-49 years	583	562	18	213	256	354	495	685	955	1144
Race 1/										
White	1775	661	12	241	303	409	583	808	1102	1314
Black	167	429	26	145	185	260	384	564	682	810
Other	76	494	36	*	*	346	446	594	*	*
Poverty status 1/										
< 100	315	532	22	155	208	318	486	695	881	1001
≥ 100	1575	652	13	238	293	404	573	798	1105	1307
< 131	414	538	23	158	206	333	487	706	890	1032
≥ 131	1476	659	14	244	297	409	578	802	1116	1311
Education 1/										
< High school	305	478	18	151	183	298	419	603	823	946
High school	854	606	17	208	256	367	525	765	1053	1244
> High school	891	699	15	273	337	461	640	857	1128	1349
Region										
Northeast	448	603	24	217	273	362	529	765	1035	1235
Midwest	564	665	20	231	300	426	598	821	1102	1273
South	660	571	23	192	242	346	489	714	931	1196
West	384	708	19	220	318	443	622	883	1261	1444
Urbanization										
Central city	499	648	19	215	278	393	567	812	1105	1404
Suburban	1039	631	19	226	279	396	564	779	1063	1268
Nonmetropolitan	518	598	20	197	249	362	515	751	1008	1252

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-103. Calcium: mean intake in milligrams per 1000 kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	412	5	202	233	298	384	495	618	710
Age										
20-29 years	661	426	9	214	244	311	398	517	650	773
30-39 years	812	410	7	199	224	294	390	506	619	692
40-49 years	583	388	9	206	233	285	362	456	572	666
Race 1/										
White	1775	426	6	214	246	309	398	514	623	728
Black	167	316	14	168	193	229	308	385	456	513
Other	76	354	23	*	*	259	334	424	*	*
Poverty status 1/										
< 100	315	376	13	174	212	262	354	465	591	647
≥ 100	1575	419	6	211	244	305	387	501	620	728
< 131	414	373	11	183	214	270	355	453	575	639
≥ 131	1476	423	7	213	244	306	391	507	625	731
Education 1/										
< High school	305	364	11	174	205	259	332	448	557	653
High school	854	398	9	199	220	285	368	480	601	718
> High school	891	439	7	237	265	326	412	524	644	733
Region										
Northeast	448	413	10	202	235	296	387	501	620	692
Midwest	564	419	9	216	247	320	399	500	613	684
South	660	378	11	199	215	271	340	443	588	690
West	384	455	12	226	255	332	416	549	691	789
Urbanization										
Central city	499	417	7	202	237	297	394	495	637	747
Suburban	1039	415	9	207	237	305	384	501	613	705
Nonmetropolitan	518	395	11	175	214	279	366	480	612	687

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-104. Calcium: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	804	15	410	490	614	769	966	1129	1299
Age										
1-2 years	224	798	23	387	488	616	789	977	1129	1203
3-5 years	423	807	18	418	492	614	764	966	1155	1324
Race 2/										
White	559	826	15	453	505	621	795	990	1160	1333
Black	53	639	31	*	*	565	657	724	*	*
Other	26	725	56	*	*	*	665	*	*	*
Poverty status 2/										
< 100	140	764	27	396	492	620	724	894	1084	1200
≥ 100	471	814	18	410	488	598	794	979	1151	1333
< 131	192	770	25	396	488	618	723	896	1085	1299
≥ 131	419	818	19	408	490	598	799	989	1149	1314
Education 2/										
< High school	99	749	26	*	441	584	738	848	1075	*
High school	252	765	19	417	488	578	715	914	1100	1192
> High school	295	852	21	434	494	662	832	1031	1175	1376
Region										
Northeast	111	812	26	*	530	631	784	991	1141	*
Midwest	199	851	23	467	506	663	799	1013	1212	1404
South	187	722	25	370	414	556	710	872	1062	1129
West	150	855	36	460	537	674	841	990	1157	1376
Urbanization										
Central city	171	818	38	483	537	674	793	966	1098	1253
Suburban	310	799	18	394	486	578	770	987	1129	1229
Nonmetropolitan	166	798	29	418	482	605	752	925	1186	1437

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-105. Calcium: mean intake in milligrams per 1000 kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	572	9	345	391	459	554	657	779	881
Age										
1-2 years	224	622	18	372	404	492	602	721	869	967
3-5 years	423	545	8	329	383	448	528	623	716	796
Race 2/										
White	559	582	9	347	393	476	567	667	789	872
Black	53	460	15	*	*	407	456	500	*	*
Other	26	606	53	*	*	*	522	*	*	*
Poverty status 2/										
< 100	140	555	18	375	393	433	529	651	748	848
≥ 100	471	574	10	329	385	464	556	663	784	889
< 131	192	564	17	372	391	439	534	649	770	910
≥ 131	419	572	11	323	380	465	556	665	774	860
Education 2/										
< High school	99	538	17	*	391	432	495	593	719	*
High school	252	544	12	309	380	438	527	626	748	821
> High school	295	605	12	329	401	506	597	698	850	910
Region										
Northeast	111	577	18	*	393	458	570	653	850	*
Midwest	199	602	14	351	403	510	599	680	796	883
South	187	520	14	303	366	425	505	608	702	749
West	150	604	21	380	420	490	569	697	849	957
Urbanization										
Central city	171	567	25	376	401	456	534	644	742	910
Suburban	310	579	12	307	385	459	572	674	813	889
Nonmetropolitan	166	561	12	354	383	462	538	653	757	834

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-106. Calcium: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

Sex and age (years)	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	885	13	755	16	770	11	843	23
3-5	921	12	759	13	818	8	828	18
6-11	1,093	18	936	12	1,029	19	-	-
Male								
12-15	1,309	37	1,146	22	1,202	41	-	-
16-19	1,310	55	1,144	26	1,370	56	-	-
20-29[1]	1,115	46	909	18	1,096	40	1,067	65
30-39[1]	917	43	819	19	889	35	853	42
40-49[1]	887	42	749	19	830	36	847	59
50-59	784	31	757	16	832	38	-	-
60-69	763	15	708	16	755	12	-	-
70+[2]	693	12	708	20	664	19	-	-
Female								
12-15	940	31	849	15	854	32	-	-
16-19	744	33	716	16	725	35	-	-
20-29	685	12	628	11	662	21	691	20
30-39	605	12	567	11	595	24	656	20
40-49	604	16	532	10	596	27	600	19
50-59	582	22	555	10	569	28	-	-
60-69	559	11	555	9	552	9	-	-
70+[2]	537	11	555	11	546	14	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

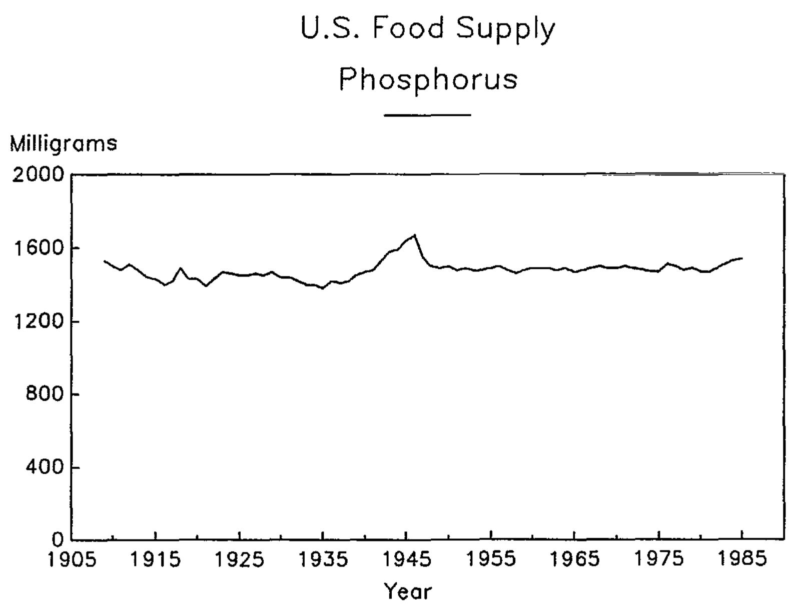


Figure II–41. Phosphorus: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

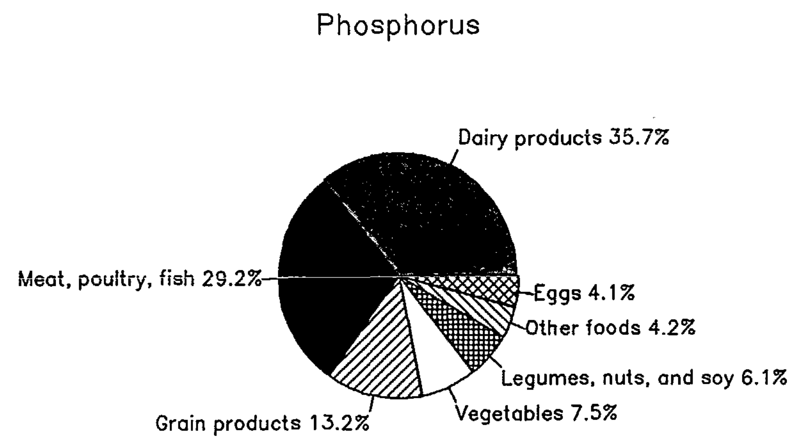


Figure II–42. Phosphorus: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include fats and oils; fruits; sugars and sweeteners; and miscellaneous foods)

Table II-107. Phosphorus: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	975	13	469	548	722	909	1172	1437	1634
Age										
20-29 years	661	1019	18	485	590	745	939	1248	1575	1854
30-39 years	812	963	18	457	534	716	908	1178	1420	1600
40-49 years	583	915	19	457	556	712	873	1096	1331	1461
Race 1/										
White	1775	1002	14	497	570	745	932	1197	1459	1679
Black	167	794	28	350	416	579	774	956	1251	1333
Other	76	894	45	*	*	689	822	1109	*	*
Poverty status 1/										
< 100	315	879	23	380	453	625	823	1105	1290	1425
≥ 100	1575	995	13	492	576	744	927	1189	1449	1635
< 131	414	882	24	371	452	636	842	1107	1313	1455
≥ 131	1476	1003	13	506	583	751	929	1194	1453	1651
Education 1/										
< High school	305	813	23	350	418	582	765	986	1255	1367
High school	854	955	16	469	547	710	874	1146	1420	1561
> High school	891	1045	16	534	632	798	980	1232	1553	1738
Region										
Northeast	448	932	26	475	547	692	874	1113	1355	1582
Midwest	564	1022	25	509	582	747	939	1250	1545	1718
South	660	931	23	424	505	695	875	1104	1393	1558
West	384	1030	24	498	590	782	969	1249	1497	1692
Urbanization										
Central city	499	1000	25	448	565	734	917	1215	1497	1738
Suburban	1039	968	19	480	547	729	910	1166	1435	1611
Nonmetropolitan	518	954	20	441	529	702	890	1133	1396	1558

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-108. Phosphorus: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1010	16	616	684	814	980	1162	1392	1498
Age										
1-2 years	224	963	21	577	664	799	947	1119	1315	1376
3-5 years	423	1036	20	633	695	827	1006	1192	1436	1547
Race 2/										
White	559	1025	16	631	695	820	998	1189	1394	1520
Black	53	930	51	*	*	763	954	1066	*	*
Other	26	915	42	*	*	*	912	*	*	*
Poverty status 2/										
< 100	140	992	34	568	667	835	954	1128	1384	1475
≥ 100	471	1016	18	616	695	806	988	1189	1394	1507
< 131	192	988	30	592	667	814	945	1132	1392	1416
≥ 131	419	1020	19	622	695	811	998	1188	1394	1524
Education 2/										
< High school	99	986	33	*	648	817	971	1114	1376	*
High school	252	994	23	621	671	763	941	1147	1394	1475
> High school	295	1030	21	627	697	870	1020	1188	1373	1507
Region										
Northeast	111	1020	33	*	669	795	1016	1191	1394	*
Midwest	199	1044	26	665	720	841	1006	1186	1407	1524
South	187	947	28	568	607	771	926	1076	1281	1465
West	150	1048	36	657	726	877	1017	1188	1402	1507
Urbanization										
Central city	171	1046	36	657	783	870	989	1212	1416	1487
Suburban	310	990	18	596	665	783	980	1141	1318	1464
Nonmetropolitan	166	1013	34	587	648	811	967	1187	1384	1541

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-109. Phosphorus: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	1,005	12	889	14	1,014	13	987	25
3-5	1,100	12	976	13	1,164	10	1,083	21
6-11	1,337	17	1,230	12	1,412	23	-	-
Male								
12-15	1,643	37	1,560	23	1,757	51	-	-
16-19	1,873	58	1,663	28	2,060	70	-	-
20-29[1]	1,775	47	1,534	22	1,911	50	1,703	71
30-39[1]	1,605	47	1,441	22	1,609	44	1,472	59
40-49[1]	1,498	42	1,385	24	1,520	46	1,446	58
50-59	1,336	36	1,358	19	1,435	41	-	-
60-69	1,244	17	1,259	23	1,290	14	-	-
70+[2]	1,096	14	1,178	22	1,133	21	-	-
Female								
12-15	1,204	29	1,178	16	1,246	40	-	-
16-19	1,046	33	1,074	18	1,125	51	-	-
20-29	1,029	13	1,010	12	1,117	38	1,065	21
30-39	970	13	976	13	1,024	28	1,049	22
40-49	974	17	949	13	994	28	972	21
50-59	939	25	965	13	932	30	-	-
60-69	880	12	932	12	894	10	-	-
70+[2]	793	11	890	13	876	16	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

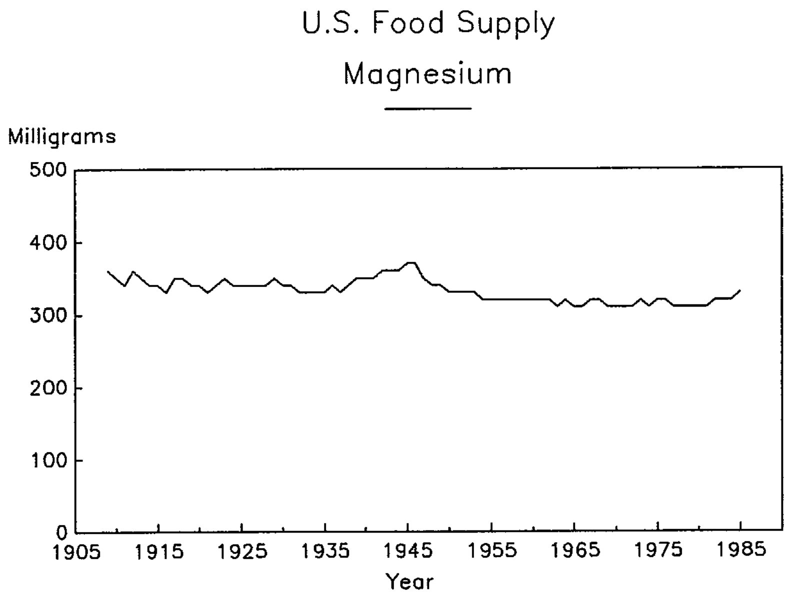


Figure II-43. Magnesium: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

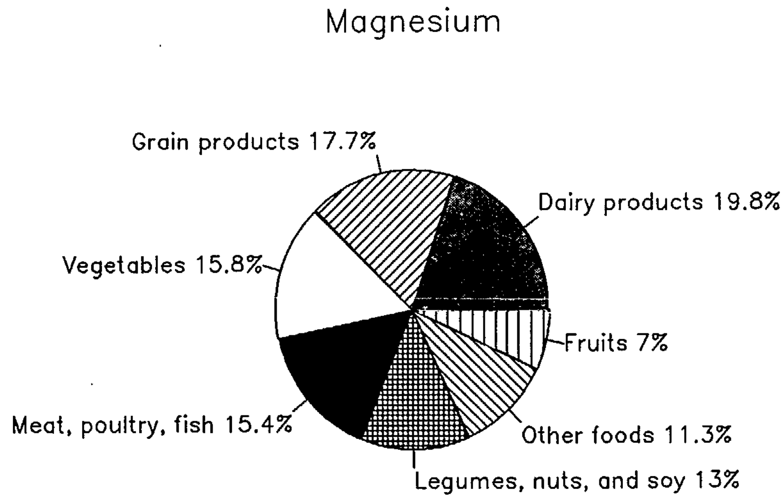


Figure II-44. Magnesium: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; fats and oils; sugars and sweeteners; and miscellaneous foods)

Table II-110. Magnesium: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	207	2.8	99	119	154	199	254	310	346
Age										
20-29 years	661	204	4.0	103	117	150	192	250	314	356
30-39 years	812	210	3.7	96	118	155	200	259	309	346
40-49 years	583	207	4.1	99	123	156	201	244	303	339
Race 1/										
White	1775	213	2.9	106	124	159	205	258	314	351
Black	167	158	6.8	64	85	112	152	185	264	304
Other	76	202	11.9	*	*	139	197	251	*	*
Poverty status 1/										
< 100	315	175	5.4	76	95	125	159	216	268	309
≥ 100	1575	213	2.7	105	124	160	206	260	314	352
< 131	414	177	5.6	76	95	126	166	220	276	313
≥ 131	1476	215	2.6	108	126	161	208	260	315	353
Education 1/										
< High school	305	170	4.5	74	96	124	158	205	265	299
High school	854	197	3.2	95	112	146	191	238	296	331
> High school	891	227	3.2	117	137	171	218	275	335	361
Region										
Northeast	448	199	5.4	105	120	147	185	239	300	330
Midwest	564	212	6.4	101	117	156	203	260	315	356
South	660	196	4.7	86	112	145	182	235	301	346
West	384	225	4.7	112	133	171	222	275	318	351
Urbanization										
Central city	499	211	6.2	98	117	153	199	260	318	356
Suburban	1039	208	4.0	105	123	156	201	254	308	345
Nonmetropolitan	518	198	3.6	91	107	144	193	240	297	333

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-111. Magnesium: mean intake in milligrams per 1000 kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	139	1.0	91	99	115	134	159	189	206
Age										
20-29 years	661	132	1.6	87	95	109	128	147	173	188
30-39 years	812	142	1.6	91	100	115	136	161	196	209
40-49 years	583	147	1.6	97	106	121	140	167	195	220
Race 1/										
White	1775	141	1.1	94	102	117	136	160	190	210
Black	167	119	3.5	78	84	96	110	137	169	177
Other	76	146	6.1	*	*	121	141	172	*	*
Poverty status 1/										
< 100	315	126	2.4	85	90	104	123	144	170	195
≥ 100	1575	141	1.1	92	101	117	136	162	190	206
< 131	414	126	2.1	84	90	104	123	143	169	189
≥ 131	1476	142	1.2	93	102	118	137	163	191	208
Education 1/										
< High school	305	132	2.5	86	92	108	132	151	184	198
High school	854	133	1.3	89	96	109	129	153	183	202
> High school	891	146	1.3	97	108	122	142	165	195	218
Region										
Northeast	448	139	1.9	92	101	116	137	158	184	199
Midwest	564	137	2.7	90	97	113	132	156	190	202
South	660	134	1.7	85	94	110	129	152	183	205
West	384	148	2.1	102	107	124	145	168	202	220
Urbanization										
Central city	499	140	1.9	91	99	116	135	158	182	209
Suburban	1039	140	1.5	91	101	116	136	163	190	205
Nonmetropolitan	518	135	2.2	89	96	110	130	152	188	214

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-112. Magnesium: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	194	3.5	108	130	156	190	229	267	298
Age										
1-2 years	224	186	4.5	107	130	154	185	213	245	264
3-5 years	423	199	4.4	109	130	158	193	237	276	310
Race 2/										
White	559	198	3.2	113	132	158	193	233	270	298
Black	53	177	12.8	*	*	143	167	202	*	*
Other	26	176	11.4	*	*	*	181	*	*	*
Poverty status 2/										
< 100	140	185	11.4	95	118	147	180	212	267	302
≥ 100	471	198	3.4	114	135	158	194	231	267	297
< 131	192	185	9.1	105	118	142	177	216	266	314
≥ 131	419	199	3.3	114	141	160	197	231	268	296
Education 2/										
< High school	99	178	6.4	*	124	146	172	202	247	*
High school	252	189	5.6	112	125	150	179	214	271	309
> High school	295	204	4.4	107	144	165	203	237	268	293
Region										
Northeast	111	196	7.6	*	130	163	193	214	273	*
Midwest	199	193	4.8	110	134	157	189	228	259	274
South	187	181	5.9	101	121	147	175	217	244	274
West	150	211	8.5	130	142	173	203	249	281	322
Urbanization										
Central city	171	209	9.2	124	141	164	202	250	302	323
Suburban	310	191	3.3	107	131	155	189	226	250	272
Nonmetropolitan	166	184	7.1	107	121	149	179	210	263	282

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-113. Magnesium: mean intake in milligrams per 1000 kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	137	1.6	98	106	120	135	154	171	182
Age										
1-2 years	224	143	2.1	102	114	126	141	162	179	192
3-5 years	423	134	1.7	97	104	115	133	149	167	178
Race 2/										
White	559	139	1.5	102	107	122	137	154	171	180
Black	53	126	6.3	*	*	108	127	140	*	*
Other	26	145	7.5	*	*	*	152	*	*	*
Poverty status 2/										
< 100	140	133	4.5	87	98	114	128	154	168	178
≥ 100	471	139	1.4	101	108	122	137	154	172	184
< 131	192	133	3.4	89	104	114	131	154	167	173
≥ 131	419	139	1.6	101	108	123	138	154	175	184
Education 2/										
< High school	99	127	3.4	*	93	113	126	146	160	*
High school	252	133	2.2	97	105	116	128	149	167	176
> High school	295	144	2.1	102	110	127	141	156	179	191
Region										
Northeast	111	136	3.3	*	106	122	137	153	166	*
Midwest	199	136	2.8	103	108	118	134	154	168	176
South	187	131	2.6	93	101	113	128	146	166	173
West	150	148	3.0	103	114	127	149	164	184	193
Urbanization										
Central city	171	141	3.1	103	110	126	139	157	173	184
Suburban	310	138	2.2	97	105	121	136	154	176	187
Nonmetropolitan	166	129	2.8	96	104	113	124	144	163	170

1/ Excludes two breastfed children.

2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-114. Sodium: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	2372	25	1061	1338	1748	2252	2862	3518	3971
Age										
20-29 years	661	2483	41	1083	1361	1827	2407	3022	3742	4228
30-39 years	812	2293	34	1051	1303	1716	2190	2811	3429	3850
40-49 years	583	2283	49	1034	1354	1740	2178	2738	3381	3710
Race 1/										
White	1775	2386	26	1119	1366	1791	2263	2862	3504	3931
Black	167	2209	82	914	1102	1542	2073	2708	3236	3804
Other	76	2502	175	*	*	1717	2425	3326	*	*
Poverty status 1/										
< 100	315	2291	66	938	1129	1576	2124	2908	3564	4138
≥ 100	1575	2396	26	1121	1379	1803	2279	2872	3501	3907
< 131	414	2301	61	938	1131	1602	2218	2914	3564	3947
≥ 131	1476	2400	28	1165	1391	1806	2275	2860	3502	3925
Education 1/										
< High school	305	2078	64	800	1033	1377	1969	2696	3296	3704
High school	854	2376	38	1099	1361	1805	2263	2862	3511	3846
> High school	891	2459	38	1237	1456	1814	2321	2922	3632	4180
Region										
Northeast	448	2257	52	1107	1312	1723	2140	2700	3239	3641
Midwest	564	2526	46	1118	1453	1855	2384	3079	3714	4208
South	660	2304	41	1021	1294	1706	2236	2767	3464	3839
West	384	2414	59	1029	1356	1781	2229	2901	3571	4242
Urbanization										
Central city	499	2418	49	1102	1390	1740	2235	2962	3632	4242
Suburban	1039	2345	38	1098	1320	1740	2257	2818	3467	3865
Nonmetropolitan	518	2367	38	1008	1286	1788	2263	2853	3532	3909

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-115. Sodium: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	2036	34	1192	1289	1608	1945	2406	2883	3102
Age										
1-2 years	224	1858	44	1096	1201	1519	1792	2153	2643	2943
3-5 years	423	2133	40	1233	1391	1682	2021	2511	2990	3362
Race 2/										
White	559	2037	37	1192	1258	1604	1936	2410	2890	3120
Black	53	2135	79	*	*	1688	2016	2450	*	*
Other	26	1885	86	*	*	*	1880	*	*	*
Poverty status 2/										
< 100	140	2077	87	1184	1312	1576	1968	2426	2933	3096
≥ 100	471	2026	37	1188	1305	1609	1928	2393	2883	3102
< 131	192	2042	68	1221	1329	1590	1963	2387	2922	3067
≥ 131	419	2035	39	1158	1258	1611	1932	2412	2890	3112
Education 2/										
< High school	99	2101	84	*	1305	1590	2028	2471	2999	*
High school	252	2067	48	1201	1278	1631	1968	2424	3007	3174
> High school	295	1992	47	1147	1261	1598	1926	2357	2746	2989
Region										
Northeast	111	2018	66	*	1233	1519	1979	2412	2970	*
Midwest	199	2130	76	1238	1325	1618	2038	2511	2990	3406
South	187	1982	59	1127	1270	1555	1926	2333	2806	3362
West	150	2023	69	1209	1423	1644	1919	2334	2836	3008
Urbanization										
Central city	171	2101	60	1231	1508	1771	2012	2424	2922	3044
Suburban	310	1968	51	1127	1233	1555	1868	2328	2814	3074
Nonmetropolitan	166	2126	59	1235	1312	1604	2005	2465	3007	3528

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-116. Sodium: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

Sex and age (years)	NHANES I 1971-74 Mean	NHANES I 1971-74 SEM	NFCS 1977-78 Mean	NFCS 1977-78 SEM	NHANES II 1976-80 Mean	NHANES II 1976-80 SEM	CSFII 1985-86 Mean	CSFII 1985-86 SEM
Both sexes								
1-2	1,631	26	-	-	1,828	21	1,873	65
3-5	1,925	24	-	-	2,173	18	2,169	51
6-11	2,393	37	-	-	2,716	44	-	-
Male								
12-15	2,923	83	-	-	3,405	96	-	-
16-19	3,219	117	-	-	4,030	135	-	-
20-29[1]	3,123	96	-	-	3,916	107	4,021	209
30-39[1]	2,928	116	-	-	3,550	112	3,604	160
40-49[1]	2,839	103	-	-	3,542	127	3,330	127
50-59	2,515	88	-	-	3,278	105	-	-
60-69	2,381	39	-	-	2,975	38	-	-
70+[2]	2,114	31	-	-	2,804	61	-	-
Female								
12-15	2,094	59	-	-	2,567	77	-	-
16-19	1,812	69	-	-	2,336	80	-	-
20-29	1,928	30	-	-	2,404	58	2,593	50
30-39	1,822	30	-	-	2,354	67	2,491	52
40-49	1,793	39	-	-	2,327	83	2,486	77
50-59	1,713	64	-	-	2,186	71	-	-
60-69	1,548	25	-	-	2,108	27	-	-
70+[2]	1,473	27	-	-	1,903	36	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

Table II-117. Sodium/potassium ratios, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean ration			Ratios at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	1.20	.01	.67	.76	.92	1.14	1.40	1.69	1.90
Age										
20-29 years	661	1.26	.02	.73	.81	.99	1.22	1.49	1.79	1.95
30-39 years	812	1.15	.02	.67	.76	.90	1.09	1.34	1.62	1.81
40-49 years	583	1.14	.02	.60	.73	.90	1.09	1.32	1.67	1.90
Race 1/										
White	1775	1.16	.01	.64	.75	.91	1.11	1.35	1.64	1.83
Black	167	1.44	.05	.84	.90	1.19	1.41	1.64	2.00	2.23
Other	76	1.33	.06	*	*	1.00	1.26	1.68	*	*
Poverty status 1/										
< 100	315	1.35	.04	.70	.80	1.01	1.31	1.64	1.90	2.09
≥ 100	1575	1.17	.01	.66	.76	.91	1.10	1.36	1.63	1.82
< 131	414	1.33	.03	.70	.80	1.01	1.29	1.59	1.90	2.06
≥ 131	1476	1.16	.01	.65	.76	.91	1.09	1.34	1.62	1.81
Education 1/										
< High school	305	1.28	.04	.56	.76	.94	1.24	1.57	1.88	2.04
High school	854	1.23	.02	.70	.79	.95	1.17	1.44	1.74	1.90
> High school	891	1.14	.01	.65	.75	.89	1.09	1.32	1.54	1.77
Region										
Northeast	448	1.17	.02	.67	.76	.93	1.13	1.36	1.62	1.77
Midwest	564	1.22	.03	.67	.77	.93	1.18	1.41	1.74	1.91
South	660	1.24	.02	.70	.79	.95	1.17	1.45	1.80	1.94
West	384	1.12	.02	.60	.72	.89	1.05	1.29	1.57	1.74
Urbanization										
Central city	499	1.21	.03	.65	.79	.94	1.17	1.43	1.71	1.90
Suburban	1039	1.17	.02	.64	.75	.91	1.11	1.36	1.65	1.86
Nonmetropolitan	518	1.24	.03	.71	.78	.93	1.16	1.46	1.80	1.93

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-118. Sodium/potassium ratios, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean ratio			Ratios at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1.10	.02	.66	.72	.86	1.07	1.28	1.54	1.69
Age										
1-2 years	224	1.03	.03	.58	.66	.76	.98	1.24	1.54	1.61
3-5 years	423	1.14	.02	.70	.78	.91	1.11	1.29	1.54	1.70
Race 2/										
White	559	1.07	.02	.65	.71	.84	1.05	1.25	1.46	1.61
Black	53	1.36	.06	*	*	1.06	1.32	1.53	*	*
Other	26	1.15	.08	*	*	*	1.14	*	*	*
Poverty status 2/										
< 100	140	1.20	.04	.71	.82	1.02	1.16	1.36	1.69	1.80
≥ 100	471	1.06	.02	.65	.70	.82	1.03	1.25	1.52	1.63
< 131	192	1.18	.04	.68	.80	1.00	1.17	1.37	1.58	1.77
≥ 131	419	1.05	.02	.65	.70	.82	1.00	1.24	1.49	1.64
Education 2/										
< High school	99	1.25	.05	*	.82	.97	1.24	1.41	1.77	*
High school	252	1.13	.02	.73	.76	.95	1.10	1.28	1.53	1.61
> High school	295	1.02	.03	.60	.68	.80	.98	1.20	1.45	1.59
Region										
Northeast	111	1.09	.05	*	.71	.87	1.11	1.32	1.47	*
Midwest	199	1.12	.03	.67	.76	.86	1.08	1.28	1.56	1.77
South	187	1.14	.04	.65	.72	.89	1.10	1.31	1.58	1.70
West	150	1.03	.03	.67	.70	.81	.98	1.22	1.46	1.61
Urbanization										
Central city	171	1.08	.02	.73	.75	.87	1.05	1.25	1.43	1.58
Suburban	310	1.08	.03	.60	.67	.82	1.07	1.28	1.55	1.70
Nonmetropolitan	166	1.17	.03	.76	.82	.92	1.15	1.33	1.55	1.77

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-119. Hypertension among persons 20-74 years of age by sex, specified Hispanic origin, and age: Hispanic Health and Nutrition Examination Survey, 1982-84

Sex, Hispanic origin, and age	Male			Female 1/		
	Number of examined persons 2/	Percent with hypertension	Standard error of the percent	Number of examined persons 2/	Percent with hypertension	Standard error of the percent
Mexican American						
20-74 years..................	1,426	17.6	1.1	1,754	15.5	0.8
20-74 years, age adjusted....	...	23.9	...	...	20.4	...
20-29 years..................	431	6.9	1.5	502	2.0	0.6
30-39 years..................	364	12.2	2.0	429	6.6	1.2
40-49 years..................	240	18.8	2.5	307	14.3	1.8
50-59 years..................	231	38.5	2.8	313	34.1	2.3
60-69 years..................	121	53.8	4.3	141	55.8	3.8
70-74 years..................	39	*65.2	7.6	62	70.4	5.4
Cuban						
20-74 years..................	370	23.9	2.4	478	16.0	1.8
20-74 years, age adjusted....	...	20.7	...	...	14.4	...
20-29 years..................	55	2.0	2.4	65	.0	0.0
30-39 years..................	56	7.5	4.4	94	2.2	1.8
40-49 years..................	82	28.1	5.4	102	10.1	3.2
50-59 years..................	107	36.8	4.6	113	23.0	3.9
60-69 years..................	42	*43.0	7.6	72	45.7	5.7
70-74 years..................	28	*53.0	9.4	32	*55.9	8.6
Puerto Rican						
20-74 years..................	436	17.1	2.0	749	12.5	1.3
20-74 years, age adjusted....	...	21.4	...	...	19.2	...
20-29 years..................	112	3.7	2.2	191	.5	0.6
30-39 years..................	90	5.5	3.0	167	2.4	1.4
40-49 years..................	87	24.9	5.2	170	15.7	2.9
50-59 years..................	99	38.9	4.4	131	37.1	3.7
60-69 years..................	37	*53.0	7.9	76	48.2	4.9
70-74 years..................	11	*	*	14	*	*

1/ Excludes pregnant women.

2/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

Table II-120. Hypertension among Mexican-American persons 20-74 years of age by sex, poverty status, and age: Hispanic Health and Nutrition Examination Survey, 1982-84

Poverty status and age	Male			Female 1/		
	Number of examined persons 2/	Percent with hypertension	Standard error of the percent	Number of examined persons 2/	Percent with hypertension	Standard error of the percent
Below poverty						
20-74 years..................	319	19.6	2.5	534	19.7	1.7
20-74 years, age adjusted....	...	24.5	...	...	22.3	...
20-29 years..................	99	5.3	2.9	146	2.0	1.2
30-39 years..................	69	13.4	4.8	120	6.6	2.3
40-49 years..................	47	12.5	4.7	89	18.2	3.7
50-59 years..................	50	46.9	6.2	96	41.1	4.4
60-69 years..................	40	*51.3	7.8	46	56.9	6.9
70-74 years..................	14	*	*	37	*70.7	7.2
Above poverty						
20-74 years..................	988	16.5	1.3	1,057	13.9	1.0
20-74 years, age adjusted....	...	23.4	...	...	20.7	...
20-29 years..................	294	6.8	1.8	320	2.3	0.9
30-39 years..................	275	11.4	2.2	277	6.9	1.5
40-49 years..................	171	19.6	3.0	184	13.9	2.3
50-59 years..................	158	35.8	3.4	181	33.5	2.9
60-69 years..................	69	56.3	5.5	77	53.9	5.1
70-74 years..................	21	*	*	18	*	*

1/ Excludes pregnant women.

2/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

Table II-121. Hypertension among persons 20-74 years of age by sex, race, and age: Second National Health and Nutrition Examination Survey, 1976-80

Race and age	Male			Female 1/		
	Number of examined persons 2/	Percent with hypertension	Standard error of the percent	Number of examined persons 2/	Percent with hypertension	Standard error of the percent
Non-Hispanic white						
20-74 years..................	4,575	34.2	0.9	4,973	27.4	0.8
20-74 years, age adjusted....	...	33.8	...	...	25.2	...
20-29 years..................	998	17.2	1.7	994	2.9	0.8
30-39 years..................	699	25.6	2.4	764	10.6	1.6
40-49 years..................	564	34.3	3.0	598	25.9	2.6
50-59 years..................	563	49.3	3.1	635	44.6	2.9
60-69 years..................	1,331	54.6	1.2	1,463	57.6	1.2
70-74 years..................	420	59.9	2.1	519	68.1	1.9
Non-Hispanic black						
20-74 years..................	580	40.3	2.5	692	41.8	2.4
20-74 years, age adjusted....	...	41.6	...	...	43.8	...
20-29 years..................	154	17.0	4.1	169	13.8	3.9
30-39 years..................	91	31.7	7.1	107	24.7	6.1
40-49 years..................	60	51.6	10.2	87	57.5	7.4
50-59 years..................	77	58.8	7.9	101	69.8	6.4
60-69 years..................	144	69.3	3.2	166	79.4	2.6
70-74 years..................	54	66.7	5.3	62	78.3	4.4

1/ Excludes pregnant women.

2/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

Table II-122. Hypertension among non-Hispanic persons 20-74 years of age by sex, poverty status, and age: Second National Health and Nutrition Examination Survey, 1976-80

Poverty status and age	Male: Number of examined persons 2/	Male: Percent with hypertension	Male: Standard error of the percent	Female 1/: Number of examined persons 2/	Female 1/: Percent with hypertension	Female 1/: Standard error of the percent
Below poverty						
20-74 years..................	522	36.3	2.6	834	32.5	2.1
20-74 years, age adjusted....	...	38.5	...	...	32.5	...
20-29 years..................	142	12.7	4.1	204	6.3	2.5
30-39 years..................	65	34.2	8.9	119	20.1	5.5
40-49 years..................	34	*40.0	13.4	68	32.5	8.5
50-59 years..................	49	66.1	9.8	79	54.7	8.3
60-69 years..................	148	57.8	3.6	245	67.5	2.7
70-74 years..................	84	60.8	4.8	119	73.2	3.7
Above poverty						
20-74 years..................	4,527	34.4	0.9	4,696	28.2	0.8
20-74 years, age adjusted....	...	34.2	...	...	26.5	...
20-29 years..................	996	17.5	1.7	959	4.5	0.9
30-39 years..................	719	25.3	2.4	743	11.2	1.6
40-49 years..................	572	36.0	3.0	606	29.0	2.7
50-59 years..................	565	48.8	3.1	632	45.2	2.9
60-69 years..................	1,296	55.9	1.2	1,320	58.8	1.2
70-74 years..................	379	60.5	2.2	436	68.6	2.0

1/ Excludes pregnant women.

2/ Includes persons for whom usable measurements for the criteria variable were obtained. The criteria variable is discussed in the table notes.

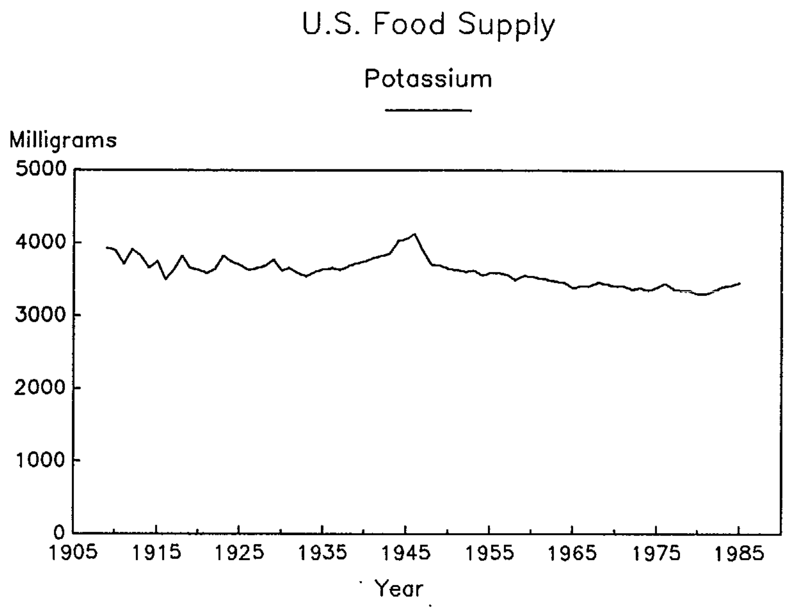


Figure II–45. Potassium: per capita amount per day in the U.S. food supply, 1909–85: U.S. Food Supply Series

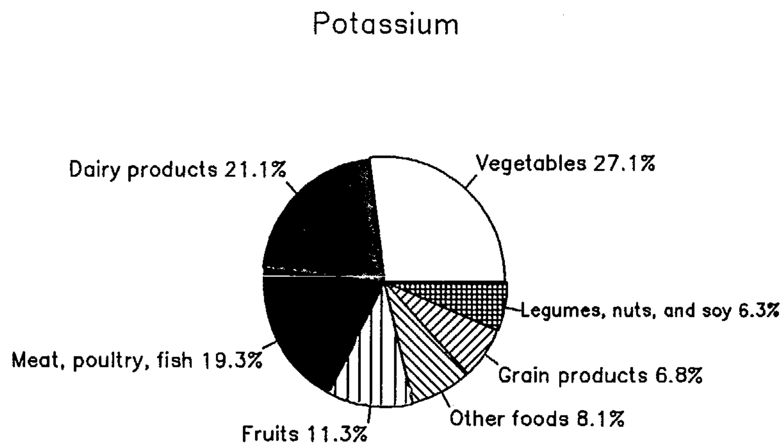


Figure II–46. Potassium: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; fats and oils; sugars and sweeteners; and miscellaneous foods)

Table II-123. Potassium: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles					
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	2073	25	996	1205	1542	1998	2515	3055	3457
Age										
20-29 years	661	2045	38	1031	1154	1448	1955	2462	3094	3586
30-39 years	812	2086	36	971	1224	1579	2012	2553	2998	3306
40-49 years	583	2105	40	995	1259	1600	2056	2491	3073	3388
Race 1/										
White	1775	2139	27	1070	1294	1623	2081	2553	3094	3477
Black	167	1589	69	678	807	1170	1523	1917	2553	2807
Other	76	1903	82	*	*	1378	1931	2388	*	*
Poverty status 1/										
< 100	315	1782	56	813	962	1234	1646	2234	2834	3082
≥ 100	1575	2138	25	1089	1294	1630	2082	2553	3094	3471
< 131	414	1805	57	759	965	1276	1676	2260	2792	3123
≥ 131	1476	2157	25	1103	1315	1643	2103	2569	3103	3477
Education 1/										
< High school	305	1685	46	734	926	1223	1581	2058	2621	2988
High school	854	2019	35	970	1190	1518	1940	2443	2978	3281
> High school	891	2241	31	1219	1358	1728	2163	2654	3243	3620
Region										
Northeast	448	2008	47	1085	1235	1464	1943	2402	2975	3303
Midwest	564	2170	62	1007	1211	1614	2125	2663	3249	3606
South	660	1963	43	853	1097	1448	1872	2361	2912	3353
West	384	2196	43	1152	1358	1668	2207	2632	3082	3428
Urbanization										
Central city	499	2096	54	995	1171	1503	1982	2537	3094	3606
Suburban	1039	2078	37	1049	1267	1589	2033	2489	3030	3406
Nonmetropolitan	518	2015	37	956	1124	1472	1943	2505	2944	3366

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-124. Potassium: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	1936	32	1133	1265	1522	1863	2305	2728	2947
Age										
1-2 years	224	1913	52	1074	1258	1522	1835	2344	2648	2899
3-5 years	423	1949	42	1141	1274	1526	1881	2295	2738	3059
Race 2/										
White	559	1983	32	1176	1291	1537	1933	2364	2777	2992
Black	53	1642	85	*	*	1295	1587	1917	*	*
Other	26	1735	120	*	*	*	1663	*	*	*
Poverty status 2/										
< 100	140	1800	87	1032	1229	1354	1713	2173	2638	2793
≥ 100	471	1989	35	1194	1314	1566	1933	2364	2777	2976
< 131	192	1798	70	1032	1244	1360	1716	2142	2631	2793
≥ 131	419	2013	36	1194	1352	1587	1973	2377	2834	3059
Education 2/										
< High school	99	1754	62	*	1195	1426	1678	2061	2442	*
High school	252	1882	48	1141	1248	1474	1720	2290	2721	2964
> High school	295	2033	40	1194	1308	1644	2031	2370	2834	2947
Region										
Northeast	111	1925	75	*	1229	1482	1859	2292	2738	*
Midwest	199	1958	44	1256	1335	1605	1915	2256	2590	3010
South	187	1834	62	1032	1210	1362	1653	2268	2743	2932
West	150	2051	78	1223	1426	1617	2061	2436	2770	2854
Urbanization										
Central city	171	2040	75	1223	1417	1602	1940	2436	2793	3135
Suburban	310	1898	37	1058	1275	1488	1845	2272	2668	2899
Nonmetropolitan	166	1895	72	1124	1246	1452	1863	2221	2728	3090

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-125. Potassium: mean intake in milligrams, by sex and age, 1 day: National Health and Nutrition Examination Survey (NHANES I), 1971-74; Nationwide Food Consumption Survey (NFCS), 1977-78; Second National Health and Nutrition Examination Survey (NHANES II), 1976-80; and Continuing Survey of Food Intakes by Individuals (CSFII), 1985-86

	NHANES I 1971-74		NFCS 1977-78		NHANES II 1976-80		CSFII 1985-86	
Sex and age (years)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Both sexes								
1-2	1,720	21	-	-	1,732	18	1,914	51
3-5	1,937	21	-	-	1,912	14	1,991	41
6-11	2,334	32	-	-	2,365	35	-	-
Male								
12-15	2,915	72	-	-	2,940	79	-	-
16-19	3,287	108	-	-	3,510	114	-	-
20-29[1]	3,131	83	-	-	3,340	81	3,308	138
30-39[1]	2,897	90	-	-	3,026	74	3,209	113
40-49[1]	2,778	80	-	-	2,963	81	3,287	136
50-59	2,557	65	-	-	2,765	74	-	-
60-69	2,398	31	-	-	2,560	27	-	-
70+[2]	2,146	29	-	-	2,291	43	-	-
Female								
12-15	2,181	53	-	-	2,121	55	-	-
16-19	1,956	64	-	-	1,952	64	-	-
20-29	1,956	25	-	-	2,055	44	2,143	43
30-39	1,929	26	-	-	2,076	51	2,260	46
40-49	1,957	34	-	-	2,096	57	2,210	47
50-59	1,980	50	-	-	1,993	58	-	-
60-69	1,870	25	-	-	1,998	20	-	-
70+[2]	1,683	22	-	-	1,973	34	-	-

[1] CSFII data for 1985 only.

[2] Ages 70-74 years only for NHANES I and NHANES II.

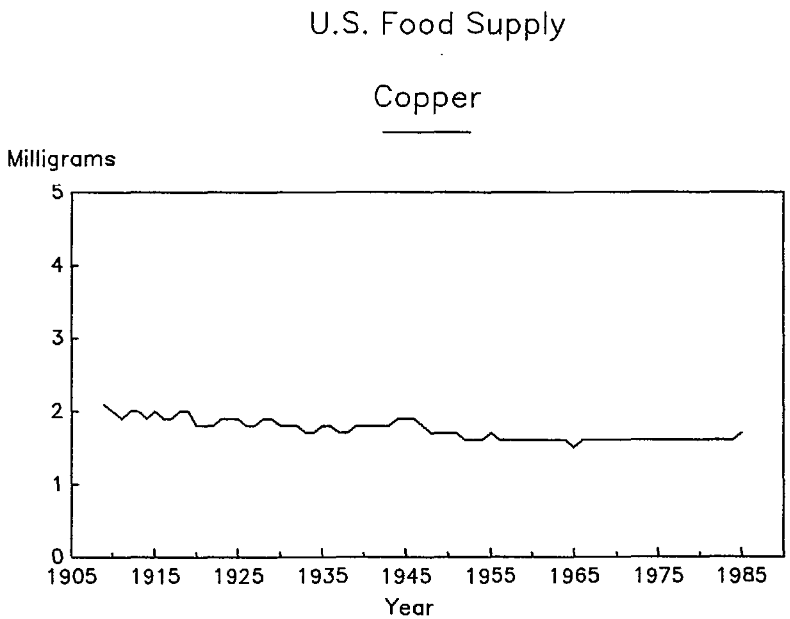


Figure II-47. Copper: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

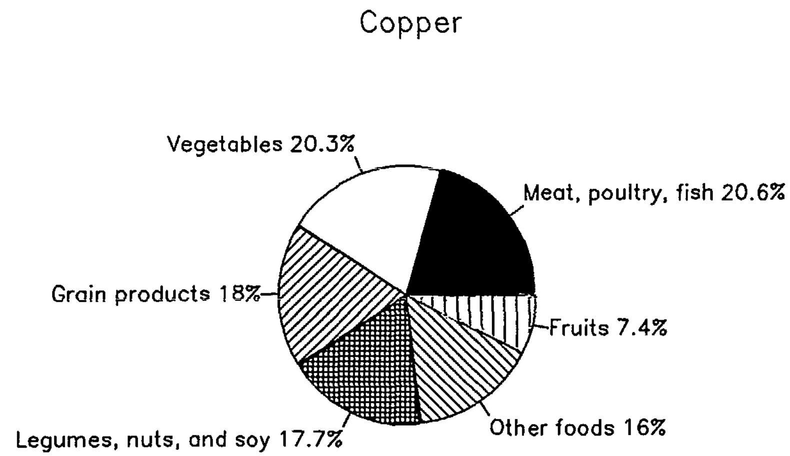


Figure II-48. Copper: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include dairy products; eggs; fats and oils; sugars and sweeteners; and miscellaneous foods)

Table II-126. Copper: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

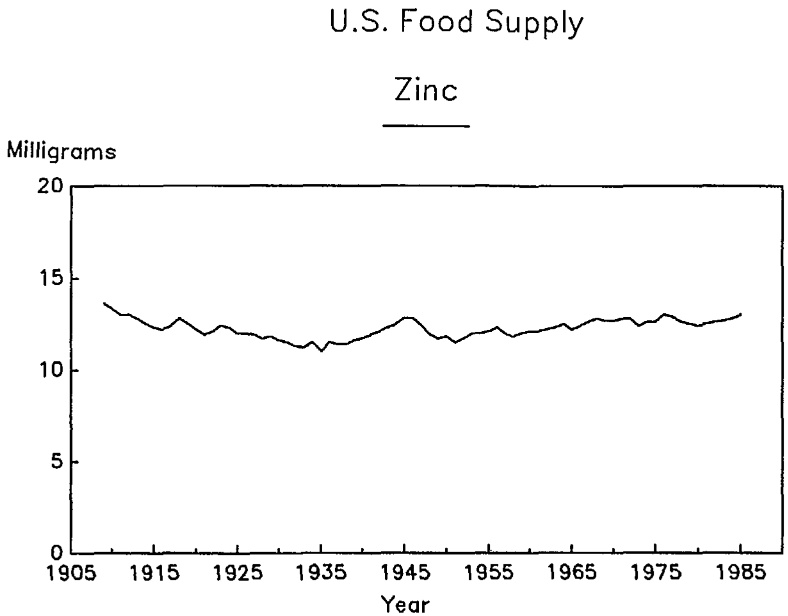
Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	1.0	.01	.5	.6	.7	.9	1.2	1.5	1.7
Age										
20-29 years	661	1.0	.02	.5	.6	.7	.9	1.1	1.5	1.7
30-39 years	812	1.0	.02	.5	.6	.7	.9	1.2	1.5	1.7
40-49 years	583	1.0	.03	.5	.6	.8	.9	1.2	1.4	1.6
Race 1/										
White	1775	1.0	.02	.5	.6	.8	.9	1.2	1.5	1.6
Black	167	.9	.03	.3	.4	.6	.8	1.0	1.4	1.9
Other	76	1.0	.07	*	*	.7	.9	1.3	*	*
Poverty status 1/										
< 100	315	.9	.03	.4	.4	.6	.8	1.0	1.4	1.7
≥ 100	1575	1.0	.01	.5	.6	.8	1.0	1.2	1.5	1.6
< 131	414	.9	.03	.4	.5	.6	.8	1.1	1.4	1.6
≥ 131	1476	1.0	.01	.5	.6	.8	1.0	1.2	1.5	1.6
Education 1/										
< High school	305	.8	.03	.4	.4	.6	.8	1.0	1.3	1.5
High school	854	1.0	.02	.5	.6	.7	.9	1.1	1.4	1.6
> High school	891	1.1	.02	.6	.7	.8	1.0	1.3	1.6	1.8
Region										
Northeast	448	1.0	.03	.5	.6	.7	.9	1.1	1.4	1.6
Midwest	564	1.0	.03	.5	.6	.8	1.0	1.2	1.5	1.8
South	660	1.0	.03	.4	.5	.7	.9	1.1	1.5	1.6
West	384	1.0	.02	.5	.6	.8	1.0	1.2	1.5	1.7
Urbanization										
Central city	499	1.0	.03	.5	.6	.7	.9	1.2	1.6	1.9
Suburban	1039	1.0	.02	.5	.6	.7	.9	1.2	1.4	1.6
Nonmetropolitan	518	1.0	.03	.5	.5	.7	.9	1.1	1.4	1.7

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-127. Copper: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	.8	.02	.4	.5	.6	.8	.9	1.1	1.2
Age										
1-2 years	224	.7	.02	.4	.5	.6	.7	.8	1.0	1.1
3-5 years	423	.8	.02	.5	.5	.7	.8	.9	1.1	1.3
Race 2/										
White	559	.8	.01	.4	.5	.6	.8	.9	1.1	1.2
Black	53	.9	.05	*	*	.6	.8	1.0	*	*
Other	26	.8	.05	*	*	*	.7	*	*	*
Poverty status 2/										
< 100	140	.8	.04	.4	.5	.6	.7	1.0	1.2	1.3
≥ 100	471	.8	.02	.4	.5	.7	.8	.9	1.1	1.2
< 131	192	.8	.04	.4	.4	.6	.7	.9	1.2	1.3
≥ 131	419	.8	.02	.5	.5	.7	.8	.9	1.1	1.2
Education 2/										
< High school	99	.8	.03	*	.5	.6	.7	.9	1.1	*
High school	252	.8	.02	.4	.5	.6	.8	.9	1.1	1.3
> High school	295	.8	.02	.5	.5	.7	.8	.9	1.1	1.2
Region										
Northeast	111	.8	.03	*	.5	.6	.8	.9	1.1	*
Midwest	199	.8	.02	.4	.5	.6	.7	.9	1.0	1.2
South	187	.8	.03	.4	.5	.6	.7	.9	1.1	1.3
West	150	.8	.03	.5	.6	.7	.8	.9	1.1	1.2
Urbanization										
Central city	171	.8	.03	.5	.5	.7	.8	1.0	1.2	1.3
Suburban	310	.8	.02	.4	.5	.6	.8	.9	1.0	1.1
Nonmetropolitan	166	.8	.03	.4	.5	.6	.7	.9	1.1	1.3

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.



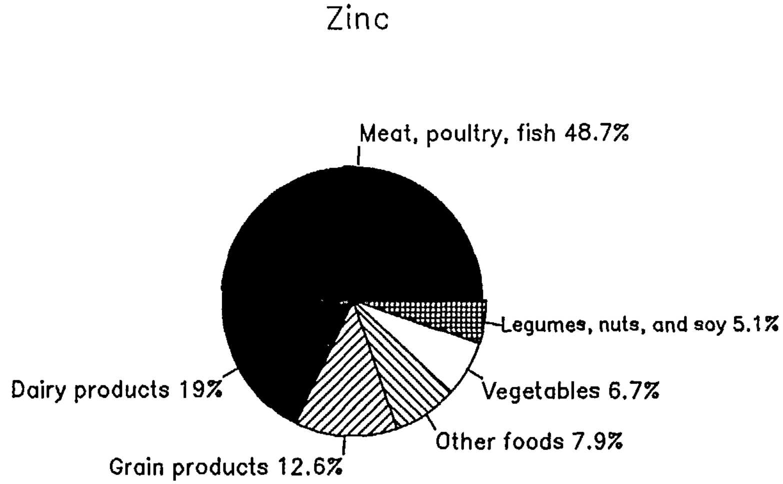


Figure II-49. Zinc: per capita amount per day in the U.S. food supply, 1909-85: U.S. Food Supply Series

Figure II-50. Zinc: food sources in the U.S. food supply, 1985: U.S. Food Supply Series (other foods include eggs; fats and oils; fruits; sugars and sweeteners; and miscellaneous foods)

Table II-128. Zinc: mean intake in milligrams, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	8.7	.10	4.0	4.8	6.4	8.2	10.4	13.0	14.5
Age										
20-29 years	661	8.8	.14	4.0	4.7	6.4	8.4	10.4	13.2	15.1
30-39 years	812	8.8	.18	3.8	4.7	6.3	8.2	10.5	12.8	14.5
40-49 years	583	8.4	.17	4.4	5.0	6.3	7.9	10.1	12.2	13.9
Race 1/										
White	1775	8.8	.11	4.2	5.0	6.5	8.3	10.4	13.1	14.5
Black	167	7.6	.38	2.9	3.9	5.0	6.8	9.6	12.6	14.6
Other	76	8.8	.43	*	*	5.9	8.3	11.2	*	*
Poverty status 1/										
< 100	315	8.1	.22	3.2	4.2	5.5	7.4	10.3	12.2	13.6
≥ 100	1575	8.8	.11	4.2	5.0	6.6	8.3	10.4	13.1	14.5
< 131	414	8.2	.22	3.2	4.2	5.8	7.7	10.3	12.3	13.6
≥ 131	1476	8.8	.11	4.2	5.1	6.6	8.3	10.5	13.1	14.6
Education 1/										
< High school	305	7.7	.23	3.4	4.1	5.3	6.9	9.4	11.9	13.8
High school	854	8.5	.14	3.9	5.0	6.4	8.0	10.2	12.7	14.5
> High school	891	9.1	.14	4.4	5.1	6.8	8.6	10.8	13.4	15.3
Region										
Northeast	448	8.4	.21	4.0	4.9	6.2	7.8	10.0	12.5	14.0
Midwest	564	8.9	.22	4.3	5.3	6.7	8.3	10.8	13.4	14.5
South	660	8.4	.17	3.6	4.4	5.8	8.0	10.1	12.8	14.5
West	384	9.0	.21	4.3	5.1	6.7	8.5	10.6	13.2	15.3
Urbanization										
Central city	499	8.8	.21	4.0	4.7	6.1	8.2	10.6	13.8	15.3
Suburban	1039	8.6	.15	4.0	4.9	6.5	8.2	10.2	12.5	14.4
Nonmetropolitan	518	8.8	.19	4.0	4.8	6.2	8.2	10.5	12.6	13.9

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-129. Zinc: mean intake in milligrams per 1000 kilocalories, women aged 20-49 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

	Mean intake			Intakes at selected percentiles						
Characteristics	n	Mean	SEM	5	10	25	50	75	90	95
All women	2056	5.8	.04	3.6	4.0	4.7	5.6	6.7	7.8	8.8
Age										
20-29 years	661	5.6	.06	3.6	4.0	4.6	5.4	6.4	7.5	8.2
30-39 years	812	5.9	.08	3.5	3.9	4.6	5.5	6.8	8.0	9.2
40-49 years	583	6.0	.09	3.8	4.2	4.9	5.7	6.9	8.0	8.8
Race 1/										
White	1775	5.8	.05	3.6	4.0	4.7	5.6	6.6	7.8	8.8
Black	167	5.6	.15	3.4	3.7	4.6	5.4	6.5	7.6	8.8
Other	76	6.3	.21	*	*	5.0	5.8	7.1	*	*
Poverty status 1/										
< 100	315	5.9	.10	3.6	4.0	4.8	5.5	6.7	7.9	8.9
≥ 100	1575	5.8	.05	3.6	4.0	4.7	5.6	6.7	7.8	8.8
< 131	414	5.8	.09	3.7	4.1	4.8	5.5	6.6	7.8	8.9
≥ 131	1476	5.8	.05	3.6	4.0	4.7	5.6	6.7	7.8	8.7
Education 1/										
< High school	305	6.0	.13	3.6	4.2	4.7	5.8	6.9	8.0	9.7
High school	854	5.7	.06	3.6	4.0	4.7	5.6	6.7	7.8	8.6
> High school	891	5.9	.07	3.6	4.0	4.7	5.5	6.6	7.9	9.1
Region										
Northeast	448	5.9	.08	3.7	4.1	4.9	5.7	6.7	7.8	8.7
Midwest	564	5.8	.09	3.6	4.0	4.7	5.6	6.6	7.7	8.8
South	660	5.7	.08	3.4	3.8	4.4	5.4	6.7	8.0	9.2
West	384	5.9	.08	3.8	4.1	4.9	5.7	6.8	7.8	8.9
Urbanization										
Central city	499	5.8	.06	3.6	4.0	4.8	5.5	6.6	7.8	8.8
Suburban	1039	5.8	.06	3.6	4.0	4.6	5.6	6.7	7.8	8.8
Nonmetropolitan	518	6.0	.12	3.7	4.1	4.8	5.6	6.8	7.9	8.8

1/ Some women did not report race, poverty status, or education. Therefore, the numbers of women in each category do not add to the number of all women.

Table II-130. Zinc: mean intake in milligrams, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	7.6	.14	4.5	5.1	6.1	7.3	8.6	10.6	12.0
Age										
1-2 years	224	6.9	.16	4.2	4.8	5.9	6.6	7.7	8.9	10.2
3-5 years	423	8.0	.17	4.6	5.3	6.3	7.6	9.1	11.2	12.5
Race 2/										
White	559	7.6	.13	4.4	5.1	6.0	7.3	8.6	10.5	12.0
Black	53	7.9	.54	*	*	6.3	7.8	9.5	*	*
Other	26	7.2	.36	*	*	*	6.8	*	*	*
Poverty status 2/										
< 100	140	7.9	.34	4.6	5.1	6.0	7.1	8.9	12.5	13.8
≥ 100	471	7.5	.14	4.6	5.2	6.0	7.3	8.4	10.2	11.4
< 131	192	7.7	.28	4.6	5.1	5.9	6.9	8.9	11.3	13.0
≥ 131	419	7.6	.14	4.5	5.2	6.1	7.4	8.5	10.2	11.4
Education 2/										
< High school	99	8.1	.35	*	5.2	6.1	7.6	9.7	12.5	*
High school	252	7.6	.19	4.2	5.0	6.1	7.3	8.9	10.6	13.0
> High school	295	7.4	.17	4.5	5.2	6.0	7.2	8.3	9.7	11.1
Region										
Northeast	111	7.6	.42	*	4.6	5.8	7.2	8.7	11.2	*
Midwest	199	7.8	.19	5.0	5.3	6.3	7.6	8.7	11.3	12.0
South	187	7.3	.22	4.3	4.8	5.7	6.8	8.3	9.8	11.2
West	150	7.7	.29	4.8	5.9	6.3	7.2	8.8	10.2	13.0
Urbanization										
Central city	171	7.7	.30	4.9	5.4	6.2	7.2	8.8	11.0	11.7
Suburban	310	7.4	.19	4.3	4.8	6.0	7.1	8.4	9.7	12.0
Nonmetropolitan	166	7.9	.19	4.6	5.1	6.1	7.6	9.5	10.8	12.3

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-131. Zinc: mean intake in milligrams per 1000 kilocalories, children aged 1-5 years, 4 nonconsecutive days: Continuing Survey of Food Intakes by Individuals, 1985-86

Characteristics	Mean intake			Intakes at selected percentiles						
	n	Mean	SEM	5	10	25	50	75	90	95
All children 1/	647	5.4	.07	3.7	3.9	4.6	5.2	6.0	6.8	7.4
Age										
1-2 years	224	5.4	.12	3.8	3.9	4.6	5.3	5.9	6.7	7.3
3-5 years	423	5.4	.08	3.7	4.0	4.5	5.2	6.0	6.9	7.4
Race 2/										
White	559	5.3	.08	3.7	3.9	4.5	5.1	5.9	6.7	7.3
Black	53	5.7	.22	*	*	5.0	5.6	6.2	*	*
Other	26	6.2	.47	*	*	*	5.5	*	*	*
Poverty status 2/										
< 100	140	5.6	.14	3.8	4.2	4.8	5.5	6.5	7.4	7.6
≥ 100	471	5.3	.08	3.7	3.9	4.5	5.1	5.9	6.7	7.3
< 131	192	5.5	.12	3.8	4.2	4.7	5.4	6.1	7.2	7.6
≥ 131	419	5.3	.09	3.7	3.9	4.5	5.1	5.9	6.7	7.3
Education 2/										
< High school	99	5.7	.18	*	4.0	4.7	5.7	6.4	7.5	*
High school	252	5.4	.11	3.5	3.9	4.6	5.4	6.3	6.9	7.3
> High school	295	5.2	.10	3.8	4.0	4.5	5.0	5.7	6.4	6.8
Region										
Northeast	111	5.3	.21	*	3.7	4.5	5.2	6.0	6.6	*
Midwest	199	5.5	.14	3.8	4.1	4.7	5.4	6.2	6.9	7.4
South	187	5.3	.11	3.6	4.0	4.4	5.0	5.8	6.7	7.2
West	150	5.5	.13	3.9	4.0	4.6	5.2	6.1	7.3	7.4
Urbanization										
Central city	171	5.3	.14	3.7	3.9	4.4	5.1	5.9	6.7	7.4
Suburban	310	5.4	.11	3.7	3.9	4.6	5.1	6.0	6.8	7.3
Nonmetropolitan	166	5.6	.13	4.0	4.3	4.8	5.3	6.3	7.1	7.5

1/ Excludes two breastfed children.
2/ Race, poverty status, and education were not reported for all children. Therefore, the numbers of children in each category do not add to the number of all children.

Table II-132. Percent[a] of supplement users consuming specific nutrients in 1980 (Stewart et al., 1985)

Rank order	Nutrient	Total population[b] (n = 2,751)	Supplement users[c] (n = 1,090)	Men 16–24 yr (n = 150)	Men 25–64 yr (n = 101)	Men 65 yr & over (n = 103)	Women 16–24 yr (n = 192)	Women 25–64 yr (n = 274)	Women 65 yr & over (n = 270)
		percent							
1	Vitamin C	35.1	90.6	92.0	89.1	94.2[d]	91.2	91.2	88.2[e]
2	Thiamin[f]	30.5	78.3	76.7	75.2	73.8[e]	78.1	83.9[d]	74.1
3	Riboflavin[f]	30.1	77.4	74.7	73.3	71.8[e]	78.1	83.9[d]	73.7
4	Vitamin B12[f]	30.1	77.3	76.7	73.3	70.9[e]	80.2	82.8[d]	72.2
5	Vitamin B6[f]	29.9	76.6	76.7	71.3	70.9[e]	77.6	83.2[d]	73.7
6	Niacin[f]	29.8	76.7	76.7	73.3	71.8[e]	76.6	82.1[d]	72.2
7	Vitamin E	28.3	72.6	71.3	68.3[e]	79.6[d]	70.8	76.6	71.5
8	Vitamin A	25.1	64.5	66.0	60.4[e]	63.1	64.6	68.6[d]	63.0
9	Vitamin D	24.4	62.4	62.0	57.4[e]	58.2	63.5	67.9[d]	61.5
10	Iron[f]	21.9	56.1	54.0	51.5	38.8[e]	65.1[d]	63.9	47.0
11	Pantothenic acid[f]	21.3	55.1	53.3	57.4	49.5	45.3[e]	59.5[d]	49.3
12	Folic acid[f]	20.3	52.3	54.0	49.5	37.9[e]	63.0[d]	55.5	44.4
13	Magnesium[f]	13.7	35.5	36.7	37.6	35.9	22.9[e]	38.7[d]	30.4
14	Zinc[f]	13.5	35.1	42.0[d]	35.6	35.9	27.1[e]	36.1	30.0
15	Calcium	13.5	34.9	30.0	37.6	32.0	27.1[e]	38.3[d]	31.1
16	Iodine[f]	12.9	33.8	40.7[d]	37.6	29.1	24.0[e]	33.6	28.1
17	Copper[f]	12.2	31.8	36.7[d]	35.6	30.1	22.4[e]	31.0	28.1
18	Manganese[f]	9.3	24.5	28.7[d]	28.7[d]	22.3	14.6[e]	23.0	23.7
19	Biotin[f]	8.5	22.4	24.0	26.7[d]	11.7[e]	18.8	23.0	14.8
20	Phosphorus	8.4	21.8	21.3	23.8[d]	19.4	17.7[e]	23.0	18.2
21	Potassium	4.5	11.8	12.0	12.9	11.6	8.8	13.1[d]	6.3[e]

[a] The percent is based upon total number of supplement users within each sex–age group.
[b] Sex–age groups are weighted proportional to census data and projected to the total U.S. population.
[c] Sex–age groups are weighted proportional to census data.
[d] Highest group percentage for a nutrient.
[e] Lowest group percentage for a nutrient.
[f] Statistically significant differences among groups.

Table II-133. Median and 95th percentile levels[a] of intake from supplements (measured in percent of RDA[b]) for individual nutrients in 1980 (Stewart et al., 1985)

Rank order	Nutrient	All specific nutrient users[c]		Men 16-24 yr		Men 25-64 yr		Men 65 yr & over		Women 16-24 yr		Women 25-64 yr		Women 65 yr & over	
		Median	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	95th Percentile
1	Thiamin	550	6,000	629	6,786	714	7,983	833[f]	6,250	150[g]	4,614	700	5,857	636	2,500
2	Riboflavin	420	5,000	345	5,882	475	5,572	714[f]	5,357	142[g]	2,876	548	4,654	476	1,688
3	Vitamin C	333	2,810	333	3,445	417[f]	3,542	417[f]	2,704	167[g]	1,798	333	2,500	333	1,837
4	Pantothenic acid[d]	257	1,929	257	2,143	257	3,071	257	1,429	143[g]	747	257	1,907	257	1,038
5	Vitamin E[d]	200	6,000	100[g]	3,668	200	6,367	200	5,333	125	3,358	250[f]	5,094	250[f]	7,250
6	Vitamin B12	200	3,338	200	6,667	200	3,333	200	2,500	200	1,905	200	3,875	200	1,937
7	Vitamin D	200	375	114[g]	256	200	400	200	500	114[g]	200	200	275	200	400
8	Niacin	190	1,200	167	1,067	159	917	316[f]	1,250	143[g]	714	231	1,518	231	837
9	Vitamin B6	143	5,000	200	4,659	136	5,482	227[f]	2,789	100[g]	2,628	200	5,168	200	2,500
10	Vitamin A[d]	125	430	100[g]	500	114	395	160[f]	500	125	367	125	365	125	313
11	Iron	119	500	120	539	180[f]	500	154	500	100[g]	592	100[g]	514	180[f]	578
12	Folic acid[d]	100	200	100	200	100	200	100	196	100	184	100	300	100	150
13	Iodine[d]	100	150	100	149	100	200	100	200	71[g]	100	100	150	100	100
14	Copper[e]	67	100	67	100	57	120	67	335	48[g]	100	67	100	67	100
15	Zinc[e]	50	286	43	178	50	288	67	313	71[f]	206	64	296	33[g]	265
16	Biotin[e]	38	300	50[f]	163	43[h]	183[h]	27[h]	518[h]	25	154	38	450	22[g]	150
17	Magnesium[e]	22	97	16[g]	71	19	79	19	96	17	67	22[f]	97	22[f]	83
18	Manganese[e]	20	150	20	343	22[f,h]	137[h]	20[h]	60[h]	20[h]	147[h]	20	172	20	150
19	Calcium[e]	16	113	13	103	9[g]	105	20	136	11	75	24[f]	111	16	94
20	Phosphorus[e]	14	73	10[g]	67	10[g,h]	83[h]	13[h]	73[h]	12[h]	48	16[f]	71	11	56
21	Potassium[e]	1	3	1[h]	1[h]	1[h]	4[h]	1[h]	2[h]	1[h]	1[h]	1	15	1[h]	21[h]

[a] The median and 95th percentile are calculated upon the basis of users of specific nutrients only.
[b] Pantothenic acid, copper, manganese, biotin, and potassium are reported as percent of the upper ESADDI level.
[c] Sex-age groups are weighted proportional to census data.
[d] All group medians ≥100 percent and ≤200 percent RDA.
[e] All group medians <100 percent RDA.
[f] Highest percent RDA for a particular nutrient.
[g] Lowest percent RDA for a particular nutrient.
[h] Cell n <30.

Appendix III

Glossary of Terms and Acronyms

AEDS: Alcohol Epidemiologic Data System

Anemia: refers a hemoglobin level below the normal reference range for individuals of the same sex and age. This assessment corresponds roughly, but not exactly, to the third stage of iron deficiency because anemia may result from causes other than iron deficiency, including infection, chronic disease, and deficiencies of folacin or vitamin B12.

ARS: Agricultural Research Service, USDA

Atherosclerosis: a progressive process that begins in childhood with the appearance of lesions in the form of fatty streaks in the lining of the coronary arteries or aorta. The fatty streaks may eventually progress to fatty and fibrous plaques or even larger, more complicated lesions. As the lesions develop, the progressive narrowing of the vessels reduces blood flow to the tissues supplied by the affected vessels, resulting in angina pectoris (chest pain), myocardial infarction (heart attack), or sudden death. These are the most common manifestations of coronary heart disease.

BMI: body mass index

BRFSS: Behavioral Risk Factors Surveillance System

Calcium: an essential mineral.

Carbohydrate: source of energy in the diet; contributes approximately 4 kilocalories/gram.

Cardiovascular disease: includes a variety of pathological processes pertaining to the heart and blood vessels.

Carotenes: beta–carotene and other provitamin A carotenoids.

CDC: Centers for Disease Control

Cerebrovascular disease (ICD–9 430–439): includes a group of disorders characterized by ischemic stroke, a serious and sudden decrease of blood supply to the brain, resulting from atherosclerosis. Stroke may also be caused by cerebral hemorrhage.

Cholesterol: fatty substance required for the synthesis of sex hormones, bile acids and vitamin D; found in animal foods and synthesized in the body; carried by lipoproteins in the blood.

Coefficient of variation: (standard deviation divided by the mean) x 100.

Copper: essential mineral.

Coronary (or ischemic) heart disease (ICD–9 410–414): several cardiovascular disorders resulting from inadequate circulation of blood to local areas of the heart muscle, almost always as a consequence of focal narrowing of the coronary arteries by atherosclerosis.

CSFII: Continuing Survey of Food Intakes by Individuals

Depleted iron stores: the condition in which the iron reserves of the body are decreased to a critically low level and are a marker for the first stage in the development of iron deficiency.

DHHS: U.S. Department of Health and Human Services

Dietary fiber: heterogeneous group of plant components that are resistant to digestion by the enzymes of the human gastrointestinal tract; soluble fiber include gums, mucilages, some pectins and hemicelluloses; insoluble fiber include cellulose, lignin, and other pectins and hemicelluloses.

Dietary status: the condition of a population's or an individual's intake of foods and food components, especially nutrients.

dl: deciliter

EPONM: Expert Panel on Nutrition Monitoring

ESADDI: Estimated Safe and Adequate Daily Dietary Intake

ERS: Economics Research Service, USDA

FASEB: Federation of American Societies for Experimental Biology

Fat: energy source in the diet; provides approximately 9 kilocalories per gram.

FDA: Food and Drug Administration

Ferritin model: a model for assessing the prevalence of iron deficiency that requires abnormal values for at least two of the following measurements--serum ferritin level, transferrin saturation, or erythrocyte protoporphyrin level.

fl: femtoliter

FLAPS: Food Label and Package Survey

Fluoride: essential mineral.

Food components: as discussed in this report, they include nutrients (macronutrients, vitamins, and minerals) and non-nutrients that may affect health (such as dietary fiber).

Food energy: chemical energy obtained from foods that supports body functions.

Folacin: water-soluble vitamin.

Four-variable model: a model for assessing the prevalence of iron deficiency that requires abnormal values for either serum ferritin level and/or mean corpuscular volume together with abnormal values for transferrin saturation and/or erythrocyte protoporphyrin level.

g: gram

GRAS: Generally Recognized as Safe

Growth retardation: impairment in linear growth that may result from undernutrition.

HANES: Health and Nutrition Examination Surveys

HHANES: Hispanic Health and Nutrition Examination Survey

HDL: high density lipoprotein

Health status: as used in this report, refers to a population's or an individual's status with respect to physical state or disease condition.

Hg: mercury

HLA: histocompatibility locus

HNIS: Human Nutrition Information Service, USDA

Hypertension (ICD-9 401): persistently elevated arterial blood pressure.

Hypertensive heart disease (ICD-9 402): includes hypertensive cardiomegaly, cardiopathy, cardiovascular disease, and heart failure.

ICD: International Classification of Diseases

Incidence: refers generally to the number of new events (for example, new cases of disease) in a defined population, within a specified time period.

Iron: essential mineral.

Iron deficiency: refers to the presence of two or more abnormal values for iron metabolism indicators and corresponds to the second and third stages in the development of iron deficiency.

Iron deficiency anemia: denotes a low hemoglobin value found in association with evidence of iron deficiency. Theoretically, it corresponds to the third stage of iron deficiency.

Iron overload: occurs in the case of excessive accumulation of storage iron in tissues.

JNMEC: Joint Nutrition Monitoring Evaluation Committee

kg: kilogram

L: liter

LDL: low density lipoprotein

LSRO: Life Sciences Research Office

m: meter

Magnesium: essential mineral.

Marginal nutritional status: a condition in which nutrient stores may be low, the activity of some enzymes may be lower or higher than normal, or growth may be slightly impaired, but impairment of performance, health, or survival may not be evident. Persons with marginal nutritional status are considered at risk of nutritional deficiency, especially when subjected to stress.

MCV: mean corpuscular (red blood cell) volume

MCV model: a model for assessing the prevalence of iron deficiency that requires abnormal values for at least two of the following measurements--mean corpuscular volume, transferrin saturation, or erythrocyte protoporphyrin level.

Mean: measure of central tendency calculated by adding all individual values and dividing by the number of values.

Median (or 50th percentile): value that divides a distribution of values into two equal parts, with 50 percent of the values above and 50 percent of the values below this point.

mg: milligram

mm: millimeter

mmol: millimole

Monounsaturated fat: fatty acids with one double bond.

µ: micro (for example, µg = microgram, µmol = micromole)

NCEP: National Cholesterol Education Program

NCHS: National Center for Health Statistics

NCI: National Cancer Institute

NFCS: Nationwide Food Consumption Survey

NHANES I: National Health and Nutrition Examination Survey

NHANES II: Second National Health and Nutrition Examination Survey

NHEFS: NHANES I Epidemiologic Followup Study

NHES: National Health Examination Survey

NHIS: National Health Interview Survey

NHLBI: National Heart, Lung, and Blood Institute

Niacin: water–soluble vitamin; obtained from food preformed or may be synthesized from tryptophan.

NIH: National Institutes of Health

NNMS: National Nutrition Monitoring System

Nutrient deficiency: a condition associated with adverse health consequences arising from inadequate intake or utilization of a nutrient.

Nutrient excess and/or toxicity: a condition associated with adverse health consequences arising from excessive intake or utilization of a nutrient.

Nutrition assessment: the measurement of indicators of dietary status and nutrition–related health status to identify the possible occurrence, nature, and extent of impaired nutritional status (ranging from deficiency to toxicity).

Nutrition monitoring: the assessment of dietary or nutritional status at intermittent times with the aim of detecting changes in the dietary or nutritional status of a population.

Nutritional status: the condition of a population's or an individual's health as influenced by the intake and utilization of nutrients and non–nutrients. It reflects, directly or inferentially, the processes of food ingestion and digestion; absorption, transport, and metabolism of food components; and excretion of food components and their metabolic products. As noted in the JNMEC report (1986), indicators of nutritional status include: (1) levels of specific food components in diets; (2) clinical, anthropometric, hematological, and biochemical measurements related to specific food components; and (3) health conditions or diseases that may be associated

Nutrition surveillance: continuous assessment of nutritional status for the purpose of detecting changes in trend or distribution in order to initiate corrective measures.

Nutritional imbalance: a condition associated with adverse health consequences arising from insufficient or excessive intake of one nutrient or food component relative to another.

Obesity: excessive accumulation of body fat.

OCA: oral contraceptive agent

Overnutrition: the condition resulting from the excessive intake of foods in general or particular food components.

Overweight: body weight in excess of standards; taken as an estimate of obesity (see chapters 3 and 4 for discussion of standards for overweight used in this report).

PedNSS: Pediatric Nutrition Surveillance System

Percentiles: divisions of a distribution into equal, ordered subgroups of hundredths.

Phosphorus: essential mineral.

PIR: poverty income ratio

PNSS: Pregnancy Nutrition Surveillance System

Potassium: essential mineral.

Polyunsaturated fat: fatty acids with two or more double bonds.

Poverty index: consists of a set of cash income cutoffs that vary by the size and number of children in a family. Since 1964, various cutoffs for the definition of poverty index have been used for a variety of analytical and policy applications. (See appendices I and II for details on the poverty indices in specific NNMS surveys.)

Prevalence: the number of instances of a given disease or other condition in a given population at a designated time.

Protein: formed from various combinations of amino acids; energy source in the diet; provides approximately 4 kilocalories per gram.

RBC: red blood cell

RDA: Recommended Dietary Allowance(s)

Relative standard error: see coefficient of variation.

Riboflavin: water–soluble vitamin.

Saturated fat: fatty acids with no double bonds.

SE: standard error

SI: Systême International

Sodium: essential mineral

Standard deviation: the square root of the sum of the squares of the deviations from the mean divided by n−1.

Standard error: the standard deviation (measure of dispersion or variation) of a statistic (mean or percent).

Thiamin: water–soluble vitamin.

Undernutrition: the condition resulting from the inadequate intake of foods in general or particular food components.

USDA: United States Department of Agriculture

Vitamin A: fat–soluble vitamin; activity is derived from both preformed vitamin A (retinol) and provitamin A carotenoids.

Vitamin B6: water–soluble vitamin.

Vitamin B12: water–soluble vitamin.

Vitamin C: water–soluble vitamin.

Vitamin E: fat–soluble vitamin.

Vit/Min: Vitamin Mineral Supplement Intake Survey

VLDL: very low density lipoprotein

WIC: Special Supplemental Food Program for Women, Infants, and Children

Zinc: essential mineral

Appendix IV

Recommended Dietary Allowances (RDA)

The RDA and Estimated Safe and Adequate Daily Dietary Intakes are recorded here from the National Research Council. 1980. *Recommended Dietary Allowances*. 9th revised edition. Washington: National Academy Press.

Table IV–1. Estimated safe and adequate daily dietary intakes of selected vitamins and minerals[a]

		Vitamins		
	Age (years)	Vitamin K (μg)	Biotin (μg)	Pantothenic Acid (mg)
Infants	0-0.5	12	35	2
	0.5-1	10-20	50	3
Children and adolescents	1-3	15-30	65	3
	4-6	20-40	85	3-4
	7-10	30-60	120	4-5
	11+	50-100	100-200	4-7
Adults		70-140	100-200	4-7

		Trace Elements[b]					
	Age (years)	Copper (mg)	Manganese (mg)	Fluoride (mg)	Chromium (mg)	Selenium (mg)	Molybdenum (mg)
Infants	0-0.5	0.5-0.7	0.5-0.7	0.1-0.5	0.01-0.04	0.01-0.04	0.03-0.06
	0.5-1	0.7-1.0	0.7-1.0	0.2-1.0	0.02-0.06	0.02-0.06	0.04-0.08
Children and adolescents	1-3	1.0-1.5	1.0-1.5	0.5-1.5	0.02-0.08	0.02-0.08	0.05-0.1
	4-6	1.5-2.0	1.5-2.0	1.0-2.5	0.03-0.12	0.03-0.12	0.06-0.15
	7-10	2.0-2.5	2.0-3.0	1.5-2.5	0.05-0.2	0.05-0.2	0.10-0.3
	11+	2.0-3.0	2.5-5.0	1.5-2.5	0.05-0.2	0.05-0.2	0.15-0.5
Adults		2.0-3.0	2.5-5.0	1.5-4.0	0.05-0.2	0.05-0.2	0.15-0.5

		Electrolytes		
	Age (years)	Sodium (mg)	Potassium (mg)	Chloride (mg)
Infants	0-0.5	115-350	350-925	275-700
	0.5-1	250-750	425-1275	400-1200
Children and adolescents	1-3	325-975	550-1650	500-1500
	4-6	450-1350	775-2325	700-2100
	7-10	600-1800	1000-3000	925-2775
	11+	900-2700	1525-1575	1400-4200
Adults		1100-3300	1875-5625	1700-5100

a Because there is less information on which to base allowances, these figures are not given in the main table of RDA and are provided here in the form of ranges of recommended intakes.

b Since the toxic levels for many trace elements may be only several times usual intakes, the upper levels for the trace elements given in this table should not be habitually exceeded.

Table IV-2. Food and Nutrition Board, National Academy of Sciences--National Research Council, Recommended Daily Dietary Allowances[a], Revised 1980. Designed for the maintenance of good nutrition of practically all healthy people in the United States

			Fat-soluble vitamins		
	Age (years)	Protein (g)	Vitamin A (μg RE)[b]	Vitamin D (μg)[c]	Vitamin E (mg α-TE)[d]
Infants	0.0 - 0.5	kg X 2.2	420	10	3
	0.5 - 1.0	kg X 2.0	400	10	4
Children	1-3	23	400	10	5
	4-6	30	500	10	6
	7-10	34	700	10	7
Males	11-14	45	1000	10	8
	15-18	56	1000	10	10
	19-22	56	1000	7.5	10
	23-50	56	1000	5	10
	51+	56	1000	5	10
Females	11-14	46	800	10	8
	15-18	46	800	10	8
	19-22	44	800	7.5	8
	23-50	44	800	5	8
	51+	44	800	5	8
Pregnant		+30	+200	+5	+2
Lactating		+20	+400	+5	+3

See footnotes at end of table.

Table IV-2. Food and Nutrition Board, National Academy of Sciences--National Research Council, Recommended Daily Dietary Allowances[a], Revised 1980. Designed for the maintenance of good nutrition of practically all healthy people in the United States--continued

	Age (years)	Water-soluble vitamins						
		Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg NE)[e]	Vitamin B6 (mg)	Folacin[f] (µg)	Vitamin B12 (µg)
Infants	0.0 - 0.5	35	0.3	0.4	6	0.3	30	0.5[a]
	0.5 - 1.0	35	0.5	0.6	8	0.6	45	1.5
Children	1-3	45	0.7	0.8	9	0.9	100	2.0
	4-6	45	0.9	1.0	11	1.3	200	2.5
	7-10	45	1.2	1.4	16	1.6	300	3.0
Males	11-14	50	1.4	1.6	18	1.8	400	3.0
	15-18	60	1.4	1.7	18	2.0	400	3.0
	19-22	60	1.5	1.7	19	2.2	400	3.0
	23-50	60	1.4	1.6	18	2.2	400	3.0
	51+	60	1.2	1.4	16	2.2	400	3.0
Females	11-14	50	1.1	1.3	15	1.8	400	3.0
	15-18	60	1.1	1.3	14	2.0	400	3.0
	19-22	60	1.1	1.3	14	2.0	400	3.0
	23-50	60	1.0	1.2	13	2.0	400	3.0
	51+	60	1.0	1.2	13	2.0	400	3.0
Pregnant		+20	+0.4	+0.3	+2	+0.6	+400	+1.0
Lactating		+40	+0.5	+0.5	+5	+0.5	+100	+1.0

See footnotes at end of table.

Table IV-2. Food and Nutrition Board, National Academy of Sciences--National Research Council, Recommended Daily Dietary Allowances[a], Revised 1980. Designed for the maintenance of good nutrition of practically all healthy people in the United States--continued

	Age (years)	Minerals: Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Iodine (µg)
Infants	0.0 - 0.5	360	240	50	10	3	40
	0.5 - 1.0	540	360	70	15	5	50
Children	1-3	800	800	150	15	10	70
	4-6	800	800	200	10	10	90
	7-10	800	800	250	10	10	120
Males	11-14	1200	1200	350	18	15	150
	15-18	1200	1200	400	18	15	150
	19-22	800	800	350	10	15	150
	23-50	800	800	350	10	15	150
	51+	800	800	350	10	15	150
Females	11-14	1200	1200	300	18	15	150
	15-18	1200	1200	300	18	15	150
	19-22	800	800	300	18	15	150
	23-50	800	800	300	18	15	150
	51+	800	800	300	10	15	150
Pregnant		+400	+400	+150	h	+5	+25
Lactating		+400	+400	+150	h	+10	+50

[a] The allowances are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined.

[b] Retinol equivalents. 1 retinol equivalent (RE) = 1 µg retinol or 6 µg β-carotene.

[c] As cholecalciferol. 10 µg cholecalciferol = 400 IU of vitamin D.

[d] α-tocopherol equivalents. 1 mg *d*-α-tocopherol = 1 α-TE.

[e] 1 NE (niacin equivalent) is equal to 1 mg of niacin or 60 mg of dietary tryptophan.

[f] The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay after treatment with enzymes (conjugases) to make polyglutamyl forms of the vitamin available to the test organism.

[g] The recommended dietary allowance for vitamin B12 in infants is based on average concentration of the vitamin in human milk. The allowances after weaning are based on energy intake (as recommended by the American Academy of Pediatrics) and consideration of other factors, such as intestinal absorption.

[h] The increased requirement during pregnancy cannot be met by the iron content of habitual American diets nor by the existing iron stores of many women; therefore the use of 30-60 mg of supplemental iron is recommended. Iron needs during lactation are not substantially different from those of nonpregnant women, but continued supplementation of the mother for 2-3 months after parturition is advisable in order to replenish stores depleted by pregnancy.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1989— 247 - 662 /00663

Other publications in the series *Nutrition Monitoring in the United States* are:

1. U.S. Department of Health and Human Services and U.S. Department of Agriculture: *Nutrition Monitoring in the United States — A Report from the Joint Nutrition Monitoring Evaluation Committee*. DHHS Publication No. (PHS) 86-1255. Public Health Service. Washington. U.S. Government Printing Office. July 1986.

2. Interagency Committee on Nutrition Monitoring: *Nutrition Monitoring in the United States — The Directory of Federal Nutrition Monitoring Activities*. DHHS Publication No. (PHS) 89-1255-1. Public Health Service. Washington, U.S. Government Printing Office. September 1989.