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USDA Methodological Research for Large-Scale Dietary Intake Surveys, 1975-88

Abstract

Since 1975, the U.S. Department of Agriculture has sponsored a substantial body of methodological research to improve its procedures for study of the dietary intake of individuals. This report summarizes studies conducted by researchers in universities and private research firms and relevant in-house research. The first chapter provides historical perspective as background for the research program. The last chapter explains how the researchers' findings have been incorporated in the ongoing dietary survey program of the Human Nutrition Information Service. Ten chapters presenting the purpose, methods, main findings, and conclusions of each study, along with tabular data, are important for understanding the research. The topics researched include cross-sectional and longitudinal survey approaches; in-person, telephone, and mail interviews; food recall, food record, and food frequency methods; and different numbers and spacing of days for collection of food intake. Two other chapters report a number of secondary analyses and in-house methodology studies and provide a comprehensive summary of the U.S. Department of Agriculture research on food composition, which is essential for analysis of dietary intakes.

KEYWORDS: Dietary intake surveys, dietary survey methods, food composition data base, food consumption surveys, survey methodology research.

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Preface

The U.S. Department of Agriculture (USDA) has long experience in conducting large-scale surveys of food consumption. USDA's responsibility for monitoring food consumption was reaffirmed in the Food and Nutrition Policy statement signed by the Secretary of Agriculture on May 17, 1985:

> "USDA has the mission to encourage the production and availability of a sufficient, safe, and nutritionally adequate supply of wholesome food for Americans...USDA, in support of this mission, will:...(e) monitor food use and food consumption patterns among the nation's population...to determine areas where nutritional guidance, food assistance, and food production programs may be focused."

The Human Nutrition Information Service (HNIS) currently has the major responsibility in USDA for nutrition monitoring.

The period from 1975 to 1988 has seen concentrated exploration and testing of new approaches for obtaining information on dietary intakes. Some of the impetus has come from changing concerns in the public, governmental, and scientific communities about interrelationships of food supply, diet, nutrition, health, and disease. USDA has attempted to meet increased and divergent needs of new users for data of high quality while continuing to meet the basic purposes of the food consumption surveys--measurement of food consumption and determination of the dietary adequacy of the U.S. population.

This report has five objectives:

- Provide historical perspective for recent methodological studies by HNIS.
- Describe and summarize those studies undertaken by HNIS in its 1975-88 research program to improve methods for obtaining valid data in large-scale surveys of individual diets.
- Provide professionals with details of the methods used and results of each study.
- Integrate findings from this series of studies with current methods.
- List topics for further methodological research that will provide increasingly relevant dietary information needed by a variety of users.

The 1975-88 period of research to improve methods of surveying dietary intakes began with an intensive review and examination of plans for the Nationwide Food Consumption Survey (NFCS) originally scheduled for 1975-76 and carried out in 1977-78. For comparative purposes, procedures similar to those used in the 1965-66 household food consumption survey seemed desirable. However, it was deemed timely to take a fresh look at those approaches before proceeding, especially in light of tight funding and the Office of Management and Budget's objective to consolidate and broaden uses of results from large surveys. Chapter 1 provides historical perspective for the direction taken by research described in this report.

First, the critical review of literature carried out at USDA in preparation for NFCS 1975-76 (Burk and Pao, 1976) was supplemented by Response Analysis Corporation, an independent private research firm (Chapter 2). Response Analysis also sought advice from a committee of six experts from the fields of statistics, agricultural economics, and nutrition and reactions from several panels of homemakers and consumers. Next, the research firm developed a series of methodological variations and tested them under field conditions, using the results to formulate recommendations to USDA for improving survey procedures. Subsequently, most of the recommendations were pilot-tested and, where feasible, incorporated into NFCS 1977-78.

While NFCS 1977-78 was still in the field, work on the assessment of the validity of the survey results was initiated. Chapter 3 relates the contribution of Survey Design Incorporated, another independent private research firm. The principal investigator, Joseph Steinberg, who had worked on surveys for many years at the Bureau of the Census, was recognized as an outstanding authority on the subject. He observed NFCS 1977-78 in action, reviewed NFCS procedures and the processes by which those procedures were selected, and consulted experts in diverse but relevant disciplines for their ideas on how to validate the survey results. A number of his suggestions, which involved the interviewers and respondents who participated in NFCS 1977-78, were implemented by the National Analysts' staff while conducting field work. As described in Chapter 4, the National Analysts' studies included (1) group interview sessions to obtain homemakers' reactions to six alternative methods for surveying foods used by households, (2) a mail survey of NFCS interviewers' perceptions of respondent accuracy and workability of survey procedures, and (3) a debriefing of NFCS March 1978 respondents to determine their views on the difficulty of survey tasks and the accuracy of information they supplied.

NFCS 1977-78 results were also appraised for validity in another way--by comparison with results obtained in another widely known dietary intake survey which was part of the National Health and Nutrition Examination Survey (NHANES) 1971-74 (Chapter 5). Dr. Frances Larkin and staff at the University of Michigan, School of Public Health, who had experience using NHANES 1971-74 data in earlier research, compared results of the NFCS 1977-78 and NHANES 1971-74. Comparisons involved food energy and nutrient intakes, consumption of food groups, eating occasions and meal patterns, alcohol consumption, and clinically measured and self-reported heights and weights. Despite differences in sample design, methods and procedures, and timing of the survey, results were found to be similar in a number of respects but dissimilar in others. This study indicated the need for greater comparability in variable definitions and procedures between surveys if data from the surveys are to be compared.

An experimental investigation of the ability of men to report their dietary intake is the subject of Chapter 6. Dr. Mary Alice Caliendo at the University of Maryland led a team of nutrition undergraduate and graduate students in a two-phase study designed to measure the accuracy of information reported in dietary surveys. Lunches by men at workplace cafeterias were unobtrusively recorded and the observations were compared with subsequent recalls by them and by surrogate household members. Two types of measurement aids were used during in-person interviews to assist the recall of portion sizes--the set of standard measuring cups and spoons and ruler used in the NFCS 1977-78 and a set of geometric models and tableware similar to those used in the NHANES 1971-74. The study focused on the accuracy of information the respondents provided.

Chapter 7 discusses an exploratory study of longitudinal measures of food intake over 1 year by about 1,700 middle-income women, 20 to 69 years of age, in households of at least two persons. National Analysts tested eight data collection methods requiring a varied number of contacts during the year. The NFCS 1977-78 in-person interview method was compared with variations involving in-person, telephone, and mail approaches. The panels surveyed by mail had such low response rates that mail methods were considered unacceptable. The telephone interview performed as well as the in-person interview used in NFCS 1977-78 when preceded by an in-person contact.

To determine the best procedures to use in national monitoring of diets of hard-to-survey, low-income population groups on a continuing basis, a pilot study was carried out by Westat, Inc. The year-long panel approach requiring 3-day dietary reports every quarter from most participants is detailed in Chapter 8. After initial in-person interviews, panels were contacted by telephone or mail. Samples included all members of specified rural and urban households of whites, blacks, Mexican-Americans, American Indians, and elderly persons from selected locations in the United States. The telephone interview was judged superior to the mail approach, but both procedures suffered considerable attrition during the year.

An archeological approach was used to measure household food discard and other factors that might account for differences in nutrient content of diets as computed from survey data on household food use and on total food intake from home supplies reported by individuals in the households. Chapter 9 describes four experimental methods used by Dr. Gail Harrison and Dr. William Rathje, University of Arizona, to track food loss by households. Food discards estimated with the experimental methods were compared with estimates derived from analysis of household refuse (garbage). Refuse from households was analyzed using methods developed previously by the research team. They concluded that food loss in households could not be entirely accounted for by any of the methods tested.

Chapter 10 describes a study by Dr. Frances Larkin, University of Michigan, concerning the development and testing of a food frequency questionnaire. The estimate of usual intake during 1 year was cross-validated by comparing intakes of food groups and nutrients derived from a food frequency questionnaire with intakes calculated from 16 food recall-record days. The research team found that the food frequency questionnaire generally yielded higher intakes than the mean intakes calculated from the 16 food recall-record days. Based on values for energy and macronutrients, the food frequency estimates for about half of the samples were outside one standard deviation of the recall-record mean.

Studies of several research questions made by USDA staff and by investigators at universities are described in Chapter 11. The topics explored included further study of the data collected by National Analysts for the exploratory study of longitudinal measures, variations between 1-day and 3-day average nutrient intakes, alcoholic beverage consumption over 3 days in NFCS 1977-78, and some issues that surfaced in the Continuing Survey of Food Intakes by Individuals in 1985.

The development of food composition tables is essential to nutritional assessment of household food consumption and individual food intakes. Chapter 12 traces work in providing food composition values and a reliable nutrient data base for determining the nutrient content of diets. The fast pace of scientific developments was reflected in the increasingly complex food composition work as more foods and more food components were included. In the mid-1970's, HNIS introduced a computerized system to handle the massive amount of data. The interface between development of the nutrient data base and its use in large-scale dietary intake surveys is described.

Chapter 13 describes the effects of using a smaller nutrient data base on the accuracy of nutritional assessments. Dr. Loretta Hoover at the University of Missouri-Columbia investigated the effects of substituting nutrient data bases of 200, 396, and 2,371 food items in place of the comprehensive data base of about 4,500 items used in NFCS 1977-78. Dr. Hoover concluded that small data bases could save time in maintenance and use, but that their disadvantages outweighed the benefits. Although the moderately reduced nutrient data base produced mean nutrient intakes similar to those based on the comprehensive data base, the investigator pointed out some of her concerns for accuracy of dietary assessments for special population groups should the smaller data bases be adopted.

Chapter 14 designates stages in the survey process wherein results of methodological research have application. The contributions of the research studies to the methods currently used in the large-scale dietary intake surveys at HNIS are discussed. Possible research questions are posed for future investigation.

Research described in this report has contributed to the rationale for current dietary survey methodology and has identified areas for improvement. One such area, interindividual and intraindividual variation of dietary intake, is now being studied to better understand dietary status of population groups. Methods will continue to be refined as experience and research point the way.

Reference Cited

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Contents

Glossary of Abbreviations

AH .... Agriculture Handbook
AMS .... Agricultural Marketing Service
AOAC ...... Association of American Chemists
ARS .... Agricultural Research Service
BAE .... Bureau of Agricultural Economics
BHNHE ..... Bureau of Human Nutrition and Home Economics
BMDP ...... Biomedical Computer Programs
cm .... centimeters
CSFII ..... Continuing Survey of Food Intakes by Individuals
Dept ...... Department
Diff ...... Difference
ERS .... Economic Research Service
FAO .... Food and Agriculture Organization
FFQ .... Food Frequency Questionnaire
FIB .... Food Instruction Booklet
FSP .... Food Stamp Program
g .... grams
GAO .... General Accounting Office
HFCS ...... Household Food Consumption Survey
HG .... Home and Garden Bulletin
HHANES .... Hispanic Health and Nutrition Examination Survey
HNIS ...... Human Nutrition Information Service
ICNND ..... Interdepartmental Committee on Nutrition for National Defense
IHE .... Institute of Home Economics
INCAP ..... Institute of Nutrition of Central America and Panama
INFOODS ... International Network of Food Data Systems
IU .... International units
JNMEC ..... Joint Nutrition Monitoring Evaluation Committee
kcal ...... kilocalories
kg .... kilograms
kj .... kilojoules
mcg .... micrograms
mg .... milligrams
misc ...... miscellaneous
MSU .... Michigan State University
N .... Number of cases
N .... Nitrogen (in estimation of protein)
NCHS ...... National Center for Health Statistics
NCL .... Nutrient Composition Laboratory
NDB .... Nutrient Data Bank
NFCS ...... Nationwide Food Consumption Survey
NFS .... Not Further Specified
NHANES .... National Health and Nutrition Examination Survey
NIR .... Noninterview report form
NNMS ...... National Nutrition Monitoring System
No. .... number
NSMS ...... Nutritional Status Monitoring System
oz .... ounces

Pct .... Percent
PDS .... Primary Nutrient Data Set
PMA .... Production and Marketing Administration
PSU .... Primary Sampling Unit
PT .... Provisional Table
Pub .... Publication
RDA .... Recommended Dietary Allowances
RE .... Retinol Equivalents
SAS .... Statistical Analysis System
SD .... Standard Deviation
SDI .... Survey Design Incorporated
SEA .... Science and Education Administration
SPSS ...... Statistical Package for the Social Sciences
UM .... University of Michigan
UMC .... University of Missouri-Columbia
U.S. ...... United States
USDA ...... U.S. Department of Agriculture
USDHEW .... U.S. Department of Health, Education, and Welfare
USDHHS .... U.S. Department of Health and Human Services
USGAO ..... U.S. General Accounting Office
vit .... vitamin

Guide to Methodological Issues Discussed in This Report

Issue	Chapter 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Data collection method:														
Recall	X	X		X	X	X	X	X	X	X	X			X
Record	X	X		X			X		X	X	X			X
Frequency										X				X
Data quality measure:														
Number of line items		X					X	X						X
Food description		X		X	X		X	X			X			X
Portion size						X	X			X				
Food composition values												X	X	X
Intersurvey comparison					X						X			X
Interview mode:														
In-person	X	X			X	X	X	X	X	X	X			X
Telephone				X			X	X			X			X
Mail		X		X			X	X			X			X
Measurement aids	X	X		X	X	X		X		X				X
Number of interview days		X	X				X	X		X	X			X
Nutrient data base size													X	X
Quality control		X	X	X			X	X						X
Reliability of data			X							X	X			X
Respondent burden		X	X				X	X			X			X
Respondent reporting:														
Self-report		X			X			X						X
Surrogate		X		X		X		X						X
Response rate		X	X	X			X	X		X				X
Sampling		X	X					X		X				
Spacing interview days		X					X				X			X
Survey type:														
Cross-sectional		X			X									
Panel							X	X		X				X
Validity of data		X	X	X		X			X	X				X
Dietary intake variation			X							X	X			X

Chapter 1. Background: USDA Food Consumption Studies

SUMMARY: This chapter outlines development of U.S. Department of Agriculture (USDA) food consumption survey methods since before the turn of the century. To meet a variety of requirements, USDA provides food consumption data at three different levels of aggregation--food available to the total country (U.S. food supply in terms of per capita food consumption), food used by households, and food eaten by individual members of households. The different methods for gathering and processing the three types of food consumption data are described. The first nationwide survey of dietary intakes by individuals in the United States was conducted by USDA in 1965. Concern about relationships between diet, health, and chronic disease has increased the demand for information about diets and nutritional status of the population. A national nutrition monitoring system was proposed and implemented. Legislation and reports by expert committees have reflected the importance accorded data obtained in national food consumption and dietary intake surveys.

1.1 Historical Perspective

Methodology has always been important in planning the increasingly complex food consumption surveys at the U.S. Department of Agriculture (USDA). Most surveys contained a methodological component to improve methods in future surveys as well as to evaluate food consumption of the sample under study. Such studies built on earlier experience and findings.

1.1.1 Early USDA Food Consumption Studies

USDA was established in 1862, terminating the Patent Office's responsibility for agricultural affairs and statistics (Baker et al., 1963). Later, the Office of Experiment Stations was authorized by the Hatch Act of 1887 as a center for exchange of research information. Dr. Wilbur O. Atwater was its first director (1888 to 1891). This marked the beginning of basic scientific research within USDA (Baker et al., 1963). In 1894, Congress mandated that human nutrition investigations be conducted by the USDA Office of Experiment Stations, and Atwater was put in charge (Murray, 1970).

As professor of chemistry at Wesleyan University in Middletown, Connecticut (site of the first State Experiment Station), Atwater had engaged in food consumption and dietary studies which were reported in 1886 as part of the Massachusetts Bureau of Labor Statistics' budgeting studies. These studies were forerunners of the income-expenditure surveys conducted by the U.S. Departments of Labor and Agriculture. It was in connection with these studies that Atwater developed much of the basic methodology for collecting and analyzing data in the USDA food consumption surveys.

Essentially, the data treated the household as the unit of observation and included kinds, quantities, and costs of food and the number, age, sex, and physical activity of persons eating those foods. Analyses consisted of reducing those quantities to "per man per day" units, calculating content of nutrients (protein, fat, carbohydrate, and ash), and comparing the nutrient content with requirements. The collection procedure used in later nutrition investigations, the well-known weighed food inventory record, was described in the 1898 Yearbook of Agriculture (Murray, 1970). Participant households were "willing families." In 1906, upon Atwater's retirement, the headquarters for Human Nutrition Investigations was moved from Connecticut to Washington, D.C., with Charles Langworthy as director (Maynard, 1962; Murray, 1970).

In 1915, the Office of Home Economics was created, and human nutrition investigations were a key component (Murray, 1970). In 1923, the Bureau of Home Economics was established with three divisions--food and nutrition, family economics, and textiles and clothing. Two more divisions were added later. Food consumption surveys were centered in the Family Economics Division. Successors to this Division--today, the Nutrition Monitoring Division of the Human Nutrition Information Service (HNIS)--have continued to conduct the USDA household food consumption surveys.

1.1.2 Requirements for Conduct of Large-Scale Food Consumption Surveys

Before large, complex, quantitative food consumption surveys of populations could be successfully accomplished, four elements had to be developed: (1) sophisticated data collection and processing techniques, (2) statistical theory and techniques for sampling and analyses, (3) reliable food composition values, and (4) recognized standards for evaluating survey results. Knowledge and experience in these areas accumulated rapidly in Europe during the late 1800's. Most of the early American scientists in nutrition went to Europe, especially Germany, to learn the latest developments. Atwater made several such trips (McCollum, 1957).

Data collection techniques for household food consumption surveys progressed from Atwater's weighed food inventory record to a food list-recall method after comparative studies showed the latter to be more feasible (Murray, 1970). Manuals were developed with explicit instructions for administering carefully constructed questionnaires to provide unbiased information. Data processing techniques advanced from hand tallies to semimanual use of cards with punched holes to machine tabulation using UNIVAC digital computers (Duncan and Shelton, 1978) and finally to today's powerful computers. Simple statistics--means, proportions, frequency distributions, cross-tabulations, and linear regressions --have been succeeded by increasingly intricate multivariate analytical methods and the application of epidemiological approaches, facilitated by the capabilities of modern computers. The development of sampling techniques, such as those described by Cochran (1953), accompanied the development and availability of better sampling frames from the Bureau of the Census during World War II (Burk, 1968).

At USDA, food composition tables were first compiled under Atwater's direction. This work, now identified as the National Nutrient Data Bank, has continued and is now conducted by HNIS. The evolution of the USDA food composition tables is traced in Chapter 12.

The dietary standards first used by Atwater to assess the adequacy of diets were based on German standards (Atwater, 1895; Maynard, 1962). These caloric and nutrient scales specified the adult male's needs as the basic unit. Needs of other household members were related to the adult male's needs. As knowledge accumulated from nutrition research, other dietary standards and scales were proposed. In the 1920's and 1930's, USDA researchers were faced with having to select which standards to use in appraising adequacy of diets surveyed (Hawley, 1927; Stiebeling and Ward, 1933; Stiebeling and Phipard, 1939; Stiebeling et al., 1941a, 1941b). In 1941, the Food and Nutrition Board of the National Academy of Sciences took over the function of providing standards for each nutrient for which information was sufficient. Starting with the 1942 national food consumption survey, the Recommended Dietary Allowances (RDA) set by the Food and Nutrition Board provided the basis for assessing the caloric and nutrient content of diets surveyed (USDA, BHNHE, 1944).

The most recent RDA are used by USDA as reference points in assessing the nutritional quality of diets of individuals in surveys. The problems involved in deciding at what level recommendations should be set--at a high level with safety margins, at a low level as a minimum requirement, or at an intermediate level--have been and continue to be debated. Statistical issues in analyses and interpretation of food and nutrient intake data have also been the subject of much deliberation, as attested to later in this chapter.

1.1.3 Types of Food Consumption Data Provided by USDA

In the first half of the 20th century, data collection by USDA was designed primarily to provide a sound basis for the development of policies and programs relevant to agricultural production, marketing of agricultural products, projecting supply and demand, and determining the adequacy of the available food supply. Survey results also helped identify groups with low nutrient levels for participation in food assistance programs. Surveys substantiated the need for enrichment in the 1930's and provided the basis for targeting nutrition education programs and their messages. Since World War II, uses of food consumption data have expanded beyond USDA to meet needs in other fields, particularly those concerned with new aspects of food product development, food safety, and public health and welfare.

To meet varied data requirements, USDA reports food consumption data at three different levels of aggregation--food available for consumption by the U.S. population (U.S. food supply), food used by households, and food ingested by individual members of households (Burk and Pao, 1976). The U.S. food supply is measured in terms of per capita food consumption by the U.S. population for each year. Consumption, initially estimated in primary distribution weights, is reported in retail-weight equivalents. Food consumption at the second and third levels is measured in national surveys. Food used by households during 1 week is measured in the "as purchased" form (retail level) or as it is brought into the kitchen and is reported in pounds per household per week. Food intake at home and away from home by individuals in survey households is usually measured in common household units and reported in grams as ingested per individual per day. More than 50 years ago, Stiebeling (1933) pointed out the far-reaching implications for agriculture of shifts in food consumption and changes in diets selected by consumers. These implications account in large part for the continued commitment to food consumption research in USDA.

1.1.3.1 U.S. Food Supply

The need for food consumption or food availability data became apparent during World War I and thereafter when agricultural surpluses developed (USDA, BAE, 1953). Later, production planning programs instituted under the Agricultural Adjustment Act of 1933 required knowledge of food available for consumption to ensure an adequate food supply for domestic consumption. In addition, the droughts of 1934 and 1936 sharpened fears of food shortages. Per capita estimates for a wide range of foods were first summarized by USDA in 1941 for use in assessing food requirements and supplies in the war emergency. In 1949, series of data going back to 1909--the first year for which reasonably adequate and comprehensive food consumption data were available--were compiled and published along with sources of the data and computation procedures (USDA, BAE, 1949).

The annual estimates of the supply of major food commodities available for consumption by the U.S. population are derived by the Economic Research Service (ERS) of USDA from estimates of supply and utilization during the year. Construction of these data sets is based on a commodity-flow concept, which begins with the produce from U.S. farms, catch by U.S. fishermen, and imports (Manchester and Farrell, 1981; Putnam, 1989). Most of these products move through manufacturing or processing plants and then into distribution channels to retail stores or eating places and to consumers. About 260 foods were measured at the national aggregate level in 1980 (Manchester and Farrell, 1981).

A balance sheet approach is used to develop the supply and utilization quantities for each food. Balance sheets of supply and utilization use data for foods in terms of the weights at the primary distribution level in the marketing system (USDA, BAE, 1953; USDA, ERS, 1965; Putnam, 1989). The primary level is the stage at which production is initially measured; that is, after a farm product is identified as a food but before it is combined with other foods. Some primary production data are for raw farm products such as fresh fruit, some for intermediate or partially processed products such as flour and crude vegetable oils, and some for finished or fully processed products such as canned fruits and vegetables. After consumption estimates are made in primary distribution weights, they are converted to retail-weight equivalents.

Factors have been developed for converting weights at the primary stage to retail-weight equivalents (USDA, BAE, 1953; USDA, ERS, 1965). Weight loss from the primary level to the retail level can be a result of additional processing, trimming, shrinkage, spoilage, or other loss in the distribution system. For example, fresh beef loses 29 percent of its weight from carcass to retail cuts (Putnam, 1989). Approximate conversion factors were first compiled during World War II (USDA, PMA, 1952). Review and some revision of conversion factors are necessary from time to time to reflect changes in food processing, handling, transportation, storage, and retailing which have reduced the losses that occur in the marketing system (USDA, ERS, 1965). Conversion factors, including revisions based on special industry surveys and appraisals by commodity specialists, were last published in 1979 (Putnam, 1989, p. 17).

In the balance sheet approach, the total supply of each food for the year is the sum of beginning stocks, production estimates, and imports. Domestic utilization for food is calculated as the residual after subtracting exports, nonfood use (as for livestock feed, seed, and industrial use), and ending stores. Thus, the available supply that is not traced into these other distribution channels or stocks is considered to have been distributed as food available for consumption by the U.S. population. This is sometimes called the disappearance method of estimating food consumption. The residual amount (pounds) of annual consumption for each food is divided by the U.S. population count (total, resident, or civilian as appropriate for the data) to derive per capita consumption of the food. These data show year-to-year changes and long-term trends and shifts in demand and use of foods and are published by ERS in the National Food Review (formerly the National Food Situation) and in Food Consumption, Prices, and Expenditures.

The procedures for estimating supply and utilization depend entirely on data collected for other purposes. Changes in the availability and adequacy of these data present problems from time to time (Putnam, 1989). Some food supply estimates are developed using data from the Census of Agriculture, the Census of Manufactures, and annual estimates of food production developed by the National Agricultural Statistics Service (formerly the Statistical Reporting Service) of USDA. Data on consumption of fishery products have been provided by the National Marine Fisheries Service of the U.S. Department of Commerce. Data from trade associations such as the National Soft Drink Association are used if available. The population count used to derive per capita food consumption is taken from the Current Population Reports issued by the Bureau of the Census.

ERS estimates of per capita amounts of food available for consumption (retail weight), imputed consumption data for foods no longer reported by ERS, and estimated quantities of produce from home gardens are used by HNIS to estimate and report contents of food energy and, currently, 25 nutrients or food constituents in food available for consumption in the U.S. food supply (Marston and Raper, 1987; USDA, HNIS, 1988c). The percentages of energy and nutrients contributed by major food commodity groups are also reported by HNIS. Currently these food commodity groups are meat, poultry, fish; eggs; dairy products, excluding butter; fats and oils, including butter; citrus fruits; noncitrus fruits; white potatoes; dark-green and deep-yellow vegetables; other vegetables; legumes, nuts, and soy products; grain products; sugars and sweeteners; coffee, tea, and cocoa; and spices. More background information on the development of the per capita food consumption data series is available in USDA handbooks (USDA, BHNHE and BAE, 1947; USDA, AMS, 1955, 1957; Burk 1961a, 1961b; USDA, ERS, 1965, 1968, 1982, 1984, 1985; Bunch, 1987; Putnam 1989).

It is evident from the procedures used to derive per capita food consumption estimates that the data must be interpreted with care. The disappearance method of calculation attributes to per capita food consumption all amounts for which separate data are not available. Limitations include possible use from time to time of inappropriate conversion factors that do not reflect current losses in the marketing system. Adequacy of the data depends on accuracy of production and inventory estimates and on whether all foods are included. Retail-weight equivalents assume that all food is sold through retail stores, whereas some food is produced for home consumption and some is sold wholesale to restaurants and other away-from-home eating places and institutions. Food supply estimates do not consider losses of food after it is sold at retail, such as spoilage, inedible parts, trimming by the consumer, and cooking losses. However, nutrient estimates by HNIS exclude inedible parts but do include nutrients from parts that might be considered edible although not always eaten (such as separable fat on meat). The per capita averages cannot take into account changes in the need for foods resulting from shifts in the sex and age distribution of the population, such as the extraordinary number of babies in a "baby boom" era or the increased number of the elderly (especially women) today.

Nevertheless, in addition to their usefulness for determining historical trends back to 1909 and for agricultural and marketing analyses, the U.S. food supply data have shown sufficient consistency in methodology over time to be useful as a rough check on the reasonableness of results of the household food consumption surveys (Clark et al., 1954; USDA, ARS and AMS, 1956, 1957; USDA, ARS, 1968, 1969). However, the U.S. food supply data cannot provide information on a regional or other demographic basis. National surveys of household food consumption are required to show how food supplies are distributed by regional and other demographic characteristics. The periodic surveys of household food use provide a basis for comparisons of consumption over time by groups in the population. Such comparisons are not possible with the per capita estimates.

1.1.3.2 Household Food Consumption

Cross-sectional surveys of household food consumption are particularly important in providing food consumption data for different regions, urbanizations, and population subgroups. They provide data for agricultural economists to use in demand and market analyses to ascertain the effects of income, household size, and other factors on the consumption of total food and specific food groups. They show the ways households combine foods into diets and allow for the assessment of diets for conformance to nutritional, budgeting, and other criteria. The household food use surveys also supply basic data for developing the USDA family food plans at different cost levels, which are national standards of food use and food cost for families differing by composition and economic level. One of these food plans--the thrifty food plan--is the legal standard for benefits in the Food Stamp Program administered by USDA. Based on proper samples, these surveys provide baseline data on the kinds, quantities, money value, and nutrient content of food used at home by households in the nation.

USDA has conducted household food consumption surveys for about 100 years. The earliest surveys used the food inventory record. In this method, the food on hand at the beginning and end of the reporting period was inventoried, and all food brought into the home during the period was recorded. The food used was measured as the beginning inventory plus the food brought in minus the closing inventory. This complex procedure was first replaced in the 1930's by the food list-recall (or food list) technique, which required only an interview with the respondent who recalled, using the food list, the amounts used by the household during the preceding week. Response rates for this food list-recall approach were much higher than for the food inventory-record method. The advent of probability sampling in surveys increased awareness of the effect of poor response rates on the representativeness of the final samples (Cochran, 1953; Hansen et al., 1953). Subsequently, increased attention was paid to sampling procedures and to maintaining the integrity of the sample.

To date, USDA has conducted seven periodic nationwide surveys--in 1936-37, 1942, 1948, 1955, 1965-66, 1977-78, and 1987-88--that collected household food use data. In 1977-78, Hawaii (USDA, SEA, 1981b), Alaska (USDA, SEA, 1981e), and Puerto Rico (USDA, HNIS, 1982a) were also surveyed. The sample, scope, and methods used in these surveys are described in Section 1.3.1. The samples in the 1930's and 1940's were admittedly less than fully representative of the U.S. population.

Briefly, the food list-recall method, used in these surveys, takes place during a personal visit to the home in which a trained interviewer asks the homemaker to recall the kinds and quantities of food used during the preceding week and the amounts paid for purchased items. Previously, the interviewer used a detailed listing of foods and entered responses manually on the questionnaire. In the Nationwide Food Consumption Survey (NFCS) 1987-88, a laptop computer was used in which questions appeared on a screen and the interviewer entered answers directly into the computer. In 1948, the food list-recall included about 200 items. In 1977, the food list-recall form contained about 2,350 food items, and nearly 3,000 in 1987. In the surveys prior to the NFCS 1977-78, only housekeeping households were sampled. In surveys before 1955, a housekeeping household usually had to have at least two persons who ate a minimum of 10 meals from home food supplies during the week surveyed. One-person households often were not included in household samples before 1955. The 1955 and 1965-66 surveys considered a household to be a housekeeping household if a minimum of 10 meals was eaten at home by at least one household member during the week surveyed. The household food consumption surveys of 1977-78 and 1987-88 sampled all households. In the basic NFCS 1977-78, about 94 percent of the households were housekeeping households (USDA, HNIS, 1983a, p. 287).

In addition to the periodic nationwide surveys of households, USDA has conducted smaller methodological or special-purpose surveys of food consumption (Section 1.3.2). More precise methods evolved as various problems were investigated starting in the 1920's. For example, the relationship between incidence of pellagra and adequacy of the household food supply was demonstrated in 1932 (Stiebeling and Munsell, 1932). In the 1940's, several studies compared the food inventory-record and food list-recall methods of data collection and confirmed the decision to adopt the list-recall technique for use in future surveys (Adelson and Blake, 1950; Reagan and Grossman, 1951; Murray et al., 1952). A few studies obtained menus served to individuals (Velat et al., 1951; Clark and Fincher, 1954; LeBovit and Baker, 1965). The 1950's and early 1960's saw widespread concern for disadvantaged and low-income families (Velat et al., 1951; Clark and LeBovit, 1955; Orshansky et al., 1957; LeBovit and Baker, 1965). In 1961, the Pilot Food Stamp Program was initiated in eight economically depressed areas. A before-and-after study of food consumption and dietary levels in an urban and a rural area showed that the Food Stamp Program increased the purchase of more nutritious foods by needy families and also expanded the market for agricultural products--a major government objective being to utilize farm surpluses (Reese and Adelson, 1962).

The latest study comparing the food inventory-record and food list-recall procedures for surveying household food consumption was conducted in Cincinnati, Ohio, during 1969-70 (Grossman and Popka, 1974; Burk and Pao, 1976). Researchers found that the response rate for the inventory record was much lower than for the list-recall procedure.

A followup study of low-income households was conducted in 1979-80 to assess shifts in food consumption and dietary quality that might be associated with rising food costs and changes in the Food Stamp Program since the survey of similar households 2 years earlier (USDA, HNIS, 1982b, 1982e). The low-income households in the 1979-80 survey used foods with a lower money value (measured in constant dollars) than did the low-income households surveyed in NFCS 1977-78 (USDA, SEA, 1981f; USDA, HNIS, 1982c).

A study of money value, quantity, and nutrient value of food used at home by Puerto Rican households during 1984 was conducted in response to a mandate from Congress (USDA, HNIS, 1985c). Compared with an earlier survey in 1977, Puerto Rican households in 1984 used food with a lower money value of food at home (measured in constant dollars) than those surveyed in 1977 (USDA, HNIS, 1982a).

Until the 1955 nationwide survey, USDA staff members directed field work and processing of the data. Beginning with the 1955 nationwide survey, the sample design, field work, and varied degrees of data processing have been carried out under contract with private firms. USDA professional staff supply the technical information required, such as food codes and weights and nutrient composition of foods; plan the data processing; and monitor all aspects of the contracts.

For tabulation and analysis, food items reported on the household food list-recall schedule are organized into major food groupings using two systems, which serve two purposes: marketing groups based on market forms and nutrition groups based primarily on similarities in nutrient composition. Both classification systems are commodity-based, as are food groups in reports of the U.S. food and nutrient supply. Marketing groups in NFCS 1977-78 reports (USDA, HNIS, 1982f), usually reported in pounds for quantity and in dollars for money value per household per week, were milk, cream, cheese; fats, oils; flour, cereal; bakery products; meat, poultry, fish; eggs; sugar, sweets; potatoes, sweetpotatoes; fresh vegetables; fresh fruit; commercially canned vegetables, fruit; commercially frozen vegetables, fruit; vegetable, fruit juices; dried vegetables, fruit; beverages, including alcoholic beverages; soups, sauces, gravies; nuts, condiments, leavenings; and mixtures, baby-food mixtures. Nutrition groups in NFCS 1977-78 reports (USDA, HNIS, 1985a), also reported in pounds and dollars as well as in unit and percentage contribution of energy and 14 nutrients, were milk, cream, cheese; meat, poultry, fish; other protein foods (eggs; dry beans, peas, lentils; nuts, peanut butter; soups, mixtures; and plate meals); vegetables, including tomatoes; fruits; grain products, enriched; grain products, not enriched; fat, oils; sugar, sweets; and miscellaneous foods, including alcoholic beverages and foods with little nutrient value. Before quantities of foods are aggregated into groups, conversion factors are applied to weights of some foods. For example, concentrated juices are converted to single-strength equivalent and dried eggs to their fresh equivalent.

Total money value of food used at home includes the respondent's report of the cost of food bought and estimates of the value of food obtained without direct expense (home produced or received as gift or pay). Reported expense for meals and snacks eaten away from home is added to that amount to derive total money value of food consumed at home and away from home. The nutrient content of food used at home is computed using nutrient data bases that make deductions for normal refuse such as peels, pits, and bones and cooking losses of vitamins and minerals.

Several concepts and measurement procedures are unique to household food consumption data and affect their appropriate use and interpretation. In order to compare or to group households with dissimilar composition and with varied numbers of meals served to household members and guests from home food supplies, the households must be put on a common basis. Several measures have been developed that enable such comparisons and combinations. One such measure is household size in 21-meal-equivalent persons which is obtained by summing the number of meals served to all persons in the household from the home food supply during one week and dividing by 21 (based on three meals a day for 7 days for one person). Household size in equivalent nutrition units is another such term and is the number of adult-male-equivalent persons in the household calculated separately for food energy and each nutrient based on the relative needs of household members. The need of a 25-year-old man, as indicated by the RDA, is assumed to be 1.0 nutrition unit. Needs of other persons in equivalent nutrition units are calculated by dividing each of their allowances by the allowance for the reference man. These measures are explained further in survey reports (USDA, HNIS, 1982f, 1985a). In calculations utilizing these equivalents to assess the nutritional content of the household food, it is assumed that food and nutrients are divided among household members according to need and that food obtained and eaten away from home has the same nutritional content as food from home supplies. Comparisons of data from different household food consumption surveys require common definitions of variables or special treatment of their dissimilarities.

It must be noted that "food use" refers to food available for consumption by the household or food used in an economic sense--not to food as ingested--and includes food eaten, thrown away as waste, and leftovers fed to pets. Moreover, household food use data cannot provide information on how food is divided among individuals within the household. Also, in household food use surveys, data are not available on the kinds and amounts of foods consumed away from home. It was such limitations--highlighted by an effort to combine individual intake studies by States (Morgan, 1959)--that led to the introduction of an individual intake component in the household food consumption survey series in 1965.

1.1.3.3 Dietary Intake by Individual Household Members

Surveys of food intakes by individuals are required to demonstrate the influence of the sex and age of household members on household food consumption patterns, to facilitate consumer-demand analysis and market research, and to appraise diets for different sex-age categories of the population. Individual food intake reports also include information about kinds and quantities of foods eaten away from home, which has become increasingly important as the away-from-home food industry has expanded.

Individual intake reports can provide data on the diversity of meal and snack patterns within households and among population subgroups. Nutrient intakes by individuals classified by sex-age groups related to recommended intakes reveal who may require dietary improvement. Such information is particularly important for targeting food assistance and nutrition education programs. Also, the Food and Drug Administration and the Environmental Protection Agency are interested in individuals who may jeopardize their health by extreme usage of particular foods or food components.

The first USDA nationwide survey of food intakes by individual members of households was conducted in spring 1965 as a supplement to the 1965-66 Household Food Consumption Survey (HFCS) (USDA, ARS, 1972a) (Section 1.3.1). Before adding this task to the 1- to 2-hour-long interview in the HFCS 1965-66, the proposed procedures were pilot-tested by USDA staff members in the Washington, D.C. area in 1963 (Burk and Pao, 1976). Results indicated that after completion of the household questionnaire it was feasible to ask the household respondent to recall dietary intake--at home and away from home--by household members for the day prior to the interview. Before 1965, most studies of individual intakes had been carried out in one or several States, often funded under the Research and Marketing Act of 1946. The spring 1965 individual intake survey data on a nationwide basis were found to be very useful as baseline data and brought many requests for enlarging their scope--more intake days per individual, all seasons, and more questions on dietary practices.

Consequently, the scope of the second nationwide survey of dietary intakes by members of households in NFCS 1977-78 was greatly expanded (USDA, SEA, 1980; USDA, HNIS, 1983b, 1984, 1985b) (Section 1.3.1). Three-day food intake reports were collected in 4 seasons for over 30,000 individuals in the 48 conterminous States. Dietary intake information was also collected for the first time from household samples in Hawaii (USDA, SEA, 1981c), Alaska (USDA, SEA, 1981d), and

Puerto Rico (USDA, HNIS, 1982d) and from special samples of low-income and elderly people in the 48 conterminous States. The third nationwide survey of dietary intakes in 1987-88 was designed to include about 15,000 individual participants from an area probability sample of about 6,000 households in the general population and, from a second area probability sample, about 10,000 individual participants from 3,600 low-income households (Peterkin et al., 1988). Most of the procedures used to obtain food intake reports for 3 consecutive days were similar to procedures used in NFCS 1977-78 except for some increased probing and a few changes in questions.

Collecting information on dietary intakes by individuals in households has a number of obstacles. The respondent may not be able to precisely recall and describe foods eaten, especially mixtures that are commercially prepared or eaten away from home. Taking the household respondent as the source of information about food intakes by other members is less satisfactory today than it had been earlier (as in HFCS 1965-66) because families today appear to be eating together or at home less often than in the past.

Interviewing the family together may also be a disadvantage. For instance, someone may be reluctant to divulge before others the intake of certain foods (such as alcoholic beverages or candy) or the skipping of meals. Scheduling all members to be at home during the interviewer's visit is often not possible. Some members, such as children, may be unable to provide all information requested without help from a parent or other caretaker. If the interviewer leaves a schedule for absent members to complete, the helpful explanations and probing of the interviewer will be lost. Especially difficult is an accurate account of amounts eaten--excluding bones and fat not eaten and other leftovers. USDA has provided a set of standard measuring cups, measuring spoons, and a ruler to assist both the interviewers and the respondents in estimating amounts eaten. Since the interview takes place in the home, the set of measuring utensils can be used to measure the capacity or usual fill of glasses, cups, mugs, bowls, and spoons used by household members at meals or for snacks in order to improve reporting of amounts eaten.

Although 3 consecutive days of food intake reports were collected in NFCS 1977-78 and in NFCS 1987-88, some new and potential users of the data, such as health professionals, want a better measure for "usual" intake, specifically intermittent days over a longer period such as 1 year. To meet this expressed need by epidemiologists and others and to provide monitoring of dietary quality of groups at high risk, a panel survey was considered.

In April 1985, the first national USDA survey of dietary intake by individuals, independent of a household food use component, began (Rizek and Posati, 1985). The Continuing Survey of Food Intakes by Individuals (CSFII) was part of the 1981 Joint Implementation Plan for a Comprehensive National Nutrition Monitoring System (Peterkin and Rizek, 1984). A national sample of women from all income levels, 19 to 50 years of age, and their children aged 1 to 5 years made up a core group for which six bimonthly dietary recalls were collected during the year. A second such survey was conducted in 1986. Further details are provided in Section 1.3.1 and published reports (USDA, HNIS, 1985d, 1986a, 1986b, 1987a, 1987b 1987c, 1988a, 1988b, 1989).

Individual food intakes reported in USDA surveys are identified using a comprehensive coding system. Reported intakes are converted into gram-weight equivalents. Then nutrient intakes are calculated by linking each food item through its unique code to its energy and nutrient contents in a nutrient data base developed by HNIS. The major food groups used in reporting are commodity-based as in the U.S. food supply and household food consumption data. For example, major food groups used in NFCS 1977-78 reports were meat, poultry, and fish; milk and milk products; eggs; legumes, nuts, and seeds; grain products; fruits; vegetables; fats and oils; sugars and sweets; nonalcoholic beverages; and alcoholic beverages. Reduction of food intakes into basic food groups, however, is hampered by the multiplicity of mixtures which increasingly characterize individual diets. Survey reports have included such mixtures in the food group containing the main ingredient. Of the 204 grams of average intake from the meat, poultry, and fish group in the NFCS 1977-78, 36 percent (74 grams) consisted of mixtures; the remainder was beef (25 percent), poultry (12 percent), and other meat cuts or products (USDA, HNIS, 1983b). The recent development of a recipe file by HNIS staff for computing nutrient content of mixed dishes has improved the calculation of nutrient contents of mixtures in the CSFII. These systems can be used in the future to report intakes by basic food ingredients as well as by foods as reported.

Information about selected factors having an impact on dietary intakes is part of the questionnaire. These factors include household characteristics such as the location, income, and size and individual characteristics such as pregnancy and lactation status, age, sex, height, weight, activity level, health status, smoking status, special diets, and use of vitamins, minerals, and other supplements. Other lifestyle, environmental, and as yet unknown factors may become important for analysis of dietary intake in the years ahead.

1.2 Recent and Current Perspectives

During the past decade, the demand for more detailed, timely, valid, and reliable data on dietary intakes by individuals has increased considerably. Food production and marketing systems and food assistance and nutrition education efforts have increased in complexity. Furthermore, USDA dietary intake survey data are being used for purposes hitherto unforeseen. In medical and epidemiological research, the association between diet and development of chronic diseases--cancer, cardiovascular disease, osteoporosis, and other health conditions--has received increasing attention. Increases in health-care costs have focused attention on improving nutrition as a means of cutting costs and maintaining good health. These and other concerns, such as the high cost of food assistance programs and the incidence of hunger, culminated in the call for a national nutritional monitoring system.

While the needs for dietary data have increased, so have difficulties in obtaining this information. The number of foods available to respondents has multiplied over the decades. Potential survey respondents have become less accessible for interview because of distrust of strangers, the increased number of women working away from home, and the increased numbers in non-English-speaking ethnic groups (Warwick and Lininger, 1975; National Analysts, 1978; Madow et al., 1983). Such problems must be dealt with while governmental constraints on respondent burden, infringement on privacy, and cost are considered.

Legislation, oversight and review by governmental bodies, and recommendations by expert committees have broadened the objectives, concepts, and approaches of USDA dietary intake surveys. Survey planners at USDA have considered various approaches for development of an effective monitoring system to signal promptly potential nutritional or hunger problems. The CSFII 1985 emphasis on concepts of surveillance and monitoring of diets of subgroups in the U.S. population complements the periodic survey focus on dietary levels, changes, and trends.

1.2.1 Background

At the end of the 1960's, several events contributed to the escalation of public consciousness of U.S. diets and nutritional status. The exposure of hunger in the Mississippi Delta during the spring 1967 investigations by the U.S. Senate Poverty Subcommittee and the publication of "Hunger, USA" by a Citizens' Board of Inquiry disturbed the nation (Goldsmith, 1973). Dietary data from individuals, first collected nationally by USDA in its Household Food Consumption Survey of 1965-66, found mean intakes of some nutrients by some sex-age groups to be well below the RDA (USDA, ARS, 1972a). Public concern led to a Congressional directive in June 1967 to the Secretary of the U.S. Department of Health, Education, and Welfare (USDHEW)—now the U.S. Department of Health and Human Services (USDHHS)--to determine the prevalence and location of serious hunger and malnutrition and health problems in the country. In response, the Ten-State Nutrition Survey was carried out in 1968-70 (USDHEW, 1972). It served as the forerunner of the National Health and Nutrition Examination Survey (NHANES) series at USDHEW (1973). NHANES is primarily health-oriented, providing data from biochemical tests, physical examinations, and anthropometric measurements, as well as dietary data.

Concurrent with the Ten-State Nutrition Survey, the U.S. Senate in 1968 appointed a Select Committee on Nutrition and Human Needs (U.S. Senate Select Committee on Nutrition and Human Needs, 1975a). Senator George McGovern served as its chairman until its termination in 1977. In 1969, the White House Conference on Food, Nutrition, and Health (1970) was called by President Richard Nixon, who appointed Dr. Jean Mayer as chairman (Mayer, 1969). The conference addressed food, nutrition, and health issues being debated at large. At this conference, an expansion of the Food Stamp Program was declared by President Nixon and free school lunches were recommended for needy children. Other recommendations included (1) development of a system for continuing surveillance and monitoring of dietary and nutritional status of the population, especially groups at high nutritional risk, and (2) research directed toward developing more effective methods of obtaining and processing dietary intake information and releasing it rapidly. The 1975 U.S. Senate Committee report on nutrition and health evaluated nutritional surveillance in the United States and included an extensive list of requirements for data from NFCS 1977-78 related to specified problem areas and users (U.S. Senate Select Committee on Nutrition and Human Needs, 1975b, pp. 187-197). The U.S. General Accounting Office (GAO) (1977a, p. 2) observed that "survey uses have evolved beyond simply measuring food consumption and developing food plans. As concerns with nutrition, health, and general physical and mental well-being of the population increase, the need for good baseline reference data grows as well." By 1977, the U.S. Senate Select Committee on Nutrition and Human Needs (1977) felt the nation needed explicit nutrition objectives and issued "Dietary Goals for the United States". A few years later, USDA and USDHHS jointly issued an official set of "Dietary Guidelines for Americans," first in 1980 and a revision in 1985 (USDA and USDHHS, 1980, 1985).

1.2.2 Legislation and Federal Agency Actions

Several Federal agencies have oversight responsibilities to ensure cost-effectiveness and quality of information collected by the Government. The General Accounting Office undertakes investigations at the request of Congress. The Office of Management and Budget must approve detailed plans for surveys by the Federal Government to protect against overburdening respondents and to coordinate the data collected and procedures used in national surveys. The NFCS 1977-78, originally scheduled for 1975-76, was deferred in order to obtain greater Government interagency input so that this one survey could meet data needs of several agencies (USGAO, 1977b, p. 11). Some other agencies having responsibilities for food, nutrition, and/or health include the Food and Drug Administration, Administration on Aging, National Center for Health Statistics, Social Security Administration, Food and Nutrition Service, and Economic Research Service (USGAO, 1977a).

Federal agencies receive authority to act and carry out their functions through legislative acts and directives by the U.S. Congress. In the past decade, Congress has shown concern about the assessment of the nutritional and dietary status of the population and the nutritional quality of the food supply of the United States. Three recent legislative actions related to food and agriculture (Farm Bills) had provisions of importance to the USDA program of nationwide food consumption surveys. The 1977 act specified that plans for a nutritional status monitoring system be developed and submitted to Congress. The 1981 act sought to improve assessment of the dietary status of low-income people in particular. The 1985 act directed that a special sample of low-income individuals be included in the Department's food surveys. The pertinent part of each act is mentioned briefly below, as well as a proposed bill to set up a national nutrition monitoring system. A description of related actions by Federal agencies follows.

1.2.2.1 Legislation

In the Food and Agriculture Act of 1977 (U.S. Congress, 1977), nutritional status monitoring was singled out for special attention as Congress mandated in Public Law 95-113, Section 1428, that USDA and USDHEW (now USDHHS) jointly formulate and submit to Congress a proposal for a Comprehensive Nutritional Status Monitoring System (NSMS). The NSMS was to provide an assessment system consisting of periodic surveys and continuous monitoring to determine the extent of risk of nutrition-related health problems in the country, which population groups or areas faced greatest risk, and the likely causes of risk and changes in the risk factors over time. A surveillance system was specified, and program evaluations were spelled out. This act, which expired at the end of 4 years, provided the impetus for the CSFII, which began in 1985.

The Agriculture and Food Act of 1981 (U.S. Congress, 1981) directed the Secretary of Agriculture to carry out a pilot program to test various methods of measuring dietary status of low-income people on a continuing basis. Special emphasis was to be placed on people participating in or eligible to participate in the Food Stamp Program. In response, USDA sponsored a methodological low-income pilot study which is described in Chapter 8.

In the Food Security Act of 1985 (U.S. Congress, 1985), part of the 1985 Farm Bill, the Secretary of Agriculture was directed to include a sample of low-income individuals in the Department's continuing survey of food intakes by individuals and nationwide food consumption surveys. Information on food purchases and other household expenditures by low-income individuals was to be collected as well. Moreover, the Secretary was to continue to maintain the Department's nutrient data base and to encourage research by public and private entities relating to effective standards, methodologies, and technologies for accurate assessment of nutritional and dietary studies (Section 1711). Special samples of low-income individuals were included in CSFII 1985 and 1986 as well as NFCS 1987-88. Extensive information on food purchases and certain household expenditures was obtained in NFCS 1987-88. Research in food composition and survey methodology continues.

Legislation to mandate a national nutrition monitoring system has been considered by the U.S. Congress each year since 1984. The 1984 bill, identified as the National Nutrition Monitoring and Related Research Act, was sponsored by Congressmen George E. Brown, Doug Walgren, and Buddy MacKay, members of the U.S. House of Representatives, Subcommittee on Science, Research, and Technology. This Subcommittee had held oversight hearings since 1977 on the progress of developing and implementing a nutritional status monitoring system (U.S. House of Representatives, 1979). Congressman Brown (1984) stated that the National Nutrition Monitoring System (NNMS) should include (1) survey of special subpopulations, (2) continuous collection and analysis of dietary and nutritional data from statistically representative samples of the population for early warning of nutritional problems, and (3) research required for development of improved methodologies and uniform indicators and standards for assessment and analyses of dietary and health status. Brown also pointed out that an NNMS could examine linkages between food consumption patterns, nutritional status, and health status. Events leading to the introduction of this legislation have been reviewed by Ostenso (1984). The 1981 Joint Implementation Plan for a Comprehensive National Nutrition Monitoring System, described below, provided the basis for this bill.

Senate bill 1081 and House bill 2151 entitled National Nutrition Monitoring and Related Research Act of 1987 sought to establish a coordinated National Nutrition Monitoring and Related Research Program, and a comprehensive plan for the assessment of the nutritional and dietary status of the U.S. population and the nutritional quality of the U.S. food supply, with provision for the conduct of scientific research and development in support of such a program and plan. Hearings on the bill were held in the spring and fall of 1988. The bill was vetoed by President Reagan in November 1988.

1.2.2.2 Federal Agency Actions: National Nutrition Monitoring System

USDA and USDHHS responded to directives in legislation by jointly submitting to Congress (1) a proposal for a nutritional status monitoring system in 1978 (USDA and USDHEW, 1978), (2) a plan for its implementation in 1981 (USDHHS and USDA, 1981), and (3) an operational plan in 1987 (USDHHS and USDA, 1987). In 1986, a Joint Nutrition Monitoring Evaluation Committee submitted to Congress a progress report on nutrition monitoring in the U.S. (USDHHS and USDA, 1986).

In response to the Food and Agriculture Act of 1977, USDA and USDHEW (1978) formulated and the Secretaries jointly submitted the Comprehensive Nutritional Status Monitoring System Proposal to Congress in May 1978. It was noted in the proposal that national surveys in the past had identified and documented nutritional problems in the country and that the Government had developed a number of programs to improve the nutrition and health of people who were poor, who underutilized health care facilities, and who lacked knowledge of healthful dietary practices. However, the proposal stated that the needs, resources, and results of the variety of programs require a coordinated approach for effective monitoring and evaluation on a continuing basis; hence, activities for that purpose were proposed.

The goal of the proposed NSMS was "to enhance the health of the American people by establishing a national system which will monitor the nutritional status, nutritional quality of the food supply, dietary practices, nutrition knowledge and attitudes, and effectiveness of food and nutrition programs for purposes of establishing public policy, determining research priorities, program planning, and assuring effective and efficient use of national resources" (USDA and USDHEW, 1978, p. 2). The NFCS and NHANES were to be the main components in the system, providing data about the nutritional status of the U.S. population and about numerous factors that influence nutrition. However, the current system was seen as deficient in (1) nutritional and dietary assessment methods, (2) evaluation of nutrition intervention programs, (3) timeliness of data, and (4) coverage of high-risk population groups and geographic areas.

Specifically, the 1978 proposal stated that the system should encompass four major subject areas--(1) nutritional and dietary status, (2) nutritional quality of foods, (3) dietary practices and knowledge, and (4) impact of nutritional intervention--with a coordination mechanism involving both USDA and USDHEW. Topics treated in detail under the subject of nutritional and dietary status were USDA and USDHEW collaboration in conduct of assessment surveys, surveillance, epidemiologic research, and methodologic research. Methodological research was to address improvement of methods for measuring indicators of nutrition and dietary status, more complete validation and examination of current dietary survey methods, and examination of a broad range of alternative approaches in obtaining dietary information. In the area of dietary practices and knowledge, surveys of food intake by individuals were seen to require development of "more timely, accurate, and cost-effective means of measuring food intake and dietary practices" and development of "a model system for integration of data on nutritional status and dietary practices" (USDA and USDHEW, 1978, p. 23). Also mentioned as needing attention was the noncomparability of statistical data collected by many different groups.

After receiving the 1978 proposal for a comprehensive NSMS, the U.S. House of Representatives, Committee on Science, Research, and Technology requested that the proposal be reviewed by GAO. GAO recommended development of a plan for implementing the proposed monitoring system. This plan, the 1981 Joint Implementation Plan for a Comprehensive National Nutrition Monitoring System (NNMS) was transmitted to Congress on September 28, 1981, by the Secretaries of USDA and USDHHS (USDHHS and USDA, 1981). The Secretaries stated that they expected implementation of the central features of the plan by 1987.

The Joint Implementation Plan for NNMS included goals, scope, uses, and current activities in nutrition monitoring, plans to be implemented and plans to be deferred, and a calendar of events. NFCS and NHANES formed the core of the system. Two primary objectives of the implementation plan were achievement of the best possible coordination of NFCS and NHANES and development of a reporting system to present findings from NFCS, NHANES, and other Federal monitoring efforts in periodic reports to the U.S. Congress.

The NNMS included five goals adapted from the 1978 Comprehensive NSMS Proposal. These goals were stated as follows: (1) "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; (2) 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; (3) Identify high-risk groups and geographic areas, as well as nutrition-related problems and trends in order to facilitate prompt implementation of nutrition intervention activities; (4) Establish national baseline data and develop and improve uniform standards, methods, criteria, policies, and procedures for nutrition monitoring; and (5) Provide data for evaluation of 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" (USDHHS and USDA, 1981, p. 10).

The NNMS activities were to involve five categories of measurements. These were (1) health and nutritional status measurements, (2) food consumption measurements, (3) food composition measurements, (4) dietary knowledge and attitudes assessment, and (5) food supply determinations. Current efforts to obtain the measurements were delineated; and deficiencies, progress, and deferrals were identified.

The NNMS also called for an evaluation and reporting system to integrate into common reports results from the component nutrition monitoring activities by a USDHHS-USDA Joint Nutrition Monitoring Evaluation Committee (JNMEC). The Committee was to develop reports on the nutritional status of the population to be submitted to Congress jointly by the two Departments every 3 years starting in fiscal year 1984. The first report was issued in 1986 (USDHHS and USDA, 1986). Future JNMEC reports are scheduled to be forwarded to Congress in 1989, 1992, and 1995.

In 1987, the report, Joint Operational Plan for the National Nutrition Monitoring System, was prepared and submitted to Congress by USDHHS and USDA (USDHHS and USDA, 1987). It defined goals for the operational phase, summarized progress achieved during the implementation phase, and presented plans for the operational phase into the mid-1990's.

Goals for the operational phase, set forth in the first chapter of the report, included two expanded goals of the implementation plan and one new goal. One continuing but expanded goal was to achieve a comprehensive system through coordination among NNMS components by including all appropriate nutrition monitoring activities, improving coverage of major population groups at risk, improving temporal coverage (continuous monitoring of diet and nutritional status of the population by having at least one national survey in the field every year), and improving comparability among surveys (related to designs of surveys by USDA and USDHHS and exploration of developing core data sets). A second such goal was to improve information dissemination and exchange with increased emphasis on timely reporting and interpretation of data, developing comparable reports and tape documentation, increasing relevance and usefulness of the NNMS for meeting decision-making needs of policy makers and program managers, and increasing information exchange between data users and generators.

The new goal for the operational phase was to improve the research base for nutrition monitoring in two areas. One area encompasses methodological research relevant to the conduct of surveys and surveillance activities, such as development of the most appropriate dietary interview instrument to measure usual intake in large, cross-sectional surveys. The second area involves a broader scope of research, as indicated in a 5-year plan by the Interagency Committee on Human Nutrition Research (1986). These research topics include nutrition requirements through the life cycle; nutrient content of foods, bioavailability of nutrients, and nutrient interactions; the role of nutrition in the etiology, prevention, and treatment of chronic diseases and conditions; energy regulation, obesity, and related eating disorders; and nutrition education. Thus, NNMS aims "to strengthen the research base for nutrition monitoring by identifying and elaborating the nutrition monitoring research needed to improve the conduct of its activities and interpretation of its data" by urging or initiating research efforts that will improve the scientific basis for monitoring (USDHHS and USDA, 1987, p. 6).

Achievements in the implementation phase, 1981 through 1986, were reviewed in the second chapter of the operational plan. They included improved coverage of Hispanic people by USDHHS, National Center for Health Statistics (NCHS), in a special survey, Hispanic Health and Nutrition Examination Survey (HHANES) in 1982-84 (USDHHS, NCHS, 1985). HNIS surveyed diets of households in Puerto Rico in 1984 and assessed their nutrient contents (USDA, HNIS, 1985c). The CSFII 1985 and CSFII 1986 included national samples of low-income households, and reports of food and nutrient intakes were published (USDA, HNIS 1986a, 1987c, 1988a, 1989). Temporal coverage was improved with continuous monitoring by means of the CSFII 1985 and 1986. Comparability among surveys was advanced by an agreement to use the USDA food composition data base in both NCHS and HNIS surveys. A joint HNIS-NCHS task force studied definitions and wording of sociodemographic and related questions planned for NFCS 1987-88 and NHANES 1988-94 for ways to attain common definitions or linkage through common questions. Other examples were also cited to show that progress had been made toward attaining goals previously specified.

In the last chapter of the operational plan, activities were proposed for achieving the goals specified for 1987-96. A few examples of planned activities are mentioned briefly here. Efforts to attain the first goal set forth in Chapter 1 include preparation of an inventory of Federal surveys and surveillance activities related to food, nutrition, and nutrition-related health conditions. This inventory is to provide a basis for integrating and coordinating relevant information sources. Gaps in coverage of populations at risk are to be identified and remedied. Working groups within USDA and USDHHS are to develop solutions to maximize comparability among the core surveys while retaining their separate objectives. The second goal is to be met by continuing the reporting system to Congress; releasing data from NNMS activities in a timely manner; developing common formats for reports, tape documentation, tables, and data categories; and presenting data in ways that will facilitate comparisons, such as using identical age ranges. Activities to achieve the third goal include continuing research by agencies responsible for conducting surveys and surveillance.

1.2.3 Reports by Expert Committees

Four expert committees have provided comprehensive evaluation of dietary intake data collection methods and suggestions for improvements. USDA provided background data to these studies. All four committee reports have been published. Some major points in each report are described below.

1.2.3.1 "Assessing Changing Food Consumption Patterns"

A Committee on Food Consumption Patterns established in 1978 by the Food and Nutrition Board of the National Research Council, National Academy of Sciences, reviewed sources of data on food consumption and recommended a system for integrating those data with data on nutrition and health status (National Research Council, 1981). This activity was carried out under contract with the Food and Drug Administration because of its concerns with the safety and nutritional efficacy of the food supply and linkage between food consumption and health. The Committee's report, "Assessing Changing Food Consumption Patterns," spurred the search for improved methods of surveying food consumption of the U.S. population (National Research Council, 1981).

The Committee noted several shortcomings of traditional methods of collecting food consumption data: (1) long periods between national dietary surveys and delays in reporting results, (2) lack of specific data on smaller geographic areas than regions and on high-risk subpopulations, (3) lack of validation of some methods, and (4) lack of standardized instruments and uniform indicators. These deficiencies prevented direct comparisons or combining of data from the various national surveys such as NHANES and NFCS. The Committee proposed an overall system which would continuously monitor the nutritional adequacy and health status of the population and its relationship to the food supply and food practices of that population. The overall system was to integrate data from three subsystems: (1) data on food intake by individuals from stratified probability samples of the U.S. population, (2) nutritional and health status data on comparable or the same samples, and (3) aggregated food data from government or commercial sources.

The Committee raised a number of methodological issues and made recommendations for their resolution. One issue concerned validity of relationships between dietary intake and nutritional status of the population. For nutritional status studies, the "usual" intake of food, "usual" composition of foods, "usual" bioavailability of nutrients, and "usual" nutrient requirements of the individual are pertinent concepts. A generally accepted definition of "usual," however, has yet to be formulated and a specified time span validated. The Committee took the "average value" approach with a time period of at least a few weeks. A definition of "usual" is required for statistical analyses based on bivariate distributions of intakes and requirements among individuals in the population to predict prevalence of individuals with "usual" intakes below requirements, as discussed in the report.

This report also recommended that collection and processing of data utilize a "moving average" basis. The suggested timeframe for data collection from a statistically adequate sample was 5 years. Information would be collected from 20 percent of the sample each year, and the annual processing and analyzing would provide trend information and "early warning" of nutritional problems. Data from the preceding 5 years would be updated annually using the "moving average" concept.

The technique recommended for collecting food intake information from individuals was to include four replicated 24-hour recalls during 1 year on the same individuals administered by trained interviewers using standardized instruments, probes, and food models. This approach was seen as providing a measure of "usual" intake as well as measures of intraindividual and interindividual variation.

In practice, no one method is without limitations so, according to the report, the best method may require adaptation to meet the needs of a particular study. Combinations of 24-hour recalls with 3-day food records, food frequency questionnaires, or extended diary records may be considered. The Committee identified a need "to develop and implement procedures to determine the validity of various methods of assessing dietary intakes, including combinations of methods" (National Research Council, 1981, p. 25). The report also noted other issues requiring research: (1) standardization of portion size estimates and food item descriptions, (2) capability of the homemaker to report for other family members, and (3) the impact of interviewer differences.

1.2.3.2 "National Survey Data on Food Consumption: Uses and Recommendations"

The Coordinating Committee on Evaluation of Food Consumption Surveys was established by the Food and Nutrition Board, at the request of HNIS, to review uses of NFCS data and to make recommendations "to facilitate wider application of the resulting survey data" (National Research Council, 1984, p. 1). The Committee was asked by the National Center for Health Statistics of USDHHS to apply the same scrutiny to the dietary component of NHANES. A workshop in June 1983 and a symposium in October 1983 were arranged for current and potential users of the data to discuss their needs. The Committee used the information presented by participants along with information from other sources in making recommendations for improving survey data as reported in "National Survey Data on Food Consumption: Uses and Recommendations" (National Research Council, 1984).

NFCS data are used primarily for food- and nutrition-related issues; whereas NHANES data are used primarily for health- and nutrition-related issues. However, joint use of data from the two surveys permits a broader view, spanning food consumption, nutrient intake, and nutritional and health status. This approach was seen as being more effective if the survey data bases were closely comparable and compatible. Although each survey must also serve its own important and distinctive purposes, a national nutritional monitoring system would require this broad coverage.

The Committee examined the wide variety of uses of the two surveys and strongly recommended that the current system of two separate national surveys be continued. It noted that the NFCS sample was less clustered and thus more representative of the population than the NHANES sample, which must be clustered around the clinical examination centers (p. 58, 71). To merge the two surveys would require NFCS to interview at least twice as many people as NFCS did in 1977-78 to obtain the same precision of mean estimates. Thus, the two separate surveys were likely to cost less than a single merged survey.

While recommending that both surveys continue to collect dietary intake information, the Committee pressed for development and implementation of a common, identical methodological core in the surveys, a compatible sampling design, and common population descriptors. They noted that categories of population descriptors should be compatible in reports from the two surveys including geographic areas, sex-age groups, income levels, and years of education. The limited overlap in the data from the two surveys was seen as providing necessary and important points for linkage between the data bases. The Committee emphasized that evaluation and study of survey methods be continuous.

A number of the recommendations by the Committee focused on specific areas; for example, survey design, food intake measurement methods, composition of foods, and population information. In the survey design area, the report recommended that the dietary intake component in both surveys be redesigned as continuous annual surveys with data collection for the total sample distributed over a number of years (5 years was mentioned) and replicated data be collected. The continuous data collection was to be coupled with continuous data processing, release of tapes, and annually updated reporting ("moving average" concept). These changes would permit timely release of data that would lead to wider and more effective use of those data. Although replicated data collection with 3 data-days as a minimum was recommended, the Committee advocated use of a single method, such as recall or record, rather than a combination of both. The 1-day intake data were seen to yield group mean intakes across population groups, and the replicated 3-day data to yield distributions of intakes within population groups.

Despite use of the 1-day dietary recall, food intake methods in the two core surveys at that time differed with respect to data collection technique, data bases used, and coding procedures. The Committee recommended that core elements in the 1-day recall methods in the two surveys be standardized --interviewing protocol, coding of food intake data, and use of a common food composition data base. These changes would contribute to dietary corroboration and greater confidence when data from the two surveys that do not overlap are linked.

1.2.3.3 "Nutrient Adequacy: Assessment Using Food Consumption Surveys"

The Subcommittee on Criteria for Dietary Evaluation was formed from the Coordinating Committee on Evaluation of Food Consumption Surveys of the Food and Nutrition Board to study criteria for evaluating dietary intake data (National Research Council, 1986). USDA requested the study because the Nationwide Food Consumption Surveys collect information on dietary intake, which is used to evaluate the nutrient adequacy of diets in the U.S. population. The RDA have been the basis for determining whether nutrient intake was adequate. Margins of safety are included in the RDA for a nutrient in order to meet the needs of most individuals. Cut-off points, such as two-thirds of the RDA for a nutrient, have frequently been used by nutritionists to estimate the prevalence of inadequate intakes. The Subcommittee decided against recommending multiple levels of requirement or proposing criteria reflecting a degree of risk associated with intakes of a nutrient that were less than the full RDA.

A different approach based on the probability that a specific nutrient intake might be inadequate to meet an individual's need was recommended by the Subcommittee in their report "Nutrient Adequacy: Assessment Using Food Consumption Surveys" (National Research Council, 1986). The probability approach, however, requires knowledge of the mean requirements for each nutrient and an estimate of the variation of requirements within population subgroups. To facilitate application of the probability approach, the Subcommittee recommended changes in the design of the surveys including repeated observations on individual 1-day intakes, preferably using the same method, and on nonadjacent days.

Data from CSFII 1985 and 1986 and methodology studies preceding them have been used to study the interindividual and intraindividual variation of intakes. The National Research Council has been asked to provide needed information about variation in requirements in conjunction with the development of the next RDA. However, the lack of knowledge of mean requirements and their variation precludes the general use of the probability approach at this time.

1.2.3.4 "Guidelines for Use of Dietary Intake Data"

An ad hoc Expert Panel on Guidelines for Use of Dietary Intake Data, selected by the Life Sciences Research Office of the Federation of American Societies for Experimental Biology on request from the Food and Drug Administration, developed guidelines for the interpretation of dietary intake data (Anderson, 1986).

General guidelines relevant for all areas of study were given regarding the definition of the problem, sampling, methods for collection of dietary intake data, and analysis of data. Guidelines were given for specific areas of study. These study areas were (1) prevalence of consumption of particular levels of foods or food components; (2) comparison of intakes of different groups within the U.S. population; (3) time trends in consumption of foods or food components; and (4) relationship of intake of a food or food component to a given health outcome.

The Panel considered collection of dietary intake information from individuals and the great impact of data collection methods on subsequent interpretation of the data. Statistical issues related to interpretation of the data were also discussed, including systematic and random error in measurement, intraindividual variation, imputation of missing values, and the effect of multicollinearity on statistical estimates. The guidelines developed by the Panel were reported in "Guidelines for Use of Dietary Intake Data" (Anderson, 1986) and are useful to both survey planners and users of dietary intake data.

1.3 Appendix: USDA Food Consumption Surveys

USDA food consumption surveys have included nationwide and special-purpose studies. The underlying objective of the surveys was initially to meet the Department's needs for food consumption data at the household level for consumer education and for planning food production and food marketing. Beginning in 1965, the scope of the surveys was broadened to include individual intake data for food eaten at home and away from home because of the need for detailed data by sex-age groups as well as by socioeconomic characteristics.

1.3.1 Nationwide Food Consumption Surveys Conducted by the U.S. Department of Agriculture, 1936-88

From 1936 through 1988, USDA conducted nine nationwide surveys of food consumption. Noncontiguous areas--Alaska, Hawaii, and Puerto Rico--have been sampled and surveyed separately. Separate samples of the low-income population and of particular age groups, such as elderly persons, have been surveyed. In the case of the first nationwide effort, the food consumption survey was part of a broader project.

The following section summarizes the national food consumption surveys conducted by USDA since 1936. Original reports that gave results of the surveys are listed.

Consumer Purchases Study, 1935-37

H. K. Stiebling, D. Monroe, C. M. Coons, E. F. Phipard, and F. Clark. 1941. Family Food Consumption and Dietary Levels, Five Regions, Consumer Purchases Study, Farm Series. U.S. Department of Agriculture, Bureau of Home Economics, Miscellaneous Publication No. 405, 393 pp.

H. K. Stiebeling, D. Monroe, E. F. Phipard, S. F. Adelson, and F. Clark. 1941. Family Food Consumption and Dietary Levels, Five Regions, Consumer Purchases Study, Urban and Village Series. U.S. Department of Agriculture, Bureau of Home Economics, Miscellaneous Publication No. 452, 268 pp.

In the Consumer Purchases Study of 1935-37, food consumption was one part of a broad investigation of family income and expenditures. Farm counties, villages, small cities, middle-sized cities, and large cities were studied within five geographic regions. The Bureau of Home Economics, USDA, was in charge of field work in farm counties, villages, and some small cities, while the Bureau of Labor Statistics was responsible for other cities.

In 1936-37, supplementary schedules were used to collect household food use information from 10,973 farm households and 9,493 village and city households for a total of 20,466 households. Two kinds of schedules were used: a food checklist (food list-recall) or a food inventory record. Among the farm households, 9,650 provided a food checklist and 1,323 provided a food inventory record; among the village and city households, 7,862 provided a checklist and 1,631 provided an inventory record. Special agents assisted with inventories and supervised record keeping. To be eligible for the food consumption survey, a household had to include a husband and wife, both native born and white (except in the Southeast), and not on relief during the past year. These families were generally better off than the general population.

The two types of 7-day food schedules, one recall and one current recording, did not agree on quantities of food reported because of a number of factors, but differences were in the expected direction. The food inventory record tended to give higher quantities than the food checklist. It was estimated that fewer than one-fifth of the families had diets that met recommendations for the seven nutrients considered, and one-third of the diets were classed as "poor."

Family Spending and Saving in Wartime, Spring 1942

U.S. Department of Agriculture, 1944. Family Food Consumption in the United States, Spring 1942. Bureau of Human Nutrition and Home Economics in cooperation with the U.S. Department of Labor, Bureau of Labor Statistics, Miscellaneous Publication No. 550, 157 pp.

This survey was a supplemental part of the Family Spending and Saving in Wartime study conducted in April through June 1942 in cooperation with the Bureau of Labor Statistics. Its primary purpose was to provide estimates on expenditures and savings by income class and community type for use in policy decisions regarding price wage controls, rationing, food production and distribution, and other forms of war financing.

The sample size was 3,060 housekeeping families and single persons. The method of drawing the sample was changed from earlier procedures in accordance with the latest developments in sampling theory to ensure the greatest possible reliability and efficiency and the inclusion of all segments of the population--such as families on relief, foreign-born, and single consumers. Three separate stratified, cluster samples were drawn--1,300 families in cities, 1,000 in rural nonfarm areas, and 760 on farms. Of these, 1,118 families in cities, 900 in rural nonfarm areas, and 730 on farms participated (U.S. Department of Labor, 1945, p. 1; USDA, BHNHE, 1943, p. 135). Appropriate weighting had to be used to combine the urban and rural samples to obtain estimates for the United States. When an eligible family did not provide a schedule, a substitute family was specified. Local residents were selected and trained as interviewers by supervisors from the Washington office.

The 7-day recall of food consumption at home (including alcoholic beverages) by the household was entered on the food list-recall schedule, which included about 200 different food items. The schedule included food bought in the last 7 days and food consumed in the last 7 days. The 1941 RDA were used to evaluate the nutrient content of diets; caloric amounts recommended for moderately active men and women were 3,000 and 2,500 kilocalories, respectively. The spring 1942 diets had a higher average content of food energy and seven nutrients than diets in the 1936-37 survey.

Food Consumption of Urban Families in the United States, 1948

F. Clark, J. Murray, G. S. Weiss, and E. Grossman. 1954. Food Consumption of Urban Families in the United States...with an Appraisal of Methods of Analysis. U.S. Department of Agriculture, Agricultural Research Service, Home Economics Research Branch, Agriculture Information Bulletin No. 132, 203 pp.

Information on food consumption by urban families was collected in three surveys, which yielded 4,489 schedules by housekeeping households of two or more persons. The number of eligible households in these samples was 5,681. Housekeeping households had at least two persons, each of whom ate 10 or more meals at home during the week prior to interview. The surveys were (1) a nationwide survey of families in spring 1948 (1,558 schedules), (2) a survey of families in four cities (Birmingham, Alabama; Buffalo, New York; Minneapolis-St. Paul, Minnesota; and San Francisco, California) in winter 1948 (1,066 schedules), and (3) seasonal surveys in the same four cities in spring and summer 1949 (1,865 schedules). "Repeat" families from four cities provided schedules for 2 or 3 weeks at different seasons of the year. The seasonal samples in the cities were restricted to families having 0 to 2 children aged 2 to 15 years in order to have more homogeneous groups which made smaller samples feasible. No substitutions were allowed in the field, but allowances were made in drawing the sample based on expected response rates.

Use of food by the household was obtained using the detailed food list-recall schedule. Information on alcoholic beverages was not requested. In two seasonal samples, the homemakers were asked to recall their dietary intakes during the 24 hours prior to interview or to provide family menus for 1 day. Interviewers were selected locally and trained by USDA staff members, who also maintained field offices in the four cities or served as traveling troubleshooters during field operations. Interviewers sent completed schedules to field offices for review, editing, and coding.

Food consumption at home in 1948 was higher for most food groups than in 1942. For most food groups, seasonal differences in consumption were relatively small. Expenditures for food were higher for families living in the North and West than for those living in the South.

Food Consumption of Households in the United States, Spring 1955

U.S. Department of Agriculture. 1956. Food Consumption of Households in the United States. Agricultural Research Service and Agricultural Marketing Service. Household Food Consumption Survey 1955, Report No. 1, 196 pp.

__________. 1957. Dietary Levels of Households in the United States. Agricultural Research Service and Agricultural Marketing Service. Household Food Consumption Survey 1955, Report No. 6, 68 pp.

This household food consumption survey was conducted in April through June 1955 and was the most comprehensive food survey undertaken to that time. Data were collected and tabulated by a private firm, National Analysts, under contract with USDA. USDA designed and analyzed the sample. The survey provided current information for use in administration of public programs affecting food supply, distribution, and consumption and for use in educational and research programs.

This survey was based on a national probability sample of 6,060 housekeeping households of one or more persons. The eligible sample numbered 6,792 households. Supplementary rural farm households were included in the sample to assure adequate coverage of this sector. Hence, the sample was divided in two parts: the basic part, 4,556 households, was a national, self-weighting, area probability sample; the supplementary part, 1,504 farm households, was selected in the same manner. No substitutions were provided for nonparticipating households. The sample permitted grouping of households by four regions, by three urbanizations within regions, and by several income classes within region-urbanization categories. Trained interviewers used the food list-recall method to obtain information on foods used at home during the survey week. Information on alcoholic beverages included only cost of purchases, not quantities.

The 1955 survey found relatively little change in urban dietary levels since the 1948 survey. About 60 percent of the diets in 1955 were rated "good." About 10 percent of the households had diets that could be classed as "poor" by standards used for the 1936-37 survey. In all, 17 reports were published in this series, including reports for regions, home freezing and canning, food production for home use, and home baking.

Food Consumption by Households in the United States, 1965-66

U.S. Department of Agriculture. 1968. Food Consumption of Households in the United States, Spring 1965. Agricultural Research Service, Consumer and Food Economics Research Division. Household Food Consumption Survey 1965-66, Report No. 1, 212 pp.

________. 1969. Dietary Levels of Households in the United States, Spring 1965. Agricultural Research Service, Consumer and Food Economics Research Division. Household Food Consumption Survey 1965-66, Report No. 6, 117 pp.

________. 1972. Food and Nutrient Intake of Individuals in the United States, Spring 1965. Agricultural Research Service, Consumer and Food Economics Research Division. Household Food Consumption Survey 1965-66, Report No. 11, 291 pp.

________. 1972. Food Consumption of Households in the United States, Seasons and Year 1965-66. Agricultural Research Service, Consumer and Food Economics Research Division. Household Food Consumption Survey 1965-66, Report No. 12, 217 pp.

________. 1974. Dietary Levels of Households in the United States, Seasons and Year 1965-66. Agricultural Research Service, Consumer and Food Economics Division. Household Food Consumption Survey 1965-66, Report No. 18, 191 pp.

The Household Food Consumption Survey was conducted in all four seasons of the year, April 1965 through March 1966. In addition, information on dietary intake by individuals in households was obtained during the first quarter. A major purpose of the survey was to compare current food consumption with that in earlier surveys.

The survey sample included 18,890 households; 15,112 housekeeping households of one or more persons participated. Of these, one-half (about 7,500) were interviewed in the first quarter; the other half was distributed equally (about 2,500) among the other three quarters. The sample design provided for a national self-weighting basic sample with a supplementary farm sample, which overweighted farm households by about five to one. The farm household universe was relatively small; and if represented in its true proportion, there would have been too few for reliable analysis. No substitutions were provided for the 20 percent of eligible households that did not participate.

Data collection, review, editing, coding, keying, and transfer to tape were done under contract with private firms. The food list-recall method was used to obtain information, usually from the homemaker, on kinds, quantities, and cost (if purchased) of food used by the household during the 7 days prior to the interview. After completing the household questionnaire, the homemaker was asked to recall the dietary intakes of household members including food at home and away from home for the preceding day. All household members under 20 and over 64 years of age were included, but only one-half of the remaining adults were surveyed. One-day diets for 14,519 men, women, and children of all ages were reported.

Comparison of results on household food consumption with the earlier survey showed that based on nutrient values of food used, fewer households had good diets in 1965 (50 percent of diets were rated "good") than in 1955 (when 60 percent were rated "good"). Household diets were rated "good" if diets met the RDA for the seven nutrients evaluated. A total of 18 reports were published, including those for regions.

Nationwide Food Consumption Survey, United States, 1977-78

U.S. Department of Agriculture. 1979. Money Value of Food Used by Households in the United States, Spring 1977. Science and Education Administration, Human Nutrition Center, Consumer and Food Economics Institute. Nationwide Food Consumption Survey 1977-78, Preliminary Rep. No. 1, 17 pp.

________. 1980. Food and Nutrient Intakes of Individuals in 1 Day in the United States, Spring 1977. Science and Education Administration, Human Nutrition, Consumer Nutrition Center. Nationwide Food Consumption Survey 1977-78, Preliminary Rep. No. 2, 121 pp.

________. 1981. Nutrient Levels in Food Used by Households in the United States, Spring 1977. Science and Education Administration, Human Nutrition, Consumer Nutrition Center. Nationwide Food Consumption Survey 1977-78, Preliminary Rep. No. 3, 16 pp.

________. 1982. Food Consumption: Households in the United States, Spring 1977. Human Nutrition Information Service, Consumer Nutrition Center. Nationwide Food Consumption Survey 1977-78, Report No. H-1, 296 pp.

________. 1983. Food Consumption: Households in the United States, Seasons and Year 1977-78. Human Nutrition Information Service, Consumer Nutrition Division. Nationwide Food Consumption Survey 1977-78, Report No. H-6, 309 pp.

________. 1985. Dietary Levels: Households in the United States, Spring 1977. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey 1977-78, Report No. H-11, 188 pp.

________. 1983. Food Intakes: Individuals in 48 States, Year 1977-78. Human Nutrition Information Service, Consumer Nutrition Center. Nationwide Food Consumption Survey 1977-78, Report No. I-1, 617 pp.

________. 1984. Nutrient Intakes: Individuals in 48 States, Year 1977-78. Human Nutrition Information Service, Consumer Nutrition Division. Nationwide Food Consumption Survey 1977-78, Report No. I-2, 439 pp.

________. 1985. Food and Nutrient Intakes: Individuals in Four Regions, 1977-78. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey 1977-78, Report No. I-3, 534 pp.

The NFCS, conducted in April 1977 through March 1978, was the most comprehensive household food consumption survey ever conducted by USDA. NFCS 1977-78 was the first USDA survey to collect 3 days of dietary intake information from individual members of the households and to survey individual intakes during all seasons of the year. Household samples were not restricted to housekeeping households, although published reports on household food use excluded the approximately 6 percent that were not housekeeping households.

The sample was designed and the data collected and processed by National Analysts under contract with USDA. USDA specified information to be collected, provided technical information, and monitored all aspects of the contract.

The NFCS basic sample was designed to be a self-weighting, multistage, stratified area probability sample expected to yield 15,000 households of one or more persons in the 48 conterminous States. The sample selected included 24,408 occupied household units. Of these occupied units, an unweighted count of 14,964 households completed interviews and 14,930 were used. During each quarter, about 3,750 households were interviewed using an interpenetrating sample design which provided four independent seasonal samples. Over the year, 30,770 individuals (of the 44,169 eligible) provided at least 1 day of usable intake data.

Five supplementary surveys were also conducted. These surveys and the numbers of households and individuals eligible, interviewed, and providing usable data are given in Table 1.1.

Methods for collecting data on household food use were generally similar to those in the 1965-66 survey with several exceptions. An advance contact was made with each household at least 7 days prior to the interview asking that grocery receipts, shopping lists, menus, and other reminders of food used during the week be kept to help in recalling foods used during the week prior to interview. The household component of the interview, conducted in the home, took an average of about 1-1/2 hours to complete. Information on dietary intake was collected from all members of the household in all five supplementary surveys and in the spring segment of the basic survey. In the following three seasons of the basic survey, all household members under 19 years of age were asked to provide dietary intake

Table 1.1--Supplementary surveys in Nationwide Food Consumption Survey, 1977-78

Survey	Households			Individuals		
	Occupied units	Interviews		Eligible respondents	At least 1 intake day	
		Completed	Used		Completed	Used
	Number					
U.S. Elderly[1].....	9,663	4,946	4,914	9,280	8,080	8,036
U.S. Low-income...	28,909	4,650	4,623	16,208	13,553	12,847
Puerto Rico.......	3,908	3,074	3,040	12,075	8,426	7,950
Alaska...........	2,300	1,133	1,131	3,374	2,395	2,393
Hawaii...........	2,291	1,260	1,256	4,255	3,094	3,086

[1]Households with at least 1 member older than 64 years.

information, but only half of those 19 years and older were included.

Food intake, both at home and away, was obtained for 3 consecutive days (1-day interviewer-administered recall, plus a 2-day self-administered record) in all surveys except the supplementary survey of individuals 65 years and older, in which only a 1-day recall was administered. The interviewer gave each household a set of measuring cups and spoons and a ruler plus a food instruction leaflet for use in estimating amounts and describing foods eaten. The interviewer returned to pick up and review the intake records.

In the spring 1977 NFCS, nutrient levels of home food supplies provided the RDA for nutrients in more households than in the spring 1965 survey (55 percent versus 50 percent)--differences that may also have reflected changes in RDA (1963 and 1974) and nutrient data bases used in the two surveys. In all, 13 preliminary reports and 18 final reports were published.

Continuing Survey of Food Intakes by Individuals, 1985

U.S. Department of Agriculture. 1985. Women 19-50 Years and Their Children 1-5 Years, 1 Day, 1985. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 85-1, 102 pp.

________. 1986. Low-Income Women 19-50 Years and Their Children 1-5 Years, 1 Day, 1985. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 85-2, 186 pp.

________. 1986. Men 19-50 Years, 1 Day, 1985. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 85-3, 94 pp.

________. 1987. Women 19-50 Years and Their Children 1-5 Years, 4 Days, 1985. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 85-4, 182 pp.

________. 1988. Low-Income Women 19-50 Years and Their Children 1-5 Years, 4 Days, 1985. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 85-5, 220 pp.

The Continuing Survey of Food Intakes by Individuals (CSFII) 1985 was the first nationwide dietary intake survey in the U.S. designed to be conducted each year between the decennial surveys. Six bimonthly 1-day recalls were to be obtained from each eligible person in a "core" sample in April 1985 through March 1986. The yearly data collection provided current data on quality of diets in selected population groups to give an early indication of dietary changes.

National Analysts conducted CSFII 1985 under contract with USDA, designing the sample, collecting and processing the information, and preparing the final data tape. The sample design was for a stratified area probability sample in 48 conterminous States. Sampling units were (1) the household and (2) specified individuals within a sample household.

The household screening procedures were designed to provide three separate samples: (1) women 19 to 50 years of age and their children 1 to 5 years of age--called the "core" monitoring group; (2) a comparable sample of low-income women and their children; and (3) men 19 to 50 years of age. The first dietary interview was in person, and the followup interviews were by telephone. Households not having a telephone were interviewed in person throughout the year.

The first CSFII food intake interview yielded 1,341 participating core households with acceptable dietary intake schedules for 1,459 women and 489 children. (The numbers of individuals are unweighted counts.) The sample of 658 men was interviewed only once. Information on household characteristics was obtained before administering the food intake schedules. A set of measuring cups and spoons, a ruler, and a food instruction booklet were used during the personal interview and were left with the respondents to use in subsequent interviews.

Energy intakes on 1 day for both women and children averaged higher in spring 1985 CSFII than in spring 1977 NFCS. Mean energy intake per day based on 4 nonconsecutive days in the 1985 survey was 1,528 kilocalories per woman (total of 1,032 women) and 1,426 kilocalories per child (total of 302 children). Participants with dietary information for all 6 days were 692 women and 171 children, less than half of those with information for the first interview.

In the low-income sample, 2,081 women and 1,170 children participated in the first wave of interviews. Mean energy intakes per day in wave 1 were 1,574 kilocalories per woman and 1,404 kilocalories per child. The counts of women and children with at least 4 days of data were 915 and 458 respectively, representing 876 households. Mean energy intakes per day based on 4 days were 1,427 kilocalories for the women and 1,332 kilocalories for the children.

Continuing Survey of Food Intakes by Individuals, 1986

U.S. Department of Agriculture. 1987. Women 19-50 Years and Their Children 1-5 Years, 1 Day, 1986. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 86-1, 98 pp.

________. 1987. Low-Income Women 19-50 Years and Their Children, 1-5 Years, 1 Day, 1986. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 86-2, 166 pp.

________. 1988. Women 19-50 Years and Their Children 1-5 Years, 4 Days, 1986. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 86-3, 182 pp.

________. 1989. Low-Income Women 19-50 Years and Their Children 1-5 Years, 4 Days, 1986. Human Nutrition Information Service, Nutrition Monitoring Division. Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals, Report No. 86-4, 224 pp.

The CSFII 1986 continued the procedures used in CSFII 1985 and was conducted in April 1986 through March 1987. The first food intake interview in the core sample was completed by 1,451 women and for 509 children from 1,352 participating households. Men were not surveyed in 1986.

Mean food energy intake by women on the 1 day was lower in 1986 than in 1985, but intakes of all nutrients and dietary components per 1,000 kilocalories were about the same or higher. Food energy intake by children on the 1 day was the same in 1986 as it was in 1985, and most nutrient intakes per 1,000 kilocalories were the same or lower. For women, mean energy intake on 1 day in CSFII 1986 was 1,588 kilocalories versus 1,661 kilocalories in CSFII 1985. For children, mean energy intake on 1 day in the 1986 survey was 1,447 kilocalories versus 1,446 kilocalories in the 1985 survey. Mean energy intake per day based on 4 nonconsecutive days in the 1986 survey was 1,473 kilocalories per woman (1,102 women) and 1,426 kilocalories per child (347 children) (1,049 households were represented). Of the 1,451 women and 509 children participants, 751 women and 219 children had information for all 6 days.

In the low-income sample, the mean energy intake per day for the initial day was 1,539 kilocalories for the 1,320 women and 1,522 kilocalories for the 762 children. These amounts were lower for the women and higher for the children in 1986 than for the corresponding period in 1985. Based on 4 nonconsecutive days, mean energy intake per day was 1,424 kilocalories per woman (953 women) and 1,450 kilocalories per child (509 children). Six waves of information were provided by 595 women and for 307 children.

Nationwide Food Consumption Survey, United States, 1987-88

The Nationwide Food Consumption Survey 1987-88 comprised two area probability samples of the 48 conterminous States: a general population sample and a low-income sample. The general population sample was planned to include 6,000 households, which would yield about 15,000 individual members. The low-income survey was planned to include 3,600 households yielding about 10,000 individual members.

Household food use and individual food intake information was collected by interviewers who visited the homes. The household portion of the questionnaire was administered using a laptop computer, but the type of information obtained was similar to that obtained in NFCS 1977-78. The individual food intake questionnaire was administered in a manner similar to NFCS 1977-78 and CSFII 1985 and 1986, but with increased probing and a few changes in questions. The first report from the survey is expected in mid-1989.

1.3.2 Selected Special-Purpose Food Consumption Surveys Conducted by USDA, 1928-88

USDA has conducted special surveys for purposes such as determining the relationship of the household food supply to the incidence of a particular disease (pellagra), comparing methods of data collection to ascertain the most feasible approaches, and comparing dietary and nutritional status of children receiving and not receiving school lunch. Before information on individuals' diets was collected, small surveys of 24-hour and 2-day recalls of dietary intake were carried out to disclose the most efficient method. Effects of pilot Food Stamp Programs were evaluated in selected geographic areas. Changes in survey methods have been tried out before use on a national scale. Selected special purpose surveys since 1928 are summarized below.

H. K. Stiebling and H. E. Munsell. 1932. Food Supply and Pellagra

Incidence in 73 South Carolina Farm Families. U.S. Department of Agriculture, Bureau of Home Economics, Technical Bulletin No. 333, 36 pp.

Relationship of family food supply to incidence of pellagra was studied in 73 farm families in Lee County, South Carolina, where pellagra was prevalent. State extension service agents selected families for study and divided them into two groups: (1) poor families, likely to develop pellagra, who received a free supply of one pellagra-preventing food, mostly tenant farmers (N=44); and (2) better-off families likely to have enough pellagra-preventing foods, mostly farm owners (N=29). Food consumption data collected by the weighed inventory-record method included all foods during 1 week in April 1929 or 1930 and specified pellagra-preventing foods over a longer period in spring 1930. Physical examination provided data on incidence of pellagra (May and June were peak months of incidence). Incidence of pellagra among aided families was less than in earlier years and less than among unaided families of similar resources during the study period.

S. F. Adelson and E. C. Blake. 1950. Diets of Families in the Open Country, a Georgia and an Ohio County, Summer 1945. U.S. Department of Agriculture, Bureau of Human Nutrition and Home Economics, Miscellaneous Publication No. 704, 90 pp.

Quality of diets was studied in housekeeping farm and rural nonfarm families in a Georgia and an Ohio county in which economic levels were below average for their regions. Housekeeping households were defined as those usually preparing at least one meal per day at home. An area sampling method was used with the help of the Statistical Laboratory of Iowa State College, Ames, Iowa. Weighed food inventory records were provided by 282 Georgia families. In Ohio, two parallel samples were drawn for a planned comparison of data collected by two methods--the weighed food inventory record and the food list-recall. The scheduled comparison was abandoned when so few families provided food inventory records (49 percent refused) because of resentment against the government's cut in sugar rations just as the canning season began. Thus, Ohio families' schedules were pooled, totaling 237 families (181 food list-recalls and 56 weighed food inventory records). USDA staff supervised field operations, setting up a central office in each county. Interviewers were local residents who received 1 week of training and written instructions. Families keeping weighed food inventory records were visited daily by interviewers, who assisted the homemaker in keeping food records and menus. Many families were found to have poor diets in early summer 1945, with more in Georgia than in Ohio.

B. B. Reagan and E. Grossman. 1951. Rural Levels of Living in Lee and Jones Counties, Mississippi, 1945, and a Comparison of Two Methods of Data Collection. U.S. Department of Agriculture, Bureau of Human Nutrition and Home Economics, Agriculture Information Bulletin 41, 164 pp.

Use of a "split" schedule was tested in a household food consumption survey to provide information on levels of living for farm and rural nonfarm families in two counties in Mississippi undergoing industrial development in summer 1946. Families were selected by an area sampling method to be representative of rural families in the two counties living in open country or centers of less than 2,500 population. The household food list-recall method was used, and 1,191 families cooperated.

To shorten interview time but still obtain desired detail, information on the schedule was split into several parts. One part was administered to one group of families and another two parts to two other groups, while all groups gave necessary income and classification information. A complete schedule was administered to a control group. Farm families, comprising three-fourths of the sample, provided the four groups for testing the split schedule.

Alcoholic beverages were not included in the survey. Data were processed by machine tabulation. The complete form took 3 hours, compared with 4 hours and 45 minutes total time for the three splits. Results showed the split schedule technique reduced interview time per family but incurred considerable field error, required a sample three times larger than for a complete schedule, increased travel and costs, and limited types of possible analyses.

C. Velat, O. Mickelsen, M. L. Hathaway, S. E. Adelson, F. L. Meyer, and B. B. Peterkin. 1951. Evaluating School Lunches and Nutritional Status of Children. U.S. Public Health Service and U.S. Department of Agriculture, Bureau of Human Nutrition and Home Economics, Circular No. 859, 85 pp.

Dietary and nutritional status of children in an elementary school serving lunch and in one not serving lunch in Cumberland, Maryland, were surveyed during spring 1947 and 1948. The "control" school had no school lunch in the first year but did during the second year. The "lunch" school served school lunch both years. The 336 children participating in the study were divided into three groups: (1) ate school lunch, (2) did not eat school lunch, and (3) occasionally ate school lunch; groups (1) and (2) were then compared. The only differences found between (1) and (2) were higher serum carotene and serum ascorbic acid in children with school lunch than in those without school lunch. A subsample of mothers kept week-long food inventory records for the family and menus at home for the children in spring 1947. In spring 1948, children's intakes at home were recalled by mothers for the 24 hours prior to interview. School lunch portions were added to the recall for each child who had school lunch.

During the first year of the study a higher percentage of diets of "lunch" school children than of the "control" school children met RDA for vitamin A, vitamin C, and calcium. When school lunch was served in both schools in the second year, diets of children participating in the school lunch at the "control" school were similar to diets of children receiving school lunch at the "lunch" school. Comparison of school and home meals showed school lunches supplemented home diets of the children.

J. Murray, E. C. Blake, D. Dickens, and A. M. Moser. 1952. Collection Methods in Dietary Surveys. A Comparison of the Food List and Record in Two Farming Areas in the South. U.S. Department of Agriculture, Bureau of Human Nutrition and Home Economics and the Agricultural Experiment Stations of Mississippi and South Carolina, Southern Cooperative Series Bulletin No. 23, 66 pp.

Two methods for collecting household food consumption data were compared during February, March, and April 1948. The methods used were the food record (weighed inventory of food on hand at the beginning and end of the study period with daily recording of food brought into the home) and the food list (food list-recall requiring the homemaker to recall with the aid of the detailed list of foods and assistance of the interviewer), which obtained the kinds and quantities of foods used during the week prior to the interview.

Two sets of parallel samples of families were selected in each of two states aided by the Institute of Statistics, North Carolina State College. Each household had to include a husband and wife and one or more children 2 to 18 years of age, and must have operated a farm in 1947. In Mississippi, only black sharecropper families were eligible (97 provided food list-recalls, 93 food inventory records). In South Carolina, families of farm owners and cash renters were eligible (80 gave food lists, 68 food records). Local residents were hired and trained as interviewers. The two methods gave generally the same results.

F. Clark and L. J. Fincher. 1954. Nutritive Content of Homemakers' Meals, Four Cities, Winter 1948. U.S. Department of Agriculture, Agricultural Research Service, Home Economics Research Branch, Agriculture Information Bulletin No. 112, 67 pp.

Information was supplied on foods eaten by a representative sample of individuals (1,037 homemakers) in the winter of 1948 as a supplement to a household food consumption survey in four cities--Birmingham, Alabama; Buffalo, New York; Minneapolis-St. Paul, Minnesota; and San Francisco, California. After completing the household questionnaire, the homemaker recalled kinds and quantities of food eaten, both at home and away, for the 24 hours prior to the interview.

A stratified, random area sampling procedure was used to select the housekeeping families. A housekeeping family consisted of at least two persons, each of whom ate a minimum of 10 meals at home during the week preceding the interview. Homemakers in the study were restricted to those who were related to the family head and who were responsible for planning meals and buying the food for the household.

Survey field work was done by trained local residents under supervision of a USDA staff member, who maintained a field office in each city for conferences, editing of schedules, and preliminary computations. Factors were used to convert quantities of food intake on 24-hour dietary recalls to the same units (pounds) used for the household food list-recalls for machine tabulation. Mixed dishes were assigned to food groups of the major component because separation into ingredients was too time consuming. Meat slices of various dimensions were found hardest to estimate. Other problems in surveying diets of individuals and in processing data surfaced.

F. Clark and C. B. LeBovit. 1955. Food Consumption of Farm Families, Meeker and Wright Counties, Minnesota, 1950. U.S. Department of Agriculture, Agriculture Information Bulletin No. 127, 112 pp.

A survey of household food consumption during spring 1950 by 235 participating farm-operator families was conducted in two counties in Minnesota. A self-weighting area probability sample design was used to obtain a sample of households representative of a restricted universe. Only housekeeping families of two adults and 0, 1, or 2 children 2 to 15 years old were included. Families were selected to be similar to city families surveyed in Minneapolis-St. Paul during 1948 and 1949 in order to compare urban and rural food consumption patterns. Many families were older couples--two-thirds of the homemakers were 40 years or older and one-half had no children at home.

The household food list-recall method was used to obtain information on food used at home during 1 week. Of eligible households, 6 percent did not participate.

The money value of food consumed by the farm families and the city families in Minneapolis-St. Paul was nearly the same. Farm families consumed more food in terms of food energy than city families. Amounts of vitamins A and C were lower in farm diets in the spring than in city diets, but amounts of other nutrients studied were comparable.

M. Orshansky, C. LeBovit, E. C. Blake, and M. A. Moss. 1957. Food Consumption and Dietary Levels of Rural Families in the North Central Region, 1952. U.S. Department of Agriculture, Agricultural Research Service, Institute of Home Economics, Agriculture Information Bulletin No. 157, 210 pp.

Household food consumption information was gathered from 1,152 rural farm (N=528) and rural nonfarm (N=624) housekeeping families of two or more persons in 12 North Central States in spring of 1952. A housekeeping household was a family serving a minimum of 10 meals at home to each of two or more persons during the period surveyed. The sample was designed and data were collected and machine tabulated by the Statistical Laboratory and Iowa Agricultural Experiment Station at Iowa State College, Ames, Iowa, under a contract with USDA. The sample design was an area probability, fixed-take (two per segment) type with geographic multistage stratification which required use of a complicated ratio-estimator but allowed substitutions for the 19 percent of nonparticipating eligible families. The food list-recall method was used to obtain information on use of food at home by the household. Home-produced food accounted for 41 percent of the money value of farm families' food at home and for 9 percent of rural nonfarm families' food at home.

C. LeBovit and D. A. Baker. 1965. Food Consumption and Dietary Levels of Older Households in Rochester, New York. U.S. Department of Agriculture, Agricultural Research Service, Consumer and Food Economics Research Division, Home Economics Research Report No. 25, 91 pp.

Food consumption of 283 elderly, low-income housekeeping households in Rochester, New York, was surveyed in spring 1957. To be eligible, participants had to be 65 years of age or older and live alone or with another person at least 55 years of age. The participants were from a systematically selected sample of Old Age, Survivors, and Disability Insurance beneficiaries provided by the Social Security Administration. The sample was designed by USDA staff. About one-third were women living alone and one-half were husband-wife families.

The food list-recall method was used to obtain information on food used in the household during 1 week. Menus of food eaten by each person were also obtained for the 2 days prior to the interview and included food eaten both at home and away from home. The nutrient contents of the 2-day recall diets of individuals were calculated by converting cooked foods back to the per pound "as purchased" or raw weight basis. Nutrient values of mixtures were computed from raw ingredients as listed in a recipe if available.

There was uneven representation of days in the 2-day recalls compared to the 7-day list recall. Food used by the household appeared to be overestimated, whereas intake by individuals may have been underestimated. A 60-percent gap in calories was found between food reported as used by the household and meals eaten by individuals.

R. B. Reese and S. F. Adelson. 1962. Food Consumption and Dietary Levels Under the Pilot Food Stamp Program, Detroit, Michigan, and Fayette County, Pennsylvania. U.S. Department of Agriculture, Economic Research Service and Agricultural Research Service, Agricultural Economic Report No. 9, 17 pp.

The pilot Food Stamp Program (FSP) was inaugurated in eight economically depressed areas in June and July 1961. The FSP had two purposes: to expand markets for agricultural products and to increase ability of needy families to obtain more nutritious diets. Before-and-after surveys of food consumption by low-income families in Detroit and rural areas of Fayette County, Pennsylvania, were carried out during April and May 1961 (before FSP) and September and October 1961 (after FSP) to determine the effects of FSP.

An area probability sample of residences in predominately low-income areas was used. Households were matched for the two survey periods. Matched households were those at the same address and whose qualifications for FSP were the same in both periods--348 families in Detroit and 291 in Fayette County. Trained interviewers obtained information from housekeeping households (at least one member eating 10 or more meals at home during the 1 week surveyed) using the food list-recall method. Households were divided into three groups in September and October: (1) participants in FSP, (2) nonparticipants but eligible for FSP, and (3) ineligible non-participants.

In the September-October period, urban FSP participants consumed food worth 34 percent more than in the April-May period before FSP began. Among rural FSP participants, the increase was 9 percent. Qualified but nonparticipating families consumed foods of slightly less value in both urban (-1 percent) and rural (-7 percent) areas.

E. Grossman and D. Popka. 1974. Methodology of a Household Food Consumption Survey in Cincinnati, Ohio, November 1969-January 1970. Unpublished document, 44 pp.

The Cincinnati, Ohio, Survey in 1969-70 examined three subsamples of 300 households each, selected so that equal representation was given to three economic levels--low-, medium-, and high-value housing. The purpose of the survey was to compare the food inventory-record and food list-recall procedures for surveying household food consumption.

Three interview procedures--list-recall, list-recall with a memory aid, and inventory record--were administered in two waves of interviewing. Households providing completed schedules in the first wave (N=544) were contacted in the second wave for interviews with alternative procedures, yielding 433 completed questionnaires. The nonresponse rate for interviews with the inventory-record method was much higher in both waves than for either of the list-recall procedures. The quantity of foods, their money value, and their nutritive values obtained with the inventory-record procedure averaged about 20 percent less than those derived for the two list-recall methods.

U.S. Department of Agriculture. 1982. Food Consumption and Dietary Levels of Low-Income Households, November 1979-March 1980. Human Nutrition Information Service, Nationwide Food Consumption Survey 1977-78, Preliminary Report No. 10, 48 pp.

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This followup survey of low-income households in 1979-80, which was comparable to the survey of low-income households conducted 2 years earlier (NFCS 1977-78), was undertaken to determine changes in food consumption and dietary quality that might be associated with escalating food prices and changes in the Food Stamp Program (FSP). Data were collected from 2,950 (weighted count) housekeeping households in the 48 conterminous States that were receiving food stamps or welfare assistance and households who would have been eligible for participation in FSP under regulations during the 1977-78 survey. Forty-two percent of the households were FSP participants and 58 percent were nonparticipants.

Slightly fewer low-income households in 1979-80 than in 1977-78 used food that met the RDA for 11 nutrients studied. A higher percentage of the households participating in the FSP than those not participating in the FSP used food that met the RDA for the 11 nutrients. The low-income households in the 1979-80 survey used foods with a lower money value (measured in constant dollars) than low-income households surveyed in NFCS 1977-78.

U.S. Department of Agriculture. 1985. Food Consumption and Dietary Levels: Households in Puerto Rico, Puerto Rico Nutrition Study 1984. Human Nutrition Information Service, Nutrition Monitoring Division, HNIS Administrative Report No. 376, 39 pp.

In the Puerto Rico Nutrition Study 1984, detailed information on household food use was collected from over 2,400 housekeeping households. This information was used to appraise food consumption, money value of food, and nutritional value of the household food supply. This survey was mandated by Congress and required study of the effects of program changes made in the Puerto Rico Nutrition Assistance Program on food usage practices. Data were collected using basically the same methodology and questionnaire (in Spanish) as used in the Puerto Rico Food Consumption Survey 1977.

Results indicated that average nutrient levels in households in Puerto Rico as a whole exceeded the 1974 RDA. The households surveyed in 1984 in Puerto Rico used food with a lower money value of food at home, when adjusted to constant dollars, than did households surveyed in Puerto Rico in 1977. Further analyses of the data were carried out by Mathematica Policy Research (1985a, 1985b).

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Chapter 2. Household Food Use and Individual Food Intake: A Methodological Study

Investigator: Response Analysis Corporation, Princeton, New Jersey. Dr. Herbert Abelson, Principal Investigator, 1975-76.

SUMMARY: This study investigated the efficacy of two methods for in-the-home collection of information on diets--an interviewer-elicited recall and a self-kept diary. Four variations were tested in a 1976 survey in three cities in low- and middle-income households. One method was a self-kept 3-day diary with special training. Three methods combined household food use and individual food intake with food intake obtained last: (1) homemaker-provided 1-day recall for each household member and a self-kept 2-day diary; (2) self-provided 1-day recall administered by an interviewer; and (3) self-kept 3-day diary. Five additional methods obtained household food use only. In all methods, all households received advance letters and had at least one in-person contact with an interviewer. Estimates for the number of servings and number of eating occasions were highest for the interviewer-administered self-provided 1-day recall. Differences among the other three methods were small. The interviewer-administered self-provided 1-day recall and the self-kept 3-day diary with special training provided the most precise description of foods and amounts. Investigators recommended an interviewer-administered self-provided 1-day recall and a self-kept 2-day diary with training as the most feasible method for obtaining individual food intake information in the Nationwide Food Consumption Survey 1977-78.

Tables

2.1 Background

The sixth national USDA food consumption survey (Nationwide Food Consumption Survey 1977-78), originally scheduled to begin in 1975, was delayed by the Office of Management and Budget while the proposed methodology and alternative approaches were further examined. Both the household food use and individual food intake phases of the survey were considered in a year-long (August 1975-July 1976) intensive study conducted by the Response Analysis Corporation (1976).

2.2 Purpose

The study formulated and systematically field tested a number of variations in technique and procedure for two main food consumption data collection methods --recall and record--in order to determine which approach minimizes errors related to respondent, method, and situational variance.

2.3 Methods

The study consisted of two phases: a planning phase and a data collection and evaluation phase. The planning phase of this study (phase one) encompassed a literature search, input from a review panel of six nongovernmental experts (with expertise in statistics, agricultural economics, and nutrition) and from two nutrition consultants, and developmental interviewing of panel groups. The literature review, preliminary to selecting various approaches to be tested, included input from two nutrition consultants on unpublished manuscripts, work in progress, and other unreported research. The review panel of experts met during three day-long sessions (September 23, 1975; November 4, 1975; and April 30, 1976) and contributed to the development of the study design and procedures and review of the findings and the recommendations by Response Analysis. Resource materials were sent to the expert panel members before the meetings for review. Their comments on the final results and the recommendations were received early in June 1976.

The developmental interviews of panels were conducted during 2-hour sessions. Five panels met twice and two panels met once. Each panel had 9 to 12 participants. Participants were selected to represent people who often pose special problems during food consumption survey data collection tasks--elderly persons, low-income persons, homemakers with two or more teenagers, homemakers with two or more children under 6 years of age, homemakers with large families of six or more members, and husbands. Panelists were assigned at least one exercise, such as recording their food consumption for a 1-day period. They then discussed their reactions to the task, problems encountered, and suggestions for improving the method. The rationale for the developmental interviews was that the respondents' thought processes could provide guidance for improving procedures and research instruments. Single-session group members were paid $10 each, and those participating in two sessions were paid $25.

The field test and evaluation of results made up the second phase of the study. Tasks included (1) designing and testing instruments and procedures. (2) sampling with prescreening and assigning households according to a factorial study design, (3) preparing interviewer training materials and scheduling assignments, (4) field testing, and (5) evaluating results.

2.3.1 Data Collection Methods

The design and testing of instruments and procedures resulted in the development of nine data collection methods to be field tested (Table 2.1). One method (number 9, a self-kept 3-day diary) involved individual food intake only. Three methods combined household food use and individual food intake. The food intake methods were: number 1, an interviewer-administered, homemaker-provided 1-day recall plus self-kept 2-day diary; number 2, an interviewer-administered, self-provided 1-day recall; and number 3, a self-kept 3-day diary. Five methods measured household food use only.

Drafts of the instruments and procedures were submitted for USDA and Office of Management and Budget approval in three stages, starting with core instruments on December 5, 1975. The remainder of the instruments were submitted on December 29 and 31, 1975. Official clearance was obtained on January 16, 1976. Pretest interviews with fewer than 10 persons per method were conducted in Trenton and New Brunswick, New Jersey.

Three geographic areas were selected for the main study--Pittsburgh, Pennsylvania; Detroit, Michigan; and Minneapolis, Minnesota. Each area was a primary sampling unit in Response Analysis's national sample. Twenty-four sample locations were picked--four low-income and four middle-income in each of the three metropolitan areas. Of the 12 low-income locations, 8 were central city and 4 were suburban; 4 were predominantly black. Middle-income locations were mostly white and 11 of the 12 were suburban.

Prescreening was carried out from December 4, 1975, to January 12, 1976, to identify elderly households (head of household aged 65 years or older), obtain demographic information in order to match households on household size and composition, identify households with a telephone (some tests required telephone contacts), eliminate vacant housing units, and obtain names and addresses for mailing a letter explaining the study. A total of 4,811 housing units (about 160 per location) were selected for prescreening and 3,345 were completed.

Prescreened households were divided into two groups--elderly and nonelderly. Nonelderly households were then subdivided into two groups according to income level. Eliminated from consideration were nonelderly one-person households, households of eight or more persons, households without telephones, households without kitchen facilities, and households with language problems.

From the pool of eligible households, 108 matched sets of households were selected as follows:

Location	Number of households: Elderly	Nonelderly: Income: Low	Nonelderly: Income: Middle	Total
Pittsburgh..	15	15	9	39
Detroit.....	8	9	18	35
Minneapolis.	9	10	15	34
Total.......	32	34	42	108

Whenever possible, all households in a matched set were the same size and composition. Matching was intended to ensure that the samples for each method would be as similar as possible on key demographic criteria. The household size categories were one, two, three or four, and five to seven persons. Household composition types were--

--head only,
--head and spouse only,
--head plus other adults (age 18 years or older),
--head and spouse plus other adults,
--head plus children,
--head and spouse plus children,

Table 2.1--Description of nine food consumption data collection methods field tested by Response Analysis

Method	Procedure[1]
One	7-day aided recall of household food use plus 1-day recall and 2-day diary of individual food intake
	--Advance letter is sent to homemaker describing the importance of the study and the interview task; enclosed pad for notes on food use and binder for keeping labels, lists, and other reminders in preparation for interview.
	--Telephone call is made to make appointment for an in-home interview at least 7 days in advance and to answer questions.
	--Homemaker recalls information for previous 7 days of household food use; homemaker provides 24-hour recall of food intake for each family member; interviewer records.
	--Interviewer leaves with the homemaker a 2-day intake diary for each household member together with instructions.
	--Interviewer administers debriefing questionnaire to homemaker.
	--Completed diaries including a self-administered debriefing are returned by mail.
	--Homemaker is called to remind her to mail back the diaries.
Two	7-day diary of household food use plus 1-day recall of individual food intake
	--Advance letter is sent to homemaker describing the importance of the study and the interview task.
	--Interviewer arrives at the home to administer core instruments, to provide household food use diary, and to instruct homemaker on keeping the diary.
	--Interviewer administers 1-day recall of food intake to available family members.
	--Interviewer makes two interim phone calls to motivate and answer questions.
	--Interviewer returns after 7 days, reviews household food use diary, debriefs homemaker, administers 1-day recall of food intake to remaining available members.
Three	7-day recall of household food use, with notes, plus 3-day diary of individual food intake
	--Advance letter is sent to homemaker describing the importance of the study and the interview task.
	--Interviewer arrives at the home to administer core instruments, to provide note pad, and to instruct homemaker on structured note keeping of household food use and on keeping of 3-day diaries by individuals.
	--Interviewer makes two interim telephone calls to motivate and answer questions.
	--Interviewer returns after 7 days to conduct 7-day recall of household food use with homemaker using notes and collects and reviews 3-day diaries of food intake. Interviewer debriefs homemaker on task.
Four	"Surprise" 7-day recall of household food use (similar to HFCS 1965-66 method)
	--Advance letter is sent to homemaker describing the importance of the study but nothing about the task.
	--Interviewer arrives at the home, administers 7-day recall of household food use and other instruments, and debriefs homemaker.

See footnote at end of table.

Continued

Table 2.1--Description of nine food consumption data collection methods field tested by Response Analysis--Continued

Method	Procedure[1]
Five	<u>3-day recall of household food use</u> --Advance letter is sent to homemaker describing importance of study and the interview task. --Interviewer arrives at the home, administers core instruments, and instructs homemaker on keeping notes on food used during next 3 days. --Interviewer makes a telephone call each day at a specified time to obtain information on household food used during previous 24-hours. --Last telephone call includes debriefing of homemaker.
Six	<u>3-day diary of household food use</u> --Advance letter is sent to homemaker describing the importance of the study and the interview task. --Interviewer arrives at the home, administers "core" instruments, and instructs homemaker on keeping a diary of household food use for 3 days. --Interviewer makes one interim telephone call to motivate and answers questions. --Interviewer returns, reviews diary, administers other instruments, and debriefs homemaker.
Seven	<u>"Surprise" 7-day recall of household food use</u> --Same as method four. --Control for method eight.
Eight	<u>"Surprise" 7-day recall of household food use without price information</u> --Similar to method four and method seven. --Advance letter is sent to homemaker describing the importance of the study but nothing about the task. --Interviewer arrives at the home, administers 7-day recall of household food use with detailed probing for description of food items such as brand names, makes no reference to prices but obtains information about food stores patronized, and debriefs homemaker. --Interviewer gets prices from store where respondent buys food.
Nine	<u>3-day diary of individual food intake</u> --Advance letter is sent to homemaker describing the importance of the study and the interview task. --Interviewer arrives at the home and trains homemaker in keeping the 3-day diary, administers family background questionnaire, administers 1-day recall to homemaker for practice and leaves it for reference. Leaves 3-day diaries for homemaker and family members to complete. --Homemaker trains other household members to keep diaries. --Homemaker mails back all diaries at end of 3 days.

[1]In individual food intake reports, the homemaker reported for children under 9 years of age.

--head plus children and other adults,
--head and spouse plus children and other adults.

In the middle-income subset, further matching was possible on the age of the head of household. Within each of the 108 matched sets, households were randomly assigned to one of nine methods as were possible replacements for non-participating households. Approximately the same number of households were assigned to each method:

Method	Number of households
One	157
Two	174
Three	174
Four	155
Five	168
Six	162
Seven	163
Eight	164
Nine	163
Total	1,480

In each of the three cities, 4 days of training were held for about 20 interviewers beginning on February 18, 1975. Each interviewer was trained for one method only. Before the training started, interviewers were assigned to complete a household recall schedule and a practice interview. During the training session, they carried out an interview in their assigned method. Because there were so many instruments, a notebook (color-coded by method) was assembled for each household. Two weeks after field work started, interviewers were debriefed in all three cities by the Response Analysis research team to uncover problems and relay experiences. Methods 1 through 6 were fielded first (February 23 to May 15, 1976), and methods 7 through 9 formed a second wave (April 19 to May 26, 1976). The total number of returned questionnaires for each individual intake method was as follows:

Method	Number of questionnaires
One	110
Two	167
Three	142
Nine	143
Total	562

2.3.2 Procedures for Comparing Methods

Analysis of variance was used to study differences among the individual methods. The factorial design was based on five factors--

--method used (numbers 1, 2, 3, and 9),
--demographic group (middle-income, low-income, and elderly),
--age group (1 to 5, 6 to 11, 12 to 64, and 65 years and over),
--sex (male, female),
--homemaker (yes or no).

(The partial confounding between the demographic group factor, elderly, and the age group factor, 65 years and over, was of no consequence for overall interpretation because demographic group by age group interactions were of no interest.) Dependent variables based on intakes of selected food groups in the analyses included quantity of food consumed, quantity of food consumed away from home, number of times reported (line item entries), and number of eating occasions at which the food was consumed.

The grand mean (mean of all methods) and the mean for each of the four food intake methods are presented for the milk and milk drinks group (Table 2.2). Index values, which expressed results as a percentage of the grand mean, were derived to facilitate comparisons of the four data collection methods. Table 2.3 lists index values for two dependent variables--the number of foods reported and the number of eating occasions--for each of the four methods across

Table 2.2--Intake and usage of milk and milk drinks obtained with four data collection methods

[Numbers in parentheses are index values calculated by dividing the method mean by the mean of all 4 methods (grand mean) and multiplying by 100. The index values are used to compare each method to the mean of all four methods]

Method	Mean per individual per day			
	Total quantity	Quantity away from home	Times reported	Eating occasions
	Ounces		Number	
All methods (grand mean).....	8.793 (100)	1.250 (100)	1.698 (100)	1.360 (100)
Method One..................	8.853 (101)	.721 (58)	1.858 (109)	1.395 (103)
Method Two..................	8.994 (102)	1.828 (146)	1.732 (102)	1.646 (121)
Method Three................	9.211 (105)	1.264 (101)	1.573 (93)	1.166 (86)
Method Nine.................	8.113 (92)	1.187 (95)	1.630 (96)	1.232 (91)

Table 2.3--Indexes of usage of eleven food groups derived from four data collection methods

Food group	Number of times reported, method--				Number of eating occasions, method--			
	One	Two	Three	Nine	One	Two	Three	Nine
	Index value[1]							
Milk, milk drinks[2].............	109	102	93	96	103	121	86	91
Beef...........................	84	108	90	118	86	112	86	115
Pork[2,3]........................	83	121	104	92	81	129	100	90
Other meat, poultry, fish.......	117	87	101	96	113	96	100	92
Meat, type not specified........	80	145	91	82	80	150	86	84
Total meat, poultry, fish[2,3]....	91	110	99	101	91	116	95	98
Table fat......................	97	88	103	112	93	98	100	108
Table sugar....................	96	83	99	122	94	96	100	110
Nonalcoholic beverages..........	96	97	105	102	93	112	101	94
Bread, nonsweet baked goods[2]....	93	106	94	107	88	123	89	101
Sweet baked goods[2,3]...........	97	127	93	83	89	137	89	84
Overall average index value.....	95	107	98	101	92	117	94	97

[1]Index value: The grand mean of the four methods tested was the base; each of the four methods was indexed to the grand mean set to 100. (See Table 2.2)
[2]Differences among methods in number of times reported were significant ($p \leq 0.05$).
[3]Differences among methods in number of eating occasions were significant ($p \leq 0.05$).

specified food groups to yield the overall average index values. Only two-factor interactions and main effects were examined. The design had many missing cells.

The adequacy of information collected was scored (Table 2.4) for the completeness of food descriptions and for the precision of quantities reported. Tables 2.5 and 2.6 contain results of this type of qualitative analysis for seven food groups. Respondents' reactions to the survey methods, obtained by debriefing (Tables 2.7 and 2.8), and response rates were also summarized by the contractor.

2.4 Main Findings

For the four individual food intake methods (numbers 1, 2, 3, and 9), analysis of variance revealed relatively small differences. No conclusions could be drawn on the basis of analyzing quantities of food consumed for a limited number of foods measured because differences between methods were not significant.

Analysis of variance in the number of servings and the number of eating occasions for a broad range of foods showed significant ($p \leq 0.05$) difference between methods for several of the foods. Estimates of these foods with method 2 (1-day food recall, interviewer-administered to each family member) were higher than with the other three methods. Differences among the other three methods were, on average, very small.

Analysis of the adequacy of information supplied by respondents suggested that their descriptions of foods and amounts were more precise for method 2 (1-day recall, interviewer administered) and method 9 (3-day diary with special training for homemaker who helped family members, and diary returned by mail) than for method 1 (1-day recall of food intake for all members by homemaker, interviewer administered; 2-day diary kept by each family member and returned by mail) and method 3 (3-day diary kept by each family member and returned by mail). Methods 2 and 9 utilized trained interviewers who probed for details or homemakers who received special training in reporting. These methods appeared to obtain better dietary reporting.

Respondent debriefing disclosed that over 80 percent of the respondents reported having made diary entries at least once a day. Sixty-eight percent made entries several times during the day. Most respondents did not carry the diaries with them when they left their homes. Less than 10 percent reported any change in eating patterns because they were in the study. Respondents tended to assess their reports as "fairly accurate" or as accurate as they could provide. They had less confidence in the accuracy of information provided for description and amounts of foods eaten than in the complete enumeration of foods eaten. Homemakers felt more confident when reporting for others if the food were eaten at home rather than away from home.

Response rates for individual food intake methods in wave one were poorer for method 1, in which records were returned by mail, than for methods 2 and 3, in which interviewers collected the forms. Since the survey of individual food intake was made in conjunction with the household food use survey, it is of special interest to note that the best response rates for the household food use component were obtained with methods 4, 6, 7, and 8, which had no individual food intake component.

Analysis of household food use methods in the study showed clear differences

Table 2.4--Scoring system for assessing adequacy of food descriptions in dietary intake reports

Food group, point assignment[1]	Description of food for scoring
<u>Milk, dairy products</u>:	
0	Name of food, e.g., milk, cheese
1	Further specification, e.g., type of milk, name of cheese
1	Accessory item in or on the food
<u>Meats</u>:	
0	Meat, type unspecified
1	Type of meat, e.g., beef, pork
1	Cut of meat, e.g., chop, roast
1	Further specification of cut, e.g., chuck roast
1	Information on bone or no bone
<u>Fruits</u>:	
0	Fruit, type unspecified
1	Name of fruit, e.g., apple
1	Form, e.g., fresh, canned
1	Accessory item on fruit
<u>Vegetables</u>:	
0	Vegetable or salad, unspecified
1	Name of vegetable, e.g., potato, radish
1	Form, e.g., fresh, raw, frozen, canned
1	Further information on cooking method
1	Accessory item added to vegetable
<u>Grain products</u>:	
0	Name of product, e.g., bread, roll, pie
1	Specification of kind, e.g., whole wheat, rye, apple pie
1	Accessory item added to product
1	Further specification on pasta
<u>Grain mixtures</u>:	
1	Name of mixture, e.g., pizza, lasagna
1	Further information, e.g., extras on pizza
<u>Cereals</u>:	
0	Cereal, type unspecified
1	Ready-to-eat (cold) or cooked (hot)
1	Name or brand name
1	Accessory item(s) added to cereal

[1]Total score = sum of points.

Table 2.5--Adequacy of descriptions of foods obtained with four data collection methods

[Dashes indicate scores were not applicable for this food group]

Food group, method		Total food entries	Adequacy of description score[1]				
			Zero	One	Two	Three	Four
		Number	Percent				
Milk, dairy products							
Method:	One	315	23	73	4	--	--
	Two	180	18	76	6	--	--
	Three	382	25	71	4	--	--
	Nine	625	20	76	4	--	--
Meats							
Method:	One	119	1	46	44	9	0
	Two	89	1	48	42	9	0
	Three	144	1	40	51	8	1
	Nine	316	2	38	40	19	1
Fruits							
Method:	One	141	1	53	43	3	--
	Two	82	0	32	67	1	--
	Three	160	0	50	44	6	--
	Nine	289	5	61	32	2	--
Vegetables							
Method:	One	364	4	36	50	10	0
	Two	268	3	24	63	10	0
	Three	462	4	34	50	13	0
	Nine	887	2	44	45	8	1
Grain products							
Method:	One	465	21	53	27	--	--
	Two	312	20	61	19	--	--
	Three	522	21	53	26	--	--
	Nine	954	17	55	28	--	--
Grain mixtures							
Method:	One	39	0	64	33	3	--
	Two	28	0	79	21	0	--
	Three	52	0	77	23	0	--
	Nine	82	0	45	54	1	--
Cereals							
Method:	One	112	1	18	80	2	--
	Two	48	2	23	71	4	--
	Three	86	4	29	64	4	--
	Nine	166	1	12	84	3	--

[1] Zero = least information, increased information with increase in score. Values may not add to 100 percent due to rounding.

Table 2.6--Adequacy of information on food quantities obtained with four data collection methods

[Dashes indicate a value of less than 0.5 percent]

Food group, method	Adequacy of quantity information[1]: Directly codeable--no assumptions necessary	Codeable--minimum assumptions	Codeable--maximum assumptions	Not codeable	No information
	-----	-----	Percent	-----	-----
Milk, dairy products					
Method: One.....	86	2	8	--	3
Two.....	88	4	6	1	2
Three...	86	4	8	1	1
Nine....	87	6	4	1	1
Meats					
Method: One.....	51	13	30	1	4
Two.....	67	18	9	3	2
Three...	58	13	24	1	4
Nine....	74	12	11	1	2
Fruits					
Method: One.....	23	31	45	1	0
Two.....	17	60	23	0	0
Three...	33	24	40	0	3
Nine....	42	36	22	0	0
Vegetables					
Method: One.....	43	12	37	1	7
Two.....	42	19	35	2	3
Three...	41	14	39	1	4
Nine....	54	11	32	--	3
Grain products					
Method: One.....	10	44	46	0	--
Two.....	20	59	20	0	1
Three...	14	45	40	0	1
Nine....	21	62	16	0	1
Grain mixtures					
Method: One.....	64	0	31	5	0
Two.....	79	7	14	0	0
Three...	54	12	33	0	2
Nine....	79	7	10	3	1
Cereals					
Method: One.....	90	0	5	4	1
Two.....	83	0	15	2	0
Three...	86	0	14	0	0
Nine....	89	0	10	0	1

[1]Values may not add to 100 percent due to rounding.

Table 2.7--Respondents' perceived accuracy of information provided in debriefing

Variable, method	Respondents	Perception by respondent: Very accurate	Fairly accurate	Not accurate
	Number	Percent		
Enumeration of all foods				
Method: One	76	41	58	1
Two	139	56	40	4
Three	120	46	52	2
Description of foods				
Method: One	76	21	74	5
Two[1]	139	52	43	4
Three	120	22	67	11
Quantity of foods				
Method: One	76	17	72	11
Two	139	24	62	14
Three	120	15	71	14

[1]Does not add to 100 percent because of "no answer" responses.

among methods. Diary methods tended to produce the smallest reported quantities of food used, recall methods without advance notification of the homemaker produced the largest quantities, and recall with homemaker having received advance notification and instructions for keeping notes and other reminders produced intermediate results.

2.5 Conclusions and Recommendations

Several crucial assumptions influenced the final conclusions and recommendations: (1) household food use data were of higher priority and more important to USDA than the individual food intake data, so that most methods tested favored the collection of household food use information; (2) a design that obtained individual food intake data from a sample within households rather than from all members would not meet all objectives of the study; (3) two separate household samples--one for household food use data and one for individual food intake data--would be desirable but much more costly than collecting both types of data from the same sample households; and (4) valid data for quantities of food used in the household are within the array of data produced by the various methods, and methods which produce extremely low or high values are not as reasonable as those which produce intermediate values.

Response Analysis made recommendations for collection of individual food intake and household food use information in the Nationwide Food Consumption Survey (NFCS) 1977-78 based on the study findings. The method recommended for collecting food intake information for individuals was a combination of 1-day food recall and 2-day food record, yielding 3 consecutive days of intake. Response Analysis advised that, following

Table 2.8--Frequency of making entries in food diaries as reported in respondent debriefing

Variable	Method One (N=72)	Method Three (N=110)	Method Nine[1] (N=134)
	Percent		
First day:			
After each eating occasion.......	21	28	--
Several times a day.............	42	39	--
Once a day......................	32	28	--
Less than once a day............	3	5	--
No answer.......................	2	0	--
Second day:			
After each eating occasion.......	18	19	--
Several times a day.............	47	44	--
Once a day......................	29	32	--
Less than once a day............	3	4	--
No answer.......................	3	1	--
Third day:			
After each eating occasion.......	21	14	--
Several times a day.............	39	43	--
Once a day......................	29	31	--
Less than once a day............	11	8	--
No answer.......................	0	4	--
Overall:			
More than twice a day...........	--	--	25
Twice a day.....................	--	--	26
Once a day......................	--	--	39
Less than once a day............	--	--	2
No answer.......................	--	--	7

[1]The debriefing questions for methods one and three were included in the back of the diaries and were, therefore, self-administered. In method nine, debriefing questions were not asked of each respondent. Instead, when the interviewer made the reminder call to the household, several questions regarding how the individual family members actually kept the diaries were asked of the homemaker. The responses to these questions are reported.

completion of the household food use component of the survey, the homemaker and other household members present should be interviewed separately for their 1-day recall; each member should then be asked to keep a diary record of food intake for the following 2 days after receiving instruction and help in starting from the interviewer. The homemaker should answer for children under 9 years of age and other household members unable to answer for themselves. A second interviewer visit was recommended to interview members who were absent during the first visit. If members were again absent, then forms should be left with the homemaker, who would transmit the forms and instructions for their completion. Completed forms were to be returned by mail. The rationale for the combination method was that it would make minimum demands on memory or recordkeeping by starting in the middle of the reporting period and going back to "yesterday" and forward to "tomorrow."

The household food use data collection method recommended was a 7-day aided recall with notification at least 7 days before the interviewer's visit. Homemaker preparation would include notes and other reminders on food used during the week preceding the interview.

Response Analysis noted that the exact procedure recommended for individual intake had not been tested in its entirety but that most of its features had been. Method 1, as field-tested by Response Analysis, was a combination of 1-day recall and 2-day diary, which provided information for three consecutive days. (Method 2 consisted of a 1-day recall only, and methods 3 and 9 each were 3-day diary approaches). In method 1, the 1-day recall was administered by an interviewer with the homemaker responding for all individuals in the household. The 2-day diary for each individual member together with instructions was left with the homemaker to give to each member for completion. The method finally recommended by Response Analysis, although a combination 1-day recall and 2-day diary, encompassed some changes. They recommended that the 1-day recall be administered by the interviewer to each individual member because he or she was the best source of this information. For the 2-day diary, they recommended that the interviewer instruct each member on keeping the diary and coach each member as he or she makes the first entries; written instructions should be provided for reference after the interviewer leaves.

Response Analysis also stressed that advance notification and preparation of the homemaker was essential and recommended sending a letter from USDA describing the importance of the research and a letter from the contractor describing the coming interview. Test results showed that this considerably increased cooperation by households. Response Analysis recommended a monetary incentive of 1 dollar per family member for completion of the 2-day food record and a gift to the household, such as a set of measuring cups, measuring spoons, and a ruler, which would also emphasize the degree of accuracy sought in measurements.

In conclusion, results of the Response Analysis study indicated several ways for improving dietary reports. Cooperation by households was increased by advance notification of the interview and its purpose. The most accurate reporting occurred in interviewer-administered 1-day recalls or in food diaries kept by individuals with assistance or special training given by interviewers. Self-reporting appeared to yield more complete dietary intake information than surrogate reporting by one household member. Household respondents had more confidence in their reports of intakes by others if the food had been eaten at home or in their presence or if the others contributed information. Response rates were higher if food diaries were reviewed and picked up by the interviewer than if they had to be returned by mail.

2.6 Comment

After pilot testing, most of the recommendations made by Response Analysis were adopted for NFCS 1977-78. One change was made by USDA in order to increase response rates; namely, interviewers returned to review and pick up completed food records instead of depending on respondents to return them by mail. USDA made other modifications in expectation of enhancing returns or quality of the data:

- Children were to be 12 years or older, rather than 9 years or older, in order to answer without assistance.

- Absent members could be included if the household respondent had knowledge of their intake and could provide the essential information.

- Only one visit was made to administer the 1-day recall and to initiate the 2-day food record with all members of a household simultaneously rather than instructing each individual separately. This was considered to be less intrusive and to be a more efficient use of interviewer time compared with making two separate visits for the same purpose.

The NFCS 1977-78 method has been described in detail elsewhere (U.S. Department of Agriculture, 1983; Pao et al., 1985).

2.7 References Cited

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U.S. Department of Agriculture, Human Nutrition Information Service. 1983. Food Intakes: Individuals in 48 States, Year 1977-78. U.S. Dept. of Agriculture, Nationwide Food Consumption Survey 1977-78, NFCS 1977-78 Rep. No. I-1, 617 pp.

Chapter 3. Recommended Survey Design for Validation of Findings of the Nationwide Food Consumption Survey 1977-78

Investigator: Survey Design, Incorporated, Silver Spring, Maryland. Joseph Steinberg, Principal Investigator, 1977.

SUMMARY: This study identified and recommended methods for appraising the validity of results from the USDA Nationwide Food Consumption Survey (NFCS) 1977-78 and was carried out as survey plans were being finalized. The study began with a step-by-step review of survey instruments, data collection, and processing procedures. Findings from earlier methodological studies were supplemented with information from indepth interviews with a variety of specialists having relevant expertise. The investigator, Survey Design, Incorporated, concluded that plans for NFCS 1977-78 had been developed according to Government administrative guidelines and that the decision to collect 3 days of individual dietary intake data was well supported by earlier research and scientific judgments. For the future, SDI recommended further research of alternative data collection methods, testing of several types and levels of incentives, publication of information on survey sampling and procedures useful for subsequent analytical work, debriefing of interviewers and respondents, retrospective tests of questionnaires, interviewer variance, methods for improving and evaluating quality of data, various time periods relevant to measurement of "usual" intake, and survey design alternatives with attention to respondent burden and response rates.

3.1 Background

The methodology used for the Nationwide Food Consumption Survey (NFCS) 1977-78 was influenced by a number of factors. Among these factors were the experience gained from the earlier USDA surveys, the Response Analysis Corporation methodological study (Chapter 2), the expansion of objectives in order to accommodate new data users, time and budget constraints, and administrative concerns. In November 1976, Senator George McGovern, Chairman of the U.S. Senate Select Committee on Nutrition and Human Needs, requested a U.S. General Accounting Office (GAO) review of the scope and methodology of the NFCS 1977-78 (USGAO, 1977). GAO concluded that "the survey methodology has not been validated, consequently its results will be open to criticism" (p. 1). GAO recommended that the Secretary of Agriculture "explore opportunities to validate survey methodology either before or during the survey" (p. 2).

As a consequence of the GAO report, Survey Design, Incorporated (SDI), was commissioned to conduct an independent study to consider (1) the current status of food consumption survey validation, (2) comments in the GAO report, (3) factors affecting the quality of NFCS 1977-78 data, and (4) alternative measurement methods and procedures.

SDI noted that the GAO report mentioned several items which the Subcommittee on Non-Sampling Errors, Statistical Policy Division, Office of Management and Budget, had targeted for attention as part of a governmentwide effort to improve the quality of data reported by statistical agencies. These items included providing information on questionnaire development, the accuracy of measurements of food consumed, optimum data collection procedures, the extent of information requested relative to respondent burden, and whether a simpler and less burdensome method was available to attain survey objectives. SDI recommended a wide variety of procedures for validating NFCS 1977-78 findings.

3.2 Purpose

This study identified and recommended methods for validating NFCS 1977-78 findings. Also, survey designs for implementation were proposed.

3.3 Methods

The recommendations for validating NFCS 1977-78 results were developed through a series of activities. First, SDI reviewed the survey instruments and interviewer instructions and procedures. Then they observed and examined in depth the actual survey data collection and processing operations by National Analysts, the successful bidder for the NFCS 1977-78. They observed timing and flow of information from survey respondents, the control of field work (including nonrespondents), and the receipt and editing of collected information, as well as other documents on file. They also had a briefing session with the National Analysts' study director.

Second, SDI reviewed methodological studies, giving special attention to the Response Analysis methodological study. All aspects of that study were examined, including questionnaire design development, transcribed tape recordings of the panel group sessions, respondent and interviewer debriefings, consultant panel letters, the literature review, other memoranda and materials pertaining to the pretests of instruments and the selection of procedures for final testing, and final recommendations. The study director was interviewed at length.

Third, SDI conducted a literature review. It began with a study of the review paper by Murray (1970), who traced the evolution of the household food consumption survey methods from the 1890's through the 1965-66 survey. Among other papers reviewed was the USDA study of the validity and reliability of methods relevant to large-scale food consumption surveys (Burk and Pao, 1976) and the plans and operations of the National Health and Nutrition Examination Survey (USDHEW, 1973).

Fourth, to gain added perspective for their task, SDI sought the advice and ideas of over 35 experts from many disciplines, including psychologists, home economists, survey and mathematical statisticians, nutritionists, and economists. Also, SDI held discussions with USDA professional staff concerned with NFCS, the staff who prepared the GAO report mentioned earlier in this chapter, and personnel at the Office of Management and Budget who were involved in statistical policy and survey design.

3.4 Main Findings and Observations

From their review, SDI reported findings and observations under four topics. Only SDI findings and observations relevant to the individual intake segment of the NFCS 1977-78 are included here; findings and observations relevant to the NFCS household food use component are included in SDI's final report.

I. Objectives of NFCS 1977-78--SDI observed that under the Federal Reports Act of 1976, the Office of Management and Budget sought to coordinate data needs of agencies so that fewer surveys would be required. This included consolidating Federal surveys of nutritional status and diets of individuals. Supplemental questions to collect additional data for other agencies had the potential of decreasing data quality and increasing respondent burden. Against this backdrop, SDI pointed out that negotiations among agencies concerning objectives that could and could not be incorporated in the NFCS were reflected in the final NFCS objectives. In particular, SDI approved of the decision to collect 3 days of information from eligible individuals in order to improve the representation of their dietary intake and its adequacy by smoothing out day-to-day fluctuations.

II. Statements regarding the NFCS 1977-78 survey questionnaires and procedures--SDI concluded that NFCS questionnaires and procedures seemed to work in the field. According to SDI, the quality of food data probably varied among the questions since no single wording would be interpreted the same way by all respondents. Interviewer performance and probes would affect the quality of respondents' answers. SDI noted that questionnaire development and selection of procedures in surveys follow a common pattern in Federal agencies, including NFCS.

The developmental phase of the Response Analysis methodological study was considered "well-designed" by SDI. Small-scale field testing and debriefing of respondents was viewed as imperative before beginning the full-scale testing of methods. Only a limited number of the methods considered could be included in the field test. SDI regarded this approach to be reasonable because time for the research effort was so short. SDI stressed that debriefing NFCS respondents and interviewers would be necessary to ascertain their understanding of questionnaires and their assessment of the quality of the information they provided, as was done in the Response Analysis study.

The selection of recommended methods by Response Analysis was found to be based on logic and objective evidence--nonresponse rates, analytical judgments, expert consultants, and results showing variation in quantity data. SDI observed that the validation of NFCS results would require a combination of evaluation techniques since "no single method is without problem" (p. 13). If these techniques provided similar results in regard to quality, that would be an important finding. Because Response Analysis was able to test only a few alternative methods, SDI urged that a wider set of alternative methods be examined before the next survey. SDI also urged reconsideration of incentives --both type and amount--since response rates and the quality of data may be sensitive to respondent motivation.

III. Survey operations--SDI evaluated the listing, sampling, interviewing, nonresponse followup, survey control, and editing operations. Each of these was seen as having been handled in a professional manner in NFCS 1977-78. SDI did comment, however, that "an important quality measure concerns listing and within segment sampling" (p. 14) and that information on quality of coverage and sampling problems in NFCS would be useful. Various measures of interviewer effort--such as variation in response rates--should be reported, according to SDI. It was also suggested that higher levels of incentives be tried in an attempt to reduce nonresponse. Complete reporting on nonresponse would provide important information concerning validity of the NFCS results. Also mentioned for inclusion in the description of survey methodology were complete disclosure of changes made during editing and imputations and evaluations of the quality of coding for descriptions of foods and amounts consumed.

IV. Publication of data from NFCS 1977-78--Most important among SDI suggestions was that survey publications should include information needed for planning subsequent analyses. This information should encompass sampling errors, nonresponse rates, and details needed for evaluating data quality.

3.5 Recommendations

SDI concluded that there was no clear evidence that any one methodology or any one validation technique was best for food consumption studies. Some methods that work in other subject matter areas are difficult to apply when the subject is food consumption. Conditioning is a potential problem in applying techniques found suitable in other areas (such as reinterview) to the food consumption survey. In making recommendations for validation of NFCS 1977-78 results, SDI considered several factors--timing, relative priority, and amount of effort. Activities were presented for three time periods: last quarter of the ongoing NFCS, the remaining 6 months of fiscal year 1978, and the following year(s). Activities were proposed for both the household food use and individual food intake components of NFCS. Only those activities concerned with the individual food intake component are described here.

3.5.1 Studies Proposed for Final Months of the NFCS 1977-78 Data Collection

1. Debriefing--The purpose of debriefing is to reveal understandings, reactions, and assessments of the quality of information provided by respondents and the reactions of interviewers. After interview tasks were completed, the respondent would be asked about his or her understanding of questions, the accuracy of information supplied, and reactions to survey procedures. The debriefing interview would take about 10 minutes. Respondents should be drawn about equally from low-, medium-, and

high-income strata. Interviewer debriefing would inquire about such items as whether he or she was comfortable asking questions, whether questions had to be rephrased, or whether excessive forcing was necessary to fit answers into codes.

2. Interviewer variance study--Differences among interviewers in the manner of interviewing or the application of instructions can affect the quality of data. This study would show each interviewer's share of the "correlated response variance" for selected items. "Correlated response variance is the component of response variance which reflects the way interviewers carry out their survey activities in ways that differ from those of other interviewers" (p. 21). SDI specified that respondents in the primary sampling units to be tested should be randomly assigned to interviewers in pairs.

3. Understanding of questions--In order to determine respondents' interpretation of survey questions, the respondents would be asked questions during a second intensive interview (after completion of interview tasks) to determine misunderstandings, distortions, and other necessary clarifications. The purpose was to find out what respondents thought the questions meant and how best to word them.

4. Rotation of food groups--In household food use component only.

5. Analysis of respondent's notes--In household food use component only.

6. Homemakers use of tape recorder for recording food use--For household food use component only.

3.5.2 Studies Proposed for the 6 Months After NFCS 1977-78 Data Collection

The following studies were considered too intrusive to be carried out during the survey partly because participation of professional staff and trained NFCS interviewers, who were already fully occupied, would be required.

1. Tape-recorded interviews--This study would determine the relationship between actual interviews in the field and the interviews as planned. The interviews would examine how questions were asked, answered, and worded; the differences between oral and recorded responses; and the nature of probes and the most successful probes. This study would also provide information on the respondents' understanding of the questions and on how interviewers rephrased questions.

2. Retrospective questionnaire pretest--This study would determine respondent understanding and the relevance and deficiencies of the NFCS questions. SDI pointed out that the starting point for planning a subsequent survey is study of the instruments and protocol of an earlier survey. The technique for this study would require a specially trained observer to sit in on a complete interview. The observer would use special codes to record interviewer and respondent reactions to each question, including difficulties with items, rephrasing of questions, and the length of time taken for answering. Following the interview, the observer would take 8 to 10 minutes to ask supplemental questions, such as how answers to questions were arrived at and the actual meanings assigned to various terms used in the questionnaire.

3. Duplicate meals for quality evaluation of reporting--This study would determine the quality of the information reported on the individual intake instrument. The homemaker would prepare duplicate amounts of each meal consumed by each individual during 1 day. All members would report their intake of these meals as usual. Containers for storing the duplicate meals would be provided. The duplicate meals would be picked up and shipped to a laboratory for analysis of contents. Homemakers would be reimbursed for ingredients, preparation, and the extra work. Each individual's intake outside the home would be recorded on a separate form, indicating the name and location of the place where each meal was eaten. Interviewers would go to the place(s) named to ask about ingredients and portion sizes. The data reported on the individual's food recall or record would be compared with the data from the duplicate meals at home and the information on meals away from home obtained by the interviewer. However, this test cannot differentiate error resulting from the data collection procedures from error introduced in the nutrient data base.

4. NHANES-type replicate individual intake--This study would determine the relationship between data from a NFCS individual intake diary for day 3 and data from a 24-hour recall obtained by the National Health and Nutrition Examination Survey (NHANES) method. The NFCS individual intake record would be completed as usual. At the pick-up visit, willing participants would be given directions to go to the central NHANES location the next day. Respondents would be reimbursed for time and transportation and given an incentive as well. The study would have to be conducted when NFCS and NHANES were interviewing in the same area at the same time.

5. Photography of various meals by household for quality evaluation of reporting--For household food use component only.

6. Partial food records for quality evaluation involving inventory and purchase information--For household food use component only.

7. Garbage survey for quality evaluation--For household food use component only.

3.5.3 Studies Proposed for the Future

Areas recommended for further research included improving the quality of data, methods for evaluating quality, and survey design. SDI emphasized the need for a continuous and integrated research effort and stated that establishment of a research center within the survey branch would best meet this need.

1. Improving quality--First, SDI strongly urged that research be instituted on methods of improving quality within current survey content and procedures. Nonresponse was mentioned first as affecting quality of data. SDI viewed experiments with types and levels of incentives as very important. Secondly, experiments to measure the effects of instructions, feedback, and motivation of respondents on the quality of data were suggested. SDI pointed out that instructions for respondents should tell them what is expected in terms of accurate and complete information and how such information should be supplied, while feedback gives respondents an indication of the adequacy of their responses. The third issue dealt with interviewer characteristics. SDI advocated experiments using home economists as interviewers, rather than the current variety of trained interviewers.

2. Methods of evaluating quality of data--SDI regarded this area as needing concerted and systematic attention. Observational approaches suggested for checking quality of data were (1) training and paying a household member to observe independently and report dietary intakes of other household members for comparison with individual members' reported intake; (2) arranging for an outside observer (dietitian) to be invited to observe meal preparation and then observe the food wastes after the meal; and (3) having a home economist accompany interviewers, then follow up with indirect probing questions after the regular interview. Repeat interview procedures were also cited for consideration. Evaluation of how well quantities are reported and ways to improve reporting were noted as meriting further research.

3. Length of survey period and random replications for units over time--Measurement of "usual" intake is often sought rather than "current" intake during 1, 3, or more days. Research on the adequacy of a "current" measure to serve as a proxy for "usual" intake was strongly recommended. SDI pointed out that effects of program changes on food intake could be analyzed more efficiently if additional rounds of data from some respondents were available.

4. Survey design alternatives--Because of changes in lifestyles and in willingness to be surveyed, SDI advised that objectives to be met in future surveys be reviewed before assigning research priorities. Respondent burden and response rates were among their primary concerns.

3.6 Comment

Recommendations made by SDI were implemented in a number of studies described in subsequent chapters of this report and in a number of household food use investigations which are not described here. The validation project undertaken by National Analysts (Chapter 4) was instituted soon after receipt of the SDI report. Nearly all projects proposed by SDI were examined for feasibility by panel groups in the early phase of the National Analysts study. Those considered most feasible and appropriate for validation of intake data were carried out. The SDI study marked the beginning of an intensive program of methodological research on food intake surveys at USDA. New directions in research were undertaken with attention given to the increasing necessity for a dietary status monitoring system which would produce timely data to answer more questions on a wider spectrum of topics at reasonable cost and with minimum burden on survey participants.

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Chapter 4. Validation of Results from the Nationwide Food Consumption Survey 1977-78

Investigator: National Analysts, Division of Booz, Allen and Hamilton, Inc., Philadelphia, Pennsylvania. Dr. Lucy A. Wilson, Project Director, 1978-80.

SUMMARY: This study provided information about the quality and validity of data obtained in the USDA Nationwide Food Consumption Survey 1977-78. Shortly after being interviewed, household respondents were surveyed by mail to obtain their assessment of how accurate their responses were and how difficult they found their participation to be. After the survey was completed, interviewers were also debriefed with a mail survey. In addition, groups of homemakers evaluated a number of alternative methods for future surveys. Most interviewers considered responses describing foods to be more accurate than those quantifying foods. Few interviewers regarded reported intakes to be very accurate if surrogates were not present when the foods were eaten. Interviewers perceived the Food Instruction Booklet to be more helpful to interviewers than to respondents. Interviewers considered the advance letter sent to respondents to be more important than promised incentives. Respondents had a more favorable view of the accuracy of their responses than did the interviewers. It was recommended that a standard procedure be developed for surrogates reporting intakes for intended respondents who were not present and that better training on proper use of measuring utensils be given to interviewers and respondents.

Tables

4.1 Background

The review of plans for the Nationwide Food Consumption Survey (NFCS) 1977-78 methodology by the U.S. General Accounting Office (GAO) in 1977 resulted in the recommendation that efforts be made to validate the survey methodology either before or during NFCS and before the next survey (USGAO, 1977). GAO proposed that standards similar to those in Standards for Educational and Psychological Tests (American Psychological Association, 1974) be applied in validating NFCS 1977-78 findings. In response, USDA arranged to have approaches for validation of the NFCS procedures reviewed by Survey Design, Incorporated (SDI), an independent firm with experience in large-scale surveys (Chapter 3). SDI recommendations regarding NFCS 1977-78 methodology and field applications formed the basis for this study by National Analysts.

4.2 Purpose

The study was designed by National Analysts to provide information on the quality and validity of the data derived from the NFCS 1977-78, on the adequacy of survey instruments and procedures, and on alternative data collection methods for use in future food consumption surveys. The project had three parts:

I. Group sessions to explore methodology for future surveys--alternative food measurement procedures,

II. Mail debriefing of interviewers, and

III. Participant followup surveys.

4.3 Methods

I. Group sessions to explore methodology for future surveys--alternative food measurement procedures (National Analysts, 1978):

This phase of the study was concerned only with methods of collecting household food use data. Because household food use information has often been collected before the individual food intake information during the same interview, the household method used and its timing may have an impact on quality of intake data obtained. Therefore, a brief description of the sessions follows.

Six panels, two in each of three geographic areas (Arizona, Pennsylvania, and Florida), were selected to consider six alternative methods of measuring household food consumption. Selected panel members usually planned and prepared the meals in their households. To begin the first of two group sessions, the 8 to 10 members in each group discussed general issues in food consumption: household buying and consumption practices, ability to recall accurately specific details, and willingness to participate in a food consumption survey. The six alternative methods were presented, discussed, compared with each other, and then compared with the NFCS aided-recall method. The six methods were tape recording descriptions of food as used in the household, photographing meals before serving, preparing duplicate meals for laboratory analysis, collecting bagged food discards, dietitian observing meal preparation, and tagging food inventory and removing tags upon use.

Before the second group interview session, interviewers administered a NFCS 1977-78 household-food-use questionnaire to each panel member. The second group interview was a debriefing of members' experiences with the NFCS-type interview and their assessment of the six alternative methods. They were asked to consider the accuracy, likely sources of error, respondent burden, willingness to participate, and the overall feasibility of each method. The six methods were rated by panel members according to likely accuracy, willingness of persons to participate, and overall feasibility. Panel members were also asked to consider likely approaches for gaining respondent cooperation, their reaction to identification of USDA as the sponsor of the survey, the most effective means of publicity, and the efficacy and the level of incentives. Participants were also asked for recommendations for improving NFCS interviews.

II. Mail debriefing of interviewers (National Analysts, 1979):

A 63-item, self-administered questionnaire was mailed in late summer of 1978 to the 826 NFCS 1977-78 interviewers who had completed three or more household interviews or screenings. Most questions were structured with precoded response choices or selections on a 7-point rating scale. The questionnaire took about 20 minutes to complete. Questions concerned interviewers' perceptions of respondent accuracy and willingness to provide information, the adequacy of interviewers' training and staff support, the workability of the survey instruments and procedures, and a profile of the interviewers. Responses were received from 76 percent of the interviewers. Analyses of data consisted of frequency counts, cross-tabulations, and means with standard deviations where appropriate.

III. Participant followup survey (National Analysts, 1980):

A 27-item, self-administered questionnaire was mailed to the 2,467 NFCS 1977-78 household respondents interviewed in the food consumption surveys in March 1978 (including the basic, elderly, Alaska, Hawaii, and low-income samples). Respondents received the questionnaire about 3 weeks after their household interview. After two waves of mailing, 980 completed questionnaires were returned (39 percent). A third wave of followup by telephone brought the number of completed returns to 1,143 (46 percent). Topics addressed in the questionnaires included demographic characteristics of respondents, attitudes toward the survey, and, relevant to the individual food intake component, perceived accuracy of food recall information for the day before the interview and for food records kept by self and others and whether measuring devices were used in estimating amounts eaten. Most questions were structured with precoded response choices or selections on a 7-point scale. About 15 minutes was required to complete the questionnaire. Analyses included frequency counts, cross-tabulations, and means with standard deviations.

4.4 Main Findings

I. Group sessions to explore methodology for future surveys--alternative food measurement procedures:

Of the six alternative household food use methods presented, panel group members chose tape recording and tagging as the most feasible for use in surveys considering both level of accuracy and willingness to participate. Photographing meals was seen as lacking accuracy because kind and amount of items would not be clear even though the method could contribute to recall of food consumption. Food discard pick-up was also viewed as inaccurate although it could provide supplemental information on waste. Duplicate meal preparation and observation by an outsider were considered likely to change usual food preparation and consumption patterns, as well as to discourage participation.

Panel members suggested additional procedures for consideration. These included use of (1) a preprinted recording form organized by food category in place of informal note-taking, (2) a check-off form with food items listed, (3) a recording form for food purchased and used plus food discard pickup of food not consumed, (4) inventory of foods at beginning and end of period plus interim purchases, (5) grocery receipts, and (6) an electronic recording device, such as a small computer. To gain respondent cooperation, panel members advocated use of an advance letter and a telephone or personal contact to explain the data collection method at the beginning of the 7-day survey period. The panels felt strongly that identifying the study as sponsored by USDA would maximize respondent cooperation. They stressed the importance of having interviewers explain (1) the nature of the study, (2) how the information is used, and (3) possible benefits to the average citizen; they felt strongly that knowing the rationale for the study would foster greater willingness to participate. The most frequently suggested means for publicity were radio and television. Incentives were considered necessary by about 90 percent of the panel members. For the NFCS method, the suggested level of incentive varied from \$10 to \$20. Panel members considered the NFCS method to be more accurate and more feasible than the six alternative methods for collecting food consumption information. The combination of respondent-kept written notes and interviewer-administered list-recall was considered the best approach, provided the respondent received adequate instructions. Adequate advance preparation of respondents for the interview was most frequently mentioned as a way to improve NFCS.

II. Mail debriefing of interviewers:

Only findings related to the individual food intake component are reported here, although the National Analyst team also reported findings for the household food use component. Interviewers' responses dealt with several phases in the process of obtaining individual dietary intake data. In this process, food intake recalls were collected for the day prior to the in-person interview, and food records were completed by the respondents for the day of and day after the interview. The household respondent recalled intake for himself or herself and for some others, including children under 12 years of age. Available household members age 12 and older were asked to recall intakes for themselves. The 2-day food record forms were left for individuals to complete. Interviewers gave respondents verbal and printed instructions (a Food Instruction Booklet) for keeping records. A set of measuring utensils was provided to aid in estimating amounts eaten. At the end of the recording period, the interviewer returned to review and pick up the food records.

Self-recalled descriptions of food items were regarded as being "very accurate" by over one-half of the interviewers, but somewhat fewer believed all foods eaten had been enumerated very accurately (Table 4.1). Only about one-fourth of the interviewers considered quantity eaten to have been very accurately recalled by the respondent. Fewer than 10 percent of the interviewers considered enumeration, descriptions, or quantities to be "inaccurate." When the respondent enumerated foods eaten by spouse or children, few interviewers (17 percent) deemed reports to be very accurate unless the respondent had been present when the food was eaten. (A question on the individual intake instrument for the survey asked with whom each meal was

Table 4.1--Interviewers' perceptions of the accuracy of individual intake data

Variable	Perceived accuracy[1]		
	Very accurate	Moderately accurate	Inaccurate
	Percent		
Self-reported recall			
Enumeration of all foods eaten.....	39	55	6
Quantities eaten................	26	65	9
Detailed descriptions of foods...	55	42	3
Recall of foods eaten by others			
All foods eaten by spouse:			
When respondent present..........	65	34	2
When respondent not present......	17	71	11
All foods eaten by children:			
When respondent present..........	67	30	3
When respondent not present......	17	67	16

[1]As perceived by 597 interviewers, rated on a scale from 1 to 7: very accurate = 6 or 7; moderately accurate = 3, 4, or 5; inaccurate = 1 or 2. Totals may not add to 100 because of rounding.

eaten. This information makes possible quality-of-data comparisons for self-reported intakes as opposed to household-respondent-reported intakes.) About two-thirds of the interviewers believed respondents were very accurate in reporting all foods eaten by other household members if the respondent was present at the meal.

Respondents are often able to provide higher quality information on food intake if an interviewer gives assistance or directions concerning how the information could best be reported. In NFCS 1977-78, one aid used in reporting was the Food Instruction Booklet (FIB). The FIB was a 4-page leaflet listing types of food with instructions about details to include in describing food items eaten and the best measures to use for reporting the amounts. The FIB was left with respondents for reference in keeping records. About half of the interviewers reported the FIB was very helpful to themselves, but somewhat less than one-third regarded the FIB as very helpful to respondents (Table 4.2). Almost one-fifth of the interviewers judged the FIB not to have been helpful at all for respondents.

Other aids--a set of measuring cups, measuring spoons, and a ruler--were given to each household to assist individual respondents in estimating quantities of food eaten. The measuring utensils were used by about half of the interviewers while administering food intake schedules (Table 4.3). Interviewers completing a large number of interviews appeared to make greater use of this measurement aid than interviewers with a lighter load. Of all interviewers, 30 percent reported using the measuring devices in few or none of

Table 4.2--Interviewers' perceptions of the helpfulness of the Food Instruction Booklet

Perceived helpfulness[1]	For interviewers	For respondents
	Percent	
Very helpful........................	51	30
Moderately helpful..................	44	52
Not helpful.........................	5	18

[1]As perceived by 592 interviewers, rated on a scale from 1 to 7: very helpful = 6 or 7; moderately helpful = 3, 4, or 5; not helpful at all = 1 or 2.

Table 4.3--Interviewers' use of measuring utensils

Variable	Interviewers	
	All assignments (N=598)	Large assignment[1] (N=304)
	Percent	
Used in all or most households............	52	60
Used in about half of the households.......	18	20
Used in few or none of the households......	30	20

[1]Large assignment = 20 or more interviews completed.

the households. National Analyst researchers drew the conclusion that interviewers either used these aids most of the time or rarely.

Survey instruments and procedures are important in achieving consistency, facilitating data collection, and maintaining response rates. Advance letters were considered very helpful in arranging appointments by 56 percent of the interviewers, moderately helpful by 35 percent, and not at all helpful by 9 percent. New interviewers and those completing few assignments were less likely to find the advance notification helpful. According to these researchers, this was probably because they were less skilled in using the advance letter effectively.

Incentives--measuring utensils and money --were considered by interviewers to be less helpful than the advance letter. Only 44 percent of the interviewers found money to be very helpful and even fewer regarded the measuring utensils as very helpful (Table 4.4). Debriefing of

Table 4.4--Interviewers' perceptions of money and measuring utensils as incentives

Perceived helpfulness[1]	Incentive	
	Money[2]	Measuring utensils[3]
	-----Percent-----	
Very helpful..........................	44	37
Moderately helpful....................	34	42
Not helpful...........................	22	21

[1]Rated on a scale from 1 to 7: very helpful = 6 or 7; moderately helpful = 3, 4, or 5; not helpful at all = 1 or 2.
[2]Number of interviewers = 435.
[3]Number of interviewers = 447.

interviewers brought forth their reasons for the low rating. The measuring utensils were not presented until after completing most of the interview--after the household food use component. Although the advance letter mentioned giving a gift, the timing of the presentation of the measuring utensils greatly diminished their value as an inducement to participate in the survey. The money for completing the 2-day food record ($1.00 per individual member up to $10.00 per household) likewise was not paid until the interviewer picked up completed diaries.

Most interviewers (62 percent) considered personal contact to be the best way to contact respondents to make appointments, while 22 percent preferred telephone contact, and 13 percent viewed the two approaches as equally satisfactory. Interviewers in the South, West, and Hawaii were more likely to prefer personal contact (70 to 76 percent of interviewers) than those in the Northeast, North Central region, and Alaska (49 to 54 percent).

The training and support that interviewers received before and during field work were also assessed by NFCS 1977-78 interviewers. Among responding interviewers, 68 percent attended one of the 23 5-day training sessions conducted by the National Analysts staff and 26 percent attended a 1- to 3-day local training session. Regional differences were found. The highest percentages of interviewers attending the 5-day training conferences were from the South and Hawaii (73 to 74 percent) and the lowest percentages were from Alaska (46 percent) and the Northeast (63 percent). (National Analysts judged interviews from Hawaii to be among the easiest to review and code and those from Alaska to be among the most difficult. A high proportion of the Hawaiian interviewers were exceptionally well-educated.) Overall assessment of training was considered to be excellent by 54 percent of the 627 interviewers responding, good by 39 percent, and fair by 6 percent.

Tabulation of characteristics of NFCS 1977-78 interviewers revealed that most (91 percent) female, well-educated (64 percent had at least some college), and experienced in interviewing (64 percent). Alaska and Hawaii had the largest proportion of interviewers with no previous interviewing experience (57 and 43 percent, respectively, of their total numbers). The most experienced interviewers were in the Northeast; almost half had over 5 years of experience.

The average number of interviews completed per interviewer in NFCS 1977-78 was 35. About 10 percent of the interviewers completed about 100 interviews each; about 50 percent completed 1 to 19 interviews each.

III. Participant followup surveys:

Slightly less than half of the March 1978 NFCS sample participants to whom questionnaires were sent responded. The average age of respondents was 47 years; 25 percent were 63 years or older. One-third had less than 12 years of formal schooling and the same proportion had at least some college. Average household size was three persons with 17 percent of the households one-person, 28 percent two-persons, and 21 percent five or more persons. All regions were similar in age distribution, but there were some variations in educational level and household size. Among all respondents, 96 percent indicated they were the usual meal planners for the household.

Of the respondents who remembered completing an individual recall for themselves, almost two-thirds regarded the information as generally very accurate, about one-third viewed it as moderately accurate, and the remainder (5 percent) as not at all accurate (no table). Almost three-fourths of the respondents were very confident of their accuracy in recalling all foods eaten; only half were as confident about their recall of amounts eaten (Table 4.5).

The majority of respondents felt they were at least moderately accurate in providing information about kinds and amounts of food eaten for other members of the household. Greatest confidence was expressed for food eaten in the respondent's presence. The elderly sample provided 1-day recall data only.

Table 4.5--Respondents' perceptions of accuracy of recall for various types of individual intake data

Variable	Respondents	Perceived accuracy of recalled data[1]		
		Very accurate	Moderately accurate	Inaccurate
	Number	Percent		
Enumeration of all foods.........	638	73	24	3
Descriptions of foods............	638	67	29	4
Price of food bought and eaten away from home.................	621	64	29	7
Quantities of foods eaten........	635	50	44	6

[1]Rated on a scale from 1 to 7: very accurate = 6 or 7; moderately accurate = 3, 4, or 5; inaccurate = 1 or 2.

All other samples provided 2-day food records as well. Although records were supposed to be kept by each subject, 44 percent of the respondents reported completing records for other members of the household. Household respondents were expected to keep the records for children and others needing assistance. Of the respondents who kept records for others, most (81 percent) reported they were very accurate in describing kinds of food eaten in their presence, and a large proportion felt the same level of accuracy was attained in reporting quantities eaten (Table 4.6). However, when food was not eaten in the respondents' presence, confidence dropped sharply. Only 43 percent rated the kinds and 31 percent rated the amounts as very accurate.

The frequency with which record entries were made was taken as an indicator of the accuracy of the record. The sooner the entry was made, the greater the accuracy expected. Nearly all respondents (96 percent) reported making entries at least once a day, and 29 percent reported making entries after each eating occasion. Among participants in the supplemental surveys, 39 percent of the respondents in the low-income sample made entries after each eating occasion, whereas only 15 percent of the Hawaiian respondents recorded information each time they ate or drank.

Accuracy may be enhanced the more frequently aids are used. The use of the set of measuring utensils in completing food intake records was reported by less than one-third of the respondents. Also, food intake records are more likely to represent actual patterns if data collection procedures are nonintrusive. Over three-fourths of the respondents reported that their eating habits were not changed by keeping a record of foods eaten. However, well

Table 4.6--Surrogates' perceptions of their accuracy in reporting food intake data for others

Variable	Respondents	Perceived accuracy of reports[1]		
		Very accurate	Moderately accurate	Inaccurate
	Number	Percent		
Respondent present:				
Descriptions of foods eaten....	397	81	17	2
Quantities of foods eaten......	393	63	30	7
Respondent not present:				
Descriptions of foods eaten....	384	43	46	11
Quantities of foods eaten......	381	31	52	17

[1]Rated on a scale from 1 to 7: very accurate = 6 or 7; moderately accurate = 3, 4, or 5; inaccurate = 1 or 2.

over one-third of the respondents felt people in general would change their usual practices if required to keep a food record.

Respondents perceived themselves to be more accurate in reporting information than did the interviewers (Table 4.7). While about three-fourths of the respondents felt all foods and beverages consumed were very accurately enumerated or described, only about two-fifths of the interviewers regarded those items to have been very accurately enumerated or described. Overall, respondents and interviewers viewed household food use data to be somewhat more accurate than individual food intake data. Most respondents regarded the NFCS experience very interesting (35 percent) or moderately interesting (53 percent) and the remainder not interesting at all. Only one-third of the respondents considered information given by the interviewer before the interview to be very helpful.

4.5 Conclusions and Recommendations

I. Group sessions to explore methodology for future surveys--alternative food measurement procedures:

The NFCS 1977-78 aided-recall method with written notes for collecting household food consumption information was considered by panel members to be more accurate, more acceptable, and less burdensome than any of the six alternative methods presented. Panelists suggested that respondents should be better prepared for the interview and

Table 4.7--Interviewers' and respondents' perceptions of the accuracy of individual intake data

Variable	Respondents	Perceived accuracy of data[1]: Very accurate	Moderately accurate	Inaccurate
	Number	Percent		
Interviewers:				
Enumeration of all foods.......	597	39	55	6
Descriptions of foods eaten....	593	54	42	4
Quantities of foods eaten......	598	26	65	9
Respondents:				
Enumeration of foods eaten.....	638	73	24	3
Descriptions of foods eaten....	638	67	29	4
Quantities of foods eaten......	635	50	44	6

[1]Rated on a scale from 1 to 7: very accurate = 6 or 7; moderately accurate = 3, 4, or 5; inaccurate = 1 or 2.

that a form for recording menus and foods used during the survey week should be provided for use in the interview.

II. Mail debriefing of interviewers:

It was recommended that intake data be reported only by persons present when the food was consumed if intakes could not be self-reported. The development of a standard procedure to assure "maximum informed response" was recommended for reporting intakes when the intended respondent is not present.

Improvements were suggested pertaining to the content and format of the Food Instruction Booklet, and the way it is introduced to respondents.

The use of measuring devices by interviewers appeared to be in proportion to the interviewer's familiarity with them. Greater emphasis during interviewer training on how to use the utensils properly should increase their use in the field, leading to improved quality of data.

Despite the limited incentive value of money or measuring utensils according to the interviewers, it was recommended that incentives should be retained for future surveys. Consideration should be given to specifying the incentives when making an appointment and to giving them early in the interview.

III. Participant followup surveys:

Most respondents felt the data were at least moderately accurate. This was especially true for recalling all items eaten and somewhat less true for descriptions of food and less true for amounts eaten. The majority of respondents completing intake reports for other members believed that the data on kinds and amounts were at least moderately accurate. More confidence was expressed in reports of food eaten in their presence. Keeping food records was not considered intrusive. Greater emphasis on self-reporting by all respondents whenever possible was recommended, as was better training for respondents in the use of the measurement aids.

4.6 Comment

The National Analyst's validation study indicated that interviewers and respondents alike felt the NFCS 1977-78 data were very accurate or moderately accurate. However, both interviewers and respondents suggested some improvements in procedures that would enhance data quality or make the reporting task easier for the respondent. A number of these suggestions were taken into account in the National Analyst study of longitudinal approaches (Chapter 7) and the Westat pilot survey of low-income groups (Chapter 8).

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Chapter 5. Comparisons of Data from the Nationwide Food Consumption Survey 1977-78 and the National Health and Nutrition Examination Survey 1971-74

Investigator: School of Public Health, University of Michigan, Ann Arbor, Michigan. Dr. Frances A. Larkin, Principal Investigator, 1981-83.

SUMMARY: The University of Michigan research group examined the types and degrees of differences between 1-day dietary intakes and body weights and heights obtained in the Nationwide Food Consumption Survey (NFCS) 1977-78 and the National Health and Nutrition Examination Survey (NHANES) 1971-74. Starting from computer tapes with the two sets of detailed survey data, the researchers made adjustments insofar as possible for differences in sampling, food item coding, specification of eating occasions, and nutrient data base used. A variety of descriptive statistics were computed for intakes of food energy, 10 nutrients, 39 food groups, alcoholic beverages, and for eating patterns by 22 sex-age groups subdivided by several demographic characteristics. The researchers found the most pronounced differences between the surveys to be in mean and median energy and nutrient intakes of the youngest and oldest age groups, lower for the youngest and higher for the oldest in NFCS compared with NHANES. Iron, thiamin, and niacin intakes were generally higher in NFCS than in NHANES probably related to changes in enrichment standards between surveys. Carbohydrate and calcium intakes tended to be lower in NFCS than in NHANES. Differences between surveys for riboflavin and vitamins A and C were small as were differences between self-reported (NFCS) and clinically measured (NHANES) weights and heights.

Tables

5.1 Background

Two nationwide surveys--the Nationwide Food Consumption Survey (NFCS) and the National Health and Nutrition Examination Survey (NHANES)--provide information on dietary intakes and heights and weights of individuals in the United States. Because the results of both surveys are widely used, the types and degrees of differences in results merited careful investigation by unbiased authorities. Although methods for collecting and processing the data in the two surveys differ, methodological differences were not the main focus of this study. The two surveys were made 3 years apart, so some differences in consumption would be expected. Other differences that might affect results are the measurement aids used to estimate portion sizes on food recalls, self-reporting (NFCS) versus clinical measurement (NHANES) of heights and weights, sampling procedures, the interview setting, the use of surrogate respondents, incentives, food coding guidelines, and nutrient data bases.

USDA contracted with a research group at the University of Michigan, led by Dr. Frances A. Larkin, to examine NFCS 1977-78 and NHANES 1971-74 data and determine the types and degrees of differences between the two surveys. The results of this study are especially relevant because the NFCS and NHANES are major components of the National Nutritional Monitoring System (NNMS). Both surveys report energy and nutrient intake data; however, the two surveys have different objectives. NFCS seeks to obtain dietary and other information relevant to the study of food consumption, dietary practices, and marketing; whereas NHANES seeks dietary and other data relevant to the study of health and disease status. The distinct objectives of each survey resulted in some differences in data collection, variable definitions, and data processing, some of which are noted in Table 5.1.

5.2 Purpose

This study examined the types and degrees of differences in individual 1-day dietary intakes and in the heights and weights obtained by two nationwide surveys.

5.3 Methods

To fulfill the objectives of the study, data from 1-day food recalls from the NFCS 1977-78 were compared with those from NHANES 1971-74 for food and alcoholic beverage intakes, food energy and nutrient intakes, and eating patterns. NFCS respondent-reported and NHANES clinically measured heights and weights were also compared.

5.3.1 Data Sets and Analyses

Computer tapes with NFCS 1977-78 1-day food and nutrient intake and attribute data for individuals and tapes with NHANES 1971-74 1-day food and nutrient intake and attribute data for individuals provided the basic data for this study. Sampling differences between the two surveys required adjustments for disparities ascribable to intentional oversampling of high-risk groups in NHANES and the uneven response rates among quarters for NFCS. The unweighted number of individuals in NFCS was 28,839, and in NHANES it was 20,749. Only individuals aged 1 to 74 years were included in this study because NHANES included only those ages. Before statistics were calculated, individuals' values were weighted to be more nearly representative of the U.S. population. Data collection and processing procedures followed in each of the surveys have been described elsewhere (USDA 1983; USDHEW 1973a, 1973b).

One-day recall data from NFCS and NHANES: For comparisons among subgroups of the population, matching variables were constructed to compensate for

Table 5.1--Methodological differences: NFCS 1977-78 and NHANES 1971-74

Element	NFCS	NHANES
1. Organization performing survey work.	Private contractor--National Analysts, Philadelphia.	Sample design: Bureau of the Census. Data collection: NHANES employees.
2. Sample.........	Multistage, stratified probability sample of about 15,000 households in 48 States provided 28,839 individuals. Levels: 114 PSU's (primary sampling unit), area segment, household. Sampling frame based on 1970 Census of Population.	Multistage, stratified, probability sample of persons in the U.S. yielded 20,749 sample persons. Levels: 65 PSU's, area segment, household, eligible person, sample person. Sampling frame based on 1960 Census of Population.
3. Length of survey.	1-year cycle.	3-year cycle.
4. Time period.....	April 1977-March 1978.	April 1971-June 1974.
5. Coverage........	Data collected throughout the year in all geographic areas simultaneously.	Data collected in northern sites in summer, southern sites in winter, in two sites at a time, moving about every 3 to 6 weeks. Takes 1 week to move.
6. Days of week....	7 days, interviewing.	5 days: Monday-Friday intakes, Tuesday through Saturday interviewing, physical examinations, and tests.
7. Seasonal data...	Seasonal data.	No seasonal data.
8. High-risk groups sampled.	Separate samples of individuals in low-income households and households containing elderly persons.	Within main sample, oversampling of low-income individuals, preschool children, women of childbearing age, elderly individuals.
9. Age of individuals.	All ages.	1 to 74 years.
10. Source of demographic and household data collected.	Household respondent, during home visit as part of household food use/individual intake interview.	Household respondent, during home visit prior to appointment for dietary interview.
11. Location of dietary interview.	In the home.	At mobile clinic where physical examination is given.

Continued

Table 5.1--Methodological differences: NFCS 1977-78 and NHANES 1971-74--Continued

Element	NFCS	NHANES
12. Dietary interviewer.	Experienced in interviewing, familiar with food preparation, special training for NFCS.	Dietitian or had degree in foods and nutrition.
13. Dietary information.	Interviewer-administered 1-day recall. Self-administered 2-day diary record, picked up and reviewed on return visit by interviewer.	Interviewer-administered 1-day recall.
14. Measurement aids.	Set of stainless steel measuring cups and spoons, and plastic ruler.	Set of 51 three-dimensional food portion models, geometric shapes, and tableware.
15. Incentives......	Set of measuring utensils given to household, $1.00 per 3-day completed intake report up to $10 per household.	$10 per individual plus transportation to clinic.
16. Height and weight measures.	Self-reported.	Clinical measurement.
17. Coders of dietary information.	Specially trained group did coding at contractor's central office.	Interviewers coded own recalls then sent them to NHANES central office.
18. Nutrient data base.	USDA Nutrient Data Bank staff provided special tape based on updated values from Agriculture Handbook No. 8 (Watt and Merrill, 1963) and other sources.	Tulane University Master Dietant List, Agriculture Handbook No. 8 (Watt and Merrill, 1963), Home and Garden Bulletin No. 72 (USDA, ARS, 1970), Bowes and Church (1966), and commercial sources.
19. Coding of mixed dishes.	Most mixed dishes were handled as a single item if reported as a single item and classified in the food group of the major ingredient. Example: "beef sandwich" reported and coded as single item in the meat mixture food group.	Most mixed dishes were split into component parts and parts coded separately into several food groups. Example: "beef sandwich" reported but coded as bread, spread, beef, and condiments--four separate food groups.

certain differences in definitions of variables measured and reported in the two surveys. The socioeconomic variables used in this study are defined as follows:

- Race

  --Black (individuals coded 'black')
  --White (individuals coded 'white' and 'other')

- Education of household head

  --None through 8th grade
  --Ninth through 11th grade
  --High school graduate
  --Some college or more

(If a value was given for a male head of household, that was used. If not, value for female head was substituted.)

- Occupation of household head

  --Blue collar (craftsmen, operators, laborers, farmers, farm laborers, service workers, private household workers)
  --White collar (professionals, managers, salespeople, clerical workers)

(Occupation of household head was not obtained for NHANES 1971-74 individuals under 17 years of age; if household head was not included in the survey, data for the individuals were not included in the tabulation.)

- Employment status of household head

  --Employed (worked in last 2 or 3 weeks or temporarily absent from job due to vacation, illness, etc.)
  --Not employed (in last 2 or 3 weeks, laid off, looking or not looking for work, homemaker, student, retired, etc.)

(Employment status of household head was not obtained for NHANES 1971-74 individuals under 17 years of age; if household head was not included in the survey, data for the individuals were not included in the tabulation.)

- Household income

  --NFCS 1977-78:
  0 - $ 7,999
  $ 8,000 - $13,999
  $14,000 - $19,999
  $20,000 and over

  --NHANES 1971-74:
  0 - $ 5,999
  $ 6,000 - $ 9,999
  $10,000 - $14,999
  $15,000 and over

(Household income was for different years and was considerably affected by inflation. Each of the four categories includes about one-fourth of the weighted sample in the particular survey.)

Computations included medians, means, percentage differences in medians and in means, intakes at given percentiles for 22 sex-age groups and strata based on several socioeconomic and demographic characteristics. Differences found between the two surveys were not tested for significance.

Five sets of measurements were studied and reported separately: (1) nutrient intakes--food energy and 10 nutrients, (2) consumption of food groups, (3) number of eating occasions and meal patterns, (4) alcohol (as ethanol) consumption, and (5) weight, height, and weight/height^2 (body mass index).

5.3.2 Energy and Nutrient Intakes

Intakes of food energy, protein, fat, carbohydrate, iron, calcium, thiamin, riboflavin, niacin, vitamin A, and vitamin C were examined. Food coding procedures and the nutrient data base used to compute nutrient content of food intake reports differed somewhat between the two surveys (Table 5.1).

5.3.3 Consumption of Food Groups

The comparison of consumption of food groups reported in NFCS and NHANES required aggregation of the large variety of foods into a much smaller number of food groups, finally numbering 39. Foods in each group were closely related on one or more attributes. However, differences in procedures for coding a number of foods between the two surveys made construction of matching food groups inexact, such as in handling mixed dishes. Data from the two surveys were compared in terms of the percentage of individuals using each of the 39 food groups and variations in percentages of users of 11 relatively comparable food groups by race and education of household head and the median energy contribution of each of 39 food groups.

5.3.4 Eating Occasions and Meal Patterns

For study of the number of eating occasions and meal patterns, foods were organized by time of eating (NHANES) or time an eating occasion began (NFCS). An eating occasion was specified as the event of eating one or more foods (including beverages) at the same time and separated from an earlier event by more than 19 minutes. In the NFCS, each eating occasion was identified by the respondent as (1) breakfast, (2) brunch, (3) lunch, (4) dinner, (5) supper, (6) coffee (beverage) break, (7) snack, or (8) other. In the NHANES interview, instead of coding the name of the eating occasion, the interviewer assigned a code for ingestion period--(1) a.m., (2) noon, (3) between meals, (4) p.m., or (5) total day. For this study, each eating occasion in both surveys was recorded as breakfast, lunch, dinner, supper, or snack. Other labels used by respondents were allocated to the most appropriate of these primary classifications. The research team categorized meal patterns for this study in terms of the number of meals with or without snacks: (1) snacks only, (2) one meal, (3) one meal plus snacks, (4) two meals, (5) two meals plus snacks, (6) three meals, and (7) three meals plus snacks. Occurence of meal patterns and nutrient adequacy measured in terms of intake as a percentage of 1980 Recommended Dietary Allowances (RDA) were compared for four meal patterns: (1) snacks only, one meal with or without snacks, or two meals, (2) two meals plus snacks, (3) three meals, and (4) three meals plus snacks.

5.3.5 Alcohol Consumption

Alcoholic beverage consumption by 15- to 74-year-old respondents in the two surveys was studied, although small amounts were recorded for younger age groups. Analyses were in terms of the percentage of consumers using and the mean and median amounts of ethanol consumed by drinkers.

5.3.6 Weight, Height, and Body Mass Index

Weight and height information in NFCS had been obtained from respondents who were asked to give their best estimate for height without shoes and for weight without shoes or heavy clothing. In NHANES, weight was measured on a self-balancing scale that mechanically printed the measurement to the nearest one-fourth of a pound directly onto a permanent record. The total weight of the clinic-provided garment worn while being measured ranged from 0.20 to 0.62 pound. Height for individuals aged 3 to 74 years was measured in disposable foam rubber slippers with each person's back and heels against the upright bar of a height scale. A camera was positioned to record the precise reading at the pointer on the scale. Recumbent length of children 1 to 2 years of age was measured on a children's measuring board. An index of body mass was calculated using a formula in which body weight in kilograms was divided by the square of height in centimeters.

5.4 Main Findings and Discussion

The results of comparisons between NFCS 1977-78 and NHANES 1971-74 were presented for five categories of data: (1) the intakes of energy and 10 nutrients by 22 sex-age groups, (2) the percentage of users of 39 specified food groups and the energy contribution of each food group, (3) the number of eating occasions and types of meal patterns, (4) the percentage of individuals consuming alcohol and the amount consumed, and (5) the weight and height of participants as self-reported or clinically measured.

5.4.1 Intakes of Food Energy and Ten Nutrients

Differences in nutrient intakes result from both differences in the foods reported and in the nutrient data bases used. For nearly all sex-age groups, NFCS median 1-day intakes were higher than NHANES median 1-day intakes for iron, thiamin, and niacin but lower for carbohydrate and calcium (Table 5.2).

Table 5.2--Summary of median energy and nutrient intakes by individuals in NFCS 1977-78 compared with NHANES 1971-74

[L = NFCS median was lower than NHANES median; H = NFCS median was higher than NHANES median. Age groups in parentheses are exceptions]

Nutrient	Males			Females		
	1-5 years	6-50 years	51-74 years	1-5 years	6-50 years	51-74 years
Food energy....	L	L	H	L	L (15-18) (35-50)	H
Protein........	L	L (12-14)	H	L	H (12-14)	H
Fat............	L	L (12-14) (35-50)	H	L	H	H
Carbohydrate...	L	L	L	L	L	L (65-74)
Calcium........	L	L	L	L	L (15-18)	H
Iron...........	H	H (19-34)	H	H	H	H
Thiamin........	H	H (19-22)	H	H	H	H
Niacin.........	H	H (19-34)	H	H	H	H
Riboflavin.....	L	L (12-18)	H	L	H	H
Vitamin A......	L	H (6-8) (19-22)	H	H (1-2)	H (19-22)	H
Vitamin C......	L (1-2)	H (19-22)	H (65-74)	H	H (19-50)	H (51-64)

Differences in energy and nutrient intakes between the two surveys were most pronounced for the two youngest (1 to 2 and 3 to 5 years) and the two oldest (51 to 64 and 65 to 74 years) age groups (Table 5.3). Nearly all median intakes for the two oldest groups were higher in NFCS than in NHANES; for the two youngest groups, intakes were substantially lower in NFCS than in NHANES. For 6- to 50-year-olds, NFCS values for food energy were generally below NHANES values. NFCS protein and fat intakes for 6- to 50-year-olds were also generally below NHANES values for males but not for females. Differences between the two surveys for riboflavin, vitamin A, and vitamin C tended to be smaller than for the other nutrients studied.

For the macronutrients, percentage differences in median intakes for 1- to 5-year-olds ranged from 5 to 10 percent (for protein) to 13 to 25 percent (for carbohydrate) lower for NFCS than for NHANES (Table 5.3). Considering energy, protein, and fat, percentage differences for 51- to 74-year-olds ranged from 4 to 9 percent (for food energy) to 16 to 19 percent (for fat), higher for NFCS than for NHANES.

Percentile distributions of energy intakes for 22 sex-age groups (Tables 5.4 and 5.5) revealed that energy values at all percentiles were generally lower for NFCS than for NHANES. Exceptions were the two oldest age groups of males and females, for whom values were higher for NFCS than for NHANES. (Tabulations of percentiles for all nutrients were included in the final report.)

Mean and median intakes of most nutrients appeared to be associated with demographic and socioeconomic factors, although the relationships were not tested for statistical significance and were not always consistent. The relationships of nutrient intakes with eight socioeconomic factors were studied one at a time, not simultaneously.

Iron, thiamin, and niacin intakes tended not to be associated with those factors, but were associated with differences in enrichment standards. Intersurvey comparisons for riboflavin appeared to be associated with region, urbanization, and income. All of the stratifying variables, except household size, generally were associated with values for energy, protein, fat, carbohydrate, calcium, vitamin A, and vitamin C. Among age groups, the 51- to 74-year-olds' intakes of all nutrients tended to be least associated with these independent variables.

Comparisons by <u>race</u> revealed that in both surveys, white males had higher median intakes than black males for all nutrients studied except thiamin. The same pattern was evident for females, except for protein, iron, and niacin. Thiamin median values were similar in the two surveys for both whites and blacks, males and females. Vitamin C median values for most age groups of blacks were considerably higher in NFCS than in NHANES, but there was little difference between surveys for whites. Possible changes in the economic situation of blacks in the 6 years between the two survey periods may have affected vitamin C intakes, which often show association with level of income; or intakes may have been changed by the increase in vitamin-C-fortified foods between 1971 and 1977.

Among <u>regions</u>, NHANES medians for most nutrients were generally highest in the Northeast, followed by the West. NFCS nutrient values tended to be highest in the West for five nutrients--carbohydrate, calcium, iron, riboflavin, and vitamin A--and in the Northeast for niacin and vitamin C. Peak values for the other

Table 5.3—Median energy and nutrient intakes by individuals: NFCS 1977-78 and NHANES 1971-74

Sex and age (years)	Number of Individuals[1]		Energy			Protein			Fat		
	NFCS	NHANES	NFCS	NHANES	Difference[2]	NFCS	NHANES	Difference	NFCS	NHANES	Difference
			Kilocalories		%	-----Grams----		%	----Grams----		%
Males:											
1-2......	583	613	1,183	1,314	-11.1	47.7	52.3	-9.6	48.0	54.7	-13.9
3-5......	975	889	1,436	1,662	-15.7	55.3	59.7	-7.9	59.2	66.3	-12.0
6-8......	990	478	1,770	2,021	-14.2	68.4	75.2	-9.9	74.4	79.7	-7.0
9-11.....	1,016	523	1,949	2,156	-10.6	77.2	80.2	-3.9	83.6	88.6	-6.0
12-14....	1,223	554	2,233	2,403	-7.6	87.6	86.1	1.7	98.1	96.8	1.3
15-18....	1,493	634	2,493	2,818	-13.0	99.6	105.9	-6.3	111.7	117.4	-5.1
19-22....	728	458	2,294	2,838	-23.7	92.9	105.6	-13.7	102.1	115.3	-12.9
23-34....	1,917	992	2,306	2,588	-12.2	92.4	100.8	-9.1	104.5	104.8	- .3
35-50....	1,836	1,127	2,208	2,336	-5.8	90.6	92.5	-2.1	101.3	95.9	5.3
51-64....	1,526	897	2,088	2,009	3.8	86.7	80.9	6.7	95.7	78.2	18.3
65-74....	766	1,655	1,833	1,696	7.5	73.8	66.7	9.6	79.3	66.4	16.2
Females:											
1-2......	542	567	1,116	1,223	-9.6	45.2	47.3	-4.8	46.8	49.8	-6.5
3-5......	863	884	1,356	1,513	-11.6	52.8	55.8	-5.6	57.2	61.9	-8.3
6-8......	1,005	488	1,706	1,763	-3.3	65.1	64.4	1.1	71.4	69.7	2.5
9-11.....	1,096	530	1,834	1,891	-3.1	69.9	69.1	1.2	78.7	75.0	4.7
12-14....	1,202	568	1,780	1,855	-4.2	69.3	71.6	-3.3	76.4	76.0	.6
15-18....	1,574	636	1,686	1,624	3.7	65.8	64.1	2.6	72.7	65.2	10.3
19-22....	912	898	1,534	1,586	-3.4	61.7	61.3	.6	67.5	61.7	8.6
23-34....	2,636	2,383	1,540	1,549	- .6	62.9	60.7	3.6	68.1	61.2	10.1
35-50....	2,558	2,154	1,490	1,477	.9	61.9	58.8	5.1	67.3	60.6	9.9
51-64....	2,210	1,010	1,450	1,363	6.0	60.4	56.1	7.1	64.4	52.3	18.8
65-74....	1,188	1,811	1,372	1,255	8.5	57.1	50.2	12.0	58.2	47.2	18.9

See footnotes at end of table.

Continued

Table 5.3--Median energy and nutrient intakes by individuals: NFCS 1977-78 and NHANES 1971-74--Continued

Sex and age (years)	Carbohydrate			Calcium			Iron			Vitamin A		
	NFCS	NHANES	Difference	NFCS	NHANES	Difference	NFCS	NHANES	Difference	NFCS	NHANES	Difference
	----Grams----		%	--Milligrams--		%	--Milligrams--		%	-----I.U.-----		%
Males:												
1-2.....	137.8	155.2	-12.7	725	852	-17.5	7.6	6.6	13.0	2,393	2,799	-17.0
3-5.....	169.1	211.5	-25.0	736	907	-23.2	9.1	8.1	11.0	2,756	2,841	-3.1
6-8.....	209.5	249.2	-19.0	896	1,094	-22.1	11.2	10.2	9.1	3,226	3,310	-2.6
9-11....	222.1	258.8	-16.5	937	1,129	-20.5	12.5	11.5	8.3	3,630	3,612	.5
12-14...	250.9	292.8	-16.7	1,035	1,195	-15.5	14.1	12.1	13.9	4,004	3,331	16.8
15-18...	267.6	323.6	-20.9	1,085	1,233	-13.6	15.5	14.9	3.8	4,207	3,726	11.4
19-22...	234.6	306.7	-30.7	805	975	-21.1	14.2	15.3	-8.0	3,337	3,786	-13.5
23-34...	229.1	269.9	-17.8	752	846	-12.5	15.0	15.3	-1.7	3,612	3,597	.4
35-50...	210.6	233.2	-10.7	665	718	-8.0	15.0	14.4	3.7	3,800	3,550	6.6
51-64...	201.3	206.0	-2.3	664	680	-2.4	14.7	12.7	13.6	4,138	3,825	7.6
65-74...	187.6	188.5	- .5	596	602	-1.0	13.3	11.0	17.4	3,968	3,331	16.1
Females:												
1-2.....	126.0	147.3	-16.9	676	849	-25.6	6.9	5.5	19.9	2,471	2,495	-1.0
3-5.....	158.9	188.7	-18.7	698	817	-17.0	8.6	7.5	11.8	2,742	2,573	6.2
6-8.....	199.0	220.5	-10.8	870	903	-3.8	10.7	8.5	21.1	3,276	2,809	14.3
9-11....	212.6	232.8	-9.5	881	935	-6.1	11.5	9.5	17.1	3,358	3,001	10.6
12-14...	206.4	223.0	-8.1	810	851	-5.1	11.1	9.7	12.9	3,005	2,761	8.1
15-18...	186.4	195.7	-5.0	712	681	4.4	10.4	8.5	17.7	2,827	2,368	16.2
19-22...	160.6	190.4	-18.5	541	566	-4.6	9.8	8.8	9.7	2,393	2,500	-4.5
23-34...	158.6	175.9	-10.9	516	552	-7.0	10.3	9.2	10.8	2,829	2,578	8.9
35-50...	145.4	161.4	-11.1	473	489	-3.4	10.3	9.6	7.1	2,993	2,763	7.7
51-64...	147.1	152.1	-3.5	489	476	2.7	10.5	9.0	13.8	3,459	2,944	14.9
65-74...	147.9	145.5	1.6	493	490	.6	9.9	8.2	16.8	3,805	2,949	22.5

See footnotes at end of table.

Continued

Table 5.3--Median energy and nutrient intakes by individuals: NFCS 1977-78 and NHANES 1971-74--Continued

Sex and age (years)	Thiamin			Riboflavin			Niacin			Vitamin C		
	NFCS	NHANES	Difference	NFCS	NHANES	Difference	NFCS	NHANES	Difference	NFCS	NHANES	Difference
	--Milligrams--		%	--Milligrams--		%	--Milligrams--		%	--Milligrams--		%
Males:												
1-2......	0.84	0.70	16.4	1.46	1.50	-3.0	10.0	8.1	18.3	49	48	2.0
3-5......	1.05	.93	11.9	1.60	1.64	-2.7	12.7	10.2	19.1	54	61	-13.0
6-8......	1.28	1.08	15.9	1.86	1.95	-4.4	15.7	13.7	12.6	68	54	20.6
9-11.....	1.36	1.18	13.3	2.03	2.10	-3.5	17.5	14.5	16.9	71	54	23.9
12-14....	1.55	1.32	14.9	2.26	2.23	1.2	20.2	16.5	18.5	74	61	17.6
15-18....	1.65	1.42	13.7	2.37	2.36	.5	22.1	19.8	10.1	77	61	20.8
19-22....	1.41	1.46	-3.8	1.92	2.21	-15.4	21.6	23.2	-7.3	64	73	-14.1
23-34....	1.36	1.26	7.7	1.86	1.96	-5.2	21.8	22.2	-1.6	61	60	1.6
35-50....	1.32	1.15	12.9	1.72	1.76	-2.4	22.0	21.6	1.6	62	59	4.8
51-64....	1.34	1.06	21.0	1.73	1.61	6.5	21.5	18.4	14.3	76	71	6.6
65-74....	1.19	.96	19.4	1.61	1.40	13.1	19.1	14.7	22.8	70	70	.0
Females:												
1-2......	.81	.69	14.1	1.35	1.46	-8.1	8.9	7.2	19.7	45	43	4.4
3-5......	.97	.83	14.6	1.49	1.50	- .6	12.1	9.7	19.8	54	49	9.3
6-8......	1.18	0.96	18.7	1.80	1.74	3.7	14.7	11.1	24.5	65	50	23.1
9-11.....	1.28	1.04	19.2	1.86	1.72	7.5	16.1	12.3	23.6	73	56	23.3
12-14....	1.19	.98	18.0	1.72	1.61	6.0	15.5	13.0	15.9	61	50	18.0
15-18....	1.09	.84	23.2	1.53	1.35	11.8	14.9	11.7	21.6	55	52	5.5
19-22....	.93	.80	13.6	1.25	1.23	1.9	14.5	12.2	15.8	41	46	-12.2
23-34....	.91	.78	14.6	1.23	1.19	3.8	14.5	13.1	9.9	49	50	-2.0
35-50....	.88	.76	14.0	1.15	1.12	2.5	14.9	13.5	9.3	55	56	-1.8
51-64....	.92	.75	18.9	1.21	1.12	7.4	15.2	12.7	16.6	72	77	-6.9
65-74....	.94	.73	21.9	1.20	1.09	9.1	13.8	11.1	19.4	83	75	9.6

[1] Unweighted sample sizes. Individual values were weighted prior to calculating above statistics to correct for nonresponse and season in NFCS and for intentional oversampling in NHANES.
[2] Percentage difference = (NFCS value minus NHANES value)/NFCS value.

Table 5.4--Energy intakes by individuals at specified percentiles: NFCS 1977-78

Sex and age (years)	Sample size[1]	Percentile 5th	10th	25th	50th	75th	90th	95th
	Number	-----	-----	-----	Kilocalories	-----	-----	-----
Males:								
1-2.........	583	595	702	924	1,183	1,467	1,736	2,034
3-5.........	975	777	903	1,150	1,436	1,781	2,171	2,472
6-8.........	990	991	1,167	1,444	1,770	2,157	2,586	2,834
9-11........	1,016	1,090	1,278	1,578	1,949	2,420	3,019	3,356
12-14.......	1,223	1,193	1,377	1,754	2,233	2,887	3,470	3,937
15-18.......	1,493	1,179	1,454	1,923	2,493	3,232	3,983	4,659
19-22.......	728	977	1,266	1,767	2,294	2,972	3,902	4,314
23-34.......	1,917	1,090	1,324	1,767	2,306	3,008	3,764	4,435
35-50.......	1,836	1,093	1,286	1,695	2,208	2,846	3,567	4,119
51-64.......	1,526	1,026	1,222	1,597	2,088	2,633	3,288	3,775
65-74.......	766	960	1,085	1,399	1,833	2,353	2,911	3,201
Females:								
1-2.........	542	580	692	877	1,116	1,396	1,727	1,956
3-5.........	863	710	822	1,079	1,356	1,688	1,986	2,254
6-8.........	1,005	945	1,108	1,394	1,706	2,024	2,358	2,666
9-11........	1,096	995	1,161	1,467	1,834	2,221	2,638	2,923
12-14.......	1,202	851	1,077	1,429	1,780	2,244	2,796	3,137
15-18.......	1,574	750	939	1,252	1,686	2,159	2,688	3,114
19-22.......	912	640	774	1,148	1,534	1,993	2,499	2,864
23-34.......	2,636	633	799	1,148	1,540	2,021	2,560	2,881
35-50.......	2,558	658	822	1,111	1,490	1,890	2,362	2,678
51-64.......	2,210	655	833	1,117	1,450	1,864	2,326	2,673
65-74.......	1,188	649	786	1,046	1,372	1,705	2,047	2,370

[1]Unweighted sample sizes are reported; however, individual values were weighted prior to calculating energy intakes.

nutrients varied between the two regions. Lowest values for both surveys were found in the South.

Analyses incorporating stratification by urbanization indicated that NHANES nutrient values tended to be highest in suburban areas and lowest in nonmetropolitan areas. The pattern for NFCS was less clear. In both surveys, suburban residents generally had higher median intakes than nonmetropolitan residents for most nutrients with notable exceptions for NFCS men. The majority of age groups in suburban areas had higher nutrient intakes, according to these two surveys, than those in central cities. However, there were a number of exceptions in NFCS.

For most sex-age groups, highest education levels of the household head in both surveys were associated with the highest mean and median intakes for energy, protein, carbohydrate, calcium, vitamin A, and vitamin C and, in NHANES only, for thiamin. Percentage differences between surveys were generally

Table 5.5--Energy intakes by individuals at specified percentiles: NHANES 1971-74

Sex and age (years)	Sample size[1]	Percentile						
		5th	10th	25th	50th	75th	90th	95th
	Number	Kilocalories						
Males:								
1-2.........	613	755	831	1,035	1,314	1,674	2,085	2,368
3-5.........	889	963	1,106	1,342	1,662	2,092	2,532	2,806
6-8.........	478	1,168	1,306	1,639	2,021	2,452	2,932	3,354
9-11........	523	1,206	1,419	1,753	2,156	2,741	3,216	3,476
12-14.......	554	1,261	1,483	1,876	2,403	2,986	3,795	4,403
15-18.......	634	1,407	1,682	2,128	2,818	3,637	4,717	5,234
19-22.......	458	1,261	1,595	2,184	2,838	3,643	4,307	4,985
23-34.......	992	1,332	1,534	2,026	2,588	3,395	4,197	4,860
35-50.......	1,127	1,192	1,397	1,876	2,336	2,940	3,667	4,167
51-64.......	897	955	1,142	1,538	2,009	2,541	3,235	3,737
65-74.......	1,655	844	998	1,320	1,696	2,140	2,612	3,150
Females:								
1-2.........	567	670	778	980	1,223	1,522	1,832	2,056
3-5.........	884	809	937	1,220	1,513	1,885	2,327	2,550
6-8.........	488	931	1,104	1,400	1,763	2,189	2,567	2,969
9-11........	530	1,121	1,239	1,514	1,891	2,301	2,793	3,379
12-14.......	568	866	1,051	1,457	1,855	2,304	2,843	3,229
15-18.......	636	777	945	1,237	1,624	2,171	2,684	3,156
19-22.......	898	745	905	1,216	1,586	2,085	2,641	2,971
23-34.......	2,383	697	859	1,159	1,549	2,009	2,536	2,943
35-50.......	2,154	695	829	1,090	1,477	1,891	2,389	2,705
51-64.......	1,010	688	813	1,036	1,363	1,736	2,241	2,399
65-74.......	1,811	614	743	965	1,255	1,576	1,924	2,220

[1]Unweighted sample sizes are reported; however, individual values were weighted prior to calculating energy intakes.

larger at the lowest education level than at the highest level for all nutrients, except calcium, riboflavin, and vitamin A for males and protein and carbohydrate for adult females. NFCS men at the highest education level had lower energy values than men at the two next lower education levels, but lowest values were found at the lowest education level.

In both surveys, occupation class of the household head apparently influenced females' median intakes for 8 of 12 nutrients--energy, protein, fat, carbohydrate, calcium, riboflavin, niacin, and vitamin C--with higher intakes in blue-collar households than in white-collar households. Among males, the pattern was more diverse.

Employment status of the household head was generally related positively to intakes of all nutrients except iron, thiamin, and niacin. NFCS males in households with employed heads had higher median and mean values than males in households with unemployed heads.

This pattern was less clear for males and females in NHANES and least consistent for NFCS females. NFCS women in unemployed household head groups had higher energy, protein, and vitamin C intakes than NHANES counterparts. Several groups of children in both surveys had higher protein intakes in the unemployed group than in the employed group.

In both surveys, income was positively associated with mean and median intakes of energy and of most nutrients, except iron in NFCS, with much stronger relationships in the case of males than females. Lowest intakes were most frequently found in the lowest quartile of incomes and highest intakes in the highest quartiles of income. Vitamin C had the closest relationship with income in both surveys.

5.4.2 Consumption of Food Groups

The percentage of individuals using food groups and the energy derived from food groups as reported in the two surveys were determined. For a number of food groups, differences between the two surveys were indicated.

5.4.2.1 Percentage of Individuals Using Food Groups

The percentages of male and female participants who recalled intake in 1 day of at least 1 food in each of 39 food groups were calculated. The food groups are described in Section 5.7. Differences between NFCS and NHANES are presented for three age groups of males in Table 5.6 to indicate the general magnitude of variations between the two surveys. For six food groups--fats and oils; table fats; sugar and sweets; sugar, syrup, and jams; cakes, pies, and cookies; and fruit ades--the percentage of users was considerably higher in NHANES than in NFCS. NHANES also surpassed NFCS in the proportion of individuals using more than 10 other food groups including categories of meat, fish, milk products, grain products, vegetables, and fruits. In contrast, NFCS users more often reported higher use of 10 other food groups; among them were poultry, meat mixtures, grain mixtures, and cereals.

The percentages of users in a few sex-age groups differed widely between the two surveys for particular foods. (Of the 22 sex-age groups reported, only three groups of males are shown in Table 5.6 and three groups of females in Table 5.7). Alcoholic beverages were reported by a much higher proportion of men in NHANES than in NFCS. Milk and milk drinks were used by a higher proportion of adults--especially 35- to 50-year-olds--in NHANES than in NFCS. Other food groups with large discrepancies in usage between the surveys for specific sex-age groups were dairy desserts (by males under 12 and females 9 to 14 years of age), salty grain snacks (by 1- to 8-year-olds), soft drinks (by 15- to 22-year-old males), fruit ades (by males under 12 and females under 22 years), and ready-to-eat cereals (by 9- to 18-year-olds). Except for the last food group, users were more common in NHANES than in NFCS.

Differences between the surveys' procedures for recording and coding food items obviously affected the frequency of reporting use of the food groups. A mixed dish in NFCS was often coded as one item, whereas in NHANES, a mixed dish was often coded into its component parts. This affected some food groups more than others.

For 11 food groups, which were the most comparable in coverage of food items for the two surveys, the percentages of users were compared for subgroups based on race and on education of household

Table 5.6--Food group use by males of specified ages: NFCS 1977-78 and NHANES 1971-74

Food group	Age group[1]								
	1-2 years			15-18 years			23-34 years		
	NFCS	NHANES	Difference[2]	NFCS	NHANES	Difference	NFCS	NHANES	Difference
	Percentage using in 1 day								
Total meats............	60.6	68.6	-8.0	75.8	82.9	-7.1	76.3	83.5	-7.2
Total beef.............	28.4	34.4	-6.0	37.7	51.1	-13.4	36.8	52.1	-15.3
Beef, not ground........	13.1	15.0	-1.9	22.2	23.8	-1.6	23.7	26.5	-2.8
Pork..................	18.7	23.1	-4.4	29.1	26.1	3.0	27.8	28.9	-1.1
Frankfurters...........	29.7	34.3	-4.6	30.9	39.1	-8.2	34.7	39.2	-4.5
Poultry................	18.0	16.0	2.0	18.0	15.4	2.6	16.9	16.7	.2
Fish...................	5.8	10.6	-4.8	7.5	9.7	-2.2	9.2	10.8	-1.6
Meat mixtures..........	20.9	16.2	4.7	35.5	19.1	16.4	31.0	18.3	12.7
Eggs...................	32.3	44.2	-11.9	30.9	23.1	7.7	35.6	32.4	3.2
Soups..................	22.8	23.1	- .3	8.7	7.4	1.3	11.1	10.8	.3
Total milk products.....	94.6	97.4	-2.8	89.2	91.7	-2.5	77.7	87.7	-10.0
Milk, milk drinks.......	92.5	93.8	-1.3	82.8	82.2	.6	60.1	67.5	-7.4
Dairy desserts..........	18.2	25.9	-7.7	19.7	25.8	-6.1	13.5	17.6	-4.1
Cheese.................	19.8	24.5	-4.7	19.8	25.8	-6.0	27.2	37.1	-9.9
Bread, cereal, pasta....	91.9	93.9	-2.0	92.8	93.5	- .7	88.6	92.0	-3.4
Bread, rolls...........	71.8	81.2	-9.4	85.4	90.6	-5.2	83.0	89.2	-6.2
Cooked cereals..........	31.8	29.2	2.6	17.9	17.2	.7	16.7	19.4	-2.7
Ready-to-eat cereals....	41.5	39.9	1.6	33.9	24.5	9.4	14.9	13.5	1.4
Sweet rolls, quick breads...............	11.6	15.2	-3.6	19.6	21.8	-2.2	17.4	20.7	-3.3
Cakes, pies, cookies....	32.1	53.9	-21.8	36.2	48.3	-12.1	29.6	39.5	-9.9
Salty grain products....	23.6	34.4	-10.8	13.2	16.6	-3.4	14.5	19.4	-4.9
Grain mixtures..........	25.0	22.3	2.7	24.2	22.3	1.9	21.7	18.0	3.7
Fats and oils..........	45.1	68.6	-23.5	52.6	68.7	-16.1	58.3	73.4	-15.1
Table fats.............	39.4	60.1	-20.7	40.4	52.9	-12.5	43.4	54.7	-11.3
Salad dressings.........	9.8	10.9	-1.1	21.9	27.1	-5.2	29.3	33.4	-4.1
Sugar and sweets........	44.4	74.0	-29.6	51.1	66.8	-15.7	51.8	69.8	-18.0
Sugar, syrups, jams.....	36.8	61.3	-24.5	44.9	54.0	-9.1	48.3	63.6	-15.3
All vegetables..........	69.4	75.6	-6.2	84.7	83.7	1.0	84.7	85.7	-1.0
White potatoes..........	45.0	50.4	-5.4	59.6	56.9	2.7	52.8	54.9	-2.1
Non-potato vegetables...	53.2	59.5	-6.3	70.8	69.9	.9	73.9	77.7	-3.8
Dark red, green, yellow vegetables.....	22.5	29.5	-7.0	32.8	44.0	-11.2	35.0	45.5	-10.5
Other vegetables........	40.1	45.1	-5.0	61.4	56.8	4.6	62.7	68.4	-5.7
Coffee, tea............	12.4	18.6	-6.2	29.9	32.2	-2.3	67.1	76.2	-9.1
Soft drinks............	37.9	34.1	3.8	53.8	65.9	-12.1	50.7	57.4	-6.7
Fruit ades.............	11.8	35.8	-24.0	10.2	18.9	-8.7	5.5	15.0	-9.5
Alcoholic beverages.....	.5	1.5	-1.0	2.1	7.8	-5.7	22.5	36.7	-14.2
All fruits.............	59.0	63.1	-4.1	47.2	48.4	-1.2	44.0	48.9	-4.9
Citrus fruits..........	31.6	36.7	-5.1	30.4	29.2	1.2	27.6	28.9	-1.3
Other fruits...........	40.1	43.4	-3.3	29.7	31.2	-1.5	25.5	30.6	-5.1

[1] Sample size: 1-2 years = 583 in NFCS, 613 in NHANES; 15-18 years = 1,493 in NFCS, 634 in NHANES; 23-34 years = 1,917 in NFCS, 992 in NHANES. Unweighted sample sizes are reported; however, individual values were weighted prior to calculating above statistics.
[2] Difference = NFCS value minus NHANES value.

Table 5.7--Food group use by females of specified ages: NFCS 1977-78 and NHANES 1971-74

Food group	Age group[1]								
	1-2 years			15-18 years			23-34 years		
	NFCS	NHANES	Difference[2]	NFCS	NHANES	Difference	NFCS	NHANES	Difference
	Percentage using in 1 day								
Total meats	67.4	75.9	-8.5	65.2	77.5	-12.3	68.0	76.1	-8.1
Total beef	27.4	33.3	-5.9	33.3	44.9	-11.6	34.0	41.8	-7.8
Beef, not ground	16.0	15.7	.3	18.6	18.8	- .2	20.9	23.3	-2.4
Pork	21.4	25.0	-3.6	20.5	19.1	1.4	23.4	26.5	-3.1
Frankfurters	33.9	36.7	-2.8	25.1	31.9	-6.8	26.2	28.7	-2.5
Poultry	16.7	15.9	.8	18.8	17.0	1.8	18.6	19.3	- .7
Fish	8.3	8.6	- .3	8.7	14.2	-5.5	9.6	13.3	-3.7
Meat mixtures	20.6	12.4	8.2	28.9	19.1	9.8	26.3	16.7	9.6
Eggs	38.2	37.4	.8	22.8	24.1	-1.3	27.7	28.3	- .6
Soups	22.3	24.7	-2.4	10.8	9.7	1.1	12.8	15.7	-2.9
Total milk products	92.5	97.0	-4.5	83.3	84.8	-1.5	77.2	86.3	-9.1
Milk, milk drinks	89.7	95.4	-5.7	74.4	74.4	.0	59.7	66.3	-6.6
Dairy desserts	13.8	22.3	-8.5	15.3	21.4	-6.1	10.2	17.9	-7.7
Cheese	16.6	22.3	-5.7	18.8	27.6	-8.8	26.3	30.9	-4.6
Bread, cereal, pasta	91.7	93.3	-1.6	85.5	91.3	-5.8	83.7	89.6	-5.9
Bread, rolls	77.1	83.0	-5.9	77.2	87.1	-9.9	76.9	84.0	-7.1
Cooked cereals	29.5	31.2	-1.7	16.5	17.1	- .6	18.1	19.2	-1.1
Ready-to-eat cereals	39.9	46.8	-6.9	25.6	13.0	12.6	15.9	13.6	2.3
Sweet rolls, quick breads	12.0	9.1	2.9	16.0	14.6	1.4	13.8	17.8	-4.0
Cakes, pies, cookies	36.6	52.9	-16.3	29.7	42.9	-13.2	25.6	37.4	-11.8
Salty grain products	18.1	33.9	-15.8	15.8	16.7	- .9	14.8	20.7	-5.9
Grain mixtures	22.2	25.0	-2.8	23.7	22.7	1.0	19.5	18.1	1.4
Fats and oils	49.4	71.5	-22.1	52.9	71.0	-18.1	58.8	74.2	-15.4
Table fats	43.2	63.0	-19.8	39.8	49.7	-9.9	42.0	56.3	-14.3
Salad dressings	10.6	11.7	-1.1	23.4	26.9	-3.5	30.6	28.0	2.6
Sugar and sweets	53.8	71.9	-18.1	43.7	59.0	-15.3	48.8	67.2	-18.4
Sugar, syrups, jams	44.3	56.5	-12.2	36.1	43.4	-7.3	43.9	58.8	-14.9
All vegetables	73.7	76.3	-2.6	79.6	84.1	-4.5	83.8	85.0	-1.2
White potatoes	48.7	49.8	-1.1	50.8	55.1	-4.3	44.3	46.5	-2.2
Nonpotato vegetables	58.9	59.2	- .3	65.6	70.9	-5.3	74.9	76.2	-1.3
Dark red, green, yellow vegetables	22.0	30.2	-8.2	31.7	40.3	-8.6	34.8	44.0	-9.2
Other vegetables	45.2	45.4	- .2	54.4	58.3	-3.9	66.0	64.2	1.8
Coffee, tea	11.9	14.8	-2.9	31.4	32.6	-1.2	70.3	76.9	-6.6
Soft drinks	34.6	31.6	3.0	55.3	62.0	-6.7	49.5	56.0	-6.5
Fruit ades	14.1	33.8	-19.7	9.5	19.8	-10.3	7.3	14.9	-7.6
Alcoholic beverage	.2	1.5	-1.3	1.7	4.6	-2.9	11.9	16.0	-4.1
All fruits	55.6	68.1	-12.5	47.6	54.9	-7.3	46.5	52.7	-6.2
Citrus fruits	31.9	37.4	-5.5	28.6	32.2	-3.6	28.4	33.7	-5.3
Other fruits	39.1	50.3	-11.2	29.1	34.0	-4.9	28.0	33.6	-5.6

[1] Sample size: 1-2 years = 542 in NFCS, 567 in NHANES; 15-18 years = 1,574 in NFCS, 636 in NHANES; 23-34 years = 2,636 in NFCS, 2,383 in NHANES. Unweighted sample sizes are reported; however, individual values were weighted prior to calculation of above statistics.

[2] Difference = NFCS value minus NHANES value.

head. In both surveys, whites surpassed blacks in reporting usage of 7 of the 11 food groups, while blacks predominated for only 2 food groups--poultry and eggs. Soft drink usage differed between surveys. In NFCS, the percentage of blacks reporting soft drinks was higher than that of whites in all sex-age groups; in NHANES, the proportion of blacks consuming soft drinks tended to be lower among younger age groups. Use of citrus fruit differed little between blacks and whites.

Comparison of percentages of individuals using each of the 11 food groups, categorized according to education of household head, disclosed some relatively strong associations. In both surveys, higher use of over half of the food groups--beef; milk and milk drinks; ready-to-eat cereals; cakes, pies, and cookies; citrus fruit; and alcoholic beverages--was found at the higher levels of education. The highest proportions of users of three food groups--poultry, eggs, and soft drinks --were in the lowest education categories in both surveys. Highest use of white potatoes occurred in the middle education levels. Coffee and tea showed little relationship to education in either survey.

5.4.2.2 Energy Derived from Food Groups

Among users of foods in 16 food groups, median intakes of food energy in NFCS were higher than in NHANES. For another nine food groups, NFCS and NHANES users tended to have similar intakes; while for four groups, median energy was generally higher in NHANES than in NFCS.

A number of factors apparently contributed to the differences between the two surveys in energy intakes from food groups. Differences reflected variations in methods used in each survey as well as some actual changes in food composition and consumption between the earlier and later time periods surveyed. Many meat descriptions were not comparable between the two surveys. Higher NFCS values for meats were often the result of coding as "lean and fat eaten" if not specified otherwise, whereas NHANES meats were more frequently coded as "lean only." For example, NFCS energy values for beef were more than double NHANES values for half of the sex-age groups. Also, for most fried foods or foods served with fat (for example, buttered vegetables), the fat was not coded separately unless reported that way in NFCS, but the fat was usually given a separate code in NHANES.

Lower values in NFCS than in NHANES for eggs and milk products probably reflected lower usage in the later survey in response to widely published public advice to reduce cholesterol and fat in diets. Generally increased usage of cheese, ready-to-eat cereals, and citrus fruit in the late 1970's contributed to higher NFCS median energy values than NHANES values for these items. Lower NFCS values for bread would result from the practice of classifying sandwiches in the category of the filling, rather than coding the bread separately.

Higher energy values for cooked cereals in NFCS could be attributed to greater usage in Northern States in the winter months, whereas NHANES avoided those States during cold weather. For several popular items among cakes, pies, and cookies, energy values were higher for homemade varieties than for commercial products. Such homemade foods were reported more often in NHANES than in NFCS. Higher values for salad dressings in NFCS than in NHANES probably reflect greater popularity of salad bars in the late 1970's compared with NHANES's earlier period. However, the researchers did not offer an explanation for the higher values for table fats. The lower values for alcoholic beverages in NFCS compared with NHANES might be explained by household respondents' lack of knowledge of away-from-home consumption of alcoholic beverages by household members not available for interview. In NHANES, all individual members 12 years and older reported for themselves.

5.4.3 Number of Eating Occasions, Meal Patterns, and Nutrient Adequacy

Investigation of eating occasions indicated that more than one eating time was frequently reported in NHANES for foods that may have been eaten during a single meal, whereas in NFCS all items in a meal usually had the same time reported. Consequently, more eating occasions were counted in NHANES than in NFCS. Also, more snacks were counted in NHANES than in NFCS. The researchers stated that a difference between the two surveys in procedures for reporting meals and snacks, as described in Section 5.3.4, was one reason for discrepancies. In NFCS, they found 39 percent of respondents reporting no snacks, compared with 10 percent for NHANES.

Comparison of frequency distributions for the number of eating occasions in a day and the types of meal patterns revealed some differences between the two surveys (Table 5.8). In NFCS, three eating occasions in a day were reported most frequently (37 and 39 percent for males and females, respectively). In NHANES, males most frequently reported five eating occasions in 1 day and females most frequently reported four occasions (26 and 29 percent, respectively). The most common meal pattern in both surveys was three meals plus snacks. The percentage of individuals reporting that meal pattern was much greater in NHANES, 68 percent of males and 66 percent of females, than in NFCS, 43 percent of males and 40 percent of females.

Comparisons of the number of eating occasions between surveys may be invalid because of the differences in reporting procedures. Although not tested for statistical significance, some consistent patterns within surveys were noted. In both surveys, whites generally reported a higher median number of eating occasions than blacks, possibly related to differences in employment and incomes. Respondents in households with an employed household head and those in households with the highest incomes reported more eating occasions than those in households with unemployed heads and with the lowest incomes. In NFCS, respondents had a higher median number of eating occasions in households with heads having higher education and white-collar jobs than respondents in households having heads with less education and blue-collar jobs. In NHANES, the associations were less distinct.

Results of the two surveys were also compared for four meal patterns in terms of nutrient intakes related to the 1980 RDA. The researchers found that differences between surveys were least for the most complex meal pattern (three meals plus snacks) (Table 5.9). Generally, as meal complexity increased, intakes related to RDA increased. For the most complex meal pattern, NFCS nutrient intakes expressed as a percentage of the appropriate RDA tended to be higher than NHANES values, except for calcium. In both surveys, those individuals with the most complex meal pattern had mean intakes for protein, vitamin A, riboflavin, and vitamin C exceeding RDA for all sex-age groups. Moreover, in NFCS, the same pattern held for thiamin and niacin. Iron and calcium were problem nutrients for young children and females of childbearing age in both surveys regardless of meal complexity.

Table 5.8—Meal patterns reported by individuals for 1 day: NFCS 1977-78 and NHANES 1971-74

Age (years) and sex	Meal pattern													
	1 meal		Snacks only		1 meal plus snacks		2 meals		2 meals plus snacks		3 meals		3 meals plus snacks	
	NFCS	NHANES	NFCS	NHANES	NFCS	NHANES	NFCS	NHANES	NFCS	NHANES	NFCS	NHANES	NFCS	NHANES
	Percent of individuals													
1-2:														
Males....	0.4	1.3	0.3	0.6	0.6	0.3	2.1	0.2	9.8	9.5	26.5	3.6	60.3	84.5
Females..	.2	1.3	0	0	1.8	.9	2.2	.4	9.0	7.7	23.6	4.7	63.2	85.1
3-5:														
Males....	.3	2.1	.4	.7	.4	.7	3.7	.3	10.0	8.9	30.7	3.4	54.5	84.0
Females..	.1	2.2	.7	.1	.5	.4	2.2	.2	8.0	10.9	31.4	4.5	57.1	81.8
6-8:														
Males....	.5	2.6	0	.4	.8	0	3.0	0.1	8.0	5.7	28.8	8.1	58.8	83.1
Females..	.1	3.6	.2	.1	.6	1.1	3.3	.1	9.3	7.0	32.3	7.7	54.1	80.4
9-11:														
Males....	.3	1.8	.3	.1	1.4	.8	4.9	2.4	11.9	12.5	29.1	6.5	52.2	76.0
Females..	.3	2.0	.2	0	1.2	.6	3.9	1.8	12.0	13.7	32.1	6.3	50.2	75.7
12-14:														
Males....	.2	1.2	.2	.3	1.6	4.2	5.3	1.6	13.7	21.4	29.9	7.5	49.2	63.8
Females..	.9	.3	.3	0	2.9	4.4	6.0	1.6	18.0	25.1	29.9	4.5	41.9	64.1
15-18:														
Males....	1.3	.7	.4	.8	2.9	5.3	7.7	1.6	18.9	28.7	28.2	4.5	40.5	58.4
Females..	1.3	.8	1.3	.5	4.9	9.8	10.0	3.5	21.3	31.3	27.3	6.3	34.0	47.9
19-22:														
Males....	1.2	.3	.9	.4	5.1	5.4	14.3	2.1	22.1	31.2	27.2	6.3	29.2	54.3
Females..	2.3	.9	.6	.8	7.9	6.8	13.0	2.9	25.5	32.9	23.4	8.3	27.3	47.5
23-34:														
Males....	.9	.3	.5	.9	5.8	4.6	10.6	1.2	25.1	27.8	21.4	4.1	35.6	61.2
Females..	1.5	.4	.6	.3	5.1	4.9	9.3	1.1	23.4	25.8	23.6	6.1	36.4	61.3
35-50:														
Males....	.7	.5	.3	.2	4.0	3.0	7.3	1.3	21.8	19.0	26.9	5.9	39.1	70.1
Females..	.8	.3	.5	.2	4.3	3.0	7.4	2.0	21.4	18.7	27.5	8.1	38.2	67.7
51-64:														
Males....	.4	.6	.2	.3	1.4	2.3	6.3	.9	16.5	18.4	31.8	10.6	43.4	66.9
Females..	.5	.6	.4	.4	3.1	1.3	7.9	1.8	16.7	14.0	30.3	12.4	41.1	69.4
65-74:														
Males....	.7	.6	.1	.1	1.6	1.3	5.9	3.0	16.4	17.8	37.2	16.1	38.3	61.1
Females..	1.0	1.1	.3	0	1.9	1.3	7.1	1.9	14.0	13.6	39.5	17.6	36.3	64.4
TOTAL:														
Males....	.7	.9	.3	.4	2.9	3.0	7.2	1.3	18.0	20.1	28.1	6.8	42.7	67.5
Females..	1.0	.9	.5	.3	3.8	3.4	7.6	1.7	18.7	19.7	28.4	8.3	40.0	65.7

Table 5.9--Mean intakes of selected nutrients as percentage of 1980 RDA for individuals eating specified meal patterns: NFCS 1977-78 and NHANES 1971-74

[An asterisk means too few individuals for analysis; 'N' means 100 percent or more of RDA in NFCS but not in NHANES; 'H' means 100 percent or more of RDA in NHANES but not in NFCS; '+' means 100 percent or more of RDA in both surveys; '-' means less than 100 percent of RDA in both surveys]

Meal pattern, sex and age (years)	Nutrient							
	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
Two meals or fewer:								
Males:								
1-2........	*	*	*	*	*	*	*	*
3-5........	+	-	-	H	H	+	-	H
6-8........	+	H	H	H	H	H	H	+
9-11.......	+	H	-	N	-	+	-	N
12-14......	+	-	-	-	-	-	-	N
15-18......	+	-	-	-	-	-	-	H
19-22......	+	-	+	-	-	H	-	-
23-34......	+	H	+	-	-	H	+	+
35-50......	+	-	+	N	-	-	+	N
51-64......	+	-	N	N	-	-	N	N
65-74......	+	-	N	N	-	N	N	N
Females:								
1-2........	*	*	*	*	*	*	*	*
3-5........	+	-	-	+	H	+	H	H
6-8........	+	H	-	+	-	H	-	H
9-11.......	+	-	-	-	-	+	-	+
12-14......	N	-	-	-	-	-	-	-
15-18......	+	-	-	-	-	-	-	-
19-22......	+	-	-	-	-	-	-	H
23-34......	N	-	-	-	-	-	-	-
35-50......	+	-	-	H	-	H	-	-
51-64......	N	-	-	N	-	-	-	+
65-74......	+	-	-	N	-	-	-	H
Two meals plus snacks:								
Males:								
1-2.........	+	-	-	+	N	+	N	+
3-5.........	+	-	-	+	+	+	N	+
6-8.........	+	+	N	+	N	+	N	+
9-11........	+	-	N	N	N	+	N	+
12-14.......	+	-	-	-	N	+	N	+
15-18.......	+	-	-	N	+	+	+	+
19-22.......	+	+	+	-	-	+	+	+
23-34.......	+	+	+	N	N	+	+	+
35-50.......	+	-	+	+	-	+	+	+
51-64.......	+	-	+	N	N	+	+	+
65-74.......	+	-	+	N	N	+	N	+

Continued

Table 5.9--Mean intakes of selected nutrients as percentage of 1980 RDA for individuals eating specified meal patterns: NFCS 1977-78 and NHANES 1971-74--Continued

[An asterisk means too few individuals for analysis; 'N' means 100 percent or more of RDA in NFCS but not in NHANES; 'H' means 100 percent or more of RDA in NHANES but not in NFCS; '+' means 100 percent or more of RDA in both surveys; '-' means less than 100 percent of RDA in both surveys]

Meal pattern, sex and age (years)	Nutrient							
	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
Two meals plus snacks (continued):								
Females:								
1-2........	+	-	-	+	N	+	-	+
3-5........	+	-	-	+	N	+	N	+
6-8........	+	-	N	N	N	N	N	N
9-11.......	+	-	-	N	N	+	N	+
12-14......	+	-	-	-	-	+	-	+
15-18......	+	-	-	-	-	+	N	+
19-22......	+	-	-	-	-	-	N	+
23-34......	+	-	-	N	-	N	+	+
35-50......	+	-	-	N	-	-	+	+
51-64......	+	-	N	+	-	N	N	+
65-74......	+	-	-	N	-	N	N	+
Three meals:								
Males:								
1-2........	*	*	*	*	*	*	*	*
3-5........	*	*	*	*	*	*	*	*
6-8........	+	+	+	+	N	+	+	+
9-11.......	+	H	N	+	N	+	N	+
12-14......	+	-	-	N	N	+	+	+
15-18......	+	-	-	N	N	+	N	+
19-22......	+	+	+	+	+	+	+	+
23-34......	+	+	+	+	+	+	+	+
35-50......	+	-	+	N	N	+	+	+
51-64......	+	-	+	+	N	+	+	+
65-74......	+	-	+	N	N	+	N	+
Females:								
1-2........	*	*	*	*	*	*	*	*
3-5........	+	-	-	+	N	+	N	+
6-8........	+	+	N	+	N	+	N	+
9-11.......	+	H	N	+	N	+	N	N
12-14......	+	-	-	N	N	+	N	+
15-18......	+	-	-	+	N	+	+	+
19-22......	+	-	-	N	N	+	N	+
23-34......	+	-	-	N	N	N	N	+
35-50......	+	-	-	N	N	N	N	N
51-64......	+	-	N	+	N	N	N	+
65-74......	+	-	N	+	N	N	N	+

Continued

Table 5.9--Mean intakes of selected nutrients as percentage of 1980 RDA for individuals eating specified meal patterns: NFCS 1977-78 and NHANES 1971-74--Continued

[An asterisk means too few individuals for analysis; 'N' means 100 percent or more of RDA in NFCS but not in NHANES; 'H' means 100 percent or more of RDA in NHANES but not in NFCS; '+' means 100 percent or more of RDA in both surveys; '-' means less than 100 percent of RDA in both surveys]

Meal pattern, sex and age (years)	Nutrient							
	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
Three meals plus snacks:								
Males:								
1-2........	+	+	-	+	+	+	+	+
3-5........	+	+	-	+	+	+	+	+
6-8........	+	+	+	+	+	+	+	+
9-11.......	+	+	+	+	+	+	+	+
12-14......	+	+	-	+	+	+	+	+
15-18......	+	+	N	+	+	+	+	+
19-22......	+	+	+	+	+	+	+	+
23-34......	+	+	+	+	+	+	+	+
35-50......	+	+	+	+	N	+	+	+
51-64......	+	+	+	+	+	+	+	+
65-74......	+	N	+	+	N	+	+	+
Females:								
1-2........	+	+	-	+	+	+	N	+
3-5........	+	+	-	+	+	+	+	+
6-8........	+	+	N	+	N	+	N	+
9-11.......	+	+	N	+	+	+	N	+
12-14......	+	-	-	+	+	+	+	+
15-18......	+	-	-	+	N	+	+	+
19-22......	+	-	-	+	N	+	+	+
23-34......	+	-	-	+	N	+	+	+
35-50......	+	-	-	+	N	+	+	+
51-64......	+	-	+	+	N	+	+	+
65-74......	+	-	N	+	N	+	+	+

5.4.4 Alcoholic Beverage Consumption

Consumers of alcoholic beverages, 15 to 74 years of age, were proportionately fewer in NFCS than in NHANES (Table 5.10). For some age groups of males, the percentage of alcoholic beverage consumers in NHANES was almost double the percentage in NFCS. Among females, the proportion of consumers in the two surveys was similar for 19- to 22-year-olds. Differences became greater in successively older age groups until, for the oldest, there were proportionately twice as many consumers in NHANES as in NFCS. In both surveys, more males than females reported alcoholic beverages. In NFCS, proportionately twice as many males as females consumed alcoholic beverages; in NHANES, the differences

Table 5.10--Alcoholic beverage use by individuals in 1 day: NFCS 1977-78 and NHANES 1971-74

Age (years)	Males			Females		
	NFCS	NHANES	Difference	NFCS	NHANES	Difference
	Percent					
1-2	0.5	1.5	([1])	0.2	1.5	([1])
3-5	.0	.7	([1])	.7	1.5	([1])
6-8	.3	.6	([1])	.2	.2	([1])
9-11	.5	.3	([1])	.0	.0	([1])
12-14	.1	1.2	([1])	.6	.2	([1])
15-18	2.1	7.8	-5.7	1.7	4.6	-2.9
19-22	15.6	28.1	-12.5	7.1	8.8	-1.7
23-34	22.5	36.7	-14.2	11.9	16.0	-4.1
35-50	22.9	40.5	-17.6	11.9	17.5	-5.6
51-64	18.5	29.0	-10.5	9.9	16.9	-7.0
65-74	13.5	23.5	-10.0	4.8	9.7	-4.9

[1] Proportions of alcohol users were too small to compare.

tended to be even greater. The percentage of alcoholic beverage consumers peaked in the 35- to 50-year-old age category in both surveys.

Strong relationships were found between the percentage of consumers and each of several demographic variables in both surveys. Overall, the highest proportion of alcoholic beverage consumers were white rather than black, from the Northeast and West rather than North Central and South, from households in the highest income category, and from households whose head was employed, had a white-collar job, and had some college education. The relationship of urbanization to alcoholic beverage use differed between the two surveys.

A closer look at differences between surveys by race indicated that, among males, twice as many whites as blacks reported using alcoholic beverages in NFCS. The same difference was found in NHANES for 35- to 50- and 65- to 74-year-old males but not among younger or 51- to 64-year-old males. More than twice as large a proportion of white females as black reported usage in NFCS; in NHANES, little difference by race was found for 15- to 50-year-olds; but among older females, twice as many whites as blacks reported consumption. The researchers cautioned that the small number of black female consumers sampled probably affects the reliability of the relationships.

Among regions, the South had substantially fewer consumers reporting alcoholic beverages than the other regions. The Northeast had about twice as large a proportion reporting alcoholic beverages as the South.

Among urbanizations, both surveys found that larger proportions of users were in central cities and suburban areas. But in NHANES, females 51 to 74 years of age in the suburbs were more likely to consume such beverages than those in central cities. For younger females, the relationship was reversed.

Variations among days of the week were described using the percentages of individuals reporting alcoholic beverages. In both surveys, there were proportionately fewer consumers on the four work days than on the three weekend days including Friday (Table 5.11). However, very few reports were obtained for Saturdays and Sundays in NHANES.

Measured in terms of grams of ethanol, alcoholic beverage intake by NFCS consumers was less, on average, than by NHANES consumers (Table 5.12). Little relationship to demographic variables could be found. The distribution of ethanol intake was very skewed. Mean, but not median, intakes showed that the most ethanol was consumed by the younger age groups.

5.4.5 Weight, Height, and Body Mass Index

Overall, differences between NFCS self-reported and NHANES clinically measured median weights and heights were small. Percentage differences were greatest for the youngest age groups and smallest (0 to 2 percent) for young and middle-aged adults. The oldest age groups showed slightly but consistently higher percentage differences between measurements in the two surveys. Median weights of males were higher in NFCS than in NHANES for age groups less than 23 years and over 50 years. The reverse was observed for females; NHANES median weights were higher than NFCS values, except for females under 9 years of age. A different pattern was found for height. Median heights were greater in

Table 5.11--Alcoholic beverage use by individuals by day of the week:[1] NFCS 1977-78 and NHANES 1971-74

Day of week of 1-day recall	Individuals interviewed				Individuals reporting alcohol use			
	NFCS		NHANES		NFCS		NHANES	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Sunday.........	3,645	18.7	66	0.4	503	13.8	13	19.7
Monday.........	3,815	19.6	2,778	19.0	404	10.6	456	16.4
Tuesday........	3,611	18.5	3,105	21.2	379	10.5	512	16.5
Wednesday......	3,252	16.7	2,814	19.2	341	10.5	498	17.7
Thursday.......	2,470	12.7	2,651	18.1	262	10.6	464	17.5
Friday.........	2,020	10.4	3,217	22.0	307	15.2	685	21.3
Saturday.......	680	3.5	21	.1	126	18.5	5	23.8
TOTAL.......	19,493	100.1	14,655	100.0	2,322	11.9	2,633	18.0

[1]Unweighted numbers and percentages.

Table 5.12--Alcohol intake by users only: NFCS 1977-78 and NHANES 1971-74

Sex and age (years)	Individuals Using[1]		Consumption (as ethanol)			
			Median		Mean	
	NFCS	NHANES	NFCS	NHANES	NFCS	NHANES
	----Number-----		---------------Grams---------------			
Males:						
15-18......	29	48	26.5	17.7	35.8	39.6
19-22......	112	126	26.5	32.5	52.4	54.5
23-34......	433	352	26.5	39.9	39.3	54.6
35-50......	419	425	26.5	36.0	41.3	49.6
51-64......	271	228	22.7	30.2	33.6	45.4
65-74......	93	343	22.4	26.5	30.5	31.8
Females:						
15-18......	24	28	17.0	13.3	20.2	19.6
19-22......	63	83	22.7	23.2	28.0	36.6
23-34......	309	376	20.1	16.1	30.4	27.5
35-50......	295	342	17.0	20.1	26.3	28.3
51-64......	204	135	17.8	26.6	25.0	31.5
65-74......	55	147	17.8	17.7	21.5	23.4

[1]Unweighted sample sizes are reported; however, individual intake values were weighted prior to calculating the consumption statistics.

NHANES for the youngest age groups (through age 14 for males and age 18 for females) while for all older groups, NFCS median heights were greater.

Differences between surveys for the youngest group (1 to 5 years) were somewhat greater for height (6 to 8 percent) than for weight (1 to 5 percent). The median index of body mass at the 5th percentile showed small differences between the two surveys, whereas at the 95th percentile differences for children under 12 years were greater; higher for NFCS than for NHANES.

5.4.5.1 Weight

Differences in median and mean weights between NFCS and NHANES did not exceed 5.3 percent for any age group in the total sample (Table 5.13). For males and females 1 to 8 years, NFCS weights were slightly higher, whereas for females over 8 years, NHANES weights were higher. There appeared to be a tendency for males (except 23- to 50-year-olds) to overestimate weight and a tendency for females over age 11 to underestimate weight. This was also noticeable for females 12 to 50 years of age at the 95th percentile, with NHANES weights 14 to 20 pounds heavier than NFCS weights. In both surveys, median weights reached a peak in the 35- to 50-year-old age group for males and in the 51- to 64-year-old age group for females. These patterns prevailed across stratifications by race, region, urbanization, education of household head, and income. However, some strong differences between categories were found within stratifications.

Stratification by race revealed little difference between NFCS and NHANES in median weight for most sex-age groups of whites. For blacks, differences between

Table 5.13--Body weight of individuals: NFCS 1977-78 and NHANES 1971-74

Sex and age (years)	Median			Mean			Percentile			
							5th		95th	
	NFCS[1]	NHANES[2]	Diff[3]	NFCS[1]	NHANES[2]	Diff[3]	NFCS	NHANES	NFCS	NHANES
	-----Pounds-----		%	-----Pounds-----		%	----------Pounds----------			
Males:										
1-2......	29.5	28.0	5.3	29.5	28.3	4.3	21.0	22.0	40.1	35.1
3-5......	39.8	38.8	2.6	41.0	39.6	2.4	29.6	30.3	57.8	50.9
6-8......	55.2	54.0	2.2	57.9	55.0	5.1	40.1	40.7	84.6	71.4
9-11.....	76.0	74.7	1.7	79.7	77.7	2.5	54.8	55.4	114.8	111.2
12-14....	109.7	108.2	1.3	110.9	111.0	- .1	74.9	73.2	154.9	159.8
15-18....	144.8	143.5	.9	146.6	148.1	-1.0	109.8	111.6	190.4	199.9
19-22....	159.8	159.0	.5	162.1	162.1	- .0	129.7	122.8	209.8	213.8
23-34....	170.0	171.4	- .8	173.2	175.5	-1.3	134.7	131.5	224.7	232.4
35-50....	175.4	176.0	- .3	179.2	177.6	.9	139.6	132.9	235.1	224.8
51-64....	174.8	170.9	2.2	176.4	172.2	2.4	135.4	127.0	229.5	224.3
65-74....	165.4	163.0	1.5	167.4	164.2	1.9	129.8	121.8	213.2	211.2
Females:										
1-2......	26.7	26.5	.8	27.7	26.6	4.1	20.1	20.0	38.1	33.2
3-5......	38.1	37.6	1.3	38.9	38.4	1.3	28.6	29.4	54.8	50.8
6-8......	52.9	52.2	1.3	55.5	54.6	1.7	39.7	40.3	80.3	75.3
9-11.....	75.3	75.6	- .5	78.7	79.3	- .8	51.2	55.8	115.1	117.3
12-14....	105.3	108.3	-2.9	107.9	113.4	-5.0	74.8	79.4	145.3	165.0
15-18....	119.9	124.0	-3.5	123.2	127.7	-3.6	97.8	96.1	160.0	175.7
19-22....	125.2	127.7	-2.0	130.0	132.1	-1.6	102.0	99.5	174.6	180.6
23-34....	129.7	131.9	-1.7	135.6	138.8	-2.4	102.6	103.1	189.9	200.6
35-50....	139.5	140.5	- .7	144.3	148.6	-3.0	107.9	108.9	199.9	214.2
51-64....	142.0	144.4	-1.7	147.5	148.5	- .7	109.6	104.5	200.0	203.0
65-74....	140.3	142.0	-1.3	145.5	145.6	- .1	106.8	104.4	195.2	195.1

[1] Self-reported weight.
[2] Clinically measured weight.
[3] Percentage difference = [(NFCS value minus NHANES value)/NFCS value] x 100.

the surveys were considerable for many sex-age groups, especially children and elderly. NFCS values for most sex-age groups of blacks were higher than NHANES values; among whites, NFCS values were higher for males only. In both surveys, median weights and range of weights were greater for black females than for white females. Black adult males in both surveys usually weighed less than their white counterparts; however, NFCS black males aged 1 to 18 years weighed more than NFCS white males of the same ages.

Regional differences between the surveys in median weights did not exceed 7 percent for any sex-age group. Greatest divergences between sex-age groups appeared in the South for males and in the Northeast and North Central regions for females. In all regions, NFCS values tended to be higher than NHANES for males and young females, whereas NHANES values tended to be higher than NFCS for teenage and adult females. Examples of median weights for several sex-age groups illustrate how small the differences in weights were between regions in the two surveys. Males aged 9 to 11 years were heaviest in the Northeast (78 pounds versus 75 to 76 pounds in other regions in NFCS and 76 pounds versus 74 to 75 pounds in NHANES). Females aged 9 to 11 years were heaviest in the South in NFCS (80 versus 73 to 75 pounds) and in the North Central region in NHANES (78 versus 73 to 76 pounds). Adults were most often heaviest in the North Central region in both surveys. NFCS males aged 23 to 34 years weighed an average of 175 pounds, compared with 168 to 170 pounds in regions other than the North Central, and the NHANES males' weight averaged 174 pounds compared with 167 to 171 pounds. NFCS females aged 23 to 34 years weighed 132 pounds versus 126 to 130 pounds; NHANES females weighed 133 pounds in the North Central and Southern regions compared with 130 and 131 pounds in the West and Northeast, respectively.

Stratification by urbanization revealed that the largest differences for weight between surveys occurred for youngest age groups in central cities and females 12 to 22 years of age in nonmetropolitan areas. In both surveys, more high values for males occurred in nonmetropolitan areas and more low values in central cities. For females, heaviest weights usually were found in central cities and nonmetropolitan areas; lightest weights were observed in suburban areas with more consistency in NFCS than in NHANES.

Education of household head had a generally negative relationship with differences between survey median weights, that is, percentage differences between surveys tended to become smaller at higher educational levels. At the two lowest levels of education, differences between survey weights for young males were 2 to 12 percent, at next highest education level 2 to 8 percent, and at the highest level (some college) 2 percent at most. Only in households with the most highly educated heads were NHANES weights for males under 9 years of age higher than NFCS values. At higher education levels, more NHANES values exceeded NFCS values. Nevertheless, NFCS values were higher for the majority of male age groups at all education levels and those for females at the two lowest education levels. In both surveys, males at the highest education level appeared to be heavier and males at the lowest education level to be lighter, while the reverse was true for females. NFCS children in households at the highest education level were lightest in weight, whereas NHANES children in corresponding households tended to be heaviest.

Income level of household was also inversely related to the magnitude of difference between median weights from NFCS and NHANES. The greatest percentage differences were generally in the two lowest quartiles of income, and the smallest differences were in the two highest quartiles. The number of sex-age groups with NHANES values exceeding NFCS values increased progressively with income. For children 1 to 8 years, NFCS weights tended to be higher than NHANES at all income levels except the highest. For males 9 to 18 years, NFCS weights were slightly heavier than NHANES weights at both income extremes, but for the two intermediate quartiles of income, NHANES and NFCS values were about evenly divided between heavier and lighter weights. For females 9 to 18 years, NHANES weights were heavier than those for NFCS at all income levels except at the lowest income level for 9- to 11-year-olds. Among adults, the heaviest weights were found at the highest income levels for males while the reverse was true for females; this held in both surveys. However, for the oldest age group (65 to 74 years), NFCS weights were heavier than NHANES weights at all income levels except for females in the second quartile of income.

5.4.5.2 Height

Differences in median and mean heights between NFCS and NHANES declined with each older age category from age 1 until the late teenage years. There the pattern reversed and differences became slowly greater with increasing age category (Table 5.14). NHANES heights were greater than NFCS values for children and adolescents, and NFCS heights were greater than NHANES values for adults. Maximum heights in NHANES appeared at an earlier age than in NFCS, but maximum heights were slightly greater in NFCS. Maximum median heights were attained by 19- to 22-year-old males and by 15- to 22-year-old females in NHANES, while maximum heights were reached by 23- to 34-year-old males and by 19- to 22-year-old females in NFCS. At the 5th percentile, heights for younger age groups were very divergent; but at the 95th percentile, agreement between the surveys was much closer.

Table 5.14--Height of individuals: NFCS 1977-78 and NHANES 1971-74

Sex and age (years)	Median			Mean			Percentile 5th		Percentile 95th	
	NFCS[1]	NHANES[2]	Diff[3]	NFCS[1]	NHANES[2]	Diff[3]	NFCS	NHANES	NFCS	NHANES
	Inches	Inches	%	Inches	Inches	%	Inches	Inches	Inches	Inches
Males:										
1-2......	31.8	34.5	-8.3	31.8	34.4	-8.4	23.7	30.5	39.3	38.3
3-5......	39.4	41.6	-5.6	39.4	41.7	-5.8	29.7	37.1	48.1	46.5
6-8......	48.1	49.1	-2.2	47.7	49.1	-3.0	36.4	44.2	56.4	53.6
9-11.....	54.8	55.3	-1.0	54.4	55.5	-2.2	45.8	50.8	61.3	60.9
12-14....	62.1	63.0	-1.3	62.0	62.8	-1.3	52.5	56.1	69.6	69.6
15-18....	69.1	68.7	.5	68.8	68.8	.0	62.5	63.8	74.3	73.4
19-22....	70.3	69.8	.7	70.1	69.6	.8	65.7	65.1	74.5	74.1
23-34....	70.4	69.5	1.2	70.3	69.6	.9	65.7	64.8	74.6	74.3
35-50....	70.3	69.0	1.8	70.1	69.0	1.5	65.2	64.6	74.4	73.3
51-64....	69.6	68.3	1.9	69.5	68.4	1.6	64.9	64.1	73.8	72.7
65-74....	68.8	67.4	2.1	68.8	67.3	2.2	63.8	63.0	73.6	71.6
Females:										
1-2......	31.6	33.9	-7.3	31.3	33.8	-8.0	23.7	29.3	37.6	38.0
3-5......	38.9	41.2	-5.8	39.0	41.4	-6.1	29.9	37.0	48.0	46.6
6-8......	47.9	48.8	-1.9	47.1	49.0	-4.0	36.3	44.3	54.9	53.5
9-11.....	55.2	55.5	- .6	54.6	55.8	-2.1	46.9	50.6	61.9	62.1
12-14....	62.0	62.4	- .7	61.6	62.3	-1.2	54.2	57.8	66.6	66.7
15-18....	64.1	64.2	- .1	64.2	64.2	- .1	59.9	60.1	68.5	68.5
19-22....	64.3	64.2	.3	64.3	64.2	.3	60.0	59.7	68.6	68.7
23-34....	64.1	64.0	.1	64.2	64.1	.2	60.0	60.3	68.4	68.2
35-50....	64.2	63.9	.4	64.2	63.9	.5	60.1	59.7	68.3	68.1
51-64....	63.8	63.0	1.4	63.8	62.9	1.4	59.8	59.0	68.0	66.9
65-74....	63.5	62.4	1.7	63.5	62.3	1.8	59.5	58.3	67.5	66.2

[1] Self-reported height.
[2] Clinically measured height.
[3] Percentage difference = [(NFCS value minus NHANES value)/NFCS value] x 100.

The differences between the two surveys in median heights for individuals grouped by race were 12 to 14 percent for the youngest age groups of blacks and 6 to 8 percent for corresponding age groups of whites. In NFCS, white males under 35 years were generally taller than black males, whereas in NHANES three of those age groups of blacks were taller than white counterparts. Among females, NFCS whites under 35 were generally taller than blacks, but NFCS blacks over 34 years were taller than corresponding white age groups. In NHANES, black females were taller than white females in the 3- to 11-year age group as well as those over 34 years. In NFCS, black adults reached peak median heights at a later age than whites--35 to 50 years for blacks versus 19 to 22 years for whites.

Regional differences between surveys for height were greatest in the youngest age groups--largest in the West (13 percent) and smallest in the North Central region (5 percent). Tallest median heights for children occurred in the North Central region, except for NHANES males (most often in the South), and shortest values occurred in the South, except for the NHANES males (most often in the West). Tallest adults were found in the North Central region, except for NHANES females, who were tallest in the South. The shortest adults in both surveys were found in the Northeast.

Upon stratification by urbanization, the greatest percentage differences between survey median heights were in the two youngest groups; differences were greatest in central cities (8 to 12 percent) and least in suburban areas (5 to 8 percent). NFCS children were tallest in suburban and nonmetropolitan areas and shortest in central cities. NFCS adult males were tallest in suburban areas and adult females were tallest in nonmetropolitan areas. Shortest adults were in central cities. For NHANES children, no pattern was found, but for adults the pattern tended to follow that for NFCS.

Education of the household head had a strong positive relationship to height in both surveys. For both males and females, the tallest persons tended to be in the two highest levels of education and the shortest in the two lowest levels. Percentage differences between surveys for the youngest age groups were greatest at the lowest education levels (8 to 16 percent) and smallest at the highest level (5 percent).

Income level of the household was closely associated with height in both surveys. Tallest median heights occurred predominantly in the highest quartiles of income and the shortest heights in the lowest quartiles. Percentage differences between surveys in the youngest age groups were largest in the lowest quartile of income (9 to 14 percent).

5.4.5.3 Body Mass Index

The median index of body mass (weight/height^2) appeared to peak for males at 35 to 50 years in NHANES, whereas in NFCS the 35- to 50- and 51- to 64-year-olds had the same values (Table 5.15). Median index of body mass of females peaked in the oldest age group in both surveys. Values at the 5th percentile showed only small differences between surveys. In contrast, at the 95th percentile, the values for children under 12 years showed wide differences. Errors in estimation of weight and height in the NFCS appeared to be magnified by this index. The researchers noted that NFCS-NHANES comparisons suggest that height seems to be underestimated in the young and overestimated in the old and that the opposite errors of reporting occur for weight.

Table 5.15--Body mass index[1] for: NFCS 1977-78 and 1971-74

Sex and age (years)	Median			Mean			Percentile 5th		Percentile 95th	
	NFCS	NHANES	Diff[2]	NFCS	NHANES	Diff[2]	NFCS	NHANES	NFCS	NHANES
			%			%				
Males:										
1-2.......	19.0	16.4	13.9	22.1	16.6	24.9	13.8	14.3	36.7	19.1
3-5.......	17.2	15.7	8.9	19.4	15.9	18.2	12.8	13.9	32.4	18.0
6-8.......	16.9	15.5	8.3	18.3	15.9	13.5	12.6	13.6	29.1	19.2
9-11......	18.3	16.8	8.2	19.2	17.5	8.7	13.6	14.5	27.8	22.4
12-14.....	19.6	18.6	5.2	20.2	19.5	3.5	15.6	15.7	26.7	26.6
15-18.....	21.4	21.2	1.0	21.8	21.9	- .4	17.8	17.4	27.3	28.6
19-22.....	22.6	22.9	-1.3	23.2	23.5	-1.1	19.0	18.5	29.1	30.6
23-34.....	24.4	24.7	-1.3	24.7	25.4	-2.7	19.8	19.9	31.3	32.9
35-50.....	25.2	26.1	-3.5	25.7	26.1	-1.7	20.5	20.3	32.2	32.1
51-64.....	25.2	25.7	-2.2	25.7	25.8	- .5	20.4	19.3	32.5	33.3
65-74.....	24.5	25.4	-4.0	24.9	25.4	-1.9	19.7	19.4	31.1	31.7
Females:										
1-2.......	18.3	16.1	12.1	21.7	16.2	25.3	13.1	14.2	37.2	18.7
3-5.......	17.1	15.4	9.8	18.9	15.6	17.6	12.6	13.5	30.5	18.5
6-8.......	16.7	15.3	8.6	18.1	15.8	12.5	12.2	13.6	28.0	19.5
9-11......	18.0	17.1	5.0	18.7	17.7	5.4	13.5	14.0	26.8	23.0
12-14.....	19.5	19.4	.7	20.0	20.4	-2.0	15.3	15.7	25.9	28.3
15-18.....	20.5	20.8	-1.1	21.1	21.7	-3.0	17.3	17.0	26.7	30.1
19-22.....	21.3	21.6	-1.6	22.1	22.6	-2.0	17.8	17.5	29.3	31.2
23-34.....	22.0	22.4	-1.8	23.2	23.7	-2.1	18.1	18.1	32.7	34.4
35-50.....	23.5	24.0	-2.2	24.6	25.5	-3.6	18.9	19.0	33.7	36.9
51-64.....	24.6	25.5	-3.6	25.5	26.3	-3.1	19.3	18.8	34.4	36.0
65-74.....	24.9	25.7	-3.4	25.5	26.4	-3.6	19.2	19.4	34.0	35.9

[1]Body mass index = body weight in kg/(height in cm)^2.
[2]Percentage difference = [(NFCS value minus NHANES value)/NFCS value] x 100.

In comparisons by race, NFCS blacks had a greater median index of body mass than whites for males under 19 years and for females of all ages. NHANES revealed the same pattern for females 12 years and over but no pattern appeared for the other sex-age groups. Among regions, greatest differences between surveys were generally found in the South and smallest differences in the North Central region. Among urbanizations, percentage differences between surveys were generally largest in central cities and smallest in suburban areas. Education of the household head was negatively related to index of body mass in NFCS; the highest education level had the lowest index values for all sex-age groups, and the lowest education levels had the highest index values. In NHANES, these relationships generally held for females but not for other groups. Income level was also negatively related to the index of body mass in NFCS. The lowest index values were found in the highest quartile of income, and the highest index values were in the lowest quartile. The pattern for NHANES was similar to NFCS for adult females, but for adult males and young females the lowest NHANES index values were in the lowest quartile of income and the highest values in the second and third quartiles.

5.5 Conclusions

Differences between the two surveys in median and mean intakes of food energy and 10 nutrients were most pronounced for the youngest (1 to 5 years) and oldest (51 to 74 years) age groups. Nearly all median nutrient intakes for the oldest age groups were higher in NFCS than in NHANES. In the youngest groups, intakes were lower in NFCS than in NHANES. For most sex-age groups, NFCS median intakes were higher than NHANES for iron, thiamin, and niacin but lower for carbohydrate and calcium. For 6- to 50-year-olds, food energy, protein, and fat tended to be lower in NFCS than in NHANES for males; only food energy was higher for females. Differences between surveys were small for riboflavin, vitamin A, and vitamin C. Intakes of most nutrients appeared to have at least a slight association with demographic and socioeconomic characteristics except for iron.

Several factors were cited which probably contributed to the differences: (1) difference between time periods of the surveys with potential for changes in public awareness of nutrition and in socioeconomic levels, (2) differences in sample, (3) differences in collecting, classifying, and processing data, (4) differences in definition of variables including region, household income, and household head's occupation and employment status, and (5) increases in enrichment standards for thiamin, riboflavin, niacin, and iron midway between the two surveys, along with other differences in the two nutrient data bases used.

The proportion of individuals using foods in specified food groups differed somewhat between the two surveys. The number of eating occasions and meal patterns differed, possibly reflecting differences in recording practices and definition of variables. Nevertheless, three meals plus snacks was the most common meal pattern in both surveys, and nutrient quality of diets was higher for this meal pattern than for the others.

Alcoholic beverage consumption was reported much more extensively in NHANES than in NFCS. The reason for this was not clear; NHANES respondents reported for themselves, whereas not all NFCS respondents did. In both surveys, proportionally more drinkers were in the 35- to 50-year-old age category. Drinkers were most likely to be white, male, from the Northeast or West, from a high-income household with an employed household head, and have a white-collar job and some college education.

Differences between NFCS self-reported weights and heights and NHANES clinical measurements were small. The greatest differences were in the youngest and the oldest groups. The youngest participants were growing and the reported measurement in NFCS might not have been as current as it was in NHANES. Elderly people have a tendency to decline in weight and height as age advances. NFCS respondents may have reported an earlier measurement, whereas NHANES obtained current measurements.

5.6 Comment

Relationships reported by one or two classification variables are undoubtedly affected by other variables. For example, education is closely related to income, so education's reported effect on intakes is also an effect on income. But NFCS was conducted several years later and after increased publicity and other education programs concerning nutrition and health. Education and income might have been more closely related in 1977-78 than in the earlier 1970's, when there was a recession. Interaction among other stratifying variables might also have affected apparently simple relationships. Multivariate regression analyses would be necessary to adequately evaluate the varying effects of particular socio-economic and demographic variables. Weight estimates in low-income households were probably less precise partly because they often do not have bathroom scales.

The dietary recall data from the NFCS and NHANES, which may appear similar on the surface, required adjustment because of procedural differences prior to comparisons. NHANES 1976-80 and Hispanic HANES 1982-84 which have taken place since NHANES 1971-74, incorporated some changes in procedures. However, a number of the differences in methodology underscored in this study remain.

In 1985 and 1986 and prior to NFCS 1987-88, NFCS/NHANES joint working groups examined socioeconomic and demographic variables, sampling procedures, and a number of other methodological issues that might be changed to achieve greater comparability between the two surveys. Among variables proposed for the NFCS 1987-88 and the NHANES 1988-94, several were tentatively identified to have identical definitions --urbanization, ethnic identification, education, age, reported height, and self-evaluation of general health status. A number of other variables in the two surveys could be linked if small changes in definitions were made including, for example, race, reported weight, cigarette smoking status, identity of surrogate respondents, and participation in specified food programs.

Some important variables, however, differed in basic concepts related to survey objectives, precluding changes to achieve comparability. For example, individuals in NFCS are part of a household, whereas individuals in NHANES are part of a family; household and family are not equivalent since a household may contain more than one family. The basic concept, for example, also affects comparability of the unit reporting total income. In NFCS, income for the household is reported and, in NHANES, income for the family is reported. Comparability between nutrient data bases used in the two surveys, however, has been achieved by use of the USDA nutrient data base by both.

5.7 Appendix: Food Groups Developed for Comparing Foods Reported: NFCS 1977-78 and NHANES 1971-74

Food groups were developed for comparing foods reported in NFCS 1977-78 and NHANES 1971-74. The 39 food groups with the main items included are described below.

Meats: Includes beef, pork, veal (and veal with vegetables), frankfurters, sausage, luncheon meats, potted meats, lamb (and lamb with vegetables), bacon, organ meats, and game. Does not include other mixed meat dishes, poultry, or fish.

Beef: Includes ground beef and other forms of beef. Does not include organ meats from beef or mixed dishes with beef.

Beef, not ground: Includes solid cuts of beef. Does not include ground beef or mixed dishes with beef.

Pork: Includes fresh pork, cured pork (ham and bacon), salt pork, and miscellaneous pork cuts such as pigs feet. Does not include mixed dishes with pork.

Frankfurters, Luncheon Meats: Includes frankfurters, luncheon meats, sausage, and potted meats. Does not include mixed dishes with these items.

Poultry: Includes chicken, turkey, duck, and pheasant. Does not include mixed dishes with these items.

Fish: Includes finfish, shellfish, and other seafood like roe and frogs legs. Does not include mixed dishes with these items.

Meat Mixtures: Meat mixtures, pork mixtures, poultry mixtures, fish and shellfish mixtures, all frozen plate meals, and sandwiches made with beef, pork, poultry, fish, luncheon meats, potted meats, frankfurters, and sausage.

Eggs: Includes eggs eaten as such, and dishes with eggs as the major ingredient, such as omelettes, souffles, and egg sandwiches. Does not include meringues or egg substitutes.

Soups: Includes all soups.

Total Milk Products: Includes all milks and flavored milks, evaporated/condensed milk, cream and cream substitutes, meal replacements with milk, sour cream, yogurt, frozen dairy desserts, puddings and custards, all cheese (including cream cheese), and cheese sandwiches. Does not include baby foods.

Milk and Milk Drinks: Includes milks and flavored milks. Does not include evaporated/condensed milk or cream.

Dairy Desserts: Includes ice cream, ice milk, popsicles, milk-based sherbert, pudding, custard, and mousse.

Cheese: Includes cottage cheese, natural cheese, processed cheese, and cheese sandwiches. Does not include cream cheese.

Breads, Cereals and Pasta: Includes white bread, whole-grain bread, cornbread, biscuits, cooked cereals, ready-to-eat cereals, grits, rice, pasta, and non-salty crackers. Does not include mixed dishes with rice, mixed dishes with pasta, other mixed grain dishes, sweet rolls, muffins and quick breads, pancakes and waffles, salty crackers, and sandwiches.

Breads, Rolls: Includes white bread, whole-grain bread, cornbread, biscuits, and non-salty crackers. Does not include sandwiches.

Cooked Cereals: Includes cooked cereals, grits, rice, and pasta. Does not include mixed dishes with rice or pasta.

Ready-to-eat Cereals: Includes all ready-to-eat cereals.

Sweet Rolls, Quick Breads: Includes muffins, quick breads, sweet rolls, Danish, doughnuts, pancakes, and waffles.

Cakes, Pies, Cookies: Includes cakes, pies, and cookies. Does not include sweet rolls, Danish, doughnuts, and quick breads.

Salty Grain Snacks: Includes salty crackers and salty snacks. Does not include potato chips/sticks.

Grain Mixtures: Includes mixed dishes with rice, mixed dishes with pasta, pizza, Mexican mixed dishes, Oriental mixed dishes.

Fats and Oils: Includes butter, margarine, cooking fats, vegetable oils, and salad dressings. Does not include gravies and sauces.

Table Fats: Includes butter and margarine.

Salad Dressings: Includes regular and low-calorie salad dressings.

Sugars and Sweets: Includes meringues, gelatin desserts, ices, sherberts and popsicles (not milk-based), sugars, syrups, jams, jellies, and candy.

Sugars, Syrups, Jams: Includes sugars, syrups, honey, jams, and jellies.

All Vegetables: Includes all vegetables (including potatoes). Does not include relishes, olives and pickles.

White Potatoes: Includes all white potatoes--baked, fried, hash browned, mashed, scalloped, au gratin, and potato chips and sticks. Does not include sweet potatoes or yams.

Non-potato Vegetables: Includes all vegetables except potatoes and relishes.

Dark Red, Green, and Yellow Vegetables: Includes tomatoes in any form (including tomato sauce and tomato juice), broccoli, carrots, pumpkin, winter squash, sweet potatoes and dark green leafy vegetables such as spinach.

Other Vegetables: Includes corn, beans, peas, salad vegetables such as lettuce and cucumber, cauliflower, and green peppers.

Coffee, Tea: Includes all kinds of coffee and tea.

Soft Drinks: Includes regular and low-calorie soft drinks.

Fruit ades: Includes regular and low-calorie fruit ades, such as Tang, Koolaid, and Hawaiian Punch. Does not include fruit juices.

Alcoholic Beverages: Includes all alcoholic beverages.

All Fruits: Includes all fruits and fruit juices. Does not include tomatoes or fruit ades.

Citrus Fruits: Includes all citrus fruits and citrus fruit juices.

Other Fruits: Includes all fruits and juices other than citrus. Does not include dried fruits, tomatoes or fruit ades.

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Chapter 6. Study of Food Intake by Men

Investigator: Department of Food, Nutrition, and Institutional Administration, College of Human Ecology, University of Maryland, College Park, Maryland. Dr. Mary Alice Caliendo, Principal Investigator, 1980-83.

SUMMARY: This small-scale survey of food intake by 193 men was designed to appraise the adequacy and validity of information reported by men. Food items in lunches selected by the male volunteers in three workplace cafeterias were unobtrusively recorded and compared with those recalled by the men on the next day as part of their intakes for the total day and those reported by a surrogate household member (usually a wife) interviewed separately. The men were divided into two groups and one of two types of measurement aids--measures or models--was offered to help estimate portion sizes. About 3 months later, 160 men of the original group participated in a repeat survey. Intake data were analyzed in terms of quantitative matching, omissions, and erroneous additions of lunch items (1) observed by unobtrusive reporters, (2) recalled by the men, and (3) recalled by their surrogates. The full day's intakes as recalled by the men in the two interviews and as reported by surrogates for the first interview were also compared. About 85 percent of the lunch items were recalled by the men. Errors of omission were proportionately about twice as common as errors of addition. In both measurement-aid groups, overestimation tended to be more common than underestimation. However, the degree of overestimation of portion sizes was generally greater by the group using measures than by the group using models. Household surrogates reported about one-third to two-fifths of the lunch items reported by subjects. The two types of measurement aids should not be used interchangeably.

Tables

Figure

6.1 Background

In dietary intake surveys, the principal objective is to collect valid and reliable information on food actually consumed. Complete and accurate descriptions and quantifications of foods and beverages ingested are essential in order to compute the best possible estimates of the energy and nutrient contents of diets. Some survey participants are unable to provide accurate (or valid) information about the food they have eaten. Moreover, it is often impossible to collect dietary information directly from some individuals in a survey because they are absent from the home when the interviewer arrives to question household members. Considerable effort is exerted to obtain answers for all sample persons because low response rates may negatively affect the quality of survey results and generalization to the population. Acceptance of poor quality information must be minimized.

In some surveys, a surrogate informant, such as the homemaker or household respondent, may be asked to provide answers about an absent member's food intake since return visits involve added expense and delay. Knowing how accurate surrogates' reports are is important for assessing data quality. Both the Nationwide Food Consumption Survey (NFCS) and the National Health and Nutrition Examination Survey (NHANES) procedures accept surrogate reporting for young children. NFCS has used surrogate reporting when individuals are unable to report for themselves and a household respondent or other household member can report their food intake. For example, the household respondent might report for an absent husband or teenager about meals and snacks they ate together and, after conferring, about foods not eaten together.

As indicated in the preceding chapter, NFCS 1977-78 and NHANES 1971-74 used different procedures to collect 1-day recalls of food intake. In both surveys, measurement aids were used to assist respondents in estimating amounts eaten, but the two sets of measurement aids were different. NFCS employed a set of household measuring utensils--cups, spoons, and rulers; NHANES used a set containing food models, abstract shapes, and tableware.

Because NFCS and NHANES are major components of the National Nutrition Monitoring System, efforts have been made to achieve greater comparability in their protocols without sacrificing quality of the data or survey objectives. Survey statisticians and nutritionists place great emphasis on improving the reliability and validity of data produced with current survey methods. The experiment described in this chapter was carried out to develop more information about problem areas in food intake surveys and to gain insight into ways of dealing with them.

6.2 Purpose

This study, performed by the University of Maryland, examined the adequacy and validity of food intake information reported by or for men. Specific objectives were to determine (1) the ability of men to recall food intake for the previous day's lunch, (2) the effectiveness of two types of measurement aids in helping subjects estimate portion sizes, (3) the agreement between recalls of each man's food intake by him and by a knowledgeable household member (surrogate respondent), (4) the comparability of two 1-day recalls about 3 months apart by the men, and (5) identification of problem foods and errors in reporting them.

6.3 Methods

This experimental study was carried out in two phases, each about 3 months long.

The subjects were 193 male volunteers who worked at firms in the Washington, D.C., area and who ate lunch in the workplace cafeterias. Three companies cooperated in the study by giving the research team permission to conduct the study in their cafeterias and by providing release time during work hours so that employees who volunteered could be interviewed. (Figure 6.1 summarizes the experimental procedure.)

6.3.1 Study Design, Data Collection, Subjects, and Data Preparation

In phase I, men from two firms were recruited at the cashiers' stations after selecting and paying for their lunches. At the other firm, employees were asked to participate before entering the cafeteria. To be accepted, however, the men's selected lunches at all three firms had to include several items from the cafeteria menu. If an employee agreed to participate, his tray was labeled with a sticker and arrangements were made to talk with him after he had eaten his lunch. Meanwhile, an unobtrusive observer recorded on a listing of the day's menu the man's food and beverage selections and portion sizes. Portion sizes recorded by the observer were the standard portion sizes specified by the cafeteria management and made available to the researchers. After lunch, the man's tray was returned to a designated location and plate waste was weighed and recorded. To participate in the study, the man had to have a member in his household who was familiar with his food intake (usually his wife or mother) and could be interviewed. If these conditions were met, an interview with the man was arranged for the next day to administer test 1, a 1-day recall of food intake, in a room provided by the firm. The man supplied the name, address, and telephone number of the household member. Later in the day, an appointment was made with the household member, if available, to administer test 2, a 1-day recall of the man's food intake on the preceding day by the household member. The meeting was planned to take place before the man had a chance to discuss his interview with the household member.

The men were assigned randomly and about equally to two treatment groups. One group, identified as the "measures" group, was interviewed using a set of standard household measuring cups (1/4, 1/3, 1/2 and 1 cup sizes), standard measuring spoons (1/4, 1/2, and 1 teaspoon and 1 tablespoon sizes), and a 6-inch plastic ruler; a similar set was used in NFCS 1977-78. The other group, the "models" group, was interviewed using a set of abstract shapes, tableware, and food models similar to the set used in NHANES 1971-74. A few exceptions to random assignment occurred when it was found that complete privacy for the interview could not be arranged for both the man and the household member. In that case, the man was assigned to the measures group to avoid attention from passers-by which was caused by the models.

About 3 months later, in phase II of the study, the men were recontacted, appointments were made to see them in the cafeterias again, their intakes at lunch were observed as before, and appointments were made for a second interview. At that time, test 3 was administered. Test 3 consisted of a 1-day recall of food intake (repeat of test 1). The men used the same type of measurement aid they had used in phase I. Household members were not interviewed in phase II. The men were paid $35 each for completing both phases.

The research team and the seven interviewers were undergraduate and graduate students in nutrition. The materials developed by the research team included

Phase I--July-September 1981

TEST 1	
Day 1	Day 2
• Recruit male employee (subject) in work place cafeteria. • Record lunch (items and amounts) of subject by unobtrusive observer. • Weigh plate waste. • Arrange interview for next day.	• Administer 1-day dietary recall of subject's intake to subject. • Use designated set of measurement aids in interview with subject: Group using measuring utensils (measures), N = 102; Group using models (models), N = 91.

TEST 2	
Day 1	Day 2
• Obtain telephone number of household member from subject. • Arrange interview for next day.	• Administer 1-day dietary recall of subject's intake to household member. • Use designated set of measurement aids in interview with household member: Group using measuring utensils (measures), N = 102; Group using models (models), N = 91.

Phase II--October-December 1981

TEST 3		
Day 1	Day 2	Day 3
• Recontact subject and arrange by telephone for subject to purchase lunch in work place cafeteria on the next day. • Arrange interview for day following lunch in cafeteria.	• Record lunch of subject by unobtrusive observer. • Weigh plate waste.	• Repeat Day 2 procedures of Test 1 with subject.

Figure 6.1--Design of experiment for study of food intake by men

dietary questionnaires; a manual of interviewer instructions; and forms and procedures for recruiting subjects, for unobtrusively recording items on lunch trays, for weighing and recording plate waste, and for arranging appointments. Interviewers were trained extensively in use of both types of measurement aids.

A pilot test consisting of eight interviews was conducted in a cafeteria at the University of Maryland to test observation, recruitment, and interviewing techniques. Practice sessions were held to increase experience and confidence of interviewers in handling instruments and interviewing procedures.

On day 1 of test 1, the interviewers worked in pairs. One interviewer approached a potential subject and asked him to participate. The other interviewer assumed the role of unobtrusive observer and recorded his lunch items and amounts. On day 2, the interview of a prospective subject began with a brief description of the study's purpose. The man was handed a letter to read which contained detailed information, and the man's written consent to participate in the study was obtained. The man was then asked to recall all foods eaten on the preceding day (day 1) from midnight (12:00) to the following midnight (11:59 p.m.). The interviewer then asked the man to describe those items in more detail and to estimate amounts eaten using the particular set of measurement aids presented. Demographic information was obtained after the food recall was completed. A standard script and set of verbal probes had been developed and were used by the interviewers. Interviewers alternated days using measures with days using models.

In phase I, 414 interview appointments were arranged with subjects and household members, and 386 interviews were completed (193 pairs). In phase II, 182 men were recontacted but only 160 were reinterviewed--86 men in the measures group and 74 men in the models group. A common reason for subject ineligibility in phase I was living alone. Interviews could not be arranged with about 20 household members, so appointments with those men had to be cancelled. Also, several household members did not keep their appointments. In these cases, the men's recalls could not be used. In phase II, a number of men could not be recontacted because of job-related travel or because they had left the firm.

Most interviews with the men took 11 to 45 minutes, but nine interviews took longer. The longest interview was 70 minutes because of initial reporting for the wrong day. Interviews with household members were usually conducted in the home (111 cases) or at the household member's place of work (80 cases). They took less time than did the interviews with the men. In most instances, 10 to 35 minutes were sufficient, but seven took longer. Only 57 household members attempted to report what the subjects had for lunch, and 33 of them did not know what the subjects had for two meals, most often breakfast and lunch. The times of day when interviews were conducted with household members were as follows:

Time of day interview began	Number of household members interviewed
8:00 - 9:59 a.m.	8
10:00 - 11:59 a.m.	39
12:00 - 1:59 p.m.	43
2:00 - 5:59 p.m.	95
7:00 - 9:00 p.m.	7

The male subjects were predominately white; 18 to 60 years old (mean age of 36 years); mostly from small households (81 percent from 2- to 4-person families); generally well educated; mostly in professional, technical, or managerial occupations; and mostly with a moderate or high income. Subjects in the measures and models groups were generally similar to each other.

Most of the household members interviewed were wives (91 percent) of the men. Only a fifth were full-time homemakers. Almost half held professional, technical, or managerial positions, and a fifth held clerical or sales jobs. There were somewhat more homemakers in the models group (28 percent) than in the measures group (15 percent); whereas professional, technical, and managerial workers in the measures group (38 percent) exceeded those in the models group (24 percent).

Food items on the recall form were coded soon after completion of the interview by the interviewer who administered the instrument. The food codes from NFCS 1977-78 were used. Numeric equivalents for the models representing portion sizes were converted before coding into gram weights. Coding of each 1-day recall took 25 to 45 minutes; checking took additional time. Household members' 1-day recalls in phase I took less time--15 to 30 minutes each--mainly because household members did not know all items eaten by the men. The food codes and gram weights for each food or beverage item on each man's tray for the observed lunch were assigned by the research associate on the study. Energy and nutrient contents of food were calculated using the nutrient data base compiled for NFCS 1977-78. The 10 nutrients examined were protein, fat, carbohydrate, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and vitamin C.

6.3.2 Data Analysis

For analysis, food items were organized into 22 food groups based on conventional classifications of foods such as meats, vegetables, and so forth, and on the appropriate method of measuring portion amounts such as by volume, by piece, by dimension, or by weight. The number of times items within each of the 22 food groups were reported in phase I on 1-day recalls were tabulated (Table 6.1). The number of men observed to have chosen items from each food group at lunch also were reported (Table 6.2). Tabulations and statistical analyses by computer were performed using Statistical Package for the Social Sciences (SPSS) (Nie et al., 1975) or Biomedical Computer Programs (BMDP) (Dixon, 1981). Statistical procedures were both descriptive (means, standard deviations, frequencies, proportions, and percentages) and inferential (t-test and repeated measures analysis of variance). Data were analyzed to meet five objectives:

-- Determine ability of men to recall lunch items eaten.
-- Examine effectiveness of two types of measurement aids in estimating portions.
-- Ascertain agreement between recalls of food intake by men and their household surrogates.
-- Compare two 1-day recalls by men taken about 3 months apart.
-- Identify problem foods and errors in reporting them.

6.3.2.1 Ability of Men to Recall Lunch Items Eaten, Phases I, II

To determine the ability of men in the measures group and the models group to recall food items eaten for lunch on the day preceding an interview, the total number of lunch items recalled by each subject was compared with the total number of items observed and recorded by the unobtrusive observer. In a computer analysis, food items for each man were considered a match if food codes on the recall and on the observer's report were within the same food group. Means were

Table 6.1--Food items in 22 food groups reported by men for total day, phase I

Food group	Times food items were reported	
	Number	Percent
Milk	257	6.3
Cheese	98	2.4
Meats	271	6.7
Fish, seafood	46	1.1
Combined main dishes	136	3.3
Breads, sliced	96	2.4
Breads, irregular shapes	177	4.3
Soups	45	1.1
Gravies, sauces	55	1.4
Fruits by piece	105	2.6
Fruits by volume	63	1.5
Vegetables by piece	180	4.4
Vegetables by volume	335	8.2
Grains, pasta, starchy vegetables	160	3.9
Crackers, salty snacks	64	1.6
Sweet baked goods	153	3.8
Desserts, milk, frozen	71	1.7
Beverages, nonalcoholic	848	20.8
Beverages, alcoholic	18	.4
Accompaniments	699	17.2
Miscellaneous	89	2.2
Oils, dressings	108	2.7
Total food items reported	4,074	100.0

computed and differences between means for the measures and the models groups were assessed for significance ($p \leq 0.05$) by t-test for three dependent variables calculated for each mean: (1) the number of items matched divided by the number of items observed, (2) the number of recalled items not observed divided by the number of items in the recall (for additions), and (3) the number of observed items not recalled divided by the number of observed items (for omissions) (Table 6.3).

The percentages of accurate, underreported, and erroneously added lunch items were determined also for each of the food groups for each man. Mean percentages were calculated and differences between means for the measures and models groups were assessed for significance at the 0.05 level by t-test for three dependent variables calculated for each man: (1) the percentage of observed items that appeared on the recall (matched items), (2) the percentage of recalled items observed (as evidence of underreporting), and (3) the percentage of recalled items that were not observed (erroneous additions), (Table 6.4). Only 21 food groups were included in analyses of lunch because no alcoholic beverages were reported for lunch.

Table 6.2--Men observed to have selected food items from each of 22 food groups at lunch, phase I

Food group	Men (N=193)	
	Number	Percent
Milk	58	30
Cheese	49	25
Meats	95	49
Fish, seafood	19	10
Combined main dishes	60	31
Breads, sliced	34	18
Breads, irregular shapes	72	37
Soups	31	16
Gravies, sauces	47	24
Fruits by piece	29	15
Fruits by volume	36	19
Vegetables by piece	59	31
Vegetables by volume	122	63
Grains, pasta, starchy vegetable	35	18
Crackers, salty snacks	23	13
Sweet baked goods	51	26
Desserts, milk, frozen	21	11
Beverages, nonalcoholic	62	32
Beverages, alcoholic	0	0
Accompaniments	100	52
Miscellaneous	6	3
Oils, salad dressings	39	20

6.3.2.2 Recall of Amounts of Lunch Items by Men and Effectiveness of Two Types of Measurement Aids

To determine the effectiveness of the two types of measurement aids in helping subjects estimate the amounts of lunch items eaten, the gram weights of lunch items recalled were compared with those of lunch items observed and recorded by an unobstrusive interviewer for the men using measures and for the men using models. The observed and recorded portions were assumed to be accurate estimates. In this way, the validity of the quantities estimated by the man was assessed. For those food groups with food items both recalled as having been eaten by each subject and observed, the amounts reported on the recalls and on the observer's record were compared after conversion to grams. Means were computed and differences between the measures and models groups were tested for significance ($p \le 0.05$) for three dependent variables: (1) the observed weight minus the recalled weight of the food group with the difference in grams being identified as the "difference score," (2) the proportion of times the observed weight was greater than the recalled weight (called underestimation), and (3) the proportion of times the recalled weight was greater than the observed weight (called overestimation) (Table 6.3).

Table 6.3--Comparisons of observed versus recalled lunch items by men using measures or models, phases I and II

Dependent variable	Phase I Measures (N=102)	Phase I Models (N=91)	Phase II Measures (N=86)	Phase II Models (N=74)
	Mean ± standard deviation			
Number of items matched divided by number of items observed, expressed as mean percent	83± 18	84± 19	82± 21	86± 18
Number of recalled items not observed divided by number in recall, expressed as mean percent added	8± 15	9± 14	10± 19	6± 13
Number of observed items not recalled divided by number observed, expressed as mean percent omitted	17± 18	16± 19	18± 21	14± 18
For matches, observed weight minus recalled weight of food expressed as mean difference score in grams	-165±223	-101±122*	-112±139	-65±161*
For matches, number of times observed weight was greater than recalled weight of food, expressed as mean percent underestimated	18± 38	16± 37	23± 42	41± 49*
For matches, number of times recalled weight was greater than observed weight of food expressed as mean percent overestimated	82± 38	84± 37	77± 42	59± 49*

*Difference between measures and models was significant ($p \leq 0.05$).

The number of lunch items in phase I with recalled portions more than (overestimation), less than (underestimation), and equivalent to (accurate) observed portions were examined for matched items within food groups for each measurement aid group (Table 6.5). The magnitude of difference in estimated amounts for the matched items within a food group was determined by using difference scores (Table 6.6). (The subtraction of the recalled weight in grams from the observed weight in grams yielded a difference score for each pair of food items that were matched.) Mean difference scores were calculated for total items, for those overestimated, and for those underestimated; differences between means for the measures and the models groups were evaluated for significance ($p \leq 0.05$) using the t-test.

Difference scores also provided a measure of accuracy for portion amounts

Table 6.4--Observed items recalled[1] and recalled items observed[2] and not observed[3] within food groups for lunch by men, phases I and II

Food group, measurement aids group	Phase I					Phase II				
	Observed items		Recalled items			Observed items		Recalled items		
	Subjects using	Recalled	Subjects using	Observed	Not observed[4]	Subjects using	Recalled	Subjects using	Observed	Not observed[4]
	Percent	Mean percent	Percent	Mean percent		Percent	Mean percent	Percent	Mean percent	
Vegetables by volume:										
Measures.............	63	80	54	95	5±18	66	81	58	91	9±24
Models...............	64	86	63	87	13±32	69	81	62	90	11±27
Accompaniments:										
Measures.............	54	75	47	84	16±33	48	61	40	78	23±41*
Models...............	49	62	42	83	17±37	60	68	46	95	5±19
Meats:										
Measures.............	47	92	45	95	5±22	43	89	41	96	4±19
Models...............	52	84	45	98	2±16	47	94	46	97	3±17
Breads, irregular shapes:										
Measures.............	36	88	34	94	6±24	35	69	30	88	13±34
Models...............	38	89	38	89	11±32	26	90	24	94	6±24
Beverages, nonalcoholic:										
Measures.............	27	93	26	98	2±10	28	90	30	92	8±28
Models...............	37	91	35	97	3±18	30	93	28	100	0
Combined main dishes:										
Measures.............	34	93	36	88	12±32	42	92	42	94	6±23
Models...............	28	96	35	75	25±44	39	97	42	90	10±30
Vegetables by piece:										
Measures.............	26	92	30	76	24±42*	33	96	35	90	10±31
Models...............	36	82	31	97	3±11*	35	89	32	94	6±22
Milk:										
Measures.............	27	93	27	93	7±26	35	90	33	96	4
Models...............	33	97	33	97	3±18	32	96	31	98	2±10
Sweet baked goods:										
Measures.............	27	80	22	100	0	23	85	20	100	0
Models...............	25	91	24	95	5±21	15	91	15	86	14±32
Cheese:										
Measures.............	22	73	16	100	0	24	81	26	90	11±32
Models...............	30	70	22	95	5±22	27	80	22	100	0
Gravies, sauces:										
Measures.............	24	60	17	94	6±24	19	69	16	79	21±43
Models...............	24	70	21	84	16±34	22	75	20	83	17
Oils, dressings:										
Measures.............	18	81	15	100	0	29	92	29	90	10±29
Models...............	23	79	20	92	8±26	20	93	22	88	13±34

See footnotes at end of table.

Continued

Table 6.4—Observed items recalled[1] and recalled items observed[2] and not observed[3] within food groups for lunch by men, phases I and II--Continued

Food group, measurement aids group	Phase I					Phase II				
	Observed items		Recalled items			Observed items		Recalled items		
	Subjects using	Recalled	Subjects using	Observed	Not observed[4]	Subjects using	Recalled	Subjects using	Observed	Not observed[4]
	Percent	Mean percent	Percent	Mean percent		Percent	Mean percent	Percent	Mean percent	
Fruits by volume:										
Measures	16	78	13	100	0	15	62	9	100	0
Models	22	75	18	94	6±25	14	100	16	83	17±39*
Grains, pasta, starchy vegetables:										
Measures	21	88	20	95	5±22	12	90	12	90	10±32
Models	15	93	18	81	19±40	26	90	19	94	6±24
Breads, sliced:										
Measures	16	88	14	100	0	12	80	10	89	11±33
Models	20	72	15	93	7±27	19	93	18	100	0
Soups:										
Measures	16	88	17	82	18±39	19	94	19	94	6±25
Models	16	93	15	100	0	15	100	15	100	0
Fruits by piece:										
Measures	14	79	11	100	0	19	84	21	93	7±26
Models	16	73	13	92	8±29	22	81	10	100	0
Crackers, salty snacks:										
Measures	13	54	8	100	0	15	73	12	100	0
Models	11	70	8	100	0	11	100	11	100	0
Desserts, milk, frozen:										
Measures	13	92	14	86	14±36	14	92	14	92	8±29
Models	9	100	10	89	11±33	16	92	15	100	0
Fish, seafood:										
Measures	10	100	11	91	9±30	0	--	0	--	--
Models	10	100	10	100	0	0	--	0	--	--
Miscellaneous:										
Measures	3	33	2	50	50±71	0	--	0	--	--
Models	3	67	2	100	0	0	--	0	--	--

[1]The number of matches (observed items on recall) divided by the number of items observed expressed as a percentage. This variable is a measure of the accuracy of recall.

[2]The number of recalled items observed divided by the total items recalled expressed as a percentage.

[3]The number of items recalled but not observed divided by the total items recalled expressed as a percentage.

[4]Mean ± standard deviation.

*Difference between measures and models was significant ($p \leq 0.05$).

Table 6.5--Lunch items with recalled portions more than, less than, and same as observed portions, phase I

Food group	Total items matched[1]		Recalled portion sizes were--												
			More than Observed				Less than Observed				Same as Observed				
	Measures	Models	Measures		Models		Measures		Models		Measures		Models		
	No.	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Milk..............	31	31	8	26	13	42	4	13	2	6	19	61	16	52	
Cheese............	16	18	3	19	5	28	2	13	2	11	11	69	11	61	
Meats.............	44	43	19	43	19	44	17	39	19	44	8	18	5	12	
Fish, seafood.....	10	9	7	70	6	67	3	30	3	33	0	0	0	0	
Combined main dishes...........	36	25	24	67	12	48	8	22	9	36	4	11	4	16	
Breads, sliced...........	15	14	2	13	4	29	2	13	1	7	11	73	9	64	
Breads, irregular shapes...........	34	31	12	35	6	19	5	15	7	23	17	50	18	58	
Soups.............	16	14	12	75	10	71	1	6	3	21	3	19	1	7	
Gravies, sauces...	17	17	9	53	9	53	7	41	7	41	1	6	1	6	
Fruits, by piece.........	12	10	3	25	4	40	4	33	2	20	5	42	4	40	
Fruits, by volume........	14	18	13	93	6	33	1	7	5	28	0	0	7	39	
Vegetables, by piece.........	27	33	17	63	20	61	7	26	11	33	3	11	2	6	
Vegetables, by volume........	68	60	48	71	34	57	12	18	16	27	8	12	10	17	
Grains, pastas, starchy vegetables.......	20	14	18	90	10	71	0	0	0	0	2	10	4	29	
Crackers, salty snacks.....	9	8	2	22	2	25	3	33	4	50	4	45	2	25	
Sweet baked goods............	23	21	9	39	12	57	10	43	7	33	4	17	2	10	
Desserts, milk, frozen...........	12	7	5	42	2	29	2	17	1	14	5	42	4	57	
Beverages, nonalcoholic.....	26	30	13	50	19	63	6	23	5	17	7	27	6	20	
Accompaniments....	53	43	23	43	13	30	17	32	19	44	13	25	11	26	
Oils, dressings...	15	16	11	73	8	50	3	20	5	31	1	7	3	19	
Miscellaneous.....	2	7	2	100	5	71	0	0	1	14	0	0	1	14	
Total items....	500	469	260	52	219	47	114	23	129	27	126	25	121	26	

[1]Total matched = observed items which are also on the recall.

Table 6.6--Difference scores for recalled lunch portions more than and less than observed portions, phase I

Food group	Difference scores[1]					
	Total items[2]		More than observed		Less than observed	
	Measures	Models	Measures	Models	Measures	Models
	----------------Mean grams ± standard deviation----------------					
Milk............	-53± 98	-36± 52	-153±142	-86± 48	101±42*	3± 2*
Cheese..........	-5± 8	-8± 12	-13± 6	-22± 9	18±12	15±16
Meats...........	-32± 31	-37± 37	-43± 36	-44± 47	34±21	40±21
Fish, seafood...	-97± 99	-38± 41	-121±110	-42± 50	40±22	31±14
Combined main dishes.........	-110±134*	-40± 45*	154±144*	-63± 54*	33±22	26±14
Breads, sliced.........	-8± 22	-5± 9	-45± 54	-16± 13	17±16	18 ([3])
Breads, irregular shapes.........	-11± 24	-10± 25	-29± 33	-39± 49	5± 3	11± 7
Soups...........	-115±113	-122±116	-152±106	-148±124	10 ([3])	74±60
Gravies, sauces.........	-30± 33	-44± 49	-31± 40	-55± 65	34±22	37±19
Fruits, by piece.......	-41± 71	-37± 48	-125±110	-75± 57	30±16	35± 1
Fruits, by volume......	-74± 37*	-38± 56*	-77± 37	-78± 74	40 ([3])	44±40
Vegetables, by piece.......	-44± 67	-34± 32	-64± 79	-37± 34	15±11	33±29
Vegetables, by volume......	-51± 62*	-29± 31*	-68± 66*	-42± 33*	18±18	18±18
Grains, pastas, starchy vegetables.....	-134±146	-66±110	-149±147	-92±121	([4])	([4])
Crackers, salty snacks...	-2± 3	-6± 6	-3± 1*	-15± 4*	4± 3	5± 3
Sweet baked goods...........	-50± 53	-26± 37	-70± 72	-35± 47	17±16	17±13
Desserts, milk, frozen.........	-51± 75	-28± 48	-109± 85	-82± 69	31±41	30 ([3])
Beverages, nonalcoholic...	-81±102	-49± 46	-136±120*	-71± 41*	57±10	22±30
Accompaniments..	-10± 13	-2± 8	-17± 16	-10± 7	8± 8	10± 8
Oils, dressings.	-26± 32	-16± 24	-24± 11	-29± 30	3± 1	6± 3
Miscellaneous...	-81± 33	-40± 40	-81± 33	-50± 44	([4])	30 ([3])

[1] Difference score for a food item = observed amount minus recalled amount in grams.

[2] See Table 6.5 for number of items.

[3] For 1 item only, there is no standard deviation.

[4] No item.

*Difference between measures and models was significant ($p \le 0.05$).

recalled by each man. Mean difference scores and mean percentages of recalled items overestimated by subjects in each measurement aid group were calculated, and differences between means for the measures and models groups were evaluated for significance ($p \leq 0.05$) by t-test (Table 6.7).

Energy and nutrient (fat, carbohydrate, calcium, iron, niacin, and thiamin) contents of the observed lunch, the recalled lunch, and the difference score were calculated as dependent variables for each man (Table 6.8). Means for each dependent variable were calculated for the type of measurement aid (independent variable) assuming no interaction by phases; differences between means for measurement aid groups were tested for significance ($p \leq 0.05$). Means for each dependent variable were calculated for the phase occurrence (independent variable) assuming no interaction by measurement aid; differences between means for phases I and II were tested for significance ($p \leq 0.05$). A repeated measures analysis of variance procedure by BMDP (Dixon, 1981) was used.

The number of times models were used in the 1-day recall interviews by men in phases I and II were tabulated and ranked from those used most often to those used least often (Table 6.9). The number of times 10 selected types of models were used to estimate amounts of items in 22 food groups were reported (Table 6.10).

6.3.2.3 Agreement Between Recalls of Subjects' Intakes by Man-Household Member Pairs, Phase I

For each man-household member pair in phase I, the recall of lunch by the man was compared with the recall of the man's lunch by the household member by measurement aid group using six dependent variables: (1) the number of matched items divided by the number of items reported by the man expressed as a percent; (2) the number of items not in the man's recall but in the household member's recall divided by the number of items in the household member's recall expressed as a percent; (3) the number of items not in the man's recall but in the household member's recall divided by the number of items in the man's recall expressed as a percent; (4) for matched items, the recalled weight of the man's minus the household member's recalled weight of the food in grams; (5) for matched items, the percentage of times the man's recalled weight was greater than the household member's recalled weight of food; and (6) for matched items, the percentage of times the household member's recalled weight was greater than the man's recalled weight of food. For each dependent variable, the difference between means for the measures and models groups was tested for significance ($p \leq 0.05$) using t-test (Table 6.11). Also, eight dependent variables were tabulated for all 57 man-household member pairs who reported lunch, combining the two measurement-aid groups because differences between means for measures and models were not significantly ($p \leq 0.05$) different. They were the percentages of observed items that were recalled (1) by both the man and the household member, (2) by the man but not by the household member, (3) by the household member but not by the man, (4) by neither the man nor the household member, (5) by the man overall and (6) by the household member overall; (7) the percentage of the man's total recalled items on the observed record; and (8) the percentage of the household member's total items on the observed record (Table 6.12).

As was the case for lunch items recalled by man-household member pairs, computer listings of food codes and gram weights of items for the men's breakfast and

Table 6.7--Difference scores for mens' lunch portion sizes estimated using measures or models, phases I and II

Food group	Phase I			Phase II		
	Subjects using	Observed minus recalled weight[1]	Percentage of items overestimated[1]	Subjects using	Observed minus recalled weight[1]	Percentage of items overestimated[1]
	Percent	Grams	Percent	Percent	Grams	Percent
Vegetables by volume:						
Measures....................	53	-44± 74	72±45	54	-36±104	57±50
Models......................	56	-26± 43	59±50	55	-13± 52	49±51
Accompaniments:						
Measures....................	41	-5± 20	36±49	31	-2± 19	30±47
Models......................	35	4± 14	28±46	45	0± 15	30±47
Meats:						
Measures....................	43	-4± 45	39±49	39	-5± 45	35±48
Models......................	44	-1± 53	43±50	43	-6± 66	56±50
Breads, irregular shapes:						
Measures....................	32	-13± 29	39±50	24	-8± 18	33±48
Models......................	33	-5± 27	20±41	23	1± 5	18±39
Beverages, nonalcoholic:						
Measures....................	26	-60±116	56±51	26	-56±100	64±49
Models......................	34	-42± 52	65±49	28	-63± 68	76±44
Combined main dishes:						
Measures....................	32	-83±122	67±48	39	-32± 90	47±51
Models......................	24	-37± 57	67±49	38	-43±142	61±50
Vegetables by piece:						
Measures....................	24	-39± 87	67±48	31	-32± 55	52±51
Models......................	31	-14± 48	64±49	31	-9± 53	48±51
Milk:						
Measures....................	25	-32±125	27±45	31	-20± 82	37±49
Models......................	32	-38	45±51	31	10± 57	13±34
Sweet baked goods:						
Measures....................	22	-24± 69	39±50	20	-16± 35	35±49
Models......................	23	-14± 43	57±51	16	5± 22	30±48
Cheese:						
Measures....................	16	- .2± 9	19±40	20	1± 14	18±39
Models......................	21	-4± 13	26±45	22	4± 21	25±45
Gravies, sauces:						
Measures....................	15	-3± 46	56±51	13	-11± 43	45±52
Models......................	19	-19± 68	47±51	18	18± 49	46±52

See footnotes at end of table.

Continued

Table 6.7--Difference scores for mens' lunch portion sizes estimated using measures or models, phases I and II--Continued

Food group	Phase I: Subjects using	Phase I: Observed minus recalled weight[1]	Phase I: Percentage of items overestimated[1]	Phase II: Subjects using	Phase II: Observed minus recalled weight[1]	Phase II: Percentage of items overestimated[1]
	Percent	Grams	Percent	Percent	Grams	Percent
Oils, dressings:						
Measures....................	15	-19± 20	73±46	27	-13±29	65±49*
Models......................	17	-7± 33	53±51	19	1±21	14±36
Fruits by volume:						
Measures....................	13	-65± 47	92±28	9	-29±40	38±52
Models......................	16	-2± 49	33±49	16	-7±44	60±52
Grains, pasta, starchy vegetables:						
Measures....................	19	-143±145	100± 0*	10	-94±88	78±44
Models......................	14	-77±113	77±77	23	-38±57	71±47
Breads, sliced:						
Measures....................	16	2± 8	7±27	9	-5±11	25±46
Models......................	20	-4± 9	23±44	17	-2± 5	23±44
Soups:						
Measures....................	14	-112±113	79±43	17	51±86	47±52
Models......................	15	-90±144	71±47	15	88±87	82±41
Fruits by piece:						
Measures....................	11	-23± 83	27±47	16	-29±49	50±52*
Models......................	12	-35± 83	33±51	18	8±64	8±28
Crackers, salty snacks:						
Measures....................	8	-1± 3	25±46	12	-11±32	30±48
Models......................	8	-1± 10	29±49	11	1± 3	13±35
Desserts, milk, frozen:						
Measures....................	12	-40± 81	42±52	13	-26±32	45±52
Models......................	9	-39± 75	38±52	15	-28±75	45±52
Fish, seafood:						
Measures....................	10	-73±119	70±48	0	--	--
Models......................	10	-18± 54	67±50	0	--	--
Miscellaneous:						
Measures....................	1	-104± 0	100± 0	0	--	--
Models......................	2	-20± 28	50±71	0	--	--

[1]Mean ± standard deviation.
* Difference between measures and models was significant ($p \leq 0.05$).

Table 6.8--Nutrient content of men's observed and recalled lunches by measurement aid group and by phase

Nutrient, dependent variable	Intake: Phase I	Intake: Phase II	Both Phases I and II
	Mean ± standard deviation		Mean
Food energy (kcal):			
Observed:			
Measures...............	686±239	680±239	683
Models.................	686±229	715±284	701
Both...................	686	696	691
Recalled:			
Measures...............	815±363	879±435	847*
Models.................	718±315	780±331	749*
Both...................	770*	833*	802
Difference score:			
Measure................	-130±248	-200±413	-165*
Models.................	-32±288	-64±237	-48*
Both...................	-85	-137	-111
Fat (g):			
Observed:			
Measures...............	33.7± 15.8	34.6± 14.9	34.1
Models.................	34.1± 15.4	36.4± 18.6	35.2
Both...................	33.9	35.4	34.6
Recalled:			
Measures...............	42.0± 25.6	45.4± 28.2	43.7*
Models.................	34.8± 19.3	38.6± 21.5	36.7*
Both...................	38.6	42.3	40.5
Difference score:			
Measures...............	8.3± 18.3	10.8± 26.4	9.6*
Models.................	-71.0± 18.3	-2.2± 16.9	-1.5*
Both...................	-4.8	-6.8	-5.8
Carbohydrate (g):			
Observed:			
Measures...............	68.7± 30.7	64.3± 30.8	66.5
Models.................	67.5± 30	68.2± 33.8	67.8
Both...................	68.1	66.1	67.1
Recalled:			
Measures...............	79.2± 40.9	82.0± 46.1	80.6
Models.................	71.4± 34.5	67.7± 37.0	74.0
Both...................	75.6	79.5	77.6
Difference score:			
Measures...............	-10.5± 26.7	-17.6± 36.8	-14.1*
Models.................	-4.0± 21.1	-8.5± 25.6	-6.2*
Both...................	-7.5*	13.4*	-10.4

See footnote at end of table.

Continued

Table 6.8--Nutrient content of men's observed and recalled lunches by measurement aid group and by phase--Continued

Nutrient, dependent variable	Intake: Phase I	Intake: Phase II	Intake: Both Phases I and II
	Mean ± standard deviation		Mean
Calcium (mg):			
Observed:			
Measures	297±240	260±205	278
Models	292±199	292±229	292
Both	295	274	284
Recalled:			
Measures	343±289	322±251	332
Models	312±255	315±236	313
Both	329	319	324
Difference score:			
Measures	-47±149	-62±146	-54
Models	-19±187	-23±146	-21
Both	-34	-44	-39
Iron (mg):			
Observed:			
Measures	4.2± 1.6	4.1± 1.8	4.2
Models	4.2± 1.8	4.1± 1.6	4.2
Both	4.2	4.1	4.2
Recalled:			
Measures	4.9± 2.4	5.6± 3.4	5.3
Models	4.6± 2.8	4.6± 2.2	4.6
Both	4.8	5.2	5.0
Difference score:			
Measures	-.7± 1.6	-1.5± 3.0	-1.1*
Models	-.4± 2.3	-.5± 1.5	-.4*
Both	-.5*	-.8*	-.8
Niacin (mg):			
Observed:			
Measures	5.6± 3.0	5.3± 2.5	5.4
Models	5.5± 2.7	5.7± 2.7	5.6
Both	5.6	5.5	5.5
Recalled:			
Measures	6.4± 3.9	7.4± 4.9	6.9
Models	6.5± 4.8	6.7± 4.5	6.6
Both	6.4	7.1	6.7
Difference score:			
Measures	-.8± 2.5	-2.1± 4.3	-1.4
Models	-.9± 4.4	-1.0± 3.1	-1.0
Both	-.9	-1.6	-1.2

See footnote at end of table.

Continued

Table 6.8--Nutrient content of men's observed and recalled lunches by measurement aid group and by phase--Continued

Nutrient, dependent variable	Intake: Phase I	Intake: Phase II	Intake: Both Phases I and II
	Mean ± standard deviation		Mean
Thiamin (mg):			
Observed:			
Measures..............	0.36±0.20	0.33±0.16	0.35
Models................	.36±0.14	.37±0.19	.36
Both..................	.37	.35	.36
Recalled:			
Measures..............	.45±0.28	.47±0.30	.46
Models................	.41±0.26	.43±0.23	.42
Both..................	.43	.45	.44
Difference score:			
Measures..............	-.06±0.19	-.15±0.27	-.10
Models................	-.06±0.21	-.06±0.13	-.06
Both..................	-.06*	-.11*	-.09

*Difference between means was significant ($p \leq 0.05$).

evening meals recalled by men themselves and by the household members were compared between measures and models groups. Matches and discrepancies in number of items and amounts recalled by the man and the household member of each pair were identified within 22 food groups. Dependent variables for analysis of breakfasts (Table 6.13) and evening meals (Table 6.14) were: (1) number of times items matched; (2) number of times the man reported an item not reported by the household member; (3) number of times the household member reported an item not reported by the man; for matches, the number of times amounts reported by the man were (4) the same as by the household member, (5) greater than by the household member, (6) smaller than by the household member; (7) for amounts greater by men than by household members, the sum of the excess amounts by men; and (8) for amounts greater by household members than by men, the sum of the excess amounts by household members. Differences between means for the measures and models groups were not tested for significance.

6.3.2.4 Comparability of Men's Two 1-Day Recalls 3 Months Apart

To determine the variability of two 1-day recalls separated by 3 months, the mean energy and nutrient contents of the two recalls by men were compared using repeated measures analysis of variance (Dixon, 1981) (Table 6.15). For the repeated measures analysis of variance, a matrix formed the basis for comparisons as follows:

Time factor	Grouping factors: Measures	Models	Both
Phase I	A	A	B
Phase II	A	A	B
Both	B	B	

Table 6.9--Number of times each model was used during interviews for a total day, phases I and II

Model	Phase I Rank	Phase I Frequency	Phase I Percent	Phase II Rank	Phase II Frequency	Phase II Percent
Mound, 1/2 cup...........	1	103	5.5	1	89	5.9
Spoon, teaspoon..........	2	100	5.3	3	81	5.4
Mug......................	3	97	5.2	4	76	5.0
Glass, medium............	4	91	4.8	9	59	3.9
Spoon, 1/2 tablespoon....	5	90	4.8	5	74	4.9
Glass, large.............	6	87	4.6	10	56	3.7
Bowl.....................	7	84	4.5	8	62	4.1
Spoon, 1 1/2 tablespoons.	8	82	4.4	2	83	5.5
Mound, 3/4 cup...........	9	77	4.1	7	64	4.2
Spoon, 1 tablespoon......	10	59	3.1	11	51	3.4
Cup......................	11	51	2.8	6	69	4.6
Glass, small.............	12	47	2.5	12	27	1.8
Disc, 3 inches...........	13	36	1.9	18	17	1.1
Disc, 2-1/2 inches.......	14	26	1.4	14	22	1.5
Disc, 4 inches...........	15	22	1.2	17	18	1.2
Pat......................	15	22	1.2	22	9	.6
Mound, 1-3/4 cup.........	16	20	1.1	15	21	1.4
Disc, 3-5/8 inches.......	17	18	1.0	13	23	1.5
Disc, 2 inches...........	18	17	.9	24	7	.5
Square, 4-1/8 inches.....	18	17	.9	23	8	.5
Disc, 4-3/4 inches.......	19	13	.7	16	19	1.3
Square, 3-3/4 inches.....	20	12	.7	27	4	.3
Rectangle, 3-1/4 x 1 inches...............	21	11	.6	21	10	.7
Rectangle, 5-1/4 x 1-3/8 inches............	21	11	.6	19	12	.8
Mound, 2 cups............	21	11	.6	22	9	.6
Rectangle, 4-1/2 x 13/16 inches............	22	9	.5	26	5	.3
Wedge....................	22	9	.5	27	4	.3
Pie piece................	23	8	.4	26	5	.3
Square, 2-13/16 inches...	24	7	.4	29	1	.1
Square, 3-3/8 inches.....	24	7	.4	20	11	.7
Chop.....................	25	6	.3	27	4	.3
Square, 2-1/2 inches.....	25	6	.3	26	5	.3
Thickness, used alone....	26	5	.3	--	0	--
Fish.....................	26	5	.3	29	1	.1
Steak....................	26	5	.3	--	0	--
Pizza, piece.............	26	5	.3	26	5	.3
Box, large...............	26	5	.3	26	5	.3
French bread.............	27	4	.2	--	0	--
Square, 1-3/16 inches....	27	4	.2	25	6	.4
Rectangle, 6-5/8 x 1-3/4 inches............	27	4	.2	25	6	.4
Rectangle, 8-1/8 x 2 inches..................	27	4	.2	26	5	.3
Rectangle, 7-1/4 x 1-3/4 inches............	28	3	.2	24	7	.5
Can, 6 fluid ounces......	28	3	.2	--	0	--
Meatball, small..........	29	2	.1	--	0	--
Sausage..................	29	5	.1	29	1	.1
Box, small...............	29	2	.1	28	3	.2
Meatball, medium.........	30	1	.1	--	0	--
Bottle, 16 fluid ounces..	--	0	--	29	1	.1
Models not used.........		571	30.3		464	30.7
TOTAL		1,884	100.0		1,509	100.0

Table 6.10--Number of times selected models were used for each of 21 food groups during interviews for an entire day, phases I and II

Type of model, phase	Food group										
	Milk	Cheese	Meats	Fish, seafood	Combined main dishes	Breads		Soups	Gravies, sauces	Fruits	
						Sliced	Irregular			By piece	By volume
	Number of times model was used										
Cups:											
I..........	14	0	2	1	2	0	0	5	1	0	4
II.........	13	0	0	0	2	0	1	4	4	1	3
Glasses:											
I..........	51	0	0	0	1	0	0	0	6	0	2
II.........	28	0	0	0	0	0	1	1	2	0	0
Spoons:											
I..........	9	8	7	1	2	0	0	0	15	1	3
II.........	18	4	0	1	3	0	1	0	20	3	3
Mounds:											
I..........	6	2	12	1	27	0	7	4	3	0	9
II.........	7	0	9	1	27	0	0	1	2	0	7
Bowl:											
I..........	7	0	0	0	1	0	0	12	0	1	4
II.........	4	0	1	1	6	0	0	10	0	0	2
Meats:											
I..........	0	0	12	4	1	1	0	0	0	4	0
II.........	0	0	3	1	0	0	1	0	0	1	0
Baked goods:											
I..........	0	0	0	1	3	0	6	0	0	0	0
II.........	0	0	1	1	4	0	2	0	0	0	0
Discs:											
I..........	0	1	23	0	3	3	24	0	0	13	0
II.........	1	2	27	0	3	4	10	0	0	7	1
Squares:											
I..........	0	13	7	3	6	6	2	0	0	0	0
II.........	0	10	9	0	0	5	0	0	0	1	0
Rectangles:											
I..........	0	5	11	3	3	2	3	0	0	1	0
II.........	0	4	16	2	1	2	3	0	0	5	0
	Number of total items in food group										
I..........	118	50	113	26	70	41	84	22	29	42	28
II.........	95	36	95	10	57	42	49	17	34	38	23
	Percent of total food items										
I..........	6.3	2.7	6.0	1.4	3.7	2.2	4.5	1.2	1.5	2.2	1.5
II.........	6.3	2.4	6.3	0.7	3.8	2.8	3.2	1.1	2.3	2.5	1.5
	Number of different models used										
I..........	13	12	25	12	21	7	16	6	8	8	9
II.........	13	13	18	7	12	4	13	5	9	14	6

Continued

Table 6.10-- Number of times selected models were used for each of 21 food groups during interviews for an entire day, phases I and II--Continued

Type of model, phase	Food group: Vegetables, By piece	Vegetables, By volume	Grains, pasta, starchy vegetables	Crackers, salty snacks	Sweet baked goods	Desserts, milk, frozen	Beverages, Nonalcoholic	Beverages, Alcoholic	Accompaniments	Oils, dressings	Miscellaneous	Total
	Number of times model was used											
Cups:												
I..........	0	3	0	0	0	9	106	0	1	0	0	148
II.........	2	6	3	0	0	7	98	0	0	0	1	145
Glasses:												
I..........	2	2	0	0	0	0	155	2	3	1	0	225
II.........	5	1	0	0	0	0	100	2	2	0	0	142
Spoons:												
I..........	6	26	0	0	0	3	5	2	199	38	6	331
II.........	4	25	4	0	0	1	19	1	151	28	3	289
Mounds:												
I..........	18	62	37	3	0	8	1	0	1	2	8	211
II.........	10	56	43	6	0	9	0	0	1	1	3	183
Bowl:												
I..........	4	23	25	5	0	2	0	0	0	0	0	84
II.........	2	16	14	3	0	3	0	0	0	0	0	62
Meats:												
I..........	1	0	0	0	0	0	1	0	0	0	0	24
II.........	0	0	0	0	0	0	0	0	0	0	0	6
Baked goods:												
I..........	0	0	0	0	23	0	0	0	0	0	0	33
II.........	0	0	0	0	14	0	0	0	0	0	0	22
Discs:												
I..........	28	12	1	3	19	0	0	0	1	0	1	132
II.........	17	9	2	2	21	0	0	0	0	0	0	106
Squares:												
I..........	0	2	0	4	8	1	0	0	1	0	0	53
II.........	0	2	0	2	4	1	0	0	0	1	0	35
Rectangles:												
I..........	7	2	0	1	5	1	0	0	1	0	2	47
II.........	3	3	0	0	0	0	0	0	5	0	1	45
	Number of total items in food group											
I..........	87	158	70	33	72	31	385	9	318	53	45	--
II.........	59	143	74	24	48	28	324	10	237	35	31	--
	Percent of total food items											
I..........	4.6	8.4	3.7	1.8	3.8	1.6	20.4	0.5	16.9	2.8	2.4	--
II.........	3.9	9.5	4.9	1.6	3.2	1.9	21.5	0.7	15.7	2.3	2.1	--
	Number of different models used											
I..........	19	20	6	9	19	10	7	3	10	7	8	--
II.........	15	21	10	7	13	7	9	3	10	5	5	--

Table 6.11--Comparison of recall of lunch items by subject and by his household member in the measures and models groups, phase I

Dependent variable	Measures		Models	
	Subject-household member pairs	Mean± standard deviation[1]	Subject-household member pairs	Mean± standard deviation[1]
	Number	Percent	Number	Percent
Number of matched items as percent of total items reported by the subject.......	32	31±27	25	44±35
Number of items not in subject's recall but in household member's recall as percent of number of items reported in the household member's recall.....	32	51±38	25	40±41
Number of items not in the subject's recall but in the household member's recall as percent of number of items in the subject's recall.......	32	69±28	25	56±35
For matched items, the percentage of times the subject's recalled weight was greater than the household member's recalled weight of food.......	23	57±51	19	47±51
For matched items, the percentage of times the household member's recalled weight was greater than the subject's recalled weight of food.......	23	43±51	19	53±51
		Grams		Grams
In matched items, recalled weight of the subject's minus the household member's recalled weight of the food...	23	15.2±163	19	-15.7±135

[1]Differences between measures and models were not significant ($p \leq 0.05$).

Table 6.12--Comparison of food items reported for the man's lunch as observed (O), recalled by the man (M), and recalled by the household member (H) for 57 man-household member pairs, phase I

Food group	Items on--			Observed items on recalls							
	O	M	H	On M, on H	On M, not on H	On H, not on M	Not on H, not on M	On M	On H	Total M on O	Total H on O
	------Number----			---Percent of items---							
Milk..............	17	16	21	65	24	6	6	88	71	94	57
Cheese............	14	10	7	29	43	0	0	72	29	100	57
Meats.............	28	28	15	43	54	4	0	97	47	96	87
Fish, seafood.....	4	4	2	50	50	0	0	100	50	100	100
Combined main dishes...........	14	16	18	71	21	7	0	93	79	81	61
Breads, sliced....	9	8	4	11	67	0	22	78	11	88	25
Breads, irregular shapes...........	20	21	9	25	65	0	10	90	25	86	56
Soups.............	9	10	7	56	44	0	0	100	56	90	71
Gravies, sauces...	12	13	7	33	42	8	17	75	42	69	71
Fruits by piece...	15	9	4	13	47	0	40	60	13	100	71
Fruits by volume..	9	6	3	22	44	0	33	67	22	100	50
Vegetables by piece............	21	21	6	19	76	0	5	95	19	95	67
Vegetables by volume...........	54	39	19	20	46	2	32	67	22	92	63
Grains, pasta, starchy vegetables.......	9	11	7	56	44	0	0	100	56	82	71
Crackers, salty snacks...........	9	5	4	22	33	22	22	56	44	100	100
Sweet baked goods............	16	13	10	38	44	13	6	81	50	100	80
Desserts, milk, frozen...........	5	6	1	20	80	0	0	100	20	83	100
Beverages, nonalcoholic.....	13	13	13	62	38	0	0	100	62	100	62
Accompaniments....	28	22	16	29	36	11	25	64	39	82	69
Oils, dressings...	13	10	10	31	46	8	15	77	36	100	50
Miscellaneous.....	1	1	1	0	0	100	0	0	100	0	100
TOTAL	320	282	184								

Table 6.13--Comparison of food item reports and amounts for the man's breakfast as recalled by the man (M) and by the household member (H) for 112 man-household member pairs, phase I

Food group	Total items		Number of times for items						Number of times for amounts						Total excess amount	
	M	H	Matches		M had, not H		H had, not M		M=H		M > H		M < H		M > H	H < M
	No.	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	----Grams----	
Milk................	87	72	63	72	24	28	9	13	11	18	29	46	23	37	3,586	2,046
Cheese..............	4	5	4	100	0	0	1	20	1	25	0	0	3	75	0	94
Meats...............	21	12	11	52	10	48	1	8	6	55	1	9	4	36	4	0
Fish, seafood.......	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Combined main dishes.............	3	1	1	33	2	67	0	0	0	0	1	100	0	0	12	0
Breads, sliced......	33	24	17	52	16	49	7	29	7	41	6	35	4	24	45	90
Breads, irregular shapes.............	23	18	17	74	6	26	1	6	3	18	9	53	5	29	314	198
Soups...............	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gravies, sauces.....	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fruits by piece.....	24	23	15	63	9	38	8	35	1	7	5	33	9	60	147	352
Fruits by volume....	11	5	3	27	8	73	2	40	0	0	3	100	0	0	186	0
Vegetables by piece.............	2	1	1	50	1	50	0	0	0	0	0	0	1	100	0	16
Vegetables by volume.............	2	4	1	50	1	50	3	75	1	100	0	0	0	0	0	0
Grains, pasta, starchy vegetables.	54	52	43	80	11	20	9	17	4	9	21	49	18	42	723	575
Crackers, salty snacks.............	2	1	1	50	1	50	0	0	0	0	1	100	0	0	29	0
Sweet baked goods...	13	7	3	23	10	77	4	57	0	0	3	100	0	0	224	0
Desserts, milk, frozen............	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beverages, nonalcoholic.......	139	111	89	64	50	36	22	20	18	20	38	43	33	37	0	4,449
Beverages, alcoholic..........	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Accompaniments......	120	83	59	49	61	51	24	29	13	22	28	48	18	31	0	0
Oils, dressings.....	4	2	1	25	3	75	1	50	0	0	0	0	1	100	0	9
Miscellaneous.......	26	20	16	62	10	39	4	20	4	25	8	50	4	25	365	172

Table 6.14--Comparison of food item reports and amounts for the man's evening meal as recalled by the man (M) and by the household member (H) for 171 man-household member pairs, phase I

Food group	Total items		Number of times for items						Number of times for amounts						Total excess amount	
	M	H	Matches		M had, not H		H had, not M		M=H		M > H		M < H		M > H	H < M
	No.	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	----Grams----	
Milk................	38	43	26	68	12	32	17	40	3	12	11	42	12	46	2,457	1,574
Cheese..............	35	29	17	49	18	51	12	41	2	12	6	35	9	53	146	304
Meats...............	130	121	108	83	22	17	13	11	10	9	48	44	50	46	4,121	4,607
Fish, seafood.......	20	18	15	75	5	25	3	17	0	0	9	60	6	40	233	619
Combined main dishes............	64	62	46	72	18	28	16	26	1	2	24	52	21	46	4,305	2,637
Breads, sliced......	25	23	16	64	9	36	7	30	8	50	4	25	4	25	96	54
Breads, irregular shapes............	61	62	52	85	9	15	10	16	18	35	17	33	17	33	815	868
Soups...............	13	14	8	62	5	39	6	43	0	0	6	75	2	25	1,259	1,171
Gravies, sauces.....	15	16	11	73	4	27	5	31	2	18	2	18	7	64	228	180
Fruits by piece.....	27	29	12	44	15	56	17	59	1	8	5	42	6	50	249	387
Fruits by volume....	8	13	5	63	3	38	8	62	0	0	2	40	3	60	70	220
Vegetables by piece..............	87	99	62	71	25	29	37	37	5	8	23	37	34	55	1,167	208
Vegetables by volume.............	168	185	116	69	52	31	69	37	11	10	48	41	57	49	3,886	3,269
Grains, pasta, starchy vegetables.	56	61	46	82	10	18	15	25	5	11	20	44	21	46	2,880	1,957
Crackers, salty snacks............	10	14	3	30	7	70	11	79	0	0	0	0	3	100	0	85
Sweet baked goods...	21	18	10	48	11	52	8	44	0	0	8	80	2	20	291	56
Desserts, milk, frozen............	8	10	6	75	2	25	4	40	1	17	2	33	3	50	165	183
Beverages, nonalcoholic.......	136	127	89	65	47	35	38	30	17	19	30	34	42	47	6,498	9,634
Beverages, alcoholic.........	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Accompaniments......	119	120	74	62	45	38	46	38	7	10	32	43	35	47	0	423
Oils, dressings.....	42	41	23	55	19	45	18	44	3	13	10	44	10	44	174	299
Miscellaneous.......	18	25	13	72	5	28	12	48	3	23	6	46	4	31	134	209

Table 6.15--Comparison of food energy and nutrient intakes for two 1-day recalls by 160 men using measures (N=86) or models (N=74), phases I and II

Nutrient and measurement aid	Intake: Phase I	Intake: Phase II	Intake: Both phases
	-----Mean ± standard deviation-----		--Mean--
Food energy (kcal):			
Measures..........	2,920 ±1,030	2,657 ± 791	2.788*
Models............	2,513 ± 775	2,443 ± 930	2,478*
Both..............	2,732*	2,558*	
Protein (g):			
Measures..........	120 ± 54	101 ± 40	111*
Models............	95 ± 35	92 ± 38	93*
Both..............	108*	97*	
Fat (g):			
Measures..........	126 ± 58	113 ± 41	120*
Models............	106 ± 42	107 ± 56	106*
Both..............	116	110	
Carbohydrate (g):			
Measures..........	310 ± 124	295 ± 111	302*
Models............	280 ± 93	266 ± 113	273*
Both..............	296	281	
Calcium (mg):			
Measures..........	1,046 ± 508	1,020 ± 590	1,033
Models............	967 ± 443	1,007 ± 643	987
Both..............	1,010	1,014	
Iron (mg):			
Measures..........	20 ± 10.5	17.3± 6.6	18.8*
Models............	15.4± 5.8	15.1± 5.9	15.2*
Both..............	18.0*	16.2*	
Vitamin A (I.U.):			
Measures..........	9,167 ±9,799	7,711 ± 8,000	8,438
Models............	6,105 ±4,995	8,596 ±12,657	7,351
Both..............	7,751	8,120	
Thiamin (mg):			
Measures..........	1.8± 0.9	1.7± 1.0	1.7*
Models............	1.4± 0.6	1.5± 0.8	1.5*
Both..............	1.6	1.6	
Riboflavin (mg):			
Measures..........	2.6± 1.4	2.2± 1.3	2.4*
Models............	2.0± 0.8	2.1± 1.4	2.1*
Both..............	2.3	2.2	
Niacin (mg):			
Measures..........	31.0± 15.6	24.5± 11.2	27.8*
Models............	22.9± 10.4	23.1± 10.0	23.0*
Both..............	27.2*	23.9*	
Vitamin C (mg):			
Measures..........	186 ± 178	153 ± 126	169*
Models	125 ± 87	137 ± 26	131*
Both..............	158	146	

*Difference between means was significant ($p \leq 0.05$).

The cell values (A) were means for dependent variables--energy and nutrient contents of 1-day diets. The marginal values (B) were means of each row (phases) or column (measurement aids). Significance ($p \leq 0.05$) of differences was computed.

6.3.2.5 Identification of Problem Foods on Men's Recalls of Lunches

To appraise foods most often forgotten by men in recalls of lunches, discrepancies between observed and recalled items were examined (Table 6.4). Items overestimated and underestimated in portion size (Tables 6.5, 6.6, and 6.7) and the mean percentages of erroneously reported items in food groups (Table 6.4) were also examined to identify problem foods.

6.4 Main Findings

Results are presented here in the order of the five objectives listed. The objectives were to assess (1) ability of men to report past food intake, (2) adequacy of reports of quantities eaten using measurement aids, (3) ability of surrogates to report past intake of a family member, (4) reliability of men's reports of past intake, and (5) identity of foods most often erroneously reported or quantified. In phase I, the 193 men reported a total of 4,074 food items in the 1-day recall; the two food groups for which the largest number of food items were reported by the men were nonalcoholic beverages (21 percent of total items) and accompaniments (17 percent) (Table 6.1). The two food groups for which the largest percentage of men reported items were vegetables by volume (63 percent) and accompaniments (52 percent) (Table 6.2).

6.4.1 Ability of Men to Recall Items Eaten at Lunch, Phases I, II

For the lunch meal, on average, men recalled about 85 percent (82 to 86 percent) of the total number of food and beverage items observed and recorded irrespective of the type of measurement aids used (Table 6.3). This percentage was about the same in both phases I and II. About 15 percent (14 to 18 percent) of the items observed and recorded were not reported. About 8 percent (6 to 10 percent) of the items on the recall were not observed and recorded for lunch. Accordingly, errors caused by not reporting items observed and recorded were more frequent than errors caused by adding items not observed. The ability of men to recall items eaten at lunch did not differ significantly ($p \leq 0.05$) between the measurement-aid groups.

The next analysis focused on food groups and the percentage of lunch items recalled accurately within each food group by subjects. The mean percentages of accurate (observed items recalled) and erroneous (recalled items not observed) recall of food items were calculated for the two measurement-aid groups of men (Table 6.4). There were few significant differences in the proportion of items accurately recalled between the group using measures and the group using models. This result was to be expected since measurement aids assist in recalling quantities eaten but not the choices of items.

In phase I, for men in both treatment groups, 90 percent or more of the observed items, on average, were recalled in five food groups (fish and seafood, combined main dishes, milk, milk and frozen desserts, and nonalcoholic beverages), and 80 to 89 percent were recalled in seven other food groups (Table 6.4). On the other hand, 90 percent or more of the recalled items in 11 of the food groups were observed. Excluding the miscellaneous food group, in only two of the food groups--vegetables by piece for the measures group and combined main dishes for the models group--were fewer than 80 percent of the recalled items observed. For vegetables by piece, the measures group erroneously recalled significantly more items than the models group.

In phase II, the two groups of men recalled generally similar proportions of observed items. The mean percentage of observed items recalled was 90 percent or more for seven food groups and 80 to 88 percent for seven other food groups. Subjects in the two treatment groups recalled, on the average, 80 percent or more of the items observed for 18 to 20 food groups. The measures group reported a significantly higher proportion of nonobserved accompaniment items recalled than did the models group, but the models group reported a significantly higher proportion of fruits by volume.

6.4.2 Recall by Men of Amounts of Lunch Items Eaten and Effectiveness of Two Types of Measurement Aids

In recall of portion sizes eaten in phase I, the mean percentages of overestimation (recall larger than observed) and underestimation (recall smaller than observed) by men in the two measurement-aid groups were similar (mean percentages of 82 and 84 percent for overestimates and 18 and 16 percent for underestimates, for measures and models, respectively, Table 6.3). Thus, the mean overestimates by both groups were much greater proportionately than the mean underestimates, and the differences between means for the measures and models groups were not significant ($p \leq 0.05$). In phase II, the mean percentage of overestimated and underestimated intakes differed significantly between the measurement-aid groups; proportionately more were overestimated by men using measures than by men using models (77 and 59 percent, respectively), and proportionately more underestimated by those using models than by those using measures (41 and 23 percent, respectively). In both phases I and II, the mean difference scores based on the observed and the recalled portion sizes were significantly greater for the groups using measures than the groups using models. Thus, difference scores indicated a greater tendency to overestimate food intakes by men interviewed with measures than those interviewed with models. However, great variation among men in both measurement-aid groups was indicated by the large standard deviations.

The number of lunch items having recalled portions more than (overestimation), less than (underestimation), and equivalent to (accurate) observed portion sizes in phase I were reported by food groups (Table 6.5). For total matched items in both measurement-aid categories, about 50 percent (52 and 47 percent) were overestimated, about 25 percent (23 and 27 percent) underestimated, and about 25 percent (25 and 26 percent) accurately estimated. However, in the measures group, portion sizes were overestimated for a greater percentage of items in 12 food groups than in the models group including these 8 items--combined main dishes; breads of irregular shape; fruits by volume; vegetables by volume; grains, pasta, and starchy vegetables; milk and frozen desserts; accompaniments; and oils and dressings. In the models group, there was a greater percentage of overestimated items than in the measures group for eight food groups including these six--milk, cheese, sliced breads, fruits by piece, sweet baked goods, and beverages. There were relatively more underestimated items in the models group for eight food groups compared with the measures group, but the latter tended to underestimate items in three other food groups. Half or more of the items in four food groups (milk, cheese, sliced breads, and breads of irregular shape) were accurately quantified in both measurement-aid groups. Some food groups had only a small number of items that matched, hampering statistical comparisons.

The degree of overestimation or underestimation of lunch portions in phase I for matched items was evaluated for 21 food groups, comparing mean difference scores for total items, overestimated items, and underestimated items by measurement-aid category (Table 6.6). Differences between mean difference scores of total items for the measures and models categories were significant ($p \leq 0.05$) for three food groups (combined main dishes, fruits by volume, and vegetables by volume). The difference scores reflecting overestimation or underestimation were larger for the measures category. For overestimated items, mean difference scores between the measures and models categories were significantly different ($p \leq 0.05$) for four food groups (combined main dishes, vegetables by volume, crackers and salty snacks, and beverages). Here, the difference scores were larger for the measures category except for the crackers and salty snacks group. The mean difference scores for underestimated items in the milk and beverage food groups differed significantly, with larger difference scores for the measures category.

Based on means for subjects, accuracy in reporting quantities of food items for lunch within each food group was also assessed by first computing observed minus recalled weight in grams for each food group for each man (difference score) and then computing the means of the difference scores for each measurement-aid group (Table 6.7). The difference scores revealed variations among food groups in the ability of the men to estimate intakes using the two sets of measurement aids. Men in the measures category generally overestimated (negative difference score) portions to a greater degree than did the men in the models category. In phase I, exceptions were in five food groups--milk, cheese, sliced breads, gravies and sauces, and fruits by the piece. However, differences between means for the two measurement-aid groups were significant ($p \leq 0.05$) only for one food group (grains, pasta, and starchy vegetables). Underestimation (positive difference score) occurred only for accompaniments reported by men using models and for sliced breads by men using measures. Relatively large standard deviations reflect the great variability in portion-size estimates by the men. In phase II, the degree of overestimation was generally less but underestimation was more prominent, particularly by the men using models (nine food groups) (Table 6.7). The men using measures tended to overestimate amounts eaten more often than those using models. Mean difference scores for the measures and models groups were significantly ($p \leq 0.05$) different for two food groups (oils and dressings and fruits by piece).

The food energy and nutrient contents of the men's observed lunches and of recalled lunches, and the difference scores, were calculated for two measurement-aid groups and for the two phases (Table 6.8). For observed lunches, intakes by the measures group were not significantly different from those by the models group; phase I intakes were not significantly different from phase II intakes in energy and nutrient content. For recalled lunches, energy and fat intakes by the measures group were significantly ($p \leq 0.05$) greater than intakes by the models group regardless of phase; phase II food energy intake was significantly greater than phase I energy intake regardless of type of measurement aid. For food energy, fat, carbohydrate, and iron, difference scores were significantly greater for the measures group than for the models group regardless of phase; phase II carbohydrate, iron, and thiamin intakes were significantly greater than those for phase I regardless of measurement aid.

Use of each of the 53 models by the models group during the men's 1-day recalls in phases I and II was tabulated. Over half of the food and beverage items in the 1-day recalls by the men were recalled with the aid of 12 of the models (Table 6.9): mounds (1/2 and 3/4 cup sizes), spoons (1 teaspoon; 1/2, 1, and 1-1/2 tablespoon sizes), cup, mug, glasses (small, medium, and large), and a bowl. The particular model most used in both phases I and II was the 1/2 cup mound; this mound was used to help estimate amounts for about 6 percent of the items. (The 4 mounds together accounted for 11 percent of the items estimated with models.) After the volume models, the set of discs was the most used model, used with about 7 percent of the items. About 35 of the 53 available models (Table 6.9) were used for less than 1 percent of the items or were never used. No model was used in estimating amounts eaten for about one-third of the food items. Ten models were never used in phase II.

Use of the 10 most popular types of models within each food group was also summarized for both phases (Table 6.10). The models which measure volume were used for somewhat more than 40 percent of all items. Dimension models--discs, squares, rectangles--did not appear to contribute to more precise estimates than measures; mean difference scores for foods estimated with dimension models--meats, fruits and vegetables by the piece, breads, and sweet baked goods--were similar to those made with measures. Considering food groups, cups and glasses were the most commonly used models for milk and beverages; spoons for milk, gravies and sauces, vegetables by volume, accompaniments, and oils and dressings; mounds for combined main dishes, fruits and vegetables by volume, and grains, pasta, and starchy vegetables; and the bowl for soups, vegetables by volume, and grains, pasta, and starchy vegetables. Discs were commonly used for meats, breads of irregular shapes, fruits and vegetables by the piece, and sweet baked goods; squares for cheese; and rectangles for meats and baked goods.

6.4.3 Agreement Between Recalls of Men's Intakes by Man-Household Member Pairs, Phase I

To determine the adequacy of recalls by a surrogate respondent, a household member was asked to recall the 1-day intake of the related man. The lunch, breakfast, and evening meals were compared for similarities in items and amounts between the men's intakes as recalled by themselves and as recalled by the household members.

Only 57 household members out of the 193 total attempted to recall the lunch eaten by the men. The other household members did not attempt to do so because they had no information about what was eaten. Of the 57 household members giving information on items eaten by the men for lunch, 32 were interviewed with measures and 25 with models, the same sets of measurement aids as used by the men themselves. Only 42 of the 57 household members had one or more items that matched those reported by the related men.

On average, about 63 percent (69 and 56 percent for measures and models, respectively) of the total items recalled by men were not matched with items listed on the recalls by household members (Table 6.11). Thirty-one percent of the items reported by men were also reported by household members in the measures group. A somewhat larger proportion (44 percent) of items was recalled by the household members in the models group. Relative to the 83 percent of the observed food items recalled and reported by the men themselves (Table 6.3), household members' reported items for the men showed considerable error. Approximately 45 percent (51 and 40 percent for measures and models, respectively) of the items reported by household members were not reported by the men. For man-household member pairs with matched items, mean scores for differences in gram weight were small, but standard deviations were extremely high. Weights reported by household members were greater than or less than those recalled by the men but were rather evenly distributed. No tendency was shown by household members to estimate greater or lesser weights than by the men. However, both the men and household members tended to overestimate recalled amounts compared with the observed amounts.

To identify variations among food groups in lunch-item recall by the 57 man-household member pairs, data for the two measurement-aid groups were combined. (Table 6.12). This was appropriate, the researchers noted, because of the small number of lunch recalls provided by household members and because differences between the two measurement-aid groups were not significant ($p \leq 0.05$). To examine, within food groups, how accurately household members reported the men's intakes, the food items recalled by household members were compared with those items observed in the men's lunches. The household members, on average, correctly identified at least half of the food items in the observed lunches of the men for seven food groups (milk; fish; combined main dishes; soups; grains, pastas, and starchy vegetables; sweet baked goods; and beverages). Items least often accurately identified by the household members (less than 25 percent of the items observed) were sliced breads, fruits by piece or volume, vegetables by piece or volume, and milk-based and frozen desserts. As expected, the information recalled by the men was more accurate than information provided by the household members. The recalls of observed items by the men themselves were relatively correct (88 percent or more) for 10 food groups (milk; meats; fish; combined main dishes; breads of irregular shape; soups; vegetables by pieces; grains, pasta, and starchy vegetables; milk-based and frozen desserts; and beverages).

Recalls of each man's breakfast by the man himself and by his household member were compared. Because the household member who plans and prepares meals for the family is often asked to report the food intake of individual household members in the course of food consumption surveys, the responses of the men and household members were compared for the degree of agreement and discrepancy. (Differences were not tested for statistical significance.) Of the 193 man-household member pairs, 112 pairs reported breakfast; 74 percent of the men reported they ate without having another family member present.

The men reported more items for breakfast in nearly all food groups than did the household members (Table 6.13). The percentage of matched items was high for cheese (100 percent); grains, pasta, and starchy vegetables (80 percent); breads of irregular shapes (74 percent); milk (72 percent); nonalcoholic beverages (64 percent); and fruits by piece (63 percent). (The number of times reported for some food items was quite small.) For items within food groups, the responses by the man and his household member were examined to determine which respondent reported the larger quantity and by how much the larger quantity (in grams) exceeded the lower report. Men reported larger amounts more often than household members for nearly all food groups having matched items except cheese, meat, and fruits by piece. The estimated gram weights of foods for each food group by all men combined exceeded those by all household members combined except for cheese, sliced breads, fruits by piece, vegetables by piece, non-alcoholic beverages, and oils and dressings. For the most frequently reported items, amounts reported by both subject and household member agreed 25 percent or less of the time except for sliced bread and meat. Out of the 17 food groups, men reported greater amounts more often than household members. Thus, men reported more items and usually reported larger portion sizes for matched food items than did the household members. This indicates that self-reports of breakfast are preferable to a household respondent reporting for other members unless the member is consulted, especially since this meal is often eaten alone.

Among the 193 man-household member pairs, 171 pairs reported an evening meal. A large percentage (81 percent) of these men reported that they ate this meal with a household member. Comparisons similar to those made for breakfast were made for the evening meal. (Differences were not tested for significance.) The similarity between number of items reported for the evening meal by both men and household members was markedly greater than for breakfast (Table 6.14). The percentage of matches for most food groups between the man and household member was also higher for the evening meal than for breakfast (for 13 of the 17 food groups which were reported at both meals).

Food items with the highest proportions reported for the evening meal, in descending order on the men's recalls were vegetables by volume; nonalcoholic beverages; meats; accompaniments; vegetables by piece; combined main dishes; breads of irregular shape; grains, pastas, and starchy vegetables; oil and salad dressings; milk; and cheese (Table 6.14). These were also the most frequently reported items on the household members' recalls and their rankings were similar to those on the men's recalls. The percentages of matched items were highest for breads of irregular shape (85 percent); meats (83 percent); and grains, pastas, and starchy vegetables (82 percent).

At the evening meal, in contrast with breakfast, more portion sizes of matched items were larger on the recalls by household members than on recalls by the men (for 12 of 21 food groups) (Table 6.14). Few portions were of equal size on the two sets of men's and household members' reports, the largest percentage being for sliced breads. The gram weights of foods for nine food groups, as estimated by all men combined, were larger than those estimated by all household members combined. Those food groups were milk; combined main dishes; sliced breads; soups; gravies and sauces; vegetables by piece and by volume; grains, pastas, and starchy vegetables; and sweet baked goods.

Examination of the percentages of matched items between man-household member pairs revealed a generally higher percentage of matched items for the evening meal than for breakfast or lunch. These results confirm the expectation that if the household member is present at a meal with the subject, that member's report of the intake for the subject will be in closer agreement than if the household member were absent.

6.4.4 Comparisons of Nutrients Derived from Recalls for the Total Day in Phases I and II

The similarity of total-day food energy and nutrient intakes from recalls for the 160 men participating in phases I and II was tested using repeated measures analysis of variance. If differences between mean food energy and nutrient intakes were not statistically significant, mean intakes in the two phases were considered similar. For food energy and all nutrients studied except calcium, vitamin A, and thiamin, mean values were larger for recalls in phase I than in phase II when comparing overall groups regardless of type of measurement aid used (Table 6.15). However, differences were significant at the 0.05 level only for food energy, protein, iron, and niacin. Therefore, results indicated that, for seven nutrients--fat, carbohydrate, calcium, vitamin A, thiamin, riboflavin, and vitamin C--the mean 1-day intakes in phase I were similar to those in phase II.

Comparisons of mean food energy and nutrient values between the two measurement-aid groups, regardless of phase, disclosed that values for the measures group were higher than for the models group for food energy and all nutrients and that differences were statistically significant for food energy; protein, iron, and niacin; and fat, carbohydrate, thiamin, and vitamin C.

6.4.5 Identification of Problem Foods on Men's Recalls of Lunches

Many more food items were reported by men on 1-day recalls in some food groups than in others (Table 6.1). About 75 percent of the total food items reported were accounted for by nine food groups. These were, in descending order, nonalcoholic beverages excluding milk; accompaniments (such as sugar, cream, jellies, and condiments); vegetables by volume; meats; milk; vegetables by piece; breads of irregular shapes; grain, pastas, and starchy vegetables; and sweet baked goods. Alcoholic beverages were the least frequently reported food on 1-day recalls, and none were reported for lunch.

On the lunch recalls by men, a majority of the food groups had items reported by less than a fourth of the subjects (Table 6.2). The three food groups most reported were vegetables by volume (by 63 percent of the men), accompaniments (57 percent), and meats (49 percent). Reported by about one-third of the men were milk (30 percent), combined main dishes (31 percent), breads of irregular shapes (37 percent), vegetables by piece (31 percent), and nonalcoholic beverages (32 percent).

In phase I, the foods omitted most often in recalls by both groups of subjects (less than 80 percent of the observed numbers) were accompaniments, cheese, gravies and sauces, fruits by volume, fruits by piece, crackers and salty snacks, and, by the models group only, sliced breads and oils and dressings (Table 6.4). In phase II, the foods most often overlooked were accompaniments and gravies and sauces. The two groups of men (measures and models) differed in remembering breads of irregular shape, fruits by volume, and crackers and salty snacks. Foods most often added (that is, reported but not observed) in phase I were accompaniments, combined main dishes, and milk-based and frozen desserts; differences between the two groups were identified for vegetables by volume; vegetables by piece; breads of irregular shapes; gravies and sauces; soups; and grains, pasta, and starchy vegetables. In phase II, 12 food groups had 10 percent or more erroneously added items by at least one measurement aid group. These were seven of the nine food groups listed for phase I plus sweet baked goods, cheese, oils and dressings, fruits by volume, and sliced bread. It is notable that although the men recalled most of the observed items accurately, they forgot to report some foods observed to have been eaten. For example, in phase I, 84 and 83 percent of the accompaniments recalled by the measures and models groups, respectively, were accurate but only 75 and 62 percent of the observed items had been recalled (Table 6.4).

The researchers classified the food groups into five categories based on their role in meals and examined forgotten items and the categories in which they occurred. The categories and food groups were as follows:

- Primary items:
  - Meats
  - Fish and seafood
  - Combined main dishes
  - Grains, pasta, and starches
- Secondary items:
  - Cheese
  - Sliced breads
  - Irregularly shaped breads
  - Soups
  - Vegetables by piece
  - Vegetables by volume
- Desserts:
  - Fruits by piece
  - Fruits by volume
  - Sweet baked goods
  - Milk-based and frozen desserts
- Auxiliary foods:
  - Accompaniments
  - Oils and dressings
  - Crackers and salty snacks
  - Gravies and sauces
  - Miscellaneous foods
- Beverages:
  - Milk
  - Nonalcholic beverages

The researchers noted that food groups with items often forgotten were auxiliary foods, desserts, and some secondary foods that might be considered side dishes. Primary items and beverages were seldom forgotten.

The food groups most difficult to quantify (based on mean difference scores of over 100 grams) were milk; fish and seafood; combined main dishes; soups; fruits by volume; desserts; and grains, pasta, and starchy vegetables in the measures group and soups in the models group (Table 6.6). In phase I, overestimation most often occurred (for 50 percent or more of the items) in both groups of men for eight food groups--fish and seafood; soups; combined main dishes; vegetables by piece; vegetables by volume; grains, pasta, and starchy vegetables; nonalcoholic beverages; and oil and dressings (Table 6.7).

6.5 Conclusions and Recommendations

Results of this study cannot be generalized to the population because the group of employed men participating was small and was not selected to be a representative sample. Rather, the group was selected on the basis of specified criteria relevant to this study of the methodological problems.

Validity of estimated food intake was evaluated on the basis of lunch food items and amounts (a) observed and recorded and (b) recalled during interviews. For each recalled lunch, on average, 82 to 86 percent of the foods observed were recalled. Of items recalled, 8 percent were not observed. Therefore, errors in the form of omitting foods observed were greater than errors in reporting foods not observed. Subjects recalled over 90 percent of beverages, combined main dishes, milk, fish, and milk-based and frozen desserts, but less than 80 percent of accompaniments, sauces, fruit, dressings, and salty snacks. Validity of amounts reported was measured with a difference score derived from amounts observed and recalled. The men more often overestimated than underestimated amounts eaten.

Household members familiar with the eating patterns of the subjects were found to be generally unsatisfactory as surrogate respondents reporting for the men. Less than one-third of the household members even attempted to report lunches about which they did not have information. Of those reporting lunches, only half of the number of items observed were reported by household members. If it is necessary for household members to report for other members, they should be given the opportunity to consult with the individuals for whom they report.

Concerning measurement aids, estimation of portion sizes was more accurate with models than with measures for fruits and vegetables measured by volume; grains, pasta, and starchy vegetables; and combined main dishes. Use of either measures or models led to overestimation of food quantities of meats, fish and seafood, irregularly shaped breads, and sweet baked goods. The majority of foods were reported in volumetric equivalents--glasses, cups, mounds, spoons, and bowl. Twice as many combination main dishes and several other items were overestimated by subjects using measures as with models, and the degree of overestimation was greater. These findings led to the recommendation that volume-type models might be considered for use in the NFCS. On the other hand, dimension-type models (rectangles, squares, discs, pie piece, wedge, boxes) were less helpful in estimating sizes of meats, fish and seafood, and baked goods. The wide variety of models proved to be more of a distraction than an aid for a number of subjects. A ruler longer than 6 inches was recommended as an improvement because some foods were longer than 6 inches. Models representing only one or two foods were also not recommended.

According to Werhan (1982), comments by the interviewers on a debriefing questionnaire indicated that models were inappropriately used more often than measures. Mounds were the models most often inappropriately used; e.g., for foods more suitably measured by dimensions. Interviewers also reported that subjects would report the amount of food eaten and then select a model (or measure) that represented a different amount.

Similarity of 1-day recalls was assessed on the basis of the relationship between food energy and nutrient contents in two 1-day recalls by the same subjects 3 months apart. The recalls provided significantly ($p \leq 0.05$) different estimates for food energy, protein, iron, and niacin; but for the other seven nutrients, the mean intakes in phases I and II were similar. From analyses of observed and recalled lunches, it was concluded that the accuracy of reporting lunches seemed to be greater in phase I, their first survey experience, than in the subsequent experience in phase II. Most respondents could recall most foods they consumed, but estimation of portion sizes was a problem.

6.6 Comment

Highlighted in this study was investigation of several persistent problems faced in collecting data in large-scale surveys. These results from a very limited sample need to be replicated with other subpopulation groups and on a larger scale. Nevertheless, findings suggest some improvements in methodology which warrant testing. These include consideration of selected models and a longer ruler in the set of NFCS measuring utensils and strengthening procedures to assure verification of intakes by each household member, rather than relying entirely on a surrogate respondent, especially for foods not eaten in the presence of the surrogate.

The findings also suggest that the two types of measurement aids are not interchangeable because they are used differently. In recalls taken away from home, models may help estimate volumetric measures more closely than measuring cups and spoons. However, for food recalls and food records administered in the home, the measuring utensils have the potential of being more helpful than models. This assumes that measuring utensils are used as instructed--to measure portions or volumetric content of servings in tableware used by the respondent. Measuring utensils should not be used as models.

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Chapter 7. Exploratory Study of Longitudinal Measures of Individual Food Intake

Investigator: National Analysts, Division of Booz, Allen, and Hamilton, Inc., Philadelphia, Pennsylvania. Dr. Lucy Wilson, Project Director, 1981-84.

SUMMARY: This study examined eight longitudinal or panel methods for collecting food intake information from women and compared results with data collected using the Nationwide Food Consumption Survey (NFCS) 1977-78 protocol. The experimental methods involved in-person, mail, and telephone contacts in several combinations. Middle-income women, aged 20 to 69 years, were selected from probability samples of households at four sites. After screening, about 1,200 women were randomly assigned to one of the nine methods. Data were collected in each of the four quarters of the year and each method produced from 4 to 12 days of dietary intake reporting. Analysis focused on response rates, several measures of data quality, and respondent burden with some attention paid to differences in time and cost of data collection and processing. Response rates and data quality varied significantly among methods. Mail methods had such low response rates that they were not considered a viable approach. The NFCS 12-day recall-record method involving in-person contact had the lowest cost and processing time per intake day and a response rate of 63 percent. The telephone methods with a 1-day recall each quarter imposed the least respondent burden coupled with the highest response rates (64 and 67 percent). The telephone method with an initial in-person interview was recommended for use in a national nutrition monitoring effort.

Tables

7.1 Background

In 1965, data on food intakes by individuals were obtained from a nationwide sample for the first time--for 1 day in spring as a supplement to the Household Food Consumption Survey 1965-66 (USDA, ARS, 1972). In the Nationwide Food Consumption Survey (NFCS) 1977-78, the survey effort was expanded to include intakes by individuals on 3 consecutive days.

The data were collected throughout the year, making seasonal analysis possible. The NFCS 1977-78 3-day intake data also permitted (1) computation of more representative average intakes for individuals, (2) investigations of intraindividual variations in intake, and (3) examination of distributions of intakes by individuals.

Despite the attention accorded the individual intake data, the long period between surveys and other shortcomings, such as the lag in issuing reports, rendered the data less than timely for use in meeting some important objectives. The U.S. Congress and several government agencies, such as the Food and Drug Administration, needed a system whereby sudden changes in food practices or dietary adequacy could be identified for prompt attention. A continuing data collection system was suggested. This was consonant with the change made by the Bureau of Labor Statistics, which had adopted in 1980 a continuous data collection approach for the Consumer Expenditures Survey, in which the Bureau of Census collected data from a panel of U.S. households during five quarters. A continuing survey would enable measurement of short-term changes, and the periodic survey would measure the long-term trends.

The number and spacing of food intake days was another concern. More intake days permit the inclusion of more infrequently eaten foods. The study of diet-health relationships by epidemiologists and others requires an operational measure of "usual" intake. Measuring 4 to 6 days of intake spaced intermittently over 1 year was suggested as a way to appraise usual intake (National Research Council, 1981).

Congressional oversight committee hearings and U.S. General Accounting Office reports have called for a number of improvements in methodology (Chapter 1). The ultimate objective has been a simpler, more cost-effective, less burdensome system which would produce timely and valid data on a continuing basis. However, there was little research on which to base a longitudinal or panel method that interviews individuals several times during a year. The study described in this chapter was the first designed to examine such possibilities in direct response to the need to find a workable method for a major monitoring effort.

The Subcommittee on Federal Longitudinal Surveys (1986) explained that "a panel is a sample of persons selected to participate at a particular point in a longitudinal sequence. In a rotating panel survey, the sample units have a fixed duration. As they leave the sample, they are replaced by new units which are introduced at specific points in time" (p. 2). For some research purposes, such as identifying frequency, duration, or causes of change, only a longitudinal approach is appropriate. The Subcommittee listed advantages of the rotating panel survey over the cross-sectional survey. These advantages are (1) reduction in sampling variability in estimates of change, (2) provision of measures of change for an individual unit, (3) reduction in recall bias with short bounded reference periods, (4) clear time sequence and magnitude of change among variables, and (5) higher quality of data than in cross-sectional surveys because of the correlational nature of the data. However, disadvantages of the rotating panel survey included (1) attrition or dropout of participants over time that may produce serious biases in analytical results and (2) possible inflation in gross change over time because of response variation.

7.2 Purpose

This study tested several longitudinal or panel methods of measuring food intake by individuals and compared results with data obtained using the NFCS 1977-78 approach (1-day recall by personal interview and 2-day diary).

7.3 Methods

An exploratory study was designed to test eight panel methods for obtaining individual food intake over 1 year. The eight experimental methods and the control method involved in-person, telephone, and mail approaches that varied by type and number of contacts.

7.3.1 Data Collection

Respondents selected for participation were women 20 to 69 years of age, from middle-income ($10,000-$35,000) households of two or more persons. Each woman was the main meal planner or preparer for the household, and only one woman per household was eligible for the study. From probability samples developed for four population sites, 5,000 households were selected and screened to identify and induct about 1,700 qualified and willing participants. The four selected interviewing sites, differing in size and degree of urbanization, were Philadelphia, Pennsylvania; Baltimore, Maryland; Wilmington, Delaware; and Vineland, New Jersey.

After agreeing to participate in the study, the homemakers were randomly assigned to one of nine data collection methods (in effect, experimental treatments) to form panels matched on site, household income, and household size. The investigators contacted each homemaker one to six times during the 12 months of 1983, following specified interview procedures.

The eight methods and the control method are described in detail in Table 7.1. Methods 1, 2, and 3 and the control method involved personal contact in all four quarters. Method 1 and the control method represented the NFCS 1977-78 approach. In method 1, the same panelists provided 3 days of intake data each quarter; the control method obtained intake data from a new panel each quarter. The first quarter panel in method 1 also served as the first quarter panel for the control method. Fully cooperative panelists in method 1 provided 12 days of intake information. Methods 2 and 3 were alike except for the food intake questionnaire. In method 2, an NFCS-type unstructured form was used; in method 3, the form was semistructured and partially precoded. Both methods 2 and 3 obtained 6 days of recall data: 3 days (1 month apart) in the first quarter and 1 day in each of the three succeeding quarters.

Methods 4 and 5 depended primarily on telephone contact. Method 4 secured a 1-day recall of intake by an in-person interview in the first quarter and a 1-day recall of intake by telephone interview in each of the subsequent three quarters for a total of 4 days of intake. Method 5 involved only telephone contact in all four quarters.

Methods 6, 7, and 8 involved primarily mail contact. Method 6 obtained 9 days of intake data: 3 days in the first

Table 7.1--Description of nine data collection methods for obtaining food intake by individuals using a panel approach

Method	Number of intake days per person Total	Quarter 1	2	3	4	Procedure
One	12	3	3	3	3	In first quarter, during personal interview, 1-day recall was obtained and recorded by interviewer. Instructions then given for keeping 2-day diary record by respondent for day of and day after interview. After completion, interviewer returned to review and pick up diary records (NFCS Method). Procedure repeated in following three quarters.
Two	6	3	1	1	1	In first quarter, personal interviewer obtained 1-day recall in each of the 3 months. In the three following quarters, interviewer obtained 1-day recall each quarter.
Three	6	3	1	1	1	Same as method 2 except a semi-structured questionnaire was used.
Four	4	1	1	1	1	In first quarter, personal interviewer obtained and recorded 1-day recall and instructed respondent in responding to subsequent telephone contacts. In following three quarters, 1-day recall obtained and recorded by telephone interviewer.
Five	4	1	1	1	1	In all four quarters, 1-day recall obtained and recorded by telephone interviewer.
Six	9	3	2	2	2	In the first quarter, personal interviewer obtained 1-day recall and 2-day diary record, as in method 1. On the return visit to pick up the record, interviewer gave instructions for keeping a 2-day diary each quarter to be returned by mail. In quarters 2, 3, and 4, forms for diary records and related materials were mailed to respondents for completion. Questions were handled by toll-free telephone.

Continued

Table 7.1--Description of nine data collection methods for obtaining food intake by individuals using a panel approach--Continued

Method	Number of intake days per person: Total	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Procedure
Seven	8	2	2	2	2	In all four quarters, 2-day diary record with related materials was mailed to respondent to complete and return by mail. Separate mailing each quarter.
Eight	4	1	1	1	1	In all four quarters, respondent received diary record forms and instructions in the mail. A telephone interviewer called to give assistance in completing the record, and respondent returned form by mail.
Control	3	3	3	3	3	Same as method 1 but with a new panel each quarter. For quarter 1, panel in method 1 served also as the first panel for control method.

quarter using the NFCS personal contact method and 2 days in each of the following three quarters using mail contact for a self-recorded, 2-day food record. The three 2-day food records were completed by the respondent and returned by mail. Method 7 obtained 8 days of intake data; the four 2-day record forms were sent by mail, self-administered, and returned by mail during each of the four quarters. Method 8 was a 1-day mail method each quarter with a telephone interviewer providing assistance.

At the initial interview in all methods, a basic questionnaire was used to obtain information on personal and household characteristics. These included variables such as age, race, educational level, employment status, household income, and household size. A short questionnaire was administered in each of the following quarters to ascertain any changes.

Procedures for listing, describing, and quantifying food items eaten and for processing data in this study were the same as those used in the NFCS 1977-78 (USDA, HNIS, 1983, 1984). Several variables developed earlier for evaluating data quality were also used. Food items (including beverages) were specified in detail sufficient for classification into food groups based on a 7-digit food code whose hierarchical schema encompassed about 4,000 foods. Quantities of foods were reported in common or convenient measures of volume (cups, fluid ounces), weight (ounces, grams), dimensions, proportions, and counts and were later converted to grams. Foods incompletely described by respondents necessitated assumptions and were flagged with a code signifying use of a default description. If portion sizes were not specified or were imprecisely quantified (such as a bowl of cereal), default values denoted by a special code were used. The NFCS 1977-78 nutrient data base was used to compute energy and nutrient content of foods as ingested. Food energy and nutrient values were summed for all food items in each day, and an average day's intake was computed based on the number of intake days reported. Respondents or interviewers were recontacted if 50 percent of food descriptions or 10 percent of portion sizes were uncodeable. Data were tabulated after each quarter and at the end of four quarters. The final report focused on respondents who participated fully in all four quarters.

7.3.2 Data Analysis

For analysis of data, "outcome" and "process" variables were developed to compare methods. Outcome measures included completion rates, data quality, and respondent burden. Process measures included number of respondents with at least one intake report requiring callback and number of minutes for review, coding, and checking per intake day.

Completion rates were compiled for fully cooperative panelists and for fully and partially cooperative panelists. Fully cooperative panelists were defined as those who provided all requested intake and questionnaire data upon every contact in each quarter. Partially cooperative panelists were those who provided part of the requested data in one, two, or three quarters. Nonrespondents provided no additional data beyond the initial screening. Chi-square test of independence was applied to completion rates to determine significant differences among methods.

Data quality was measured by five variables: (1) day of week coverage in terms of number of initial intake days that were different days of the week, (2) the number of food line items per intake day, (3) the number of incomplete food descriptions per intake day, (4) the number of imprecise or missing portion sizes per intake day, and (5) the caloric and nutrient intakes per intake day. Analysis of variance was used to test whether results were significantly different among methods for the data quality measures.

Respondent burden was a variable consisting of the interview plus callback time in number of minutes. Respondent callback time was estimated by multiplying the number of times a respondent was called by 2 minutes, which was the average length of a callback. A set interview time was assumed for each quarter for mail methods 6, 7, and 8. The times were based on estimates obtained during debriefings. For method 6, the time was 69 minutes in quarter 2 and 39 minutes in quarters 3 and 4. For method 7, the time was 69 minutes in quarters 1 and 2 and 37 minutes in quarters 3 and 4. For method 8, the time was 50 minutes in quarters 1 and 2 and 38 minutes in quarters 3 and 4. In consecutive 3-day approaches (method 1, all quarters, and method 6, first quarter), no time was ascribed to respondents for filling out the 2-day diary records.

The process measures used in evaluating the methods were related to shortcomings in data collection and coding. Callbacks to interviewers or respondents were mandated if a 1-day intake report had (1) omission of time when an eating occasion began, (2) only one eating occasion listed or fewer than four food items listed, (3) incomplete food descriptions for one-half or more items, (4) the amount of a main dish or the amounts of 10 percent of the items missing, (5) unreasonable portion sizes reported, (6) the source of food (home or away-from-home) missing, (7) an incomplete answer to the typical eating practices question, or (8) any information missing on the basic questionnaire concerning personal or household characteristics. Process measures to evaluate data collection were (1) the number of respondents providing a callback about descriptions or amounts of food items, (2) the number of line items that had incomplete descriptions or amounts, (3) the number of respondents requiring USDA input for at least one intake report, and (4) the subjective scoring of quality of respondents' intake reports by coding supervisors on a 6-point scale (1 and 2 points were poor, 3 and 4 points were mediocre, and 5 and 6 points were good). Process measures to evaluate coding efforts required by each method included (1) the review and coding time in minutes, (2) the checking time in minutes, (3) the number of line item errors (computed by dividing total number of errors by total number of line items coded), and (4) the number of errors per respondent on the basic questionnaire (computed by dividing total number of errors by total number of forms coded).

The researchers noted some assumptions that could have affected analyses. These concerned (1) the similarity of treatment groups and interviewing sites, (2) the absence of valid (or true) outcome food consumption measures and the use of the NFCS method as the baseline, and (3) the interrelationships among and the confounding effects of several outcome measures. Another assumption that influenced judgments of strengths and weaknesses of methods was that data correct at point of entry were viewed as "better" than data improved by manipulation or recontact of respondent after time had elapsed since consumption and reporting.

Quarter 1 provided baseline measures for comparisons of the experimental methods with the control NFCS method. Quarter 2 was the initial test of the panel design and changes in technique. Quarters 3 and 4 tested viability of the panel approach for use in a monitoring system.

7.4 Main Findings and Discussion

At induction, panelists in each of the eight treatments and the control group were comparable according to several sociodemographic criteria. Characteristics of panelists changed to a small degree across the study period, but no significant differences were observed based on screening data. The characteristics of first quarter panelists and of fully cooperative panelists (four quarters) are shown in Table 7.2.

7.4.1 Completion Rates

Completion rates among methods varied significantly ($p \leq 0.001$, chi-square test of independence) (Table 7.3). The telephone and personal methods obtained a significantly higher proportion of complete responses for the four quarters (61 to 67 percent) than the mail methods (19 to 26 percent). Even at the end of the first quarter, the exclusively mail and the mail with telephone assistance methods had low complete response rates (49 and 52 percent, respectively); whereas personal and telephone methods had relatively high response rates (68 to 81 percent). Personal contact combined with mail (method 6) had high initial participation (81 percent), but participation dropped steeply with no further personal contact (24 percent). All respondents were contacted in person during the screening process.

7.4.2 Data Quality

Only fully cooperative panelists were included in the final outcome and process evaluations. The results represented the degree to which methods obtained intake data on all days of the

Table 7.2--Characteristics of quarter 1 panelists and fully cooperative panelists at initial interview[1]

Characteristics	First quarter panelists	Fully cooperative panelists	Data collection method: Personal 1	Personal 2	Personal 3	Telephone 4	Telephone 5	Mail 6	Mail 7	Mail 8
	Percent									
Age:										
20 to 29..........	23	21	16	23	33	22	16	17	17	18
30 to 39..........	30	30	33	35	23	28	32	36	34	26
40 to 49..........	19	20	17	17	15	27	18	28	24	20
50 to 69..........	28	29	34	25	30	24	34	20	24	36
	Years									
Mean age..........	40.7	41.1	42.4	40.1	39.4	40.8	42.4	39.5	41.4	43.7
	Percent									
Race:										
White..............	91	92	91	90	90	94	92	89	97	92
Nonwhite..........	9	7	9	10	10	6	8	11	3	8
Ethnicity:										
Hispanic..........	4	4	5	4	6	2	6	--	7	--
Non-Hispanic.......	96	96	95	96	94	98	94	100	93	100
Educational level:										
High school or less	70	70	78	72	67	66	69	61	64	71
College or beyond..	30	30	22	28	33	34	31	39	36	29
Employment status:										
Working...........	60	58	65	60	54	56	56	56	69	51
Nonworking........	40	42	35	40	46	44	44	44	31	49
Dietary status:										
Dieting...........	14	14	10	13	16	11	16	17	14	23
Not dieting.......	86	86	90	87	84	89	83	83	86	77

See footnote at end of table.

Continued

Table 7.2--Characteristics of quarter 1 panelists and fully cooperative panelists at initial interview[1]--Continued

Characteristics	First quarter panelists	Fully cooperative panelists	Data collection method: Personal			Telephone		Mail		
			1	2	3	4	5	6	7	8
	Percent									
Household size:										
Two.................	28	28	29	24	31	30	27	25	38	28
Three or four.......	51	52	49	56	48	52	54	53	55	56
Five or more........	20	19	22	20	21	18	20	22	7	15
	Number									
Mean number of persons...........	3.5	3.4	3.5	3.5	3.3	3.3	3.5	3.6	3.0	3.4
	Percent									
Household income (1982):										
Under $20,000.......	27	26	34	28	23	30	18	19	19	27
$20,000 to $34,999..	57	40	33	47	36	39	50	32	35	43
$35,000 or more.....	16	34	32	25	41	31	32	48	46	30
	Dollars in Thousands									
Mean income.........	$24.9	$25.0	$23.9	$24.0	$25.7	$24.8	$26.1	$27.2	$27.0	$24.1

[1]Data from first interview questionnaire.

Table 7.3--Panelists and completion rates at the end of the first and fourth quarters by method

Time period, panelists, type of response	Total	Data collection method							
		Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	Number								
At end of screening:									
Total panelists assigned..	1,235	155	155	155	154	154	154	154	154
Ineligible panelists[1]....	19	--	--	4	1	9	1	2	2
Adjusted sample size......	1,216	155	155	151	153	145	153	152	152
	Percent								
Completion rates at end of first quarter:									
Complete response.........	--	81	68	73	81	81	81	49	52
Partial response..........	--	1	14	12	1	0	1	3	2
Nonresponse...............	--	18	18	15	18	19	18	48	46
Completion rates at end of four quarters:[2]									
Complete response.........	49	63	61	67	64	67	24	19	26
Partial response..........	27	25	20	16	24	20	59	34	30
Nonresponse...............	24	12	19	17	12	13	17	47	44

[1]Outside age or income parameters.
[2]Chi-square test of independence is significant at $p \leq 0.001$.

week and the quality of intake entries used to derive nutrient measures.

7.4.2.1 Initial Intake Days

Ideally, the initial days for food intake reports should be spread so that all days of the week would be represented equally because of the generally recognized differences between intakes on weekdays and weekend days (Thompson, 1984). The number of initial intake days that were different days of the week for each individual varied significantly ($p \le 0.001$, chi-square test of independence) among methods. Those methods relying on respondent self-enumeration (mail methods) generated fewer initial intake days that were different days of the week (28 to 42 percent) than those which were administered by an in-person interviewer (64 to 83 percent) (Table 7.4). Overall, more than half (55 percent) of fully cooperative respondents began each quarter's intake report on a different day of the week.

Weekend days were not equally represented; only 22 percent of total intake days were weekend days. Proportions for each weekday were relatively comparable.

7.4.2.2 Food Intake Entries

To evaluate the adequacy of the eight methods for obtaining information on food intakes, four types of variables were examined--number of line items, number of incomplete food descriptions, number of unspecified portion sizes, and nutrient intakes. These dependent variables were measured on a "per day" basis to permit comparisons across methods with differing numbers of days. Analysis of variance was used to test whether results for each dependent variable were significantly different among methods.

Number of food and beverage line items. The mean number of food line items per intake day for fully cooperative respondents was 16.3, but it differed significantly ($p \le 0.05$) among methods (Table 7.5). Consecutive multiple-day methods generated fewer line items per day, on average, than single-day methods. Method 1 (panelists recontacted for four sets of 3 consecutive days of intake) produced the lowest mean number of items per day (15.1 items).

Methods 4 and 8 (four sets of single intake days) produced the highest means per day (17.0 and 17.6 items, respectively). Day-by-day tabulations revealed a slight but generally steady decline in mean number of line items on the second and third days of each quarterly contact (Table 7.5). The decline was most pronounced for method 1, which required the most days of intake recording; day 12 had nearly three items less, on average, than day 1.

Much homogeneity was evidenced in the mean number of items reported per day for each of five food groups. However, two of the five groups had significant differences ($p \le 0.05$) among methods--the meat, fish, and poultry group and the vegetables, legumes, nuts, seeds, and fruits group.

Number of incomplete food descriptions. The mean number of incomplete food descriptions reported per intake day was used to indicate the quality of responses obtained. This number of incomplete descriptions varied significantly ($p \le 0.001$) among methods and, among fully cooperative respondents, averaged 1.9 items (Table 7.6). Method 3 (personal contact, semistructured form) and method 8 (mail contact, telephone assistance) yielded the highest mean number of incomplete descriptions (2.5 and 2.4 items, respectively); methods 1 and 6

Table 7.4--Fully cooperative respondents reporting initial intakes for different days of the week by method

Number of initial intake days that were different days of the week	All methods	Data collection method							
		Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	(N=593)	(N=98)	(N=95)	(N=101)	(N=98)	(N=97)	(N=36)	(N=29)	(N=39)
	Percent								
One or two.........	6*	4	0	2	11	9	3	17	8
Three..............	39*	32	17	30	51	47	66	55	50
Four...............	55*	64	83	68	39	43	31	28	42

*Chi-square test of independence is significant at $p \leq 0.001$.

Table 7.5--Food line items reported per intake day,[1] all quarters, by method

[Dashes indicate that the method did not require an intake report on this day]

Intake day	All methods	Data collection method: Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	(N=593)	(N=98)	(N=95)	(N=101)	(N=98)	(N=97)	(N=36)	(N=29)	(N=39)
	Mean number								
Day 1.............	17.0	17.0	15.7	17.2	17.3	16.9	17.7	--	18.7
Day 2.............	15.8	14.5	15.1	16.6	--	--	17.0	17.3	--
Day 3.............	16.2	14.9	16.3	17.0	--	--	16.2	16.6	--
Day 4.............	16.4	16.7	15.3	16.2	16.7	16.4	--	--	18.0
Day 5.............	15.8	15.0	--	--	--	--	16.0	18.3	--
Day 6.............	15.1	14.3	--	--	--	--	16.3	16.5	--
Day 7.............	16.4	15.2	16.3	16.4	16.9	16.7	--	--	17.2
Day 8.............	15.7	14.8	--	--	--	--	17.7	16.4	--
Day 9.............	15.4	14.4	--	--	--	--	16.9	17.0	--
Day 10............	16.1	15.4	15.0	16.6	16.9	16.2	--	--	16.7
Day 11............	14.9	14.4	--	--	--	--	15.1	16.3	--
Day 12............	14.9	14.1	--	--	--	--	16.1	15.9	--
Per day...........	16.3*	15.1	15.6	16.7	17.0	16.6	16.6	16.8	17.6

[1]Mean-per-intake-day measures were derived by summing numbers for each day and dividing by the number of days in the particular method.

*Significantly different at $p \leq 0.05$.

Table 7.6--Incomplete food descriptions for each intake day, all quarters,[1] by method

[Dashes indicate that the method did not require an intake report on this day]

Intake day	All methods (N=593)	Personal 1 (N=98)	Personal 2 (N=95)	Personal 3 (N=101)	Telephone 4 (N=98)	Telephone 5 (N=97)	Mail 6 (N=36)	Mail 7 (N=29)	Mail 8 (N=39)
	Mean number								
Day 1.............	2.41	2.29	1.65	2.89	2.34	2.20	2.47	--	4.00
Day 2.............	2.12	1.72	1.85	2.68	--	--	2.00	2.52	--
Day 3.............	2.53	2.39	2.19	3.21	--	--	1.86	2.59	--
Day 4.............	1.86	1.63	1.49	2.46	1.91	1.85	--	--	1.72
Day 5.............	1.49	1.40	--	--	--	--	1.58	1.69	--
Day 6.............	1.45	1.37	--	--	--	--	1.39	1.83	--
Day 7.............	1.77	1.52	1.56	2.00	1.91	1.69	--	--	2.13
Day 8.............	1.45	1.47	--	--	--	--	1.58	1.24	--
Day 9.............	1.34	1.39	--	--	--	--	1.33	1.17	--
Day 10............	1.64	1.35	1.68	1.87	1.55	1.71	--	--	1.72
Day 11............	1.40	1.41	--	--	--	--	1.22	1.59	--
Day 12............	1.34	1.48	--	--	--	--	1.17	1.07	--
Per day[1]..........	1.94*	1.62	1.74	2.52	1.93	1.86	1.62	1.71	2.39

[1]Mean-per-intake-day measures were derived by summing each day's numbers and dividing by the number of days in the method.

*Significantly different at $p \leq 0.001$.

generated the fewest incomplete descriptions (1.6 items each). Although not significantly different from personal methods (except for method 3) and mail methods, the telephone approaches produced more incomplete descriptions, on average, than those methods and, according to the researchers, may reflect the stringent guidelines regarding coding and callback. (Respondents were not called back unless at least 50 percent of the descriptions were incomplete. Many of the intake reports by telephone respondents did not exceed this limit, so incomplete descriptions may have reflected accumulation of a small number of description deficiencies that did not mandate a callback.) The incomplete descriptions were fewer in the last quarter, on average, than in the first quarter for nearly all methods and may reflect improvement with experience or dropout of less motivated participants. There were substantial differences among methods in the number of incomplete food descriptions. The differences were statistically significant for three of the five food groups --grain products ($p \leq 0.001$); vegetables, fruits, and legumes ($p \leq 0.01$); and sugars, sweets, and beverages ($p \leq 0.001$). These groups included accompaniments and non-main-meal foods which, according to the researchers, were less comprehensively reported.

Number of imprecise portion sizes. The overall mean number of unspecified or imprecisely reported portion sizes eaten per day per individual was small (0.4); nevertheless, the methods differed significantly ($p \leq 0.001$) on this dimension (Table 7.7). Method 7 (continuous mail) produced the highest mean number of imprecisely specified amounts per day. Personal methods 1 and 2 produced the fewest imprecise amounts. These results, the researchers pointed out, demonstrate the advantage of having the intake instrument administered by competent interviewers.

For each food group except the sugars, sweets, and beverages group, the mean number of imprecise portion sizes varied significantly among methods (Table 7.8). Methods 5 and 7 (telephone and continuous-mail methods, respectively) generated the largest number of poorly specified portion sizes, and method 2 (interviewer-administered recalls) generated the smallest number.

Food energy and nutrient intake data. Mean food energy and nutrient intake estimates derived with the various methods were significantly different for only three nutrients--protein ($p \leq 0.05$), niacin ($p \leq 0.001$) and vitamin C ($p \leq 0.01$) (Table 7.9). Method 8 (mail with telephone assistance) produced the highest mean intakes for the most nutrients (nine) and method 1 (replicating NFCS personal contact) produced the lowest mean intakes for the most nutrients (nine). Examination of mean food energy intakes for each intake day revealed the tendency for a dropoff to occur as more days were reported (Table 7.10). Method 1, with 12 intake days, had a decline of about 300 kilocalories; method 8 had an even larger dropoff by the last quarter. Differences among days were not tested for significance.

7.4.3. Respondent Burden

Respondent burden was evaluated only in terms of respondent time required. Respondent burden (mean interview time plus mean respondent callback time) varied significantly ($p \leq 0.001$) across methods with methods 3 and 7 being more burdensome than the other methods (Table 7.11). Both methods 3 and 7 required about 4 hours during the year-long study. The least time-consuming methods were the telephone methods 4 and 5, averaging just over 2 hours for four contacts.

Table 7.7--Inadequately specified portion sizes for each intake day,[1] all quarters, by method

[Dashes indicate that the method did not require an intake report on this day]

Intake day	All methods (N=593)	Personal 1 (N=98)	Personal 2 (N=95)	Personal 3 (N=101)	Telephone 4 (N=98)	Telephone 5 (N=97)	Mail 6 (N=36)	Mail 7 (N=29)	Mail 8 (N=39)
	Mean number								
Day 1	0.36	0.35	0.22	0.44	0.36	0.45	0.31	--	0.41
Day 2	.26	.17	.17	.36	--	--	.25	0.48	--
Day 3	.25	.16	.22	.30	--	--	.17	.52	--
Day 4	.37	.30	.28	.44	.32	.42	--	--	.64
Day 5	.36	.20	--	--	--	--	.33	.93	--
Day 6	.31	.28	--	--	--	--	.17	.62	--
Day 7	.59	.40	.33	.53	.78	.92	--	--	.54
Day 8	.53	.43	--	--	--	--	.69	.69	--
Day 9	.59	.49	--	--	--	--	.78	.69	--
Day 10	.39	.39	.23	.33	.45	.47	--	--	.56
Day 11	.39	.28	--	--	--	--	.36	.79	--
Day 12	.49	.40	--	--	--	--	.36	.97	--
Per day[1]	.42*	.32	.24	.40	.47	.57	.38	.71	.54

[1] Mean-per-intake-day measures were derived by summing each day's numbers and dividing by the number of days in the method.

*Significantly different at $p \leq 0.001$.

Table 7.8--Inadequately specified portion sizes per intake day, by food group, all quarters, by method

Food group	All methods	Data collection method							
		Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	(N=593)	(N=98)	(N=95)	(N=101)	(N=98)	(N=97)	(N=36)	(N=29)	(N=39)
	Mean number								
Meat, fish, poultry.......	0.08*	0.06	0.05	0.05	0.09	0.13	0.08	0.13	0.06
Milk products, eggs, fats, oils, seasonings...	.07**	.06	.04	.09	.07	.11	.03	.11	.08
Vegetables, legumes, nuts, seeds, fruits......	.11***	.07	.06	.10	.16	.13	.08	.20	.17
Grain products...........	.12*	.08	.05	.08	.13	.16	.17	.19	.20
Sugar, sweets, beverages..	.04	.06	.03	.08	.03	.04	.01	.08	.03

*Significantly different at p≤0.001.
**Significantly different at p≤0.05.
***Significantly different at p≤0.01.

Table 7.9--Food energy and nutrient intake per individual per day, all quarters, by method

Nutrient	All methods (N=593)	Data collection method: Personal 1 (N=98)	Personal 2 (N=95)	Personal 3 (N=101)	Telephone 4 (N=98)	Telephone 5 (N=97)	Mail 6 (N=36)	Mail 7 (N=29)	Mail 8 (N=39)
	Mean intake								
Food energy (kcal).....	1,519	1,432	1,579	1,579	1,490	1,494	1,508	1,527	1,583
Protein (g)...........	62*	59	64	65	58	60	61	65	69
Fat (g)...............	65	62	65	66	64	65	64	67	69
Carbohydrate (g).......	170	157	182	179	167	164	174	161	170
Calcium (mg)..........	599	568	600	625	587	585	646	619	614
Iron (mg).............	10.5	10.0	10.8	10.9	9.7	10.6	10.4	10.8	11.5
Magnesium (mg).........	226	213	227	230	221	220	240	243	248
Phosphorus (mg)........	975	931	1,000	1,006	932	946	1,010	1,031	1,052
Vitamin A (IU).........	5,064	4,476	4,802	5,093	4,903	5,662	5,465	5,802	5,106
Thiamin (mg)..........	1.02	.96	1.05	1.06	0.96	1.00	1.05	0.98	1.17
Riboflavin (mg)........	1.34	1.24	1.38	1.37	1.29	1.38	1.36	1.40	1.40
Niacin (mg)...........	6.65**	4.85	9.18	9.15	5.34	4.94	6.65	6.09	6.44
Vitamin B-6 (mg).......	1.19	1.08	1.23	1.23	1.15	1.17	1.22	1.24	1.33
Vitamin B-12 (mcg).....	4.03	4.00	4.03	4.04	3.64	4.87	3.37	4.34	3.30
Vitamin C (mg).........	89***	82	76	97	85	88	95	86	121

*Significantly different at p≤0.05.
**Significantly different at p≤0.001.
***Significantly different at p≤0.01.

Table 7.10--Food energy per individual per day of intake, all quarters, by method

[Dashes indicate that the method did not require an intake report on this day]

Intake day	All methods	Data collection method: Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	(N=593)	(N=98)	(N=95)	(N=101)	(N=98)	(N=97)	(N=36)	(N=29)	(N=39)
	Mean kilocalories								
Day 1..........	1,625	1,667	1,589	1,656	1,620	1,542	1,542	--	1,802
Day 2..........	1,514	1,432	1,492	1,570	--	--	1,567	1,598	--
Day 3..........	1,668	1,452	1,911	1,684	--	--	1,606	1,623	--
Day 4..........	1,475	1,537	1,466	1,436	1,433	1,477	--	--	1,548
Day 5..........	1,468	1,410	--	--	--	--	1,432	1,711	--
Day 6..........	1,398	1,396	--	--	--	--	1,428	1,368	--
Day 7..........	1,515	1,410	1,520	1,584	1,495	1,542	--	--	1,575
Day 8..........	1,431	1,392	--	--	--	--	1,567	1,395	--
Day 9..........	1,371	1,293	--	--	--	--	1,471	1,510	--
Day 10.........	1,458	1,456	1,487	1,542	1,411	1,413	--	--	1,408
Day 11.........	1,416	1,375	--	--	--	--	1,430	1,538	--
Day 12.........	1,420	1,364	--	--	--	--	1,527	1,477	--

Table 7.11--Respondent burden based on mean interview and callback time, all quarters, by method

Method	Individuals	Respondent burden: Total	Respondent burden: Interview time	Respondent burden: Callback time
	Number	-----Mean number of minutes-----		
(1): Personal, recontacted (12 days).............	75	147	139	8.05
(2): Personal, unstructured (6 days).............	75	188	185	3.3
(3): Personal, structured (6 days)................	67	237	233	3.5
(4): Personal, followed by telephone (4 days).....	39	108	106	1.5
(5): Repeated telephone (4 days)..................	47	112	111	1.3
(6): Personal, followed by mail (9 days)..........	35	199	187	11.3
(7): Repeated mail (8 days).......................	29	225	212	13.4
(8): Repeated mail, telephone-assisted (4 days)...	39	186	176	10.4
All methods......................................	406	176*	170	5.9

*Significantly different at $p \leq 0.001$.

Comparison of callback burden on respondents among methods revealed that methods 6, 7, and 8--primarily mail contacts with self-administered food records--required the most callback time--over 10 minutes (Table 7.11). The lowest callback time was required for telephone methods--less than 2 minutes.

7.4.4 Process Evaluation

The quality of intake reports provided by respondents affected the time required for data processing. Process evaluation measures were developed to compare the amount of effort necessary to convert intake information into nutrient intake data.

7.4.4.1 Incompleteness of Intake Reports

Shortcomings of intake reports were indicated by the fact that about three-fourths of the respondents had to be recontacted at least once during the year to provide additional description of foods (Table 7.12). Nearly as many respondents had to be called back at least once because portion size information could not be coded. Only about one-half of the panelists in the telephone groups (methods 4 and 5) required callbacks; whereas almost all panelists in the predominantly mail methods (6, 7, and 8) had to be recontacted. One-day personal methods (2 and 3) were more satisfactory than the 3-day personal method (1), which probably reflected the effects of two self-recorded intake days within the 3-day method. The researchers noted that the degree of completeness of the methods reflected the skill of trained interviewers and demonstrated the lack of relevant skills on the part of the mail respondents. Also noted as a positive influence was the close monitoring of the centralized telephone interviewers and their concentrated effort during the interviews.

The overall mean percentage of line items with inadequate descriptions for all methods (although a callback may not have been made) was 8 percent over the four quarters (Table 7.12). The mean percentage of line items with a deficiency in reporting of quantities was 4 percent over all methods. The telephone methods produced the fewest incomplete entries per report, and the mail methods produced the most. A large majority of panelists had at least one intake record that required coding or other special assistance from USDA professional staff. USDA input was greatest for the methods with the most days and least for methods with the fewest days.

After callbacks and improvements in the questionnaires had been made, coding supervisors subjectively assessed the overall quality of intake records across all methods by fully cooperative panelists (Table 7.12). Each intake record was evaluated for legibility, comprehensiveness, interpretability, and codeability on a 6-point scale, on which number 1 meant very poor quality and number 6 meant very good quality. Nearly two-thirds of the intake records were rated overall as good and about one-third as mediocre. Telephone methods received by far the best ratings (90 to 92 percent were good), and the mail methods 7 and 8 received the poorest ratings (7 and 8 percent).

7.4.4.2 Coding Requirements

The amount of time spent in preparing data for processing (reviewing, coding, and checking) during four quarters across all methods was, on average, more than 6 hours per individual (Table 7.13). Somewhat more than 4 hours were required for review and coding and the remainder for checking by supervisors. Taking into account the varying number of intake days across methods, mean handling time was just over 1 hour per

Table 7.12--Process evaluation based on measures of inadequacy of intake records, all quarters, by method

Measure	All methods	Data collection method							
		Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	(N=593)	(N=98)	(N=95)	(N=101)	(N=98)	(N=97)	(N=36)	(N=29)	(N=39)
	Percent								
Respondents providing at least one intake record requiring callback for--									
Descriptions	74	88	81	72	54	50	97	97	92
Amounts......................	68	83	66	65	48	46	100	97	92
Mean percent of line items that were incomplete:[1]									
Descriptions.................	8	8	5	5	3	3	13	19	18
Amounts......................	4	4	2	3	2	2	6	9	8
Respondents requiring USDA input for at least one intake record........................	78	88	81	75	71	77	83	83	69
Respondent reports with quality judged to be--									
Good (scored 5 or 6).........	64	49	68	53	92	90	42	17	33
Mediocre (scored 3 or 4).....	35	50	32	45	8	10	58	76	59
Poor (scored 1 or 2).........	1	1	0	2	0	0	0	7	8

[1]Number of line items was summed across all quarters for each person and the percentage of incomplete line items for each person was calculated; then the percentage of incomplete line items for each person was summed across all persons to yield the mean percent per person of incomplete lines.

Table 7.13--Review, coding, and checking time and error rates, all quarters, by method

Variable	All methods	Data collection method							
		Personal			Telephone		Mail		
		1	2	3	4	5	6	7	8
	(N=593)	(N=98)	(N=95)	(N=101)	(N=98)	(N=97)	(N=36)	(N=29)	(N=39)
	Minutes								
Review, coding, and checking time (means):									
Per respondent:									
Review and coding time.....	254	382	256	354	157	159	299	271	160
Checking time.............	115	158	106	193	69	69	120	111	69
Total time.................	369	540	362	547	226	228	419	382	229
Per day of intake............	63	45	60	91	56	57	47	48	57
	Number								
Coding error rates:									
Line item errors[1].........	.21	.16	.27	.25	.24	.22	.17	.16	.21
Errors per respondent on basic questionnaire[2]...	1.87	1.53	2.60	2.46	1.49	1.30	2.14	2.07	1.46

[1]Computed by dividing total number of errors by total number of line items coded.
[2]Computed by dividing total number of errors by total number of forms coded.

intake day. The time per day for handling was lowest for multiple consecutive day methods 1, 6, and 7--about 45 minutes per intake day. These methods benefited from having the multiple days handled together as one package so that less time was spent searching for appropriate codes for foods eaten on more than 1 day.

Coding supervisors checked the intake records after coders completed their task. About one coding error was identified for every five line items (Table 7.13). This included omissions as well as erroneous codings.

7.4.5 Costs

At the end of the first quarter of the study the researchers compared costs among the different methods (Table 7.14). The costs considered were those for field preparation and monitoring, data collection, and data reduction and file preparation. Costs independent of the differing methods--such as sample selection, screening, questionnaire development, tabulations, and analysis--were not included.

The tabulations revealed that among 1-day methods, personal and telephone approaches (methods 4 and 5) cost about the same--about $70 per completed interview for the three components assessed (Table 7.14). The mail approach, with 2 days of intake data to be processed, cost $63 per completed interview ($31 per intake day). The 3-day NFCS method cost $112 for the 3 consecutive days ($37 per intake day); whereas the 3 nonconsecutive day approach (method 2) cost $192 for the complete quarter ($64 per intake day).

7.5 Conclusions and Recommendations

Telephone methods--used exclusively or in combination with in-person interviews --emerged as the most viable approach for a national nutrition monitoring system involving middle-income female homemakers. Researchers noted, however, that all panelists had at least one in-person contact during the screening process and that some form of in-person contact may be necessary for the monitoring effort to be successful. Therefore, for panelists like those in this study, the researchers recommended the combination of initial personal contact followed by telephone. On the basis of very low response rates, mail methods were found to be unsuitable for conducting a nationwide monitoring survey. The continuing in-person interview methods tested had some very strong advantages but also some disadvantages. Results of the analyses performed in this study are summarized in Table 7.15.

The mail approaches (methods 6, 7, and 8) generated among the highest number of incomplete food description entries, on average, and the highest proportion of panelists requiring callback. Mail approaches also produced the largest proportion of imprecisely specified portion sizes and high respondent time requirements.

The replicated NFCS personal approach (method 1) required the least time per intake day for review, coding, and checking. This performance demonstrated the advantage of processing the 3 days together. However, method 1 had the lowest mean energy value (and values for most other nutrients) and the lowest mean number of line items per intake day among all methods. The self-kept food record required for 2 of the 3 days per quarter probably contributed to the weak showing for number of line items; interviewer review at pickup would be expected to improve performance on complete reporting of descriptions and portion sizes. A slight but steady decline in average number of line items

Table 7.14--Survey costs for quarter 1 per completed interview by method

Survey costs[2]	Data collection method[1]						
	Personal			Telephone		Mail	
	1 (N=247)	2 (N=105)	3 (N=109)	4 (N=124)	5 (N=119)	7 (N=74)	8 (N=79)
	Mean dollars						
Field preparation and monitoring....................	16.37	27.65	26.64	16.30	17.08	4.44	5.06
Data collection.............	25.50	83.33	82.57	25.20	27.83	16.62[3]	24.05[3]
Data reduction and file preparation................	70.07	81.12	116.20	27.56	26.17	41.96	26.38
Total per fully completed respondent.......	111.94	192.10	225.41	69.06	71.08	63.02	55.49

[1] Method 6, quarter 1, and method 1, quarter 1, are identical; costs are combined under method 1.
[2] Dollar figures represent averages per completed interview obtained. The calculation of cost figures include expenditures associated with "working the entire panel," i.e., costs associated with attempting as well as obtaining a fully completed interview.
[3] Represents interviewer calling time to prompt participation among nonrespondents and to instruct respondents on how to complete the intake record.

Table 7.15--Summary of important measures used in evaluation of longitudinal data collection approaches

Measure	Data collection method							
	Personal			Telephone		Mail		
	1 (N=98)	2 (N=95)	3 (N=101)	4 (N=98)	5 (N=97)	6 (N=36)	7 (N=29)	8 (N=39)
Panelists completion rate:								
Fully cooperative (percent)....	63	61	67	64	67	24	19	26
Partially cooperative (percent)	25	20	16	24	20	59	34	30
Data quality:								
Line items (mean number per day)..........	15.1	15.6	16.7	17.0	16.6	16.6	16.8	17.6
Incomplete descriptions (percent of descriptions)......	8	5	5	3	3	13	19	18
Imprecise portion sizes (percent of portions)..........	4	2	3	2	2	6	9	8
Energy intake (mean kcal per person per day)...........	1,432	1,579	1,579	1,490	1,494	1,508	1,527	1,583
Process measures:								
Descriptions required callbacks (percent of panelists).........	88	81	72	54	50	97	97	92
Review/checking/coding time: (mean minutes per intake day)..	45	60	91	56	57	47	48	57
Respondent burden:								
Interview and callback time (mean time in minutes per respondent)	147	188	237	108	112	199	225	186
Cost:[1]								
Quarter 1 (mean dollars per intake day).................	37	64	75	69	71	37	31	55

[1] Mean per completed interview based on costs affected by method excluding costs which are similar for all methods.

on the second and third days tended to occur in each successive quarter, and a falloff in the number of line items occurred over the year, with day 1 having the highest number and day 12 the lowest.

The 1-day personal approaches (methods 2 and 3) were administered by the interviewer. This advantage was apparent in the smallest number of imprecise portion sizes and the greater number of line items per intake day compared with the replicated NFCS method. However, these two 1-day methods required the greatest amount of time for reviewing, coding, and checking of all the methods.

The telephone approaches (methods 4 and 5) had among the highest completion rates, required the least respondent burden time by far, necessitated proportionately the fewest callbacks, had the fewest incomplete descriptions, and had among the fewest imprecise portion sizes. The cost of training both personal and telephone interviewers for method 4--a combination of personal interview in the first quarter followed by telephone interviews in subsequent quarters--was similar to the cost per intake day of the continuing telephone method 5. The researchers recommended further investigation of the suitability of telephone methods for monitoring before using them for low-income, elderly, and other subpopulations.

7.6 Comment

A national nutritional monitoring system provides (1) needed data in a timely and cost-effective manner from small targeted surveys and (2) baseline data on a nationwide probability sample of individuals of all ages from the periodic, large-scale food consumption surveys. Data from monitoring surveys can be compared with the more extensive periodic data to check validity. The periodic surveys also provide data for tracking longer-term trends over decades. The subject of autocorrelation of intakes on consecutive days was examined in another study reported in Chapter 11. The structured questionnaire used in one of the test methods was not considered feasible, but it did lead to the more detailed Food Instruction Booklet and a more structured dietary intake interview for subsequent surveys. Study findings should be useful to researchers planning both large- and small-scale surveys for special purposes.

The preliminary results of this experimental study by National Analysts were used in designing the mandated pilot study of methodology suitable for monitoring nutritional intakes of low-income, elderly, and ethnic population groups (Chapter 8). Information on these vulnerable population groups is required by Congress and other governmental units in order to make decisions on policies and programs affecting their welfare. The results of this experimental study by National Analysts led USDA to select the rotating panel approach for use in the 1985 and 1986 monitoring surveys called the Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals (USDA, HNIS, 1985, 1987). An abstract and short summary of this investigation has been published (Wilson and Rothschild, 1987a, 1987b).

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Chapter 8. Pilot Study of Measures of Individual Food Intakes by the Low-Income Populations

Investigator: Westat, Inc. Rockville, Maryland
Renee F. Slobasky, Officer-in-charge, 1983-85.

SUMMARY: This pilot study evaluated telephone and mail procedures for collecting 12 days of dietary intake information, 3 days each quarter, during 1 year from all individuals in 10 samples of low-income households. Feasibility of taking weight, height, and arm circumference measurements during a home interview was also assessed. After screening, households in samples of whites, blacks, Mexican-Americans, and American Indians were assigned systematically to telephone and mail panels. The first 1-day recall for all individuals was collected with in-person interviews and was followed by a self-kept 2-day record for mail panel members and by two 1-day recalls by telephone interview for telephone panel members. During the next three quarters, the mail panels kept 3-day food records on forms mailed by Westat; telephone panels were interviewed by telephone for three 1-day recalls. Overall response rates by telephone panels (47 percent) were higher than by mail panels (22 percent). Rural sites generally had higher response rates than urban sites for both telephone and mail panels. Respondent burden was higher for mail panels than for telephone panels. Surrogates reported for 26 percent of the telephone panel members, but for fewer in mail panels (16 percent). The number of line items in reports by telephone was generally greater than in mail reports and there were fewer inadequately described foods and portion sizes. Westat concluded that telephone methods were superior to mail procedures but that providing 12 days of data for all household members was overwhelming for many households.

Tables

Figures

8.1 Background

In the Agriculture and Food Act of 1981, the U.S. Congress instructed the Secretary of Agriculture to implement a pilot program to test methods of measuring, on a continuing basis, the dietary status of low-income populations in the United States. This pilot study contributed importantly to USDA's continuing research on methods of collecting data on dietary intakes of individuals. The earlier exploratory study by National Analysts (Chapter 7) provided guidance in selecting two promising approaches for testing measurement methods for use in surveying low-income populations. The procedures and results of this pilot study are described here in detail because of the contribution of this study to development of an effective data collection method for the National Nutrition Monitoring System and because the data have not been published elsewhere.

8.2 Purpose

Phase I of the pilot study evaluated two types of data collection procedures--mail and telephone--for obtaining repeated measures of dietary intake from selected low-income population groups. Phase II tested further the more effective method from phase I with three additional low-income population groups before recommending the most appropriate method for a national nutrition monitoring system. In both phases, the feasibility of taking anthropometric measurements--height, weight, and arm circumference-- during a home visit was evaluated, and the differences between interviewer-measured and self-reported height and weight were determined.

8.3 Methods

Two methods--telephone and mail--for collecting 12 days of dietary intake information were compared using 10 samples of low-income households. In phase I, each of five samples was evenly divided into two panels, one assigned to the telephone method and the other to the mail method. Two special purpose samples were also included in phase I. In phase II, three samples were initially assigned to the telephone method. An overview of the entire study is outlined next before describing procedures in more detail.

8.3.1 Overview

Five samples in phase I and three samples in phase II were selected after listing and screening operations had been carried out. Two special samples were also selected in phase I--a sample of households having no telephones and a sample asked to participate for only one quarter rather than four. Data collection for phase I extended from September 1983 to December 1984 and for phase II from February 1984 through March 1985. A large-scale pretest of proposed procedures was conducted prior to survey operations and is described in the following section.

In both phases of the study, dietary intake information was collected from individuals in the participating low-income households for 3 consecutive days in each of four quarters, except for the telephone sample in the first quarter and the two special samples. During the first quarter, all households were visited in-person by interviewers who obtained a 1-day dietary recall for the preceding day for all members in the household. Dietary intake information for the other 2 days was collected differently according to whether the household was assigned to a telephone or a mail followup panel. Household members in the mail followup panels were asked to keep 2-day food records so as to complete 3 consecutive days of food intake reporting for the first quarter. In the following three quarters, the 3-day record forms were mailed to the households to be completed and returned. Household members in the first quarter's telephone followup panels were asked to provide 2 additional days of dietary intake information to telephone interviewers. For procedural reasons, those telephone interviews took place about 2 weeks after the home visit. In each of the subsequent three quarters, telephone interviewers obtained 3 consecutive days of dietary intake information. Phase II samples were assigned to the telephone method; but one sample had half of the households followed up by mail because of lack of telephones. The samples and panels are shown in figure 8.1.

8.3.2 Large-Scale Pretest

After a 5-day briefing session, materials were tested in a full-scale dress rehearsal of data collection procedures during a 4-week period in May and June 1983. Interviewing took place in 11 low-income areas of Baltimore and Hagerstown, Maryland. White, black, and Spanish-speaking households were included. Of the 731 dwelling units designated for screening, 140 were either vacant or not dwelling units; 501 of the remaining 591 dwelling units were successfully screened (85 percent), and 149 households were eligible to participate. A second round of data collection took place for households interviewed during the first 2 weeks, but time was too short for a second round for the remaining households.

8.3.3 Selection of Samples of Households

Selection of households for the pilot study was based on region, urbanization, ethnic or racial heritage, income level, presence and age of the female head of household, and presence of a telephone. The demographic characteristics and number of households designated for the five phase I samples were as follows:

(1) 360 Black, Northeast, central city--Philadelphia, Pennsylvania;
(2) 360 Black, South, rural--Bradford, Putnam, and Columbia Counties, Florida;
(3) 360 White, West, central city--Los Angeles County, California;
(4) 360 White, North Central, rural--Butler, Dunklin, and New Madrid Counties, Missouri; and
(5) 180 Mexican-American, West, central city--El Paso, Texas.

Two special-purpose samples were also selected in phase I as follows:

(1) 150 Black, South, rural, no telephone--Florida site; and
(2) 120 Black, South, rural, administer NFCS method (same as quarter 1 in mail followup method), first quarter only--Florence County, South Carolina.

In phase II, the three household samples were--

(1) 180 Mexican-American, West, rural--Dona Ana County, New Mexico;
(2) 180 American Indian, North Central, rural--Chippewa Indian Reservation and surrounding area, North Dakota; and
(3) 180 Elderly, West and Northeast, urban, all members 65 years or older--Los Angeles County, California and Philadelphia, Pennsylvania.

Only low-income households were eligible to participate in the survey. Low-income was defined as currently receiving or eligible to receive food

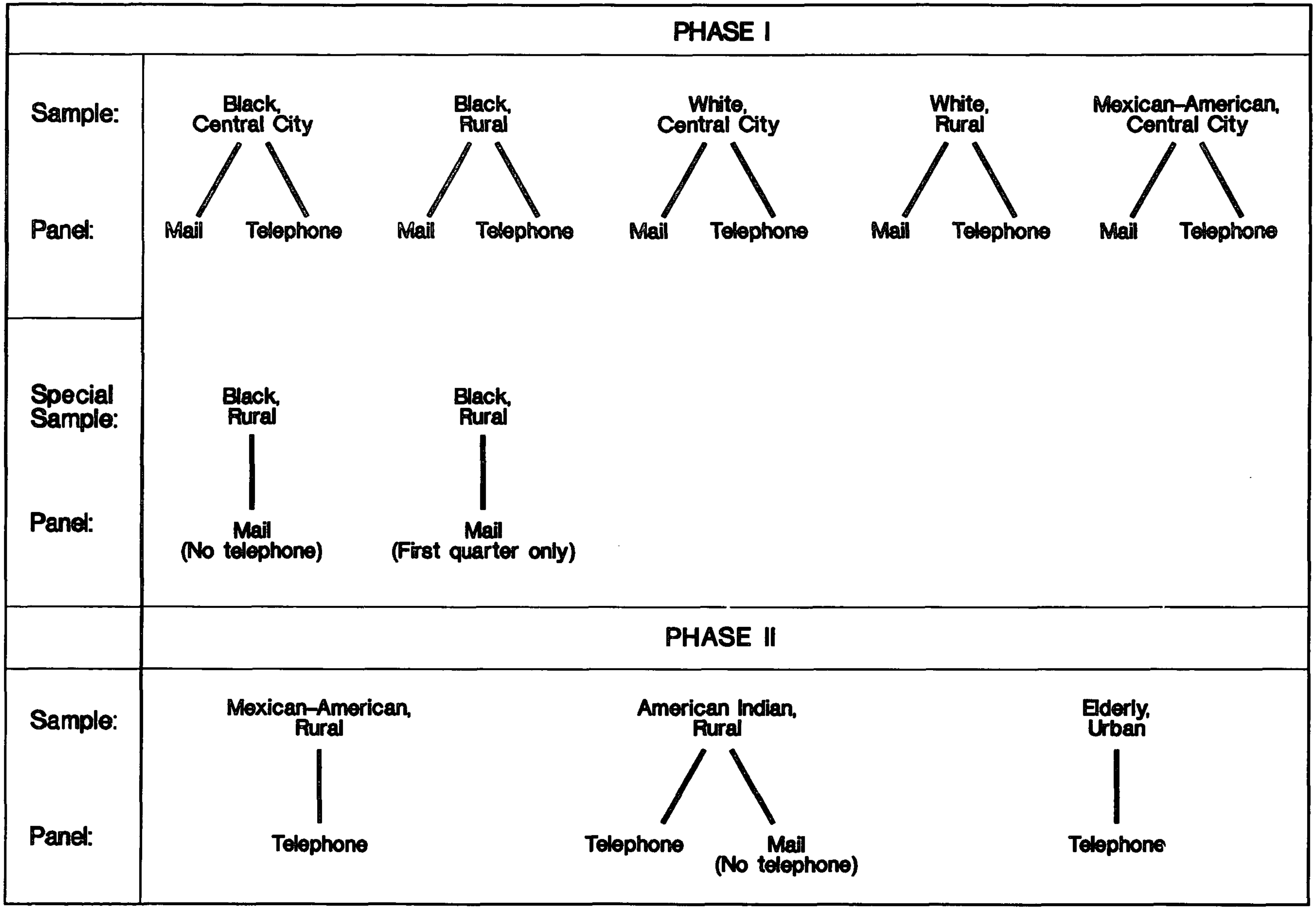

Figure 8.1—Characteristics of samples and panels by phase

stamps at the time of the screening interview. Each household was required to have a female head between 20 and 50 years of age, consist of two or more persons, and have a telephone. A household was defined as a group of persons occupying the same dwelling unit who were related to one another or who shared a common food supply. An unrelated person living with a family and a group of unrelated persons living together were considered to be a single household or "eating group" if they shared a common food supply. If they did not share a common food supply, they were treated as two or more separate households.

Selection of households for screening interviews included several stages. During the first stage, sites were selected by Westat sampling staff after reviewing census population and income data to identify rural and metropolitan areas in designated regions with specified populations sufficiently large to yield acceptable screening rates. The second stage consisted of selecting smaller geographic segments (census enumerator districts or block groups) in which low-income households of specified ethnic or racial heritage were concentrated.

The first field activity was the listing of street addresses or descriptions of all dwelling units in each segment by Westat field staff. The listings were sent to Westat's central office for review. The households at which screening was to be attempted were randomly selected from the listings.

Screening interviewers, recruited locally, received on-site training for 1-1/2 days during the last week of June 1983 given by four Westat site supervisors. Initial screening interview assignments were handed out at the final training session, and interviewing began immediately, continuing until mid-August 1983.

During the screening operation in the field, a short screening questionnaire was administered by interviewers to determine the households' eligibility for the survey. At two sites (Philadelphia and Los Angeles), the questionnaire was used concurrently to identify a sample of elderly households for phase II. Questioning was terminated whenever answers indicated a household was not eligible for the survey; for example, the household had no female head, the household had no telephone, or the household neither received nor was eligible to receive food stamps. If the household received food stamps and was otherwise eligible, the monthly value of the household's food stamps was obtained. If the household was not receiving food stamps, but was otherwise eligible, questioning continued to determine whether liquid assets exceeded the allowable limit for food stamp eligibility. If they did, the screening interview was terminated.

Households that had assets within specified limits were asked additional questions about pretax income in the preceding month. Respondents selected an income category, printed on cards, which was based on poverty guidelines for the specific household size. Households with incomes above 130 percent of poverty guidelines were ineligible. Those having incomes 100 percent or below the poverty guidelines were considered eligible. Households with income between 100 and 130 percent of the poverty levels were asked additional questions about deductions that could bring income within the eligibility range--payments for child care, care for disabled or elderly persons, excess medical expense, and excess rent or utilities payments.

After completion, screening interviews were mailed by interviewers to the field supervisor for review and eligibility classification of the households. The results were then transmitted to Westat's headquarters. There the eligibility classifications were verified. Households which were classified as "possibly eligible" required further processing at Westat to determine which cases were eligible.

Phase II screening to identify the rural samples of Mexican-American and American Indian households began in November 1984. The procedure was generally similar to phase I. Severe winter weather slowed screening of the American Indian households by about 6 weeks. As stated above, screening to identify the urban elderly samples was completed during phase I. Criteria for the elderly sample of households differed from those for other households. A female head was not necessary and single-person households were accepted. However, all persons in the household had to be 65 years or older at the time of the first dietary interview.

All eligible households from a site were pooled for selection of samples to participate in dietary interviews. The sample design for the study specified that the mail and telephone panels in each sample be matched as nearly as possible on the following characteristics:

--Number of persons in the household (2, 3, 4, or 5 or more).
--Age of female head (20 to 29 years, 30 to 39 years, or 40 to 50 years).
--Educational level of female head (less than high school graduation, high school graduation, or beyond high school graduation).
--Income and Food Stamp Program status (receiving food stamps by value of food stamps or not receiving food stamps by screener income category--less than 85 percent of poverty guidelines, 85 to 100 percent, 100 to 115, or 115 to 130 percent before deductions).

After sorting according to characteristics, households in phase I samples were paired. One household was assigned to the mail followup panel and the other to the telephone followup panel (Figure 8.1).

All phase II households were initially to be assigned to the telephone recall method for followup after the first quarter. Households which had had a telephone at the time of screening but no longer had one at the first dietary interview were switched to mail record procedures for the remaining quarters. However, in screening the American Indian households, 57 percent of the households were eligible for participation except for lack of a telephone. Therefore, a modified procedure was adopted. Half of the American Indian sample households selected for dietary interviews were chosen from households that had telephones and the other half of the sample households were chosen from households without telephones; the latter group was to be followed up by the mail method.

In phases I and II, 27 and 25 households, respectively, that had telephones during screening and were assigned to the telephone method, no longer had a telephone at the first in-person interview. These households were then assigned to be followed up by mail. However, after the first quarter, for households in telephone panels, participation was terminated if they no longer had a telephone. For households in the mail panels, the loss of the telephone did not preclude further participation.

8.3.4 Data Collection

Interviewer training for phase I of the project took place in a single 5-day session at Westat's headquarters in Rockville, Maryland, August 20-25, 1983. Most of the 54 interviewers attending had worked on screening interviews. Over half of the time was spent on learning to use the individual dietary intake questionnaire. The HNIS (Human Nutrition Information Service) food coding system was presented and practice was supervised as interviewers learned how to probe for adequate descriptions of kinds and amounts of foods eaten to assure proper coding. One day was devoted to training in techniques for taking the anthropometric measurements. A separate training session was conducted for telephone interviewers on September 19-22, 1983. Materials used in training field interviewers were adapted for telephone interviewers.

For phase II, local training sessions were held for the interviewers in the New Mexico and North Dakota locations. Trained interviewers from phase I interviewed the phase II urban elderly sample.

Scheduling of each household for 3 days of dietary reporting during each of four quarters was arranged to ensure that reports would be spread among different days of the week, weeks of the month, and months of the quarter. Assignments for the full year were based on the initial day. Adjustments were made as necessary during the survey, but changes were made in 7-day increments in order to maintain a reporting schedule of different but consecutive days of the week.

8.3.4.1 First Quarter Data Collection

Data collection procedures for the first quarter differed from procedures used in the subsequent three quarters. (See figure 8.2 for an outline of interview procedures.) The initial contact in the first quarter was the same for all panels. An advance letter informed the household that it had been selected for the study, described the study, noted an incentive payment of $1 per person per day for cooperation, and stated that a Westat interviewer would contact them soon.

Interviewers contacted the household in person, explained the survey, answered questions, and began the interview by administering a short household questionnaire. Then a 1-day recall of the preceding day's food intake was administered to each member of the household. The interviewer found it helpful to have a primary respondent--usually the main meal preparer--act as coordinator for participation by family members. Initial questions dealt with height, weight, dietary habits, use of vitamin/mineral supplements, followed by the detailed section about foods eaten during the day. To help specify amounts of food eaten, a set of stainless steel measuring cups and spoons and a 6-inch ruler were supplied and left in the household for use in later reporting. The interviewer also carried a set of soft plastic food models (cornbread, hamburger, and ham slice) to demonstrate use of the ruler in measuring dimensions of foods. Intakes by children under 12 years, and by other household members as necessary, were reported by adults knowledgeable about their intake.

If members were absent during the first visit, interviewers tried to arrange a return visit when they would be present. A return visit was required for the mail-followup panels. The interviewer tried to schedule the return visit when all members would be at home. For an absent member in a telephone household,

Household Screening Interview
(Sample Selection)

QUARTER ONE
(Advance letter to selected household)

Day 1 Report

Interviewer visit to household
—Explain study, invite participation
—Administer questionnaire
—Household characteristics
—Day 1 dietary recall by each individual
—Explain followup method

Mail panel

—Leave 2–day food record form
—Begin recording Day 2
—Leave Food Instruction Booklet, measuring devices
—Schedule appointment for return visit

Telephone panel

—Leave Food Instruction Booklet, measuring devices
—Leave Food and Drink List sheets
—Schedule appointment for telephone interview
—Take physical measurements

Day 2 and 3 Reports

2 days later

—Pick up and review food records
—Take physical measurements

2 weeks, 1 day, and 2 days later

—First telephone interview for Day 2 Record
—Second telephone interview for Day 3 record

QUARTERS TWO, THREE, AND FOUR

Followup by mail

Followup by telephone

Figure 8.2--Sequence of interview activities

the interviewer made an appointment to return whenever that member would be there. Personal contact with each household member was necessary to take the anthropometric measurements. When personal contact was not possible, food records were left to be completed even though individuals might be unable to report in adequate detail without assistance from an interviewer. However, two restrictions were imposed: (1) all members of the household were to report for the same days and (2) recalled intakes had to be recorded within 3 days of the actual day of intake.

Two-day food records were required in addition to the 1-day recall during the first quarter. For the mail followup panels, data for 3 consecutive days were obtained. After administering the 1-day recalls, the interviewer explained how to keep the 2-day records and gave the household a set of the measuring devices and a copy of the Food Instruction Booklet detailing how to describe food items and portions. The interviewer then helped members start the day 2 record and made an appointment to return to review and pick up the records and explain procedures for the remainder of the survey in which records were to be completed and mailed. On the return visit, measurements of height, weight, and arm circumference were taken for all members.

Interviewing procedures for the telephone followup panels differed somewhat from those for the mail followup panels. Food intake records for the second and third days of the telephone method were obtained 2 weeks later by a telephone interviewer. This gap was scheduled because the completed 1-day recalls could not be transmitted to the Westat headquarters, processed, and routed to the telephone operation for calling on the next day. Since the interviewer made only one visit to the household, height, weight, and arm circumference measurements were taken after completing the 1-day recall. The interviewer then briefed the household on the next phases of the survey; gave the household a set of measuring cups and spoons, ruler, and the Food Instruction Booklet; explained how to use them; and outlined the kinds of information the telephone interviewers would expect. The interviewer left for each household member two "Food and Drink List" sheets with name and dates for each member to record his or her intakes for day 2 and day 3. The sheets were designed to facilitate the telephone interviews. The household was told that the telephone interviewer would call on the day after the day 2 intakes were scheduled and that another call would be received the following day for the day 3 intakes. The telephone interviewer usually spoke first with the primary respondent and had him or her coordinate the interviews with the other members. A detailed description of an item was obtained only once in each household. For home-prepared items, the primary respondent usually provided this information. At the end of the first call, the interviewer arranged a time for the next day's call.

Self-reported heights and weights were obtained at the beginning of the initial interview and by actual measurements at the end of the interview--height (in inches), weight (in pounds), and arm circumference (in inches). Weight was measured using a light-weight bathroom scale (Health-O-Meter Model 32). A special plastic tape was used for measuring arm circumference (Ross Laboratories "Inser-Tape"). Adult height was measured using a device with a molded plastic frame on which a standard carpenter's tape was mounted. The infant measuring board was made of light-weight plastic and was hinged in the center so it could be fitted in the interviewer's carrying kit. The kit weighed about 10 pounds. In subsequent quarters, all participants were asked to report their weights, and participants under 20 years of age also reported their height.

8.3.4.2 Data Collection in Quarters 2, 3, and 4

Collection of data in subsequent quarters for the mail followup panel of households required separate mailings each quarter. The mailings included a cover letter, an instruction sheet, a brief household questionnaire to ascertain any changes, a 3-day food record for each member, and a postage-paid return envelope. Mexican-American households received both Spanish and English versions of the materials. The packages of materials were mailed 7 to 10 days before recording of food intake was to begin. Telephone interviewers placed advance calls to the mail follow-up households to alert them to watch for the materials. If a new person in the household was reported, a "New Person Questionnaire" was administered. Respondents were also asked if the set of measuring devices and Food Instruction Booklet were still available. If not, replacements were mailed.

The telephone followup panels of households also received materials by mail before being interviewed--a cover letter with dates for the 3-day reporting period and a set of three "Food and Drink List" sheets for each member to keep notes to help recall intake during the telephone interview. Each quarter, the interview began with the household questionnaire to identify any changes in household composition or financial condition. Before beginning the 1-day food recalls, the respondent was reminded to have the measuring devices handy, as well as the "Food and Drink List" sheets for the day. The interviewer usually asked first for the primary respondent's 1-day food recall for the preceding day, then proceeded with the other household members. This procedure was repeated on the 2 successive days. Most of phase II followup was by telephone. Procedures in phase II were essentially the same as in phase I.

8.3.4.3 Partially Responding and Nonresponding Households

In the review process, partially responding households (reporting for only 1 or 2 days) were separated from fully responding households. Reports from the partially responding households were reviewed to determine whether they should be included for another quarter.

Nonresponding households in the mail followup panels were contacted by both telephone and mail if food records had not been received 2 weeks after the scheduled reporting days. If the household reported it had not received food record forms, a new set of forms was sent. If an address was faulty, it was corrected and a second batch sent. Followup of households with no telephone was carried out by mail.

Followup of nonrespondents among the telephone panels consisted of repeated calls at different times of day until contact was made. When an interview was refused by a telephone household, a Noninterview Report Form was used to document reasons for refusal. If the refusal was not clearly firm, the case was assigned to an interviewer experienced in refusal conversion.

Households that moved between rounds of data collection were traced in several ways. Mailings were sent first class with address correction requested. Westat's toll-free telephone number was always included in all mailings, and cover letters encouraged reporting of any changes in address or telephone number. Mail households that did not return food records and did not have a telephone were treated as nonresponding households, and a followup letter was sent. For telephone households, tracing was needed if an attempt to contact the household revealed a telephone number was no longer in service. The telephone interviewer would then attempt to call "contact persons"--identified on the first quarter household questionnaire--who were apt to know how to contact the household. If telephone tracing did not succeed, a letter was mailed to the most recent address, asking the respondent to contact Westat using the toll-free number. These were last-resort tactics and were relatively nonproductive.

8.3.5 Data Preparation and Data Analysis

The survey questionnaires were sent to the Westat central office for review within 2 working days after a field supervisor received them from an interviewer. A document control system identified the status of every questionnaire. All items on the questionnaires were designed for direct data entry except for the food reports.

The food reports were coded by hand onto transcription sheets, checked, keyed, machine-edited, corrected, and entered onto data tape. The USDA Food Code Manual was used to select the proper 7-digit code to identify each food item and to calculate the number of grams ingested. Food coders alternated between mail and telephone records. About 60 food coders (separate from general coders) were trained during the study. USDA staff supplied new codes and assistance with new foods and other problem entries on food reports as needed.

After the 5-day coder training session, the trainee began coding actual survey food reports as soon as the trainee's error rate was less than 3 percent. Initially, 100 percent of the food codes and gram conversions for the 3 days of food reports from the primary respondent were verified. If an error was found, all reports of the other household members were verified to see if the error was repeated. If the error rate on a primary respondent's food report was greater than 3 percent, the entire batch for the household was 100 percent verified. As coders became more experienced, the amount of verification depended on a coder's error rate, which was calculated weekly.

Analysis of data utilized mainly descriptive statistics--means, frequency distributions, and percentages. Student's t was used to test the significance of differences between means.

8.4 Main Findings and Discussion

This section summarizes the results of testing mail and telephone procedures for obtaining dietary intake data from low-income people in terms of (1) differences in response rates, (2) estimates of respondent burden, and (3) several measures of the quality of dietary intake data obtained. The effects of two special conditions--lack of a telephone and time committed to survey participation--on dietary intake reporting are described. The last part reports comparisons of interviewer-measured and self-reported height and weight and interviewer-measured arm circumference.

8.4.1 Response Rates

Several types of response rate were calculated. These included response rates for the screening questionnaires, two types of response rate for households--overall and within each quarter--for partially responsive households, for individuals, and for two special samples. Response rates related to household characteristics and sex-age groups were reported.

8.4.1.1 Screening Response Rates

Screening response rates were calculated by dividing the number of completed screeners (screening questionnaires) by the total number of screeners assigned, excluding those for unoccupied and vacant dwelling units. In phase I, the screening response rate was lowest in Philadelphia at 79 percent (Table 8.1). The response rate for Los Angeles (83 percent) reflected screening difficulties during the survey scheduling which allowed little time for nonresponse conversion. The percentage of screened households which met eligibility criteria was lowest at the Los Angeles site. The percentage of income eligible households receiving food stamps ranged from 40 percent in Missouri to 70 percent in Philadelphia (Table 8.2). Households otherwise eligible for the survey but lacking a telephone ranged from 30 percent in Philadelphia to 56 percent in Florida. Screening response rates in phase II were 93 percent for the Mexican-American households and 85 percent for the American Indian households. Characteristics of the 2,142 households in

Table 8.1—Screening response rates, Phase I

Site	Households						
	Total households	Sample loss	Complete, ineligible	Complete, eligible	Other refusal	NIR[1]	Response rate
	Number						Percent
Philadelphia...	2,443	595	1,046	406	180	216	78.6
Florida........	4,271	619	2,509	[2]892	136	115	93.1
Los Angeles....	4,618	360	3,188	367	353	350	83.4
Missouri.......	4,242	580	2,896	477	124	165	92.1
El Paso........	1,269	121	840	265	33	10	96.3
South Carolina.	1,165	146	796	170	26	27	94.8
TOTAL.......	18,008	2,421	11,275	2,577	852	883	88.9

[1]NIR = Noninterview report
[2]395 with telephones; 497 without telephones.

Table 8.2--Food stamp receipt and telephone status of screened households, Phase I

Sample	Eligible households receiving food stamps		Households eligible except for lack of telephone	
	Percent	Number	Percent	Number
Urban black (Philadelphia)....	69.7	406	30.2	582
Rural black (Florida):				
With telephone............	45.1	395	--	--
Without telephone..........	65.0	497	--	--
All......................	--	--	55.7	892
Urban white (Los Angeles).....	53.7	367	30.5	528
Rural white (Missouri)........	39.6	477	38.5	775
Urban Mexican-American (El Paso)....................	38.5	265	31.7	388
Rural black (South Carolina)..	47.6	170	47.4	323
TOTAL......................	52.5	2,577	40.4	3,488

phase I and the 681 households in phase II selected for dietary interviewing are shown in Table 8.3.

8.4.1.2 Household Response Rates

A household was defined as responsive if at least one member completed a 24-hour food record. Two types of household response rate were computed. An "overall" response rate to evaluate losses over the year was based on the number of households at the beginning of the survey (number of cooperating households divided by number of households in the survey at the start of the first quarter). "Within-quarter" response rates were based on the number of households contacted during each quarter and indicated losses during succeeding quarters. A household was not contacted in a quarter unless it had cooperated in the preceding quarter.

The response rates for the telephone and mail panels in phase I for each of the 3 days in each of the four quarters for each panel and all panels are shown in Table 8.4. The overall response rate for the combined telephone panels at the end of the fourth quarter was 47 percent, more than twice that for the mail panels (22 percent). By the end of the fourth quarter, the overall response rate for the telephone panels varied from 40 percent for urban whites in Los Angeles to 62 percent for Mexican-Americans in El Paso. The response rate for the first day of the first quarter for both panels and for combined samples was 82 percent. The same in-person method was used for all panels on the first day. The rates declined 3 to 6 percentage points for the second and third days, falling less for the mail followup panels than for the telephone followup panels, probably reflecting the

Table 8.3--Characteristics of households selected for dietary intake interview

Phase, sample	Households	Average persons per household	Age of female head (years): 20-29	30-39	40-50	Education of female head: Under 12 years	12 years and over	Food stamp status: Recipient	Nonrecipient
	------Number------		------Percent------						
Phase I									
Urban black (Philadelphia)..	404	4.3	30	41	29	46	54	71	29
Rural black (Florida):									
With telephone...........	386	4.8	22	42	36	42	58	47	53
Without telephone........	150	4.6	51	27	22	49	51	61	39
Urban white (Los Angeles)...	363	3.6	44	35	22	32	68	54	46
Rural white (Missouri)......	450	3.9	30	39	31	52	48	40	60
Urban Mexican-American (El Paso)..................	226	4.9	26	37	37	75	25	39	61
Rural black, no followup (South Carolina)...........	163	4.8	18	41	41	51	49	49	51
TOTAL....................	2,142	4.3	31	38	31	48	52	52	48
Phase II									
Rural Mexican-American (New Mexico)...............	225	5.2	30	33	37	73	27	36	64
Rural American Indian (North Dakota).............	226	5.0	47	32	21	45	55	57	43
Urban White Elderly (Los Angeles)..............	115	1.2	([1])	([1])	([1])	([2])	([2])	0	100
Urban Black Elderly (Philadelphia).............	115	1.3	([1])	([1])	([1])	([2])	([2])	27	73
TOTAL....................	681	3.8	39	33	29	59	41	35	65

[1] For elderly persons, age was 65 years and over.
[2] Information was unavailable for elderly households.

Table 8.4—Household response rates by quarter, day, sample, and panel

Phase, sample, panel, rate	Day in quarter 1: 1	2	3	Day in quarter 2: 1	2	3	Day in quarter 3: 1	2	3	Day in quarter 4: 1	2	3
	Percent											
Phase I												
Urban blacks:												
Phone:												
Overall..........	78	70	69	59	57	57	47	45	45	43	42	42
Within quarter...				85	82	81	81	84	78	92	90	90
(Number)	(200)			(139)			(116)			(92)		
Mail:												
Overall..........	76	70	72	23	23	23	19	19	19	15	15	15
Within quarter...				32	32	32	72	72	70	80	80	80
(Number)	(204)			(147)			(47)			(39)		
Rural blacks:												
Phone:												
Overall..........	88	81	80	65	63	62	55	54	53	50	50	49
Within quarter...				80	77	76	85	83	82	91	90	89
(Number)	(187)			(152)			(121)			(103)		
Mail:												
Overall..........	88	84	81	35	35	34	25	25	25	20	20	20
Within quarter...				44	44	44	73	73	73	75	75	75
(Number)	(199)			(168)			(73)			(56)		
Urban whites:												
Phone:												
Overall..........	85	75	74	62	62	61	50	48	48	41	41	40
Within quarter...				82	82	81	80	77	77	83	83	82
(Number)	(171)			(129)			(106)			(84)		
Mail:												
Overall..........	87	83	82	35	35	35	22	22	22	16	16	16
Within quarter...				41	41	41	58	58	58	69	69	69
(Number)	(192)			(162)			(67)			(42)		
Rural whites:												
Phone:												
Overall..........	74	71	71	61	59	59	52	51	51	49	49	49
Within quarter...				85	83	83	87	85	85	94	94	94
(Number)	(221)			(157)			(133)			(115)		

Continued

Table 8.4—Household response rates by quarter, day, sample, and panel--Continued

Phase, sample, panel, rate	Day in quarter 1			Day in quarter 2			Day in quarter 3			Day in quarter 4		
	1	2	3	1	2	3	1	2	3	1	2	3
	Percent											
Phase I												
Rural whites:												
Mail:												
Overall..........	68	66	65	44	44	44	35	35	35	30	30	30
Within quarter....				67	67	67	79	79	79	83	83	83
(Number)	(229)			(150)			(101)			(81)		
Urban Mexican-Americans:												
Phone:												
Overall..........	95	91	90	82	77	76	67	67	67	62	62	62
Within quarter....				91	86	85	84	84	84	93	93	93
(Number)	(109)			(98)			(87)			(73)		
Mail:												
Overall..........	93	92	92	46	46	46	32	32	32	27	27	27
Within quarter....				50	50	50	70	70	70	87	87	87
(Number)	(117)			(108)			(53)			(37)		
Rural S.C. blacks:												
Mail:												
Overall..........	86	86	85									
(Number)	(163)											
Total all panels:												
Phone:												
Overall..........	82	76	75	64	62	62	53	52	52	48	48	47
Within quarter....				84	82	81	84	81	81	91	90	90
(Number)	(888)			(675)			(563)			(467)		
Mail:												
Overall..........	81	78	78	36	36	36	27	27	27	22	22	22
Within quarter....				47	47	47	72	72	72	79	79	79
(Number)	(1,104)			(735)			(341)			(255)		

Continued

Table 8.4--Household response rates by quarter, day, sample, and panel--Continued

Phase, sample, panel, rate	Day in quarter 1			Day in quarter 2			Day in quarter 3			Day in quarter 4		
	1	2	3	1	2	3	1	2	3	1	2	3
	Percent											
Phase II												
Rural Mexican-Americans:												
Phone:												
Overall..........	93	86	86	80	79	79	72	72	71	66	66	66
Within quarter....				90	89	89	91	91	90	92	92	92
(Number)	(220)			(195)			(174)			(158)		
Rural American Indians:												
Phone:												
Overall..........	90	80	79	58	57	57	50	50	50	34	34	34
Within quarter....				70	69	69	86	86	86	68	68	68
(Number)	(101)			(84)			(58)			(50)		
Mail:												
Overall..........	85	77	77	13	13	13	7	7	7	6	6	6
Within quarters...				15	15	15	56	56	56	89	89	89
(Number)	(125)			(105)			(16)			(9)		
Elderly urban white:												
Phone:												
Overall..........	76	73	70	60	60	60	50	50	50	49	49	49
Within quarter....				80	78	78	82	82	82	94	94	94
(Number)	(109)			(83)			(66)			(54)		
Elderly urban black:												
Phone:												
Overall..........	81	73	68	62	60	57	53	52	51	47	47	47
Within quarter....				80	77	73	86	83	83	91	91	91
(Number)	(113)			(88)			(70)			(58)		

pickup visits by the interviewers in the case of the former and the 2-week lapse before telephone interviewer calls in the case of the latter.

In the second quarter, the combined mail panels suffered a steep decline in response rate (81 to 36 percent), but the attrition rate in later quarters was less (Table 8.4). The telephone and mail panels for rural whites in Missouri were exceptions. Those panels had the lowest response rates of all panels in the first quarter, but the rates decreased less in subsequent quarters, and the Missouri mail panel ended up with the highest year-end response rate among mail panels (30 percent). Mail respondents, if they returned the food record at all, usually completed all 3 days, as shown by the same response rate for all 3 days in the table.

For the telephone panels, the attrition rates were about the same in the second and third quarters, but less in the fourth quarter (Table 8.4). About 5 to 15 percent of the households were lost during each quarter. By the fourth quarter, the overall response rate for telephone panels was 47 percent. Telephone response rates varied from day to day because there was more opportunity for nonresponse. Rural sites tended to have higher response rates than urban for both mail and telephone panels.

In phase II, the rural Mexican-American sample in New Mexico, a telephone panel, had the highest year-end response rate of all samples (66 percent), even higher than those in phase I (Table 8.4). The two elderly urban telephone samples (blacks in Philadelphia and whites in Los Angeles) had higher overall response rates than the nonelderly urban samples from the same cities in phase I. Westat noted that several factors contributed to the higher response rates. The elderly were the easiest of all samples to interview. They were in small households, were easier to reach at home, and were more willing to cooperate than younger individuals. However, telephone interviewers experienced several difficulties in collecting food intake information from the elderly sample. They discovered that some of the elderly had hearing problems, did not understand the task required, and could not differentiate one day's meals from another day's in dietary recall. Also, some were too ill or frail to take part in the survey. During the study, 8 died and 39 had to discontinue participation because of illness.

Response rates for the rural American Indians in North Dakota were similar for both panels in the first quarter and compared favorably with other samples. However, in the second quarter the response rate for the mail followup panel of American Indians fell so drastically (to 13 percent) that it could no longer be included in the analyses. In the first quarter, interviewing of the American Indian sample encountered difficulties and took longer than the other two phase II samples. Local interviewer attrition during the first few weeks was very high, and interviewers from other sites had to be sent to North Dakota to finish the first quarter's in-person interviews. The telephone followup panel of American Indians had response rates comparable to the urban elderly samples in the second and third quarters but fell off in the last quarter, apparently because their interviews were scheduled so late and not because of lack of cooperation. Westat concluded that the heavy attrition in the second quarter suggests that telephone interviewing alone is not acceptable for repeated data collection for the American Indian population.

8.4.1.3. Partial and Nonresponding Households

The largest number of partial respondents occurred in the first quarter (and between the first and second days of reporting) and the number diminished with each succeeding quarter (Table 8.5). In-person interviewers on the first day were apparently persuasive enough to obtain cooperation from reluctant households at least for 1 day. There were fewer partial responders among the mail followup panels during the third and fourth quarters, indicating that respondents who completed recording for 1 day usually did so for all 3 days. Mail respondents who filled out forms for 1 or 2 days but did not return them had to be classified as nonresponders rather than partial responders. The number of partial responders providing complete records in later quarters was small--only 2 of the 27 mail partial responders and 14 of the 35 telephone partial responders. In retrospect, Westat concluded that a more effective procedure would be to drop households that were partial responders in the first quarter, then attempt to reinterview only those who cooperated fully at least once even though they might become partial responders in subsequent quarters.

Nonresponse by the mail followup panels (Table 8.6) may have been affected by the fact that a number of the households reported not receiving forms in the mail (over 50 households for the first quarter). Westat speculated that the package of materials might have been too large to fit into mailboxes, especially in inner city areas. If left near the mailboxes, it might not have been found or claimed by the respondent.

Followup of nonrespondents in telephone panels required repeated calls. The first day in each quarter required the most calls before contact was made (3.3 calls, on average, in the first quarter and 5.2 calls in the last quarter). The second and third days were usually completed in one or two calls for each day. During the first quarter, 55 percent of the household interviews for the first day were completed in one or

Table 8.5--Results of attempts to interview households that responded only 1 or 2 days during the preceding quarter (partial respondents), all sites

Panel method, quarter	Partially responsive households: Previous quarter	Attempted in new quarter	Completed in new quarter
	Number		
Telephone:			
Quarter 2.........	64	10	4
Quarter 3.........	22	15	5
Quarter 4.........	13	10	5
Mail:			
Quarter 2.........	53	22	1
Quarter 3.........	3	3	0
Quarter 4.........	2	2	1

Table 8.6--Followup for mail household nonresponse

Followup stage, action	Quarter 2	Quarter 3	Quarter 4
	Number		
First call:			
Households contacted........	326	106	60
Households completed........	59	42	25
Second call:			
Households contacted........	125	26	--
Households completed........	19	2	--
Letter:			
Households contacted........	124	52	20
Households completed........	15	31	7

two calls; almost 86 percent of the interviews for the third day were completed in one or two calls. The pattern was similar in subsequent quarters.

Refusal conversion of telephone households reached no higher than 17 percent during the first three quarters but was 28 percent in the fourth. The primary reason for refusals appeared to be the cumulative burden of reporting--3 consecutive days each quarter for four quarters meant a total of 12 days for each household member. Respondents reported they were "too busy," "had no time," "were tired of it," or simply did not want to continue. Some mentioned the "hassle" of arranging for all members of the household to report. Refusals often were preceded by delay and avoidance on the part of the household. Some respondents in the telephone followup group preferred to recall all food eaten on all 3 days during a single call. This sometimes resulted in a long and tiring interview. If the primary respondent reported for all household members, this person might well feel overburdened. The primary respondent was especially important in the less cohesive families having members who spent little time at home. It was more difficult for primary respondents in inner city areas than in rural areas to arrange for all members to participate directly.

The tracing efforts for three quarters disclosed that 8 percent of the telephone households were lost. Actually many of these respondents were still at the same address. After their telephones were disconnected, they did not contact Westat.

8.4.1.4 Response Rates for Individuals

The response rates for individuals in the households were similar to those for households. The overall response rate was determined by dividing the number of individuals with completed forms by the number of individuals in the initial sample of households. If households cooperated, all members of the households usually cooperated. The overall cooperation rates for individuals for the first day of each quarter are shown in Table 8.7.

Table 8.7--Response rates for individuals on first day of each quarter by phase, sample, and panel

Phase, sample	Day one panel and quarter: Telephone panel, Initial size	Telephone panel, Quarter 1	Telephone panel, Quarter 2	Telephone panel, Quarter 3	Telephone panel, Quarter 4	Mail panel, Initial size	Mail panel, Quarter 1	Mail panel, Quarter 2	Mail panel, Quarter 3	Mail panel, Quarter 4
	Number	----Percent------				Number	----- Percent-----			
Phase I										
Urban blacks, Philadelphia..	889	69	54	42	39	858	66	22	18	15
Rural blacks, Florida.......	913	79	58	48	43	935	82	37	29	23
Urban whites, Los Angeles...	626	79	58	45	38	695	81	32	21	16
Rural whites, Missouri......	863	70	58	49	47	881	64	43	34	30
Urban Mexican-American, El Paso....................	530	88	76	63	59	585	91	45	32	27
Rural blacks, South Carolina..................						777	79	--	--	--
TOTAL....................	3,821	76	59	48	44	4,731	76	35	27	22
Phase II										
Rural Mexican-Americans, New Mexico................	1,130	86	73	66	62	--	--	--	--	--
Rural American Indians, North Dakota...............	540	78	48	40	28	596	73	12	7	7
Elderly, Urban white, Los Angeles................	126	71	56	47	46	--	--	--	--	--
Elderly, Urban black, Philadelphia..............	149	74	60	54	44	--	--	--	--	--
TOTAL....................	1,945	76	64	57	50	--	--	--	--	--

By the end of the last quarter of phase I, 44 percent of the individuals in the telephone followup panel were still participating, compared with 22 percent of the mail panel and 50 percent of the phase II telephone panel. Overall, 76 percent of the individuals participated on the first day of the first quarter. About 3 percent of the sample could not be located or had died between the screening contact in July 1983 and the beginning of interviewing in September 1983. Sample loss because of moving or death varied from 2 to 4 percent each quarter.

8.4.1.5 Response Rates for Special Samples

The overall response rates were similar for the special sample of rural black households in Florida without telephones and the mail panel of rural black households in Florida with telephones in the first quarter. But for the subsequent three quarters, they were significantly ($p \leq 0.05$) different, the no-telephone sample having lower response rates (Table 8.8). Followup in subsequent quarters was by mail in both samples. Analysis disclosed that the no-telephone

Table 8.8--Overall household response rates for Florida mail panels; telephone and no-telephone samples, by quarter

Quarter	Response rates-- With telephone	Response rates-- Without telephone
	---------Percent---------	
1	87	89
2	51*	33*
3	41*	21*
4	35*	18*

*Significantly different at $p \leq 0.05$.

sample was younger, less well educated, and more likely to be receiving food stamps than the panel with telephones.

The response rate of the special sample of rural black households in South Carolina, which was committed to one quarter of participation was compared with that of the rural black Florida mail followup panel with telephones, which was committed to participate in four quarters. No relationship between length of commitment and response rate was found.

8.4.1.6 Response Rates Relative to Household Characteristics and Sex-Age Groups

Response rates for phase I panels were examined to determine if they were related to selected household characteristics--age and educational level of female household head, household size, and Food Stamp Program status. In the first quarter, households receiving food stamps had a significantly higher ($p \leq 0.05$) response rate than those not receiving stamps. In phase II panels, food stamp status apparently had little relationship to response rates. However, response rates in the last two quarters for rural Mexican-American female heads of household with 12 or more years of education were significantly ($p \leq 0.05$) higher than for heads with less education. In the first quarter panels of American Indians, the largest households and those with female heads 30 to 39 years of age in the mail panel had lower response rates than matching households in the telephone panel. By the fourth quarter of phase I, males 13 to 19 years of age had the lowest response rate (38 percent) among sex-age groups in the telephone panels and females over 50 years (8 percent) had the lowest rate in the mail panels. In the first quarter, males 20 to 50 years of age had the lowest response rate for both the telephone and mail panels (60 and 62 percent, respectively). In the phase II American Indian panels, males 13 to 19 years had the lowest response rate (64 percent) of all sex-age groups during the first quarter. However, by the last quarter their response rate was similar to that of most of the other groups. The males over 50 years had the highest response rate (62 percent). The rural Mexican-Americans had the highest response rates of all samples for most sex-age groups in both the first and last quarters.

Respondents and nonrespondents were compared for each panel method to determine if the characteristics of panel members had changed significantly by the end of the study. Few differences were found between responding and nonresponding households and among distributions of sex-age groups. Therefore, Westat concluded that differences in results could be attributed to differences in methods and not to differences in the panel members.

8.4.2 Respondent Burden

Respondent burden was measured in two ways: the length of time the respondent spent in completing a food record and the type of assistance the respondent received in providing dietary information. The first day recall, administered by the interviewer in a home visit, was excluded from comparisons because it was the same for both panel methods. The amount of other respondent time was computed differently for the two panel methods. The mail respondents recorded at the end of the schedule the length of time it took to complete the record. Telephone interviewers recorded the beginning and ending times of each interview with telephone respondents, but time spent by respondents in keeping notes on the "Food and Drink List" sheets was not included.

Respondent burden appeared to be heavier for respondents in the mail panels (14 to 17 minutes) than in the telephone panels (4 to 11 minutes) in phase I. Reporting time tended to decrease as the survey progressed and respondents in both panel methods gained expertise. The elderly urban telephone panel required, on average, almost twice as much time to complete a food record as nonelderly panels did. The reasons for the longer time were related to the small size of most households--often only one person. In larger households, the primary respondent usually gave the detailed descriptions of food items eaten in the household so that intakes of other members could be cross-referenced to this description to save time. This contributed to the lower average time per person for nonelderly panels.

The extent of assistance given to individuals in order to help them complete the food record could lighten the burden for some respondents but increase the burden for others. Assistance was recorded as (1) self-reported entirely, (2) self-reported with help, and (3) surrogate-reported. Individuals under 12 years were excluded from the analysis since surrogate respondents usually supplied information for them. In phase I, 73 to 77 percent of mail respondents were unassisted and 42 to 60 percent of the telephone respondents were unassisted (Table 8.9). About one quarter of the telephone panel reports were by a surrogate, whereas surrogate respondents were reported less frequently by mail panels. In phase II, self-reporting was high for the elderly (70 to 90 percent), apparently because many had no one else to report for them, and low for the nonelderly (Table 8.10).

8.4.3 Appraisal of Quality of Dietary Data

The completeness and general quality of the dietary intake data provided by the mail and telephone panels were compared. The measures of data quality used to compare the two methods were (1) the mean number of food items reported per day, (2) the mean number of incomplete descriptions of food items, (3) the mean number of inadequate portion amounts

Table 8.9--Self-reporting and surrogate status by quarter, panel, and sample, Phase I

Sample, reporting status	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	Mail	Phone	Mail	Phone	Mail	Phone	Mail	Phone	Mail	Phone
	Percent									
Urban blacks (Philadelphia):										
Self-report..........	82.4	65.0	75.5	47.2	81.2	45.7	74.7	43.0	79.9	51.9
Self-report with help	4.5	10.3	3.8	29.9	2.9	31.0	6.4	28.0	4.4	23.3
Surrogate...........	13.1	24.7	20.7	22.9	15.9	23.4	18.9	29.0	15.7	24.8
(Number)............	(971)	(1,060)	(343)	(860)	(276)	(668)	(233)	(635)	(1,823)	(3,223)
Urban Mexican-Americans (El Paso):										
Self-report..........	70.9	54.1	75.0	39.1	75.0	43.1	81.4	35.8	73.9	43.9
Self-report with help	9.1	25.4	8.1	33.5	6.9	32.3	2.4	34.2	7.6	30.9
Surrogate...........	20.0	20.5	16.9	27.3	18.1	24.6	16.2	30.0	18.5	25.2
(Number)............	(1,064)	(897)	(509)	(772)	(360)	(650)	(290)	(617)	(2,223)	(2,936)
Rural blacks (Florida):										
Self-report..........	74.8	62.3	73.1	46.8	75.4	42.6	59.9	41.0	72.5	49.9
Self-report with help	8.2	12.4	5.2	28.8	3.9	30.0	8.8	26.9	6.9	23.2
Surrogate...........	4.2	25.4	21.7	24.4	20.7	27.4	31.3	32.1	20.6	26.9
(Number)............	(1,338)	(1,254)	(618)	(971)	(459)	(813)	(387)	(729)	(2,802)	(3,767)
Urban whites (Los Angeles):										
Self-report..........	77.8	61.8	77.4	50.7	74.8	49.4	78.4	49.5	77.3	53.9
Self-report with help	7.2	12.6	11.9	24.3	5.3	25.6	8.2	21.7	8.1	20.2
Surrogate...........	15.0	25.5	10.7	25.0	19.8	25.0	13.4	28.8	14.6	25.9
(Number)............	(947)	(783)	(402)	(625)	(262)	(512)	(194)	(420)	(1,805)	(2,340)
Rural whites (Missouri):										
Self-report..........	77.7	56.0	80.2	41.7	77.1	41.2	74.8	40.9	77.8	45.8
Self-report with help	11.6	16.3	11.0	35.4	12.7	36.5	13.1	32.0	11.9	29.0
Surrogate...........	10.6	27.7	8.9	23.0	10.2	22.3	12.1	27.2	10.3	25.2
(Number)............	(1,127)	(1,213)	(757)	(1,018)	(581)	(852)	(473)	(820)	(2,938)	(3,903)
TOTAL, all panels:										
Self-report..........	76.5	59.9	76.5	44.8	76.6	43.9	72.8	41.5	76.0	48.8
Self-report with help	8.3	15.2	8.3	30.8	7.2	31.6	8.5	29.1	8.1	25.6
Surrogate...........	15.2	25.0	15.3	24.4	16.3	24.5	18.7	29.4	15.9	25.6
(Number)	(5,447)	(5,207)	(2,629)	(4,246)	(1,938)	(3,495)	(1,577)	(3221)	(11,591)	(16,169)

Table 8.10--Self-reporting and surrogate status by quarter, panel, and sample, Phase II

Panel, sample, reporting status	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	Percent			
Telephone:				
Rural Mexican-Americans (New Mexico):				
Self-report	36	23	24	23
Self-report with help	25	24	30	32
Surrogate	39	53	46	45
Total	100	100	100	100
(Number)	(2,742)	(2,416)	(2,190)	(2,087)
Rural American Indians (North Dakota):				
Self-report	33	24	26	25
Self-report with help	15	30	38	46
Surrogate	52	46	36	28
Total	100	100	100	100
(Number)	(1,177)	(767)	(646)	(454)
Urban white elderly (Los Angeles):				
Self-report	85	82	88	90
Self-report with help	3	1	1	1
Surrogate	12	16	11	9
Total	100	100	100	100
(Number)	(255)	(210)	(174)	(174)
Urban black elderly (Philadelphia):				
Self-report	77	70	73	73
Self-report with help	6	2	12	7
Surrogate	17	28	16	20
Total	100	100	100	100
(Number)	(302)	(256)	(239)	(198)
Mail:				
Rural American Indian (North Dakota):				
Self-report	37	--	--	--
Self-report with help	7	--	--	--
Surrogate	56	--	--	--
Total	100	--	--	--
(Number)	(1,159)	--	--	--

requiring use of default values, and (4) the mean day's intakes of food energy and nutrients (protein, calcium, iron, vitamin A, and vitamin C). Data were weighted to hold constant the number of persons in each sex-age group on each day of the week.

Overall, the average error rate for all food item coders was less than 1 percent of all data items coded. Food coding problems arose primarily from questionable or unreasonable entries that would have required respondent input in order to resolve them. School lunch items and mail records were involved most often. Westat reasoned that since data retrieval by telephoning the respondents might have alienated or challenged them and also could have confounded the results for the mail panels, few callbacks should be made. A mail food record took, on average, 31.4 minutes to code, compared with 28.5 minutes for a telephone food record. More line items were reported per record, on average, by the telephone panel than by the mail panel; but each telephone case took less time to code. Thus, noted Westat, an interviewer-administered food record was easier to code than a respondent-kept food record because the quality of response was better.

Westat cautioned that both mail and telephone data collection procedures have multiple sources of error since not all respondents have good memories, adequately describe foods, or accurately estimate quantities eaten. Westat assumed that a higher level of reporting for certain measures was closer to the actual or the preferred method because underreporting of items was considered such a pervasive source of error.

8.4.3.1 Number of Food Items Reported

Between-method comparisons of number of food items reported per day per record indicated that respondents in telephone panels reported significantly ($p \leq 0.05$) more items than did respondents in mail panels (Table 8.11). The rural black Florida mail panel in the fourth quarter was an exception. Generally, differences were smaller among rural panels than among urban ones. Quarterly means for the numbers of food items remained about constant, although the rural white Missouri panel showed a decline from quarter to quarter.

The day-to-day differences in mean number of line items within each quarter were also examined to determine if the level of reporting deteriorated. Slightly more items tended to be reported on the first day of each quarter than on succeeding days in both telephone and mail panels (Table 8.12).

8.4.3.2 Number of Inadequate Food Descriptions and Portion Sizes

Foods inadequately described were given a code indicating that the item was not further specified (NFS). Variations in the frequency with which the NFS codes were used provided the basis for comparisons of the two data collection methods. Telephone respondents reporting with the assistance of an interviewer had significantly ($p \leq 0.05$) fewer inadequately described items than did mail respondents (Table 8.13). The mail panels had a considerable increase in the number of inadequate descriptions between the first and second quarters (reflecting the change from interviewer-assisted to self-reported food records), but less variation thereafter. The telephone panels showed little fluctuation from quarter to quarter and fewer codes designating inadequate descriptions. Foods with inadequate specification of quantities eaten were given a default value. The frequency of default values was the basis for a comparison between methods, again using

Table 8.11--Comparison of food items reported per day by samples and panels each quarter and phase

Phase, sample, quarter	Method		Difference
	Mail	Telephone	
	Mean number of items		
Phase I			
Urban blacks, Philadelphia:			
Quarter 1	10.36	11.50	-1.14*
Quarter 2	9.77	12.28	-2.51*
Quarter 3	10.29	12.03	-1.74*
Quarter 4	10.06	12.27	-2.21*
Overall mean	10.12	12.02	-1.9
Rural blacks, Florida:			
Quarter 1	11.44	11.81	- .37*
Quarter 2	11.48	11.55	- .07
Quarter 3	11.42	11.73	- .31*
Quarter 4	11.58	11.34	.24
Overall mean	11.48	11.61	- .13*
Urban whites, Los Angeles:			
Quarter 1	11.46	12.67	-1.21*
Quarter 2	10.98	12.76	-1.78*
Quarter 3	10.85	13.43	-2.58*
Quarter 4	11.63	13.13	-1.50*
Overall mean	11.23	13.00	-1.77
Rural whites, Missouri:			
Quarter 1	13.29	13.77	- .48*
Quarter 2	12.90	13.08	- .18
Quarter 3	12.66	13.20	- .54*
Quarter 4	12.51	13.34	- .83*
Overall mean	12.84	13.35	- .51
Urban Mexican-Americans, El Paso:			
Quarter 1	12.46	12.76	- .30*
Quarter 2	11.44	12.68	-1.24*
Quarter 3	12.16	13.17	-1.01*
Quarter 4	12.00	13.05	-1.05*
Overall mean	12.01	12.91	- .90
Total phase I:			
Quarter 1	11.81	12.48	- .67*
Quarter 2	11.36	12.43	-1.07*
Quarter 3	11.50	12.65	-1.15*
Quarter 4	11.56	12.53	-1.00*
Overall mean	11.56	12.53	- .97

Continued

Table 8.11--Comparison of food items reported per day by samples and panels, each quarter and phase--Continued

Phase, sample, quarter	Method		Difference
	Mail	Telephone	
	Mean number of items		
Phase II[1]			
Rural Mexican-Americans, New Mexico:			
Quarter 1		12.79	
Quarter 2		12.49	
Quarter 3		12.72	
Quarter 4		12.85	
Overall mean		12.71	
Rural American Indians, North Dakota:			
Quarter 1		12.26	
Quarter 2		13.45	
Quarter 3		13.37	
Quarter 4		12.85	
Overall mean		12.84	
Urban white elderly, Los Angeles:			
Quarter 1		14.26	
Quarter 2		14.10	
Quarter 3		13.84	
Quarter 4		14.03	
Overall mean		14.06	
Urban black elderly, Philadelphia:			
Quarter 1		13.32	
Quarter 2		14.16	
Quarter 3		14.28	
Quarter 4		13.81	
Overall mean		13.89	

[1]Only telephone panels participated during 4 quarters in phase II.
*Significantly different at $p \leq 0.05$.

Table 8.12--Food items reported per day for each of the 12 days of the survey by phase, sample, and panel

Phase, sample, panel	Day in the survey											
	1	2	3	4	5	6	7	8	9	10	11	12
	Mean number											
Phase I												
Urban blacks:												
Mail.............	10.88	9.80	10.30	9.85	9.87	9.59	10.32	10.57	9.99	10.41	10.20	9.58
Phone............	10.81	12.27	11.51	12.69	12.29	11.85	12.61	11.82	11.63	12.28	12.29	12.25
Rural blacks:												
Mail.............	12.15	11.07	11.03	11.52	11.72	11.21	11.96	11.27	11.00	11.57	11.72	11.45
Phone............	12.17	11.76	11.45	11.83	11.48	11.32	11.87	11.93	11.40	11.48	11.09	11.44
Urban whites:												
Mail.............	12.07	11.23	11.06	11.07	10.94	10.93	10.93	10.92	10.69	11.83	12.19	10.85
Phone............	12.61	12.91	12.51	13.13	12.41	12.74	13.84	13.47	12.97	13.12	13.36	12.92
Rural whites:												
Mail.............	14.33	12.75	12.68	13.32	12.93	12.45	12.87	12.57	12.53	12.54	12.43	12.55
Phone............	14.04	13.64	13.60	13.28	12.90	13.07	13.12	13.36	13.12	13.63	13.28	13.12
Urban Mexican-Americans:												
Mail.............	13.10	12.33	11.92	11.35	11.64	11.33	12.34	12.65	11.45	12.72	11.90	11.33
Phone............	13.14	12.79	12.29	12.70	12.87	12.48	13.15	13.18	13.18	13.10	12.92	13.12
Phase II												
Rural Mexican-Americans (New Mexico):												
Phone...........	12.47	12.98	12.98	12.59	12.42	12.46	12.71	12.64	12.81	13.07	13.01	12.47
Rural American Indians (North Dakota):												
Phone...........	12.13	13.76	14.24	13.32	13.55	13.46	13.27	13.26	13.58	13.03	12.71	12.82
Mail............	11.77	10.82	10.91	--	--	--	--	--	--	--	--	--

Continued

Table 8.12--Food items reported per day for each of the 12 days of the survey by phase, sample, and panel--Continued

Phase, sample, panel	Day in the survey											
	1	2	3	4	5	6	7	8	9	10	11	12
	Mean number											
Phase II												
Urban Elderly:												
White (Los Angeles):												
Phone........	14.70	14.20	13.80	14.12	14.13	14.06	13.79	13.59	14.15	13.81	13.74	14.52
Black (Philadelphia):												
Phone........	12.77	13.87	13.35	14.35	14.09	14.03	14.50	14.57	13.76	13.41	14.10	13.93

means. Mail reports required use of the default code significantly ($p \leq 0.05$) more often than did telephone reports (Table 8.13).

Several problems were noted in the field interviewing operations. One in the first quarter concerned the return visits to pick up and review the food diaries for days 2 and 3 among the mail followup group. Interviewers often found that respondents missed appointments or that food diaries were incomplete. If so, the interviewer had to administer a recall or repeat instructions for completing the forms. In comments in the margins, interviewers often mentioned the poor reading and writing ability of many respondents and that they would have difficulty in

Table 8.13—Inadequate food descriptions and food quantities by phase, sample, panel, and quarter

Phase, sample	Food descriptions: Mail	Food descriptions: Telephone	Food descriptions: Difference	Food quantities: Mail	Food quantities: Telephone	Food quantities: Difference
	Mean number					
Phase I, four quarters						
Urban blacks, Philadelphia...	3.32	2.13	1.19*	1.75	.47	1.28*
Rural blacks, Florida........	4.06	2.63	1.43*	1.80	.46	1.34*
Urban whites, Los Angeles....	2.78	1.93	.85*	.92	.37	.55*
Rural whites, Missouri.......	2.93	2.39	.54*	.72	.32	.40*
Urban Mexican-Americans, El Paso....................	3.73	1.91	1.82*	1.79	.44	1.35*
Total, phase I..............	3.39	2.23	1.16*	1.41	.41	1.00*
Phase II, quarters 1 and 4						
Rural Mexican-American, New Mexico:						
Quarter 1.................		1.60	--		.52	--
Quarter 4.................		2.20	-.60*		.33	.19*
Rural American Indians, North Dakota:						
Quarter 1.................		1.93	--		.34	--
Quarter 4.................		1.87	.06		.21	.13*
Urban white elderly, Los Angeles:						
Quarter 1.................		2.58	--		.51	--
Quarter 4.................		2.23	.35		.45	.06
Urban black elderly, Philadelphia:						
Quarter 1.................		2.57	--		.56	--
Quarter 4.................		2.25	.32		.60	- .04

*Significantly different at $p \leq 0.05$.

Table 8.14—Energy and nutrient intakes per individual per day by phase, sample, and panel

Phase, sample, nutrient	Panel[1]		Difference
	Mail	Telephone	
	------Mean intake-------		
Phase I			
Urban blacks, Philadelphia:			
Food energy (kcal)..........	1,717	1,895	-178*
Protein (g).................	68.46	72.84	-4.38*
Calcium (mg)................	582.8	681.7	-98.9*
Iron (mg)...................	12.76	13.77	-1.01*
Vitamin A (IU)..............	5,060	6,092	-1,032*
Vitamin C (mg)..............	87.43	103.82	-16.39*
Rural blacks, Florida:			
Food energy (kcal)..........	1,913	1,706	207*
Protein (g).................	77.39	68.66	8.73*
Calcium (mg)................	644.1	575.0	69.1*
Iron (mg)...................	13.17	11.77	1.41*
Vitamin A (IU)..............	6,432	5,381	1,051*
Vitamin C (mg)..............	90.78	85.76	5.02*
Urban whites, Los Angeles:			
Food energy (kcal)..........	1,639	1,729	-90*
Protein (g).................	65.04	67.48	-2.44*
Calcium (mg)................	809.8	880.3	-70.5*
Iron (mg)...................	11.62	11.59	.03
Vitamin A (IU)..............	4,685	4,616	69
Vitamin C (mg)..............	68.28	73.47	-5.19*
Rural whites, Missouri:			
Food energy (kcal)..........	1,840	1,821	19
Protein (g).................	69.65	68.87	1.78*
Calcium (mg)................	681.0	679.3	1.7
Iron (mg)...................	12.38	12.40	- .02
Vitamin A (IU)..............	3,957	3,687	270*
Vitamin C (mg)..............	53.97	57.69	-3.72*
Urban Mexican-Americans, El Paso:			
Food energy (kcal)..........	1,992	1,910	82*
Protein (g).................	80.73	77.23	3.50*
Calcium (mg)................	935.3	847.0	88.3*
Iron (mg)...................	15.67	14.34	1.33*
Vitamin A (IU)..............	5,646	5,381	265
Vitamin C (mg)..............	94.14	93.60	.54

Continued

Table 8.14--Energy and nutrient intakes per individual per day by phase, sample, and panel--Continued

Phase, sample, nutrient	Panel[1] Mail	Panel[1] Telephone	Difference
	------Mean intake-------		
Phase II[1]			
Rural Mexican-Americans, New Mexico:			
Food energy (kcal)...............		1,936	
Protein (g)......................		74.92	
Calcium (mg).....................		820.39	
Iron (mg)........................		14.73	
Vitamin A (IU)...................		4,563	
Vitamin C (mg)...................		83.39	
Rural American Indians, North Dakota:			
Food energy (kcal)...............		1,734	
Protein (g)......................		68.82	
Calcium (mg).....................		697.46	
Iron (mg)........................		13.09	
Vitamin A (IU)...................		4,527	
Vitamin C (mg)...................		78.45	
Urban white elderly, Los Angeles:			
Food energy (kcal)...............		1,464	
Protein (g)......................		63.29	
Calcium (mg).....................		628.98	
Iron (mg)........................		11.04	
Vitamin A (IU)...................		6,584	
Vitamin C (mg)...................		92.53	
Urban black elderly, Philadelphia:			
Food energy (kcal)...............		1,360	
Protein (g)......................		57.39	
Calcium (mg).....................		488.41	
Iron (mg)........................		9.83	
Vitamin A (IU)...................		7,068	
Vitamin C (mg)...................		86.16	

[1]Only telephone panels participated during four quarters in phase II.
*Significantly different at p≤0.05.

cooperating in later quarters. Another problem involved school lunches for families with school-age children. Interviewers often contacted schools for information on menu items and portion sizes.

8.4.3.3 Energy and Nutrient Intakes

Comparisons of mean food energy and nutrient intakes by the mail and telephone panels did not show the telephone method to be as advantageous over the mail method as the preceding comparisons had indicated. The mail panel of rural blacks in Florida and urban Mexican-Americans in El Paso had mean intakes of food energy and most nutrients that were significantly ($p \leq 0.05$) higher than intakes by the telephone panels (Table 8.14). On the other hand, the urban blacks and whites interviewed by telephone generally had mean intakes that were significantly higher than intakes by the corresponding mail panels.

Westat looked for explanations of the reversal in relative advantage of the mail and telephone methods, which was indicated by data for the food energy and nutrient variables. One striking difference between methods was the higher number of default values used in processing food records from mail panels than from telephone panels. The mail panels of rural blacks in Florida, urban blacks in Philadelphia, and urban Mexican-Americans in El Paso required the greatest use of default values (Table 8.15).

8.4.4 Comparisons of Dietary Intake Data from Two Special Samples and the American Indian Sample

Two special samples were included in phase I. All panels assigned to mail followup were required to have telephones to improve comparability with telephone panels. A special sample of Florida households with no telephones was selected for comparison with the Florida households having telephones that were assigned to the mail followup panel; the comparison was intended to determine if there were significant differences between the two groups which might have an impact on dietary intake data. The other special sample of households was from South Carolina and

Table 8.15--Default values used per respondent per day by type of problem, sample, and panel, Phase I

Sample	Incomplete report plus default values used to determine portions		All portion data derived from default values	
	Mail	Telephone	Mail	Telephone
	Mean number			
Urban black.............	0.76	0.23	1.24	0.23
Rural black.............	1.15	.28	.88	.28
Urban white.............	.37	.22	.50	.14
Rural white.............	.40	.20	.34	.07
Urban Mexican-American..	1.04	.26	.88	.19

was selected to measure the impact of asking households to participate in a year-long study compared to a one-time study. The American Indian sample had a large number of households without telephones; therefore a mail panel as well as telephone panel was planned. However, after the first quarter, too few responses were received from the mail panel for further analysis. First quarter responses of the telephone and mail panels were compared and reported.

8.4.4.1 Households With and Without Telephones

Results with two rural black mail panels in Florida--one special sample without telephones and one (the basic panel) with telephones--were compared during the year-long survey. The no-telephone panel had mean values that suggested "poorer" reporting compared with the telephone panel, for example, significantly ($p \leq 0.05$) fewer line items, more poorly specified foods and amounts, and significantly ($p \leq 0.05$) lower food energy and nutrient intakes (Table 8.16). Examination of characteristics of the no-telephone households indicated the household heads were less-educated and younger and had lower income levels than the telephone households. Westat concluded it would be necessary to conduct in-person interviews with households having no telephones to obtain an acceptable quality of information.

8.4.4.2 Households Reporting in One and All of Four Seasons

Another question examined in this study was the possible effect on reporting of the time period that respondents were asked to participate. This part of the study compared performance of the rural black South Carolina panel inducted for one quarter only and that of a similar Florida panel that participated in the year-long study. Both were assigned to the mail data-collection technique. The Florida households provided "better" reports than did the South Carolina households with a significantly ($p \leq 0.05$) larger mean number of line items, a lower mean number of inadequate descriptions and amounts, and higher mean intakes except for vitamin A (Table 8.16). Westat concluded the longer term commitment did not adversely affect results in the first quarter.

8.4.4.3 Mail and Telephone Panels for the American Indian Sample in the First Quarter

The mean number of food items reported per day in the first quarter by the telephone panel was compared with that reported by the mail panel of the American Indian sample. The number of line items was significantly higher ($p \leq 0.05$) for the telephone panel than for the mail panel (13.3 versus 11.2 line items). The mean number of items per day decreased for the second and third days in the mail panel, but it increased in the telephone panel. The mail panel did not differ significantly from the telephone panel on number of inadequately described food items; however, the mail respondents did have a significantly ($p \leq 0.05$) higher mean number of poorly specified food quantities than did the telephone respondents (0.5 versus 0.3). Mean food energy, protein, and iron intakes were significantly ($p \leq 0.05$) higher for the mail than for the telephone panel (2,025 versus 1,849 kilocalories, 81 versus 70 grams, and 15 versus 13 milligrams). However, the pattern was reversed for the other three nutrients; mean intakes of calcium, vitamin A, and vitamin C were lower for the mail than for the telephone panel. Again, Westat speculated

Table 8.16—Comparison of data collected by mail from special samples of (1) households with versus without a telephone and (2) households recruited for one versus four quarters

[All comparisons were significantly different at $p \leq 0.05$ except for vitamin A in the one quarter versus four quarter comparison]

Variable	(1) Telephone in the household[1]		(2) Number of quarters to participate[2]	
	Yes (N=4,683)	No (N=3,088)	Four (N=2,202)	One (N=1,823)
Line items (number)......	11.48	11.04	11.44	10.81
Inadequate food descriptions (number)...	4.06	4.41	2.72	3.28
Inadequate food quantities (number).....	1.80	2.76	.46	.69
Day's intake of:				
Food energy (kcal)....	1,913	1,681	1,852	1,677
Protein (g)...........	77.39	73.06	73.23	67.47
Calcium (mg)..........	644.1	624.0	617.7	568.3
Iron (mg).............	13.17	12.08	13.01	11.42
Vitamin A (IU)........	6,432	5,256	5,650	5,750
Vitamin C (mg)........	90.78	70.53	93.41	82.31

[1] Two samples of black rural Florida households reporting by mail were compared for impact on data quality of having versus not having a telephone in the household.

[2] Two samples of black rural households reporting by mail were compared for impact on data quality of commitment to participate for one quarter (South Carolina) versus four quarters (Florida). Data for the Florida sample are for the first quarter only.

that the use of default portion values for inadequately specified reports may have contributed to the higher intake values for the partially self-reported records compared with records obtained through telephone interviews. However, Westat was unable to explain this observation.

8.4.5 Anthropometric Measurements

Three anthropometric measurements--height, weight, and arm circumference--were obtained in the survey. Response rates are considered first, followed by comparisons of means for interviewer-measured and self-reported heights and weights.

8.4.5.1 Response Rates

In calculating response rates for anthropometric measurements taken by the interviewer, only persons who completed a 1-day dietary recall were included in the base, i.e., the denominator. Response rates thus reflected participation in the collection of the anthropometric measurements and not in the overall study. Response rates for height and weight were similar, but for arm circumference they were lower (Table 8.17). This was not because of lack of cooperation but because of logistical difficulties in taking the arm measurement, such as sleeves which could not be rolled up. In phase I, 34 percent of the nonresponses for arm circumference were for this reason. Only 4 percent of the respondents refused to have height or weight measured. A complete response was one in which both height and weight measurements were obtained. Some nonresponse for the self-reported measure was the result of not knowing the measure rather than of refusing to give it.

Comparisons between the telephone and mail panel response rates in phase I disclosed that the urban black sample had the largest difference between panels; the telephone panel was 10 to 11

Table 8.17--Response rates for anthropometric measurements by phase, sample, and panel

Phase, sample	Response rates					
	Height		Weight		Arm circumference	
	Telephone	Mail	Telephone	Mail	Telephone	Mail
	Percent					
Phase I						
Urban blacks............	89	78	90	80	81	65
Rural blacks............	80	74	80	75	54	51
Urban whites............	76	76	76	76	74	74
Rural whites............	86	82	87	81	62	56
Urban Mexican-Americans..	81	82	82	82	68	67
TOTAL................	83	79	83	79	67	62
Phase II						
Rural Mexican-Americans..	76	--	77	--	69	--
Rural American Indians...	72	--	74	--	67	--
Urban white elderly.....	41	--	46	--	44	--
Urban black elderly......	42	--	47	--	27	--

percentage points higher for height and weight than the mail panel (Table 8.17). Researchers stated that rural blacks and rural whites had significantly ($p \leq 0.05$) different response rates for the two methods. Response rates for phase II panels were lower than those for most phase I panels.

Males 15 to 22 and 23 to 59 years of age were the most difficult to reach. About one-third of the 23- to 59-year-old males were nonrespondents (Table 8.18). Also, 21 percent of the mail responses and 47 percent of the telephone responses for food records for males over 10 years were provided by surrogates. Thus, the interviewers presumably were unable to arrange contact with these males. Across panels, male nonresponse was the highest among the rural black adults. There was large nonresponse among the elderly in all panels.

8.4.5.2 Interviewer-Measured and Respondent-Reported Height and Weight

Mean respondent-reported height was compared with mean interviewer-measured height. Largest differences in height between the two measurements were for children ages 2 to 8 years and boys ages 9 to 14 years; self-reported heights were less than measured (Table 8.19). Surrogate respondents (usually a parent for children) sometimes reported height (or weight) recalled for the last time the child was measured, but these were apparently out of date. Differences were less for adults than for children. Self-reported height was generally greater than the measured value. Self-reporting yielded significantly ($p \leq 0.05$) higher values in phase I for males age 15 to 22 and 23 to 59 years of age and for females age 23 to 59 and 60 and over. Mean self-reported weights for younger groups generally were lower than the measured weights. In contrast with height, adults tended to report weights that were lower than measured weights.

The mean time required to take the three measurements (height, weight, and arm circumference) for each respondent was about 7 minutes in phase I and about 6 minutes in phase II. Interviewers took each measurement twice. If they differed by a specified amount, a third measurement was taken. The percentage of times a third measure was taken in phases I and II was small--height 0.2 and 4.0 percent; weight 1.7 and 1.0; and arm circumference 1.3 and 1.0, respectively.

8.5 Conclusions and Recommendations

Westat concluded that the telephone method was superior to the mail method for collecting dietary intake information from low-income population groups in several respects. The overall response rate for the telephone panels for four quarters was 47 percent compared with 22 percent for the mail panels. However, attrition in the telephone panels was considerable in each followup quarter. The response burden required to provide 12 days of dietary data for each household member was apparently overwhelming for many households in low-income groups, no matter which data collection method was used. But response rates varied among panels. Mexican-Americans had the highest response rate among telephone panels and second highest among mail panels. Rural panels--white or black--had higher response rates for both telephone and mail methods than urban panels.

The quality of dietary information collected was higher in telephone panels than in the mail panels. Telephone respondents reported a significantly ($p \leq 0.05$) greater number of food items per day and supplied significantly fewer

Table 8.18--Nonresponse rates for anthropometric measurements by sex-age category, phase, sample, and panel

Phase, sample	Age (in years) and sex								
	0-8	9-14		15-22		23-59		60 and over	
	Both	Male	Female	Male	Female	Male	Female	Male	Female
	Percent								
Phase I									
Urban blacks...........	15	16	16	27	22	33	11	40	40
Rural blacks...........	22	17	9	42	22	48	20	56	36
Urban whites...........	29	26	24	20	25	28	21	100	100
Rural whites...........	16	13	9	18	12	29	11	38	--
Urban Mexican-Americans	18	10	13	34	16	38	12	40	43
TOTAL...............	21	16	13	30	20	35	15	48	36
Phase II									
Rural Mexican-Americans	18	18	18	33	12	48	23	0	17
Rural American Indians.	27	30	30	41	32	49	24	33	100
Urban white elderly....	--	--	--	--	--	--	--	67	59
Urban black elderly....	--	--	--	--	--	--	--	32	68

Table 8.19—Interviewer-measured and self-reported height and weight, by sex-age group, all samples combined, Phase I

Sex and age (years)	Mean height		Mean weight	
	Measured	Self-reported	Measured	Self-reported
	Centimeters		Kilograms	
Males and females:				
0-12 months.................	67.2	65.9	9.1	8.4
13-24 months.................	86.2	84.4	13.3	13.2
2-5 years...................	104.6	96.8*	18.3	17.6*
6-8 years...................	124.0	113.8*	26.6	25.2*
Males:				
9-14 years..................	150.8	146.7*	44.0	42.2*
15-22........................	173.7	174.5*	68.0	66.9*
23-59........................	174.9	176.3*	80.6	80.5
60 and over..................	172.7	174.0	73.1	75.6*
Females:				
9-14 years..................	151.8	149.3	46.1	43.8*
15-22........................	161.9	162.3	61.4	59.7*
23-59........................	161.9	162.5*	72.0	70.3*
60 and over..................	157.7	161.1*	70.6	73.2

*Significantly different at $p \le 0.05$.

inadequately reported food descriptions and amounts. Probing by telephone interviewers obviously contributed to more complete reporting.

Households without telephones had lower response rates than households with telephones when the mail method was used to report dietary intakes. Respondents in households without telephones had less education and were poorer than those with telephones. Westat recommended in-person data collection methods for households without telephones.

In comparisons of interviewer-measured and respondent-reported height and weight, differences between adult height measurements were small but self-reported weights were underestimated. For children, mean reported heights and weights were less than mean measurements by interviewers.

8.6 Comment

The study delineated many of the problems faced in collecting food consumption information from low-income populations, and the researchers suggested ways of dealing with a number of them. A variation of the telephone-followup method was used in the Continuing Survey of Food Intakes by Individuals (CSFII), which was initiated in 1985 as part of the National Nutritional Monitoring System (USDA, HNIS, 1985). In CSFII 1985 and 1986, only 1 day of dietary information was requested per contact (once every 2 months for 1 year), rather than 3 days as in the Westat study. A 3-day reporting period was considered too great a burden for respondents in a survey requiring dietary reports every 2 months for 1 year. The Westat study also suggested that requiring all household members to report their dietary intake was expecting too much. Therefore, in the core CSFII 1985, only women 19 to 50 years and their children 1 to 5 years were asked to participate. National Analysts had interviewed one woman per household from a middle-income sample in their exploratory study of longitudinal measures and recognized the necessity of further testing with low-income samples. The Westat study clearly showed the relevance of National Analysts' recommendation. An abstract and a short summary of this research have been published (Reese, 1987a, 1987b).

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Chapter 9. The Food Loss Project: Methodologies for Estimating Household Food Losses

Investigator: Department of Family and Community Medicine and Department of Anthropology, University of Arizona, Tucson, Arizona. Dr. Gail G. Harrison and Dr. William L. Rathje, Principal Investigators, 1981-83.

SUMMARY: Using an archeological approach, the adequacy of four experimental methods for estimating household food loss was tested in relation to household food refuse (garbage) and to difference between reports of household food use and individual intake from home supplies. The Nationwide Food Consumption Survey 1977-78 household and individual interview procedures were used with eight groups of seven to nine participating households, four groups in a low-income and four in a middle-income neighborhood in Tucson, Arizona. In each area, household refuse of participating and nonparticipating (control) households was collected for a 5-week study period and analyzed. The total sample was 63 participating and 119 nonparticipating households. Each group of participating households was assigned to an experimental method. The four methods included recall, estimated record, weighed record of discards, and placing all food discards from each meal in special plastic bags plus recording spillage or loss by another route (bagged method). The researchers then sorted refuse and discard by food category and measured them. Only the bagged method yielded estimates exceeding estimates from household refuse collections for both neighborhoods. Recall and estimation procedures yielded unrealistically low estimates. Adjusting for garbage disposals and results from the bagged method, researchers estimated food loss accounted for 20 percent (107 grams/person/day) of the difference (547 grams/person/day) between household food use and individual food intake. However, the bagged method could not be used in large-scale surveys. Ethnographic interviews and panel discussions with households provided information about food use patterns.

<u>Tables</u>

<u>Figure</u>

9.1 Background

The USDA household food consumption survey obtains information on food used in the household for 1 week as purchased or brought into the home. The individual food intake survey obtains information on food as ingested by members of the household. The difference between food used by the household and food eaten by its members has not been satisfactorily accounted for despite several attempts (Adelson et al., 1961, 1963; Batcher, 1983). In these studies, the energy value of food loss or discard of edible food in households was estimated to be about 7 to 10 percent of the food energy in the week's household edible food supplies.

Several factors may contribute to the difference. These include overestimation of food used in the household and underestimation of food eaten by individuals. After food enters the household, it undergoes various forms of preparation--storage, trimming, cooking--before it is eaten. Adjustments have been made in food composition factors for usual amounts of refuse (Watt and Merrill, 1963, Table 2); these adjustments do not take into account differences by households in discarding inedible parts of foods. Amounts of edible food thrown away as kitchen and plate waste, spoilage, food fed to pets and inedible discard have not been successfully quantified on earlier questionnaires. Surveyed homemakers indicate that providing the needed information on such food loss or discard is burdensome, and efforts to do so apparently change usual practices to the extent that reported food losses appear unrealistically low.

A different approach to the study of food loss and discard in the household is the household refuse analysis developed in the Garbage Project at the University of Arizona. The approach infers behavior patterns from material remains, based on methods used for many years by archeologists. Initiated in 1973, the Garbage Project is a cooperative endeavor between the University of Arizona and the City of Tucson Sanitation Division to provide quantitative longitudinal data on household food losses. The researchers believe that their method of refuse analysis provides a measure of food losses which requires no time or active participation on the part of householders, thus avoiding respondent changes in usual practices. However, the researchers mentioned a number of biases in the refuse analyses in this study, such as food discard by means other than trash cans, food ground in garbage disposals, and food fed to pets. This approach was among projects proposed by Survey Design, Incorporated, for validation of USDA methodology used in the Nationwide Food Consumption Survey (NFCS) 1977-78 (see Chapter 3).

9.2 Purpose

This study tested the adequacy of four experimental methods for estimating food losses in households by comparing the food discard results from the four methods with food discarded by the households in refuse (garbage). Here, food loss refers to the difference between household food used and individual food intake in terms of grams of edible, ready-to-eat food per person per day.

9.3 Methods

The study design closely replicated the NFCS 1977-78 household food use and individual food intake interview procedures with eight groups of six to nine households (Table 9.1). In addition to the NFCS interviews, each group of households was administered one of four experimental methods for estimating food

Table 9.1--Characteristics of respondent households by type of neighborhood and method

Neighborhood and method	Households	Mean cost/week		Households having				
							Food discard	
		Grocery store	Eating out	Home gardens	Fruit trees	Dogs and cats in household	Fed to pets	Garbage disposal
	Number	-----Dollars------		----------Percent----------				
Low-income.........	30	52.10	8.90	--	--	--	--	--
Recalled........	6	49.70	10.80	17	17	83	83	0
Weighed.........	7	61.40	6.30	14	14	85	57	0
Estimated.......	8	44.30	7.90	38	25	88	88	0
Bagged..........	9	53.30	10.90	22	33	89	78	11
Middle-income.....	33	51.30	26.80	--	--	--	--	--
Recalled.......	7	47.90	28.10	29	57	57	57	43
Weighed........	9	53.00	16.20	33	33	78	11	44
Estimated......	8	72.00	27.50	13	50	100	88	75
Bagged.........	9	60.30	35.60	11	56	78	56	78

loss. Briefly, they were a recall of the amount of household foods discarded in a week; a recall of amount of household food discarded during the preceding day and a record of amounts discarded during the next 2 days; a recall for the preceding day followed by weighing of food discarded for 2 days; and bagging of food discards for 2 days for subsequent proximate analysis. The household refuse analysis was an external criterion for comparing results of each experimental food loss method. Refuse from the entire surrounding area was collected for a 5-week study period--2 weeks before the survey interview, the week of the interview, and the 2 weeks following (Figure 9.1).

Respondent households were drawn from several sample areas of about 20 contiguous households within a selected middle-income neighborhood and from several sample areas within a selected low-income neighborhood in Tucson, Arizona. All households in a study area were sent an advance letter announcing the survey and indicating that they might be asked to participate. About 1 week later, interviewers recruited households. There were 63 respondent households and 119 nonrespondent households in the study.

Interviews were arranged with households consenting to participate. The household respondent was then asked to permit collection and analysis of the household garbage as required for the particular experimental method.

The four experimental methods for study of food loss in households and their descriptions are as follows:

Recalled: For each food and beverage item reported in the NFCS household food use questionnaire, the household respondent reported amount consumed, stored, or discarded during the preceding 7 days and if discarded, how. Refuse collection took place concurrently.

Estimated Record: Interviewer administered a recall of food used in the household during the previous 24 hours and the proportions consumed, stored, and discarded were recorded on a special form. The same information plus route of discard was recorded for the next 2 days on special forms left with the respondent. This time period was the same time period for which the 24-hour recall and 2-day diary were provided for individual household members. The special forms were collected and reviewed by the interviewer on the third day. Refuse collection took place concurrently

Weighed Record: This method was the same as the estimated record method, except that food discarded was weighed on dietetic scales and recorded for 2 days by the respondent. Refuse collection took place concurrently.

Bagged: During the 2 days for which individual intake diary records were kept, the respondent put all food discards into special plastic bags provided by the researchers. A separate bag was provided for each meal or eating occasion. A staff member collected the bags once a day. The bags were taken to the Sanitation Division Maintenance Yard for sorting and recording of contents. The edible discards were rebagged and sent to the laboratory for proximate analysis. A form was also given to the respondent for recording food which was spilled or was discarded unintentionally via another route.

Participants were given special yellow bags and were asked to tag their refuse with an identification number for 2 weeks after the interview. Unknown to the respondents, refuse from the entire study area was also analyzed for a 2-week period before the interview and

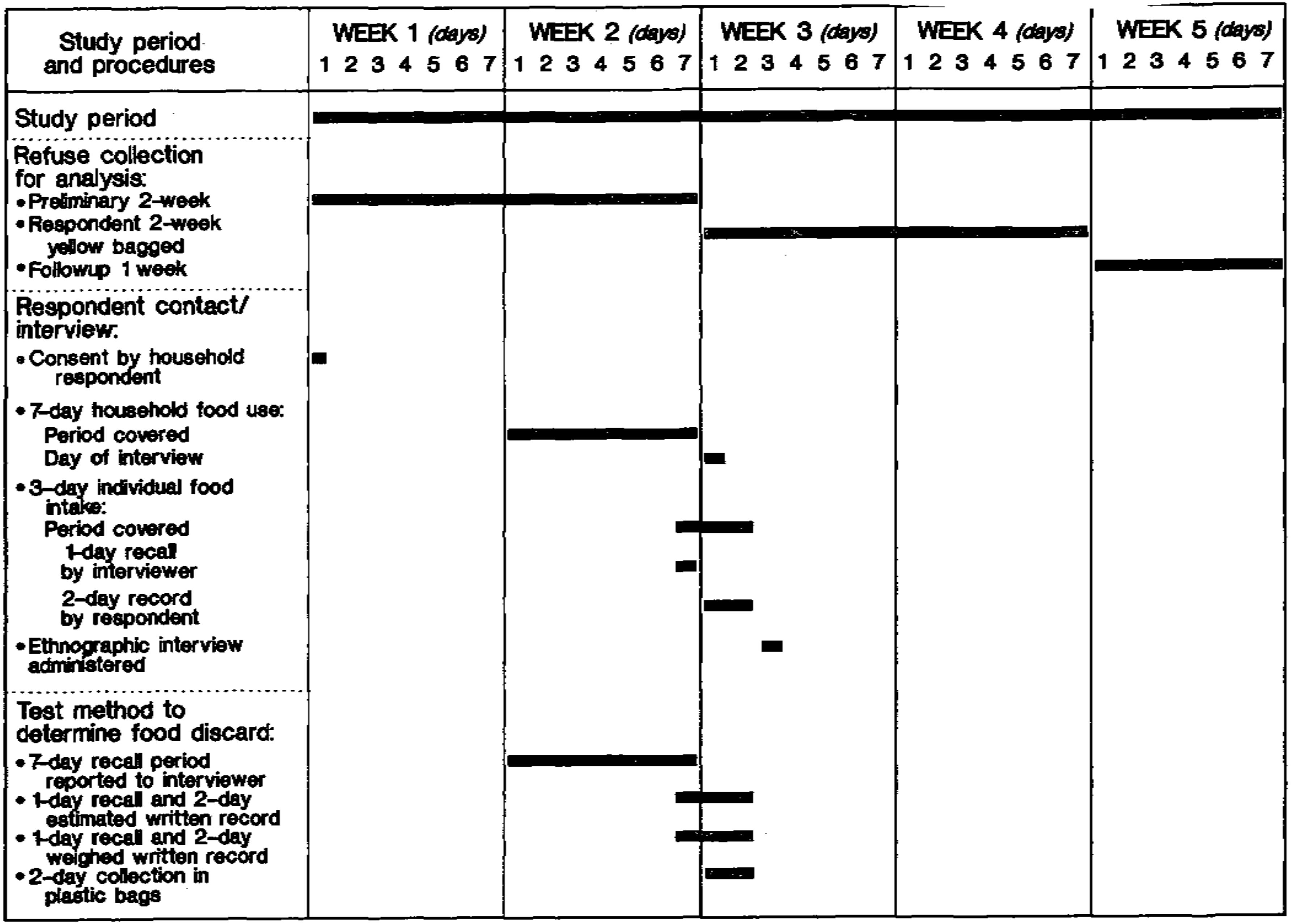

Figure 9.1—Time line of study procedures

for 1 week following the 2-week tagging period to determine if awareness might be associated with change in refuse. A special city crew kept refuse from individual households separate and gave the pickups proper designation. Standard Garbage Project procedures were followed in analyzing refuse from both participant and nonparticipant households. Refuse analysis procedures in the study of food loss consisted of the following 5 steps and activities:

Step 1: Refuse pickup from sample areas. Day of first sample collection and all regular garbage pickup days for next 5 weeks.

Activities: Special refuse pickups arranged with Tucson Sanitation Division. Special city crew collected all household refuse put out in sample areas. Each household's refuse was kept separate. Refuse from respondent households was identified with numbers relating it to specific interviews. Refuse pickups from nonrespondent households were kept separate for the 5-week period also but were not identified for specific households. A single pickup on a twice-a-week pickup schedule was assumed to represent 3.5 days.

Step 2: Delivery of tagged refuse samples for logging in at Sanitation Division Maintenance Yard.

Activities: Student volunteers sorted and recorded items in each household refuse pickup. Students wore lab coats, rubber gloves, and surgical masks and had the required immunizations.

Step 3: Each refuse sample recorded by the regular-sort procedure.

Activities: Items in each refuse sample were recorded, both food discard and packaging, with following information: Garbage Project item code, number of items, net weight or volume, cost, "waste" in grams (if less than 30 grams, or unidentifiable, recorded as "slop"), type of item, brand name, and material composition code. (Only one measure was used for each food item in analysis. For example, egg shells and egg cartons might both have been recorded, but only one was used in analyses to avoid double counting.)

Step 4: Each refuse sample recorded by weight-sort procedure.

Activity: Items in each refuse sample were sorted into 15 material composition categories and weight was recorded.

Step 5: Disposal after completion of sorting and recording.

Activity: Returned to Sanitation Division for deposit in landfill.

At the time of the interview (held at the end of the second week of the 5-week study period), the household respondent provided information on foods used in the household (as purchased or as brought into the household from the garden) during the preceding 7 days, using the NFCS household questionnaire. Also provided was a 24-hour recall of food eaten by each household member. The interviewer left a form for a 2-day diary of food eaten to be completed for each member. Two days later, the interviewer returned to pick up and review the completed 2-day diaries. At this time, an ethnographic interview was conducted to elicit information about food use and food-flow patterns in the household, including decisions about leftovers and food discard and factors that might explain different routes of food loss. In addition to the household food use and individual food intake questionnaires, each household also carried out one of the four experimental methods for determining food loss.

Food-related data derived from the refuse sorting process (Tables 9.2 and 9.3) were organized into 15 food categories directly comparable to the categories used for analyses of NFCS 1977-78 data plus 5 other categories. The food categories used for analysis of refuse were meat, poultry, seafood, eggs, legumes, nuts and seeds, vegetables, fruits, bakery and cereal products, milk and dairy products, fats and oils, sweets, nonalcoholic beverages, alcoholic beverages, baby food, spices and health food, fast food, fruit and vegetable juice, potato peels, and "slop." "Slop" was the term applied to the unclassifiable mix of small amounts of not easily separated food waste usually found at the bottom of garbage bags. "Slop" made up about 20 percent of total food waste. Potato peels were made a separate category because of their large quantity. For each food category, five variables were derived: (1) evidence of use in solid ounces (weight), (2) evidence of use in liquid ounces, (3) frequency of solid use, (4) frequency of liquid use, and (5) waste in grams. Group discussions about the Garbage Project and food waste were held with 10 consumer panels, most consisting of 10 to 15 women. Six panels were

Table 9.2--Food waste for each of 20 food groups during 5-week study period, 182 households

Food group	Total food waste	
	Middle-income neighborhood	Low-income neighborhood
	Percent	
Meat	5.4	3.6
Poultry	2.8	1.6
Seafood	.4	.2
Eggs	.2	.2
Legumes	.5	2.6
Nuts and seeds	.4	.4
Vegetables	21.8	22.3
Fruits	14.7	12.6
Bakery and cereal products	18.7	15.8
Milk	3.1	1.9
Fats and oils	.9	1.3
Sweets	.6	1.0
Nonalcoholic beverages	.4	.6
Alcoholic beverages	.1	.6
Baby food	.4	.3
Slop	21.6	22.7
Spices, health food	.4	.4
Fast food	3.4	4.9
Fruit and vegetable juice	.0	.0
Potato peels	4.0	7.1

NOTE: Differences between the two neighborhoods were not statistically ($p \leq 0.05$) different.

Table 9.3--Food waste per household by 20 food groups during 5-week study period, 182 households

Food group	Middle-income-neighborhood households			Low-income-neighborhood households		
	Respondent (N=33)	Nonrespondent (N=55)	Total (N=88)	Respondent (N=29)	Nonrespondent (N=64)	Total (N=94)
	Mean grams ± standard deviation					
Meat	367± 491	306± 412	329± 441	171± 232	224± 446	207± 391
Poultry	237± 286	125± 215	167± 248	43± 84	117± 328	94± 248
Seafood	32± 111	15± 76	22± 90	14± 58	13± 44	14± 48
Eggs	26± 84	5± 16	13± 54	4± 11	11± 34	9± 29
Legumes	18± 74	39± 158	31± 133	196± 701	131± 399	151± 509
Nuts and seeds	3± 7	38± 249	25± 197	50± 124	9± 41	21± 79
Vegetables	1,389±1,233	1,282±1,296	1,322±1,254	1,549±1,474	1,161±1,263	1,282±1,337
Fruits	943±1,467	860±1,040	892±1,210	554± 815	797± 355	722±1,214
Bakery and cereal products	1,075±1,466	1,168±1,246	1,133±1,325	939±1,323	893± 859	908±1,019
Milk	115± 177	230± 451	187± 375	154± 308	87± 147	107± 211
Fats and oils	62± 299	53± 175	57± 228	128± 350	48± 175	73± 244
Sweets	36± 104	33± 75	34± 86	45± 140	63± 194	58± 178
Non-alcoholic beverages	45± 228	15± 41	26± 143	20± 86	39± 140	33± 125
Alcoholic beverages	0	13± 56	8± 45	21± 111	24± 150	23± 138
Baby food	3± 17	41± 256	27± 202	28± 93	13± 69	18± 77
Slop	1,253±1,307	1,334±1,430	1,304±1,378	1,189± 959	1,351±1,548	1,301±1,388
Spices, health food	13± 54	30± 90	24± 79	9± 27	32± 97	25± 82
Fast food	248± 436	182± 280	207± 246	280± 373	283± 381	282± 376
Fruit and vegetable juices	0	0	0	0	3± 23	2± 19
Potato peels	247± 355	242± 417	244± 392	465± 555	383± 522	409± 531

NOTE: Differences between respondent and nonrespondent households by neighborhood were not statistically significant ($p \leq 0.05$).

Extension homemakers clubs. The discussions were structured to obtain information about food purchased but never used, waste in food preparation, leftovers, and attitudes towards food waste. Food waste (or food debris) was considered to be any discarded, once-edible food including separable meat fat and potato peels but excluding bones, egg shells, tops, rinds, and other items considered to be inedible by most Americans.

Interview data from the household food use and individual food intake forms were entered into computer files by the interviewers. Ethnographic open-ended questions and the written transcription of the taped panel discussions were coded by a graduate student in cultural anthropology. Analysis of data on refuse included a description of each group of households (neighborhood, method, and respondent or nonrespondent) and two time periods (yellow bag and non-yellow bag). Analysis of variance was used to determine if there were differences in weight of food use or waste overall and among food categories. Feasibility and adequacy of methods were evaluated using indicators developed from interviews, experimental methods, and refuse data. A subproject was conducted to determine the content of "slop" (Section 9.7).

9.4 Main Findings

Results of testing the adequacy of four experimental methods in providing estimates of food discarded by households were reported here. Three of the methods were found to be inadequate because estimates of food discard were unrealistically low. One of the three methods--weighing--provided an estimate of food discard higher than estimated from refuse for middle-income households, but the method was unproductive for low-income households. The fourth method, in which discarded food was put into plastic bags and collected daily, produced the largest estimates of food loss by households.

9.4.1 Description of participating households and refuse behavior

Of the 63 households in the 8 groups participating in this study, 71 percent were Anglo-American, 21 percent Mexican-American, and 8 percent black. Ethnicity of the low-income households differed considerably from that of the middle-income households. The mean annual household income of the middle-income-neighborhood households surveyed was $27,670; for those in low-income-neighborhood households, it was $14,698. The average household size of the former was 3.5 members (ranging from 2.8 to 4.0 members per group). For the latter, it was 3.9 members (ranging from 2.6 to 5.2 members). Other characteristics of the households were tabulated for the separate experimental method groups within the two types of neighborhoods (Table 9.1). Despite their larger number of persons, low-income households spent less for food at home and away from home than middle-income households ($61.00 versus $78.10 per week). Low-income households spent considerably less on eating out than middle-income households ($8.90 versus $26.80). Fruit trees contributed to home food supplies of over half of the families, and home gardens to one-third or more, in some experimental groups. Large percentages of the households (57 to 100 percent, depending on neighborhood and method) reported having pets, and most, especially of the low-income families, reported feeding discarded food to pets. Garbage disposals were rare in the low-income households, but were quite common in the middle income groups. Refuse behavior during the 5-week study period was tabulated for a total of 182 households (63 participating and 119 nonparticipating households). Respondent households in both neighborhoods had a greater number of refuse pickups, on average, than nonrespondent households. Researchers reasoned that nonrespondent households may have been away from home or eating out more frequently than respondent households. These activities may have also influenced the selection process. The average weight of refuse pickups was slightly greater for respondent than nonrespondent households in the low-income neighborhood, but there was generally no difference for the middle-income neighborhood.

Food discard patterns based on refuse pickups during the 5-week study period for all 182 households were calculated for the middle- and low-income neighborhoods. Differences in food discard patterns between the two types of neighborhood and between respondent and nonrespondent households were not statistically significant at the 0.05 level (Tables 9.2 and 9.3). However, more evidence of using legumes and baby foods was found for low-income households than for the middle-income group. Of the 20 food categories analyzed, the following 4 had the greatest waste: vegetables, fruits, bakery and cereal products, and slop.

Chemical analyses were performed on food discarded by the experimental groups of households whose members bagged food discard on the 2 days for which individual intakes were being recorded. Total weight of bagged food discard was not significantly ($p \leq 0.05$) different between the two neighborhoods or between the 2 days of collection. Overall, discarded food on day 1 and day 2 for the low-income households (N=9) contained 18 and 22 percent protein, 20 and 14 percent fat, 12 and 15 percent fiber, 6 percent ash, and 42 and 47 percent carbohydrate. Corresponding contents of bagged food discard for the middle-income households (N=8) contained 21 and 22 percent protein, 30 and 22 percent fat, 4 and 5 percent fiber, 4 and 6 percent ash, and 42 and 45 percent carbohydrate. Differences in proximate analyses between days or neighborhoods were not significant ($p \leq 0.05$).

9.4.2 Respondent behavior

Respondents' reactions during the time they knew refuse was being analyzed were contrasted with behavior when they did not know refuse was undergoing analysis. The refuse in yellow bags (for the 2 weeks after the household interview) was compared with refuse in non-yellow bags (the other 3 weeks in study period) for respondents. Refuse from nonrespondent households during equivalent time periods served as controls in the comparisons. No statistically significant ($p \leq 0.05$) difference between periods of known observation and "unknown" observation was found in weight of food waste for either group of households or for any methods (Table 9.4). However, for some households, differences were observed in the content of the bags during the two time periods, particularly that reflecting alcohol consumption. For example, one household's garbage bags contained empty liquor bottles during the "unknown" observation period but contained none during the yellow-bag period (Ritenbaugh and Harrison, 1984). The mean percentage of food waste per household expressed as a percentage of estimated food use overall was 10.2 percent by weight (Table 9.5). This value was not corrected for presence of garbage disposals so it represents a minimum percentage of waste.

9.4.3 Acceptability and feasibility of experimental methods

Researchers regarded the rate of refusal by households to participate in the food

Table 9.4--Food waste per household per day as measured from refuse collection

Neighborhood and method	Respondent households: Yellow bag	Respondent households: Non-yellow bag	Nonrespondent households: Yellow bag equivalent time period	Nonrespondent households: Non-yellow bag equivalent time period
	Mean grams			
Middle-income:				
Recalled..........	158	232	244	225
Estimated.........	169	181	164	182
Weighed...........	105	136	147	144
Bagged............	201	213	208	121
All methods.......	155	190	191	166
Low-income:				
Recalled..........	252	151	162	153
Estimated.........	325	69	212	220
Weighed...........	193	269	140	217
Bagged............	131	179	155	329
All methods.......	205	161	168	229
Both neighborhoods:				
All methods.......	176	176	179	196

NOTE: Differences between yellow bag and non-yellow bag households were not statistically significant ($p \leq 0.05$).

Table 9.5--Food waste as a percentage of solid food use estimated from refuse collection

Neighborhood and method	Respondent households: Yellow bag	Respondent households: Non-yellow bag	Nonrespondent households: Yellow bag equivalent	Nonrespondent households: Non-yellow bag equivalent
	Mean percent			
Middle-income:				
Recalled...........	8.6	12.7	15.7	11.7
Estimated..........	9.8	11.6	7.8	9.6
Weighed............	6.5	7.4	10.5	9.3
Bagged.............	9.5	10.3	14.8	9.4
Low-income:				
Recalled...........	10.2	6.8	8.7	8.6
Estimated..........	10.8	8.6	14.3	11.2
Weighed............	10.8	9.8	9.5	11.5
Bagged.............	8.4	14.9	8.4	12.5
TOTAL..............	9.3	10.2	11.1	10.1

NOTE: Results were not corrected for presence of garbage disposals.

loss project as an indicator of the acceptability of the project. Generally the refusal rate was about 50 percent.

Rate of noncompliance was another indicator of acceptability of tasks required in the study. Missing individual intake forms were obvious evidence of noncompliance and were most common (11 to 14 percent) for the two experimental methods--estimated and weighed--which required the most paperwork. Compliance with the experimental methods was considered good by the researchers. Adherence to the request to put out refuse in tagged yellow bags for four consecutive pickups was considered satisfactory if three or four bags were delivered. Of the 63 households, 12 provided only 1 yellow bag of refuse; whereas 36 households provided 4, and 14 households provided 3.

Respondent reactions to the project and the experimental methods were obtained in the ethnographic interviews. Reactions to the various tasks in the study revealed that completing individual intake forms was viewed as the hardest task by 24 household respondents, the food loss experimental methods by 7, the 7-day household food use recall by 6, and the ethnographic interview by 1.

The measure used to indicate feasibility of the methods was the time required. The time required for each household included time for interview, tagging garbage four times, and keeping food waste records. Time required by project personnel included interview, travel, and other tasks. Overall, the recall method required the least time for both respondent household (2.5 hours) and project personnel (2.0 hours). The weighed method required the most respondent household time (5 hours), and the bagged method required the most project staff time (3.5 hours).

9.4.4 Adequacy of data

The criterion of adequacy of data on food discard was the completeness of information provided by the experimental method. Overreporting of discarded food was considered unlikely while underreporting was considered very likely by the researchers.

The mean reported food discard differed widely among the four experimental methods (Table 9.6). Comparisons between food discard reports and the food waste found in refuse pickups indicated that the weighing method for middle-income households and the bagged method for both low- and middle-income households provided higher mean amounts of food waste than the minimum weight of food waste actually found in household refuse. A correction factor was applied for presence of a garbage disposal (Table 9.6). This factor was derived from a 1975 study of 22 households with disposals and 10 households without, in which it was found that households with disposals discarded about 49 percent as much edible food in refuse pickups as households without disposals. This percentage does not include liquid waste.

The recall and estimated methods elicited so little food waste information from respondents that the researchers called them useless. These two methods had a high proportion of households reporting no food discarded, especially in the low-income neighborhood.

9.4.5 Difference between household food use and individual food intake data

The 7-day household food use reported with the NFCS method by the 63 household respondents in this 1981-82 study was, on average, 2,122±857 grams/person/day. The mean household members' 3-day individual food intake was 1,575±608

Table 9.6--Food loss estimates from experimental methods and household refuse

Method and neighborhood income	Households reporting no food waste		Experimental period: Total reported as discarded or bagged food discard[1]		Experimental period: Total to garbage can	5-week study period: Food waste from refuse[2]	
	Solid	Liquid	Solid	Liquid	Solid	Uncorrected for garbage disposals	Corrected for garbage disposals
	---Percent---		------------Mean grams per day per person------------				
Recalled:							
Low......	50	67	11.2	0.2	1.2	44.6	44.6
Middle...	14	57	40.9	12.8	39.9	65.1	79.1
Weighed:							
Low......	33	50	20.8	--	16.6	67.9	67.9
Middle...	22	67	51.3	46.8	33.0	59.9	73.1
Estimated:							
Low......	63	38	12.5	29.9	2.2	83.4	83.4
Middle...	38	75	11.1	26.7	2.5	87.3	125.7
Bagged:							
Low......	0	29	97.5	25.5	--	61.2	85.0
Middle...	0	0	91.2	--	--	73.2	77.2
TOTAL....	--	--	--	--	--	71.3	83.06

[1] Converted to "as prepared."
[2] May include some inedible food waste.

grams/person/day. The difference was 547 grams/person/day. An analysis of data from NFCS 1977-78, reported by Batcher in 1983, disclosed a difference of 564 grams per person per day.

Mean total food loss from household refuse was found to be 71 grams/person/day almost all (97 percent) in the "as prepared" form. After adjustment for garbage disposals, it was estimated at 83 grams/person/day (Table 9.6). Researchers, after adjusting this value upward based on results from the bagged method, estimated food loss accounted for in this study to be 107 grams/person/day, or 20 percent of the difference between the household food use and individual food intake. The researchers found, in the ethnographic interview, that respondents did not regard food fed to pets as food discard or waste and speculated that this information might explain some of the divergence between the two levels of food consumption. Other factors mentioned by the researchers as possibly contributing to the difference were overestimation of food use in the household, underestimation of individual food intake, and sampling error caused by different time periods during which data were collected at the household (7 days) and individual (3 days) levels.

9.4.6 Household Perceptions of Food Use, Reuse, and Discard

In the ethnographic interview, respondents were asked to define leftovers, how decisions were made about discarding or storing leftovers, and what gave rise to leftovers. The majority of respondents regarded any food left after a meal to be leftovers. Respondents said the decision about discarding or keeping leftovers depended on the type of food, the quantity left, and its chances of being eaten. Two contrasting practices of serving food were uncovered--family style with each member serving himself in the middle-income group and a single member serving plates of all members in the low-income group. The quantity of leftovers was expected to differ between the two styles.

Panel discussion groups considered reasons for unused purchased foods, food waste, and leftovers. Reasons noted for discard of purchased foods included food not fresh when bought or spoiled before it could be used; change in plans, illness, or guests who did not arrive; or shopper was not the meal preparer. Waste in preparation of food included fat trimmed off meat; for chicken, the back, neck, tail, or skin discarded; and use of paring knife instead of vegetable peeler. Leftovers were thrown away under several conditions: after serving a number of times, members were tired of dish, after 1 week, too little for one serving, forgotten, spoiled, members were dieting, dish was not liked, and lack of freezer space. Also seen as generating leftovers were a tendency to serve young children too much food, time lags in adjusting quantities to smaller family size after children leave home, and difficulty in preparing small amounts for one- or two-person households.

9.5 Summary and Conclusions

Actual food loss in households was unknown but it likely exceeded the amount found in refuse collections--estimated at about 107 grams per person per day, which was about 20 percent of the difference between household food use and individual food intake. Respondent reactions to refuse analysis indicated little change in usual food use and discard patterns during the study. The four experimental methods showed clear differences in resulting amounts of food discards. The bagged method provided the most complete data on food losses and exceeded the amounts found by refuse collection, which yielded a minimum estimate of food loss. Household refuse seldom included liquid food discarded and would not include leftovers fed to pets and food debris thrown on compost piles. The bagged method included all food discarded for the 2 specified days. The recall and estimated methods yielded very incomplete data. The weighed method provided moderately complete data for the middle-income households but not for the low-income group.

Researchers concluded that current recording, rather than recall of past losses, would stand a better chance of succeeding since many people are unaware of food loss until it is brought to their attention. Also, respondents, even though meal preparers, may be unable to provide precise information about food loss or discard if they are not responsible for cleanup and care of leftovers.

9.6 Comment

The two methodologies for estimation of household food losses found to be most adequate in this study--the bagged and weighed methods--would not be suitable for use in large food consumption surveys. The other two methodologies--the recalled and estimated methods--were unsuccessful in eliciting food loss information. The concurrent recording of household food discard and food fed to pets along with the keeping of 2-day individual intake diaries appears to be the most suitable approach to be further tested for use in large-scale studies. If successful, a few tightly organized and rigorously tested queries about food discard and related problems might provide information to begin closing the gap between the estimates of household food use and individual food intakes. A pilot test, in which the validity of results could be assessed for a subsample by having the 2-day discards bagged as well as recorded, is one possibility.

9.7 Appendix: Summary of the Subproject on Evaluation of "Slop"

A subproject was carried out to determine the composition and appropriate interpretation of small bits of food waste in refuse called "slop." The elements of the project are listed and described below:

Purpose: Provide information for more precise interpretation of food waste data from refuse.

Objective: Determine the typical composition of small amounts of unclassifiable residual food waste, often lumped together in the bottom of sample bags and called "slop."

Sample: Sixty-nine households participated in a separate study in spring 1982. They were from seven Census tracts--four low-income and three middle-income.

9.7.1 Procedures

Sorting: "Slop" from the 69 refuse pickups was weighed and then meticulously sorted into component parts. Each food item was then weighed separately.

Composition: "Slop" was often plate scrapings or small bits of specific foods, such as bread crust or macaroni and cheese. If food waste was mixed with cigarette butts, coffee grounds, dirt, etc., the sorter estimated what percentage of the mixture was "slop" and used that weight rather than trying to separate "slop" items.

9.7.2 Results

"Slop" accounted for 20 to 30 percent of total food waste from Tucson households and 22 percent by weight of food discarded by households in this study. Nine food groups were responsible for 93 percent of total weight and 86 percent of frequency count of "slop": meat, poultry, seafood, legumes, vegetables, fruits, bakery products and cereals, milk and cheese, and fats and oils.

Fresh vegetables and bakery and cereal products were the largest contributors to total "slop"--52 percent by weight, 63 percent by frequency count. Amounts were smaller than 30 grams for 73 percent of food items found in "slop." Almost all of "slop" was in the "as prepared" form.

The average caloric value of "slop" was 240 kcal/100 grams.

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Chapter 10. Development and Validation of a Food Frequency Report

Investigator: School of Public Health, University of Michigan, Ann Arbor, Michigan. Dr. Frances A. Larkin, Principal Investigator, 1983-86.

SUMMARY: This study reports the extensive efforts of the University of Michigan researchers in development and testing of a quantified food frequency method (FFQ) to measure usual food intake. The method involved estimating frequency of use of food groups and typical portion sizes. These estimates were obtained in personal interviews from a sample of 228 adults about 3 months after they had participated in four quarterly rounds of interviewing to obtain 1-day food recalls and 3-day food records yielding 16 intake days. The FFQ consisted of sequential sorting of slips for 118 food groups into frequency of use categories. Intake data calculated from the 16 days of recalls-records served as the standard for comparisons with FFQ data. The FFQ produced higher estimates of consumption than recalls-records for fruits and dairy foods. Apparently, comparable results from the two approaches for a number of 13 broad food groups reflected counterbalancing of high and low estimates on the FFQ of frequency of use and portion size. The best agreement between the two sets of data was found in consumption of meats, breads and cereals, and vegetables. The FFQ yielded higher estimates of food energy and macronutrients per day than the recalls-records. For about half of the sample, mean estimates of the FFQ food energy were within one standard deviation of the recall-record mean. The recall-record mean food energy for the fourth quarter days, however, was less than corresponding days for the first quarter.

Tables

10.1 Background

In the food frequency method of obtaining food intake information, individuals are asked to report how often over a specified period, a food had been consumed. Some believe that this method gives information that is more representative of an extended period or of usual intake than other methods currently used, such as the 1-day recall or a 1- to 7-day record. A valid quantified food frequency method, in which the individuals are also asked to estimate the usual or average portion size of a food, is particularly sought by epidemiologists, public health professionals, and others. This method could be used to discern relationships between past dietary practices and disease conditions that develop slowly over time, such as cancer, heart disease, osteoporosis, diabetes, and gallstones.

A reliable and valid short method for assessing usual food intake has been elusive, although a number of researchers have tried. Most food frequency methods have been too imprecise for reliable calculation of dietary energy and nutrient intakes for a number of reasons--difficulties in constructing food groups that encompass all foods eaten, in keeping foods within a food group sufficiently similar that portion size and frequency of use are applicable to each food item, in handling variability of portion sizes eaten by an individual at different times, and accurately portraying various time periods within which foods were eaten. However, measurements obtained through a food frequency method, if properly developed and tested, might yield data of quality sufficient for many purposes. To be acceptable, the method must be validated. This is complicated by the absence of a "true" value to be used as a standard for comparison.

A team of researchers at the University of Michigan (UM) developed a food frequency questionnaire and used it to collect information on food intakes during a 1-year period from a sample of 228 individuals. Data from the food frequency questionnaire were tested against data collected from the same individuals during the same time period using a food recall-record questionnaire similar to that used in the Nationwide Food Consumption Survey (NFCS) 1977-78. To develop food groups for use in this study, the UM team built upon food groups developed during an earlier study (Chapter 5).

10.2 Purpose

The purpose of this study was to design and validate a quantitative food frequency questionnaire (FFQ) that would permit estimation of average nutrient and caloric content of foods eaten.

10.3 Methods

The study design called for validation of information obtained with a FFQ by comparing those data with information from the full detail of 16 food recalls-records gathered from the same respondents during the preceding 15-month period. Respondents were contacted in five rounds of data collection. During each of the first four rounds, spaced about 3 months apart, a 1-day food recall and a 3-day food record were administered. At the first and fifth contacts, a FFQ was completed. Each of the first four rounds required two interviewer visits to the home. During the first interview of each of the four rounds, the 1-day recall was completed and instructions were given for keeping the 3-day record. On the return visit, the interviewer picked up and reviewed the completed 3-day record forms. To minimize conditioning effects, the FFQ was administered about 3 months after the last interview. Interviews were scheduled to include all days of the week as far as possible. Food reports for 75 percent of the respondents included all days of the week; 23 respondents had no records for a Sunday, the day most frequently missed.

10.3.1 Questionnaire Development

Six questionnaires were developed. Two of the instruments were for obtaining food intake information--a food frequency for usual intake during the preceding year and a 1-day recall plus 3-day record for current intake during 4 consecutive days. Four questionnaires were designed to obtain health, demographic, and life events information and possible dietary changes during the year of the study.

10.3.1.1 Food Frequency Questionnaire

Development of the FFQ started by setting criteria to guide the researchers in forming food groups. Criteria specified were: (1) inclusion of a minimum number of food groups, (2) inclusion of the most frequently consumed foods, (3) construction of easily recognized food groups, (4) construction of mutually exclusive food groups, and (5) inclusion within a food group of only foods for which a common portion size was appropriate.

The development of food groups for the FFQ began with a study of the food usage patterns in a 30 percent subsample of 23- to 74-year-olds (N=3,918) randomly drawn from the NFCS 1977-78 3-day food intake recall-record reports. Starting with the 137 food groups developed in a previous study (Chapter 5), the researchers computed the percentage of respondents using each food group on any 1 day and the average number of times each food group was reported during the 3-day period. This information indicated the impact of aggregation or omission of the food on nutrient estimations for food groups on the FFQ. Bivariate frequency distributions were used to examine the tendency of certain foods to be eaten together--usually, rarely, or with no apparent pattern (independently). This information also helped define foods or food groups that could be combined, kept separate, or dropped. Certain foods were regarded as substitutes because they were seldom eaten together (such as bacon and sausage) and thus were grouped together; other foods were considered complements because they were often eaten together (such as bacon and eggs) and therefore were placed in separate groups. Further modifications were made to facilitate reporting, such as separating beef into one group for beef alone and another for beef in mixtures. Foods used mainly as complements to many other foods, such as margarine or butter on bread and vegetables, did not appear as separate items but were probed for in conjunction with the main food. Other foods appeared both as a complement (milk on cereal and milk in coffee) and as an independent food group (milk as a beverage).

After finalizing the grouping of foods and the probes to obtain additional detail and portion size, the researchers designed the FFQ. The FFQ instrument consisted of 113 different slips of paper, 5-1/2 inches by 8-1/2 inches, with each slip representing a different food or food group. The name of the food appeared on the front of the slip and on the back were questions about frequency of use and amounts eaten with spaces for recording answers.

The UM team devised a simplified protocol for the FFQ after trying several more complex and time-consuming approaches. The protocol consisted of a sequential sorting of the food slips based on frequency of use during the previous year. Participants were instructed to carry out four sorts of the food slips into frequency categories using 11 labeled envelopes) in a specified order. First round, all food slips were sorted into three categories: (1) not eaten last year, (2) eaten less than 12 times last year, and (3) eaten 12 or more times last year. Second round, slips in category 3 of the first round were sorted into two subcategories: (1) eaten more seasonally and (2) eaten about the same all year round. Third round, slips in category 2 of the second round were sorted into seven subcategories: (1) eaten more than once a day, (2) eaten about once a day, (3) eaten 5 to 6 times a week, (4) eaten 3 to 4 times a week, (5) eaten 1 to 2 times a week, (6) eaten 1 to 3 times a month, and (7) eaten 1 to 11 times a year. Fourth round, slips in category 1 of the second round were sorted into two subcategories: (1) foods eaten in season only and (2) foods eaten more in season but also at other times of the year. After the sorting was completed, the interviewer marked the back of the food slips indicating the frequency of eating and the usual amount per eating occasion and asked other questions specific to the food or food group.

10.3.1.2 One-Day Recall and 3-Day Record

The 1-day recall and 3-day record instruments were placed in a three-ring binder for each respondent along with an instruction manual. After the 1-day recall was completed, it was left in the binder as a reference for the respondent during the 3 days of record-keeping. The recall-record forms provided a full page for recording kinds and amounts of foods eaten at each eating occasion with helpful probes and prompts on the opposite page and the top and bottom of the recording page. To help in estimating amounts eaten, the interviewer used a set of measuring cups and spoons, a 12-inch ruler, a set of plastic oblongs--each an eighth of an inch in thickness, and beanbags representing 1/4, 1/3, 1/2, 3/4 and 1 cup volumes. The capacity or usual fill levels of the respondent's eating vessels--cups, glasses, bowls, and spoons--were measured and recorded on the cover of the questionnaire. All measurement aids except the beanbags were left with the respondent to use in estimating amounts eaten during the 3-day record.

10.3.1.3 Other Questionnaires

A health questionnaire was used to obtain information about height, weight, smoking, special diet, and pregnancy status. A demographic questionnaire had questions about employment status, occupation, and the past 12-month's income as adapted from the Tecumseh Dietary Methodology Questionnaire (Thompson et al., 1987). A life-events questionnaire helped update health status and happenings that could affect customary food intake. An exit questionnaire was used to determine whether participation in the study had caused any changes in the respondent's diet and to ask about usual overall frequency of eating meat, poultry, and fish and fruits and juices.

10.3.2 Sample

A quota sample of 200 adults, about equally divided by sex and race, was required by the study design. Door-to-door recruiting in Ann Arbor and Ypsilanti, Michigan, took place over a 5-month period in census tracts with a high proportion of black residents. Only one participant per household was allowed. Refusal rates were high--50 percent in Ann Arbor and 70 percent in Ypsilanti--perhaps because participation was needed for 1 year. Because the quota of men, particularly black men, was inadequate, 60 additional men were recruited near the end of the period by informal means at the University and through various nearby health, religious, and social welfare agencies. Of the 273 subjects originally enrolled, 228 completed the study. Over one-half of the respondents who dropped out of the study did so at the second interview. Characteristics of participants are shown in Table 10.1.

10.3.3 Data Collection

Eight women interviewers, five white and three black college graduates, received 28 hours of training before going into the field in July 1984. The interviewers recruited subjects and made an appointment for a convenient time to hold the first interview. At that time, the 1-day recall was conducted, followed by the FFQ, and instructions to the respondent for keeping the 3-day record. The average length of time for the first interview was 102 to 104 minutes. About 3 or 4 days later, the interviewer picked up and reviewed the records and administered the health and demographic questionnaires, which took about 30 minutes. On the three later rounds, the 1-day recall took, on average, 18 minutes for men and 30 minutes for women to complete. Interviewers required an average of 16 to 20 minutes to review and pickup food records and administer the life-events questionnaire. The last interview (round five) included the FFQ, the life-events questionnaire, and the exit questions and took about 66 to 77 minutes.

10.3.4 Data Processing

Special computer programs converted reported portion sizes of identified foods from the recalls-records and the typical serving sizes of foods or food groups from the FFQ to food energy and nutrient equivalents. The Michigan State University (MSU) nutrient data base provided conversion factors for common measures to gram equivalents and food composition values. For comparison of food recall-record and FFQ data, about 2,200 MSU food codes for foods on the recalls-records were assigned to 118 FFQ food groups--113 groups from the food slips; 3 groups from probes for added butter, added sugar, and added milk; 1 group for recipe ingredients such as flour; and 1 group for miscellaneous food items rarely eaten and not reported on the FFQ. For some analyses, the 118 food groups were aggregated into 13 broad food groups.

It was necessary to construct two subsidiary nutrient data bases: a recipe data base for foods not in the MSU data base and a composite data base containing values for FFQ food groups. The composite value for a FFQ food group was an average derived from the nutrient values for each item within the food group (based on the typical serving size) weighted by its frequency of consumption. If the FFQ food group consisted of a single item, its nutrient value from the MSU data base or the recipe data base was appropriate.

10.3.5 Analyses of the Two Sets of Data

Validation of the FFQ food intake data was carried out by comparing for each individual the FFQ data with those from the 16 days of food intake collected using the recall-record questionnaires. The 16 days of food recall-record data were treated as the standards for comparisons with FFQ data. The following types of comparisons were made:

- The average frequencies of consumption of each of 13 broad and of 118 detailed food groups.

Table 10.1--Participation and demographic characteristics of the study sample

Characteristic	Men				Women			
	White		Black		White		Black	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Recruits	75	100	56	100	78	100	69	100
Full participants	64	85	43	77	73	94	48	70
Full participants								
Age in years:								
25-29	15	23	10	23	17	23	11	23
30-34	20	31	11	26	20	27	12	25
35-39	19	30	13	30	17	23	13	27
40-44	7	11	7	16	11	15	8	17
45-50	3	5	2	4	8	11	4	8
Education completed:								
Less than 12 years	0	0	0	0	4	5	4	8
12 years	3	5	1	2	17	23	12	25
1-3 years college	13	20	12	30	10	14	18	37
4 years college	28	44	8	19	25	34	5	10
5+ years college	19	30	22	51	16	22	9	19
Unknown	1	2	0	0	1	1	0	0
Occupation:								
Professional/ managerial	38	59	23	53	24	33	10	21
Clerical/sales	10	16	8	19	14	19	15	31
Craftsmen/ operatives	8	12	5	12	4	5	2	4
Service workers/ laborers	5	8	4	9	10	14	7	15
Not employed	3	5	3	7	21	29	14	29
Family income in thousand dollars:								
0-2.4	1	2	2	5	0	0	6	12
2.5-9.9	6	9	3	7	7	10	9	19
10.0-19.9	11	17	10	23	11	15	12	25
20.0-29.9	19	30	8	19	18	25	9	19
30.0-44.9	20	31	5	12	22	30	5	10
45.0 and over	6	9	15	35	13	18	6	12
No response	1	2	0	0	2	3	1	2

--The average size of serving calculated from the recall-record data for each of 118 food groups with the typical sizes reported on the FFQ.
--The average amount of food consumed per day for each of 118 food groups.
--Diet diversity (number of different foods).
--Mean energy and nutrient values.

All data were analyzed within sex and race groups. As measures of central tendency, both medians and means were usually computed for both methods. Medians may be more appropriate because of the skewed nature of intake distributions. Comparisons of medians included median values from the FFQ and from the recall-record method and the medians of the differences for each respondent for each food group (which is not the same as difference between medians). Median difference as a percentage of the records' medians was also calculated to indicate degree of difference. Comparisons of means included mean differences and standard deviations. Percentage distributions of respondents were also used for some comparisons.

Frequency of consumption--reported on the FFQ as the number of times a day, a week, a month, or a year--was converted into number of times per week, then multiplied by 52 to give times per year. Frequency conversions for the FFQ categories were set as follows:

	Times per week
More than once a day	14
Once a day	7
5 to 6 times a week	5.5
3 to 4 times a week	3.5
1 to 2 times a week	1.5
1 to 3 times a month	0.5
1 to 11 times a year	0.12

Frequencies reported on the 16 food recalls-records were converted to the same categories by multiplying the 16-day frequency by 22.8125 to estimate the frequency for the year and then dividing by 52 to estimate the frequency per week. The analyses of frequency of consumption were made only for respondents who reported a food at least once on the recall-record days or at least 12 times a year on the FFQ. Nonusers were excluded because zero values by over half of the respondents would give zero medians and prevent comparison of differences between methods.

For analysis of the amount in ounces consumed per year for each of the 118 food groups, amount consumed per year from the FFQ for each respondent for each food group was the product of reported frequency multiplied by the reported typical serving size. The amount consumed per year from the recalls-records for each respondent for each food group was the product of the total amount consumed per food group reported during the 16 recall-record days multiplied by 22.8125 to derive a yearly amount consumed. The yearly amounts were used for comparisons because daily or weekly amounts for some food groups would have been very small. (For the same reason, frequencies of consumption were converted to a yearly basis before dividing by 52 to obtain the frequency per week.)

The relationships of values for food energy and macronutrients derived from FFQ estimates per day to the daily variation in the values for food energy and macronutrients estimated from 16 recall-record days were examined. Each FFQ estimate was compared with the 16-day recall-record mean and its standard deviation (SD). Six categories were used in sorting individuals: FFQ estimates (1) greater than two SD less than the record mean, (2) between one and two SD less, (3) between the mean and one SD less, (4) between the mean and one SD more, (5) between one and two SD more, and (6) greater than two SD beyond the mean.

Another way of comparing food energy estimates was to look at the degree of agreement for food energy per day between FFQ and the 16 food recall-record days. This was studied by separating respondents into four groups defined by the ratio of FFQ food energy to the mean value for food energy from the recalls-records.

The groups were:

0.8 or less....FFQ energy was less than record energy by 400 kilocalories or more

0.81 to 1.2....FFQ energy and record energy were within 400 kilocalories

1.21 to 1.5....FFQ energy was more than record energy by about 400 to 1,000 kilocalories

Over 1.5.......FFQ energy was greater than record energy by more than 1,000 kilocalories

10.4 Main Findings

A number of different comparisons were made between the two sets of data derived from the FFQ and the 16 recall-record days. Results of analyses were reported for the following:

- --Frequency of eating each food group.
- --Agreement by frequencies of eating each food group.
- --Average portion size consumed in a year.
- --Levels of food energy and macronutrients.
- --FFQ-based estimates for food energy and macronutrients compared to the variability of corresponding values from 16 recall-record days.
- --Characteristics of respondents categorized by degree of agreement between methods for food energy intake.
- --Diet diversity.
- --Food energy and macronutrient intake based on recall-record days.

10.4.1 Frequency of Consumption per Year by Food Groups

Median and mean frequencies of consumption of 13 food groups during 1 year derived from FFQ data and from food recall-record data are given in Table 10.2. For the total sample, the median estimates of frequency were similar for 7 of the food groups. The FFQ procedure produced much larger estimates for three food groups: fruits and juices, added butter, and dairy foods. (The "other foods" category had foods from records only). Mean frequencies of consumption tended to be higher than median frequencies. White men's median estimates with the two methods were closer than black men's estimates. Likewise, white women's were closer than black women's (Table 10.3). Black men had more estimates that differed than did black women.

Comparison of median and mean frequencies of consumption during 1 year

Table 10.2--Frequency of eating specified food groups in a year derived from two methods[1]

Food group	Median				Mean			
	Food recall-record method	Food frequency method	Median difference	Percent difference	Food recall-record method	Food frequency method	Mean difference	Standard deviation
	-----Number of times-----			Percent	-----------Number of times-----------			
Meat.................	639	572	42.3	6.6	645	654	-9.4	425.1
Dairy foods..........	684	845	-75.4	-11.0	794	980	-186.8	548.6
Eggs.................	114	156	-6.4	-5.6	135	190	-55.1	192.6
Bread and cereal.....	844	910	25.6	3.0	892	953	-61.1	423.8
Vegetables...........	924	924	.4	([2])	975	1,094	-119.0	703.4
Fruits and juices....	456	730	-233.4	-51.2	533	870	-336.7	662.7
Other beverages including alcohol...	935	918	10.6	1.1	999	970	29.5	503.5
Desserts.............	240	254	7.1	3.0	279	318	-39.1	296.9
High-fat foods.......	319	368	-39.8	-12.5	345	430	-85.2	333.1
Added sugar..........	125	52	22.8	18.2	246	243	2.8	258.2
Added butter.........	411	546	-76.5	-18.6	437	567	-129.8	357.7
Other foods..........	684	0	661.6	96.7	866	85	781.5	588.2
Pizza................	23	26	([2])	([2])	33	32	.4	35.4

[1] For subjects reporting consumption of the food group by either method.
[2] Less than 0.1.

Table 10.3--Median frequency of eating specified food groups in a year by sex and race[1]

Race and food group	Men: Food recall-record method	Men: Food frequency method	Men: Median difference	Men: Percent difference	Women: Food recall-record method	Women: Food frequency method	Women: Median difference	Women: Percent difference
	-----Number of times-----			Percent	-----Number of times-----			Percent
White:								
Meat................	616	547	54.0	8.8	593	507	59.9	10.1
Dairy foods.........	958	1,041	-52.9	-5.5	821	930	-1.9	- .2
Eggs................	125	108	9.8	7.8	160	156	-21.8	-13.7
Bread and cereal....	1,004	936	78.7	7.8	890	910	53.5	6.0
Vegetables..........	1,038	872	30.2	2.9	1,118	1,142	9.6	.9
Fruits and juices...	479	702	-70.0	-14.6	548	754	-186.6	-34.1
Other beverages including alcohol..	1,106	1,109	70.5	6.4	1,095	962	24.3	2.2
Desserts............	285	299	-12.8	-4.5	297	260	24.2	8.2
High-fat foods......	422	459	-49.4	-11.7	365	390	-9.1	-2.5
Added sugar.........	148	39	22.8	15.4	68	0	43.3	63.2
Added butter........	502	530	28.5	5.7	433	598	-86.7	-20.0
Other foods.........	958	0	985.1	100.0	798	0	707.2	88.6
Pizza...............	46	26	([2])	([2])	23	26	([2])	([2])
Black:								
Meat................	684	679	51.1	7.5	662	650	14.8	2.2
Dairy foods.........	456	780	-151.8	-33.3	433	663	-163.9	-37.8
Eggs................	91	156	-12.8	-14.0	103	104	-17.8	-17.3
Bread and cereal....	730	908	-147.1	-20.2	753	884	-54.5	-7.2
Vegetables..........	707	676	41.8	5.9	787	924	-155.9	-19.8
Fruits and juices...	365	719	-275.3	-75.4	376	923	-488.2	-129.7
Other beverages including alcohol..	798	914	-59.7	-7.5	639	735	17.2	2.7
Desserts............	228	260	6.9	3.0	171	156	7.1	4.2
High-fat foods......	228	364	-118.9	-52.1	240	234	-4.2	-1.7
Added sugar.........	160	94	22.8	14.3	160	169	([2])	([2])
Added butter........	274	494	-105.7	-38.6	319	520	-173.0	-54.2
Other foods.........	456	0	433.4	95.0	616	0	467.7	75.9
Pizza...............	0	26	-3.2	([2])	23	26	([2])	([2])

[1] For subjects reporting consumption of the food group by either method.
[2] Less than 0.1.

for 118 detailed food groups indicated that agreement between broad food groups was sometimes achieved as a result of counterbalance of differences in frequencies of consuming the detailed food groups (Table 10.4). In general, median frequency of eating meat was slightly lower by the FFQ than by the recalls-records, and was lower to about the same extent for all sex-race groups (Table 10.3). Chicken and ground beef were reported by the largest number of respondents as most frequently eaten by both methods (Table 10.4). Dairy foods frequencies were higher by FFQ than by recalls-records mainly due to higher reporting of milk as a beverage, especially by black men and women, but cheeses were lower by the FFQ than the recalls-records for all sex-race groups.

Fruits and juices were estimated as consumed about 14 times per week on the FFQ (13.5 to 17.7 times per week), whereas recall-record data indicated about 8 times per week. The larger frequency appeared to result from consistent higher reporting on the FFQ than on recalls-records for nearly all detailed fruit and juice groups. The UM team mentioned that the differences may be a function of how the values were assigned to the frequency category, rather than of real differences in the reports by the two methods. Frequencies of beverages including alcoholic drinks were lower by the FFQ compared to the recalls-records.

Among desserts, estimates with the two methods appeared closer for cookies than for cakes. Among high-fat foods, peanut butter was considerably higher by the FFQ than recalls-records according to both medians and means. As can be seen in the tables, medians and means sometimes differ. For frequency of consumption, the two methods tended to show better agreement for broad food groups than for detailed food groups.

10.4.2 Agreement Between Recalls-Records and FFQ Frequencies of Consumption

The degree to which respondents were in the same or adjoining frequency of consumption categories derived from the two methods--FFQ and recalls-records--was examined on the individual case level using frequency categories. The seven frequency categories developed for the FFQ were applied to the frequencies in the recalls-records. To categorize the recall-record frequencies, the lower and upper limits of each frequency category were specified. The percentage of respondents was subdivided according to whether (1) the frequency from food recalls-records was below the lower limits of the reported FFQ frequency, (2) within the lower and upper limits (considered agreement), or (3) above the upper limits.

For the total sample, the most agreement between sets of data from the two methods for 13 food groups was shown for meat (56 percent), bread and cereal (50 percent), and vegetables (50 percent); and the least agreement occurred for fruits and juices (28 percent) and added sugar (17 percent) (Table 10.5). Analysis based on 118 food groups showed lower percentages in the agreement category. Foods with the most agreement for the two methods (30 to 39 percent of respondents) were ground beef (35 percent), sausage (33 percent), chicken (35 percent), eggs (32 percent), pancakes (31 percent), pasta (35 percent), rice (39 percent), fried potatoes (35 percent), broccoli (35 percent), corn (30 percent), coffee (30 percent), beer (32 percent), syrup and molasses (33 percent), added butter (31 percent), and pizza (35 percent). These foods were consumed by many respondents. Although milk as a beverage and cheeses were also reported by many consumers, fewer respondents showed agreement between the

Table 10.4--Frequency of eating food items in a year derived from two data collection methods[1]

Food group	Individuals using[1]	Median: Food recall-record method	Median: Food frequency method	Median: Median difference	Median: Percent difference	Mean: Food recall-record method	Mean: Food frequency method	Mean: Mean difference	Mean: Standard deviation
	Number	Number of times	Number of times	Number of times	Percent	Number of times	Number of times	Number of times	Number of times
Meats:									
Canadian bacon...	20	23	17	19.6	86.0	17	21	-4.2	36.9
Bacon............	160	46	26	19.6	43.0	53	51	1.8	69.5
Ground beef......	209	91	78	13.3	14.5	108	107	1.1	103.2
Beefsteak........	188	46	26	19.6	43.0	54	45	9.5	72.7
Beef in mixes....	151	0	26	-26.0	([2])	15	56	-41.1	67.5
Corned beef......	51	23	26	19.6	86.0	26	28	-1.7	54.5
Veal.............	34	23	0	22.8	100.0	25	17	8.2	37.7
Lamb.............	39	23	0	22.8	100.0	29	15	13.3	42.7
Sausages.........	165	46	26	13.3	29.0	54	55	- .9	89.3
Frankfurters.....	157	23	26	-3.2	-14.0	33	51	-17.8	66.3
Lunch meats......	189	68	26	22.8	33.3	80	76	4.5	97.8
Chicken..........	216	114	78	19.6	17.2	136	126	10.3	146.8
Pork chops.......	184	46	26	21.2	46.5	58	38	19.2	51.0
Spareribs........	72	23	26	-3.2	-14.0	22	26	-4.6	58.3
Pork parts.......	20	23	26	-8.8	-38.4	19	34	-14.6	52.8
Liver, etc.......	36	23	26	-3.2	-14.0	22	29	-6.7	65.6
Game meats.......	0	--	--	--	--	--	--	--	--
Shellfish........	123	23	26	22.8	100.0	42	31	11.5	52.5
Canned fish......	177	23	26	-9.6	-41.9	34	56	-22.7	80.6
Fish.............	174	23	26	-9.6	-41.9	43	55	-11.4	59.8
Broth soup.......	173	46	26	22.8	50.0	52	35	16.7	61.5
Dairy foods:									
Milk to drink....	221	251	364	-52.0	-20.7	339	535	-196.4	426.2
Cottage cheese...	122	23	26	-3.2	-14.0	43	59	-16.1	78.1
Cheeses..........	222	160	78	68.4	42.9	199	141	57.3	149.5
Creamed soup.....	131	23	18	19.6	86.0	29	29	- .4	49.1
Ice cream........	196	46	37	-2.5	-5.5	62	66	-4.0	88.2
Milk shakes......	64	23	26	-9.0	-39.6	17	30	-13.2	40.6
Puddings.........	68	23	0	22.8	100.0	27	17	10.7	46.5
Added milk.......	147	91	0	22.8	25.0	201	219	-18.0	293.5
Yogurt...........	119	46	78	-32.4	-71.0	70	123	-53.3	108.2

See footnotes at end of table.

Continued

Table 10.4--Frequency of eating food items in a year derived from two data collection methods[1]--Continued

Food group	Individuals using[1]	Median: Food recall-record method	Median: Food frequency method	Median: Median difference	Median: Percent difference	Mean: Food recall-record method	Mean: Food frequency method	Mean: Mean difference	Mean: Standard deviation
	Number	Number of times	Number of times	Number of times	Percent	Number of times	Number of times	Number of times	Number of times
Eggs:									
Eggs in combination......	66	23	0	22.8	100.0	35	0	34.6	24.4
Eggs..............	221	114	156	-19.1	-16.8	129	196	-67.2	195.4
Bread and cereal:									
Breakfast cereals.	191	91	78	-26.0	-28.5	125	175	-49.8	150.9
Hominy grits, etc.	37	23	26	-26.0	-114.0	8	45	-27.1	79.5
Bread or rolls....	228	365	364	46.6	12.8	397	345	52.1	174.8
Biscuits..........	129	23	26	-3.2	-14.0	28	47	-18.9	96.2
Muffins, etc......	114	0	26	-26.0	([2])	27	40	-13.1	62.1
Cornbread.........	91	23	26	-3.2	-14.0	30	43	-12.8	73.3
Sweet rolls.......	184	46	26	-3.2	-7.0	53	62	-8.8	75.8
Pancakes..........	154	23	26	-3.2	-14.0	26	42	-15.6	53.1
Pasta.............	216	68	78	22.8	33.3	81	59	21.1	67.1
Rice..............	201	46	78	-9.6	-21.0	62	86	-23.7	76.4
Potato chips......	195	68	26	22.8	33.3	81	75	5.7	95.2
Popcorn...........	154	23	26	-19.2	-84.0	40	77	-36.4	88.9
Sweet crackers....	71	23	26	-26.0	-114.0	21	39	-17.7	56.9
Crackers..........	187	46	26	13.3	29.0	62	63	-1.3	96.7
Vegetables:									
Tomato juice......	66	23	26	22.8	100.0	34	37	-3.1	74.0
Bean soup.........	94	23	26	-8.5	-37.3	18	29	-11.1	46.3
Dried beans.......	179	46	26	22.8	50.0	56	33	23.4	71.0
Sweet potatoes....	57	23	26	-9.4	-41.3	20	34	-14.1	89.8
Fried potatoes....	202	46	26	-3.2	-7.0	62	69	-6.6	76.3
Escalloped potatoes.........	68	0	26	-26.0	([2])	14	27	-13.0	45.4
White potatoes....	211	68	78	13.3	19.4	77	76	.8	81.4
Greens............	157	23	26	-25.5	-111.8	36	73	-36.4	104.8

See footnotes at end of table.

Continued

Table 10.4--Frequency of eating food items in a year derived from two data collection methods[1]--Continued

Food group	Individuals using[1]	Median: Food recall-record method	Median: Food frequency method	Median: Median difference	Median: Percent difference	Mean: Food recall-record method	Mean: Food frequency method	Mean: Mean difference	Mean: Standard deviation
	Number	Number of times			Percent	Number of times			
Vegetables (con.):									
Broccoli..........	181	23	78	-26.0	-114.0	46	81	-34.7	76.0
Carrots...........	195	68	78	19.6	28.7	88	95	-7.6	106.7
Pumpkin...........	32	23	10	15.3	67.1	16	20	-3.7	38.0
Raw tomatoes......	215	91	77	22.8	25.0	107	97	9.7	101.4
Cooked tomatoes...	130	23	26	22.8	100.0	35	35	.2	74.7
Tomato sauce......	223	114	26	58.9	51.6	115	56	59.2	82.8
Cabbage...........	169	46	26	19.6	43.0	47	37	10.7	67.9
Lettuce...........	223	114	182	-12.3	-10.7	140	176	-36.3	140.7
Sweet peppers.....	193	46	26	21.4	47.0	71	76	-5.0	107.9
Blackeye peas.....	42	0	26	-26.0	([2])	12	38	-26.1	43.1
Lima beans........	165	23	26	-3.2	-14.0	37	44	-6.6	59.9
String beans......	197	23	39	-26.0	-114.0	38	63	-25.2	70.0
Corn..............	190	23	33	-17.4	-76.1	31	55	-23.5	54.3
Brussels sprouts..	139	23	26	-3.2	-14.0	26	45	-18.7	62.4
Cucumbers, etc....	198	46	49	-1.6	-3.4	68	98	-30.5	127.6
Soybean products..	44	46	26	-6.4	-14.0	55	89	-33.1	120.7
Fruits and juices:									
Citrus fruit......	175	46	65	-26.0	-57.0	54	95	-41.2	118.7
Orange juice, etc.	211	114	182	-55.2	-48.4	143	224	-80.9	171.1
Fruit juices......	181	46	78	-32.4	-71.0	93	152	-59.4	192.6
Fresh melon.......	147	23	30	-8.7	-38.1	33	55	-22.3	96.7
Bananas...........	177	46	78	-26.0	-57.0	72	132	-59.7	154.7
Raw apples........	194	46	78	-26.0	-57.0	69	126	-56.7	131.9
Cooked apples.....	99	23	26	-3.2	-14.0	30	42	-11.5	83.0
Fresh cherries....	34	0	12	-11.1	([2])	13	32	-18.5	66.1
Fresh peaches.....	136	23	29	-13.5	-59.2	32	51	-19.2	95.0
Canned peaches....	88	23	26	-3.2	-14.0	24	40	-16.0	94.1
Fresh pears.......	87	0	26	-19.5	([2])	20	49	-28.7	98.4

See footnotes at end of table.

Continued

Table 10.4--Frequency of eating food items in a year derived from two data collection methods[1]--Continued

Food group	Individuals using[1]	Median: Food recall-record method	Median: Food frequency method	Median: Median difference	Median: Percent difference	Mean: Food recall-record method	Mean: Food frequency method	Mean: Mean difference	Mean: Standard deviation
	Number	Number of times	Number of times	Number of times	Percent	Number of times	Number of times	Number of times	Number of times
Fruits and juices (con.):									
Fruit cocktail....	102	23	26	-22.0	-96.6	23	50	-27.4	118.3
Fresh grapes......	147	0	30	-24.2	([2])	23	58	-35.5	92.9
Fresh berries.....	134	23	26	-2.7	-11.8	32	37	-5.4	63.9
Canned berries....	54	23	22	1.0	4.4	33	23	10.7	57.1
Dried fruit.......	131	46	26	22.8	50.0	65	62	2.7	114.1
Avocado...........	61	23	26	-9.6	-41.9	36	50	-13.5	65.2
Beverages including alcohol:									
Coffee............	181	456	364	.5	.1	535	468	66.8	364.9
Tea...............	171	46	78	-26.0	-57.0	110	184	-74.6	201.8
Koolade, etc......	154	46	26	22.8	50.0	88	107	-18.3	146.9
Diet soda.........	125	68	78	22.8	33.3	147	161	-14.0	159.8
Regular sodas.....	193	137	78	22.8	16.7	195	173	21.9	177.4
Beer..............	124	91	78	22.4	24.6	178	152	26.5	157.7
Wine..............	132	68	26	22.8	33.3	96	70	25.5	73.0
Alcoholic drinks..	116	46	26	22.8	50.0	69	60	9.2	74.2
Desserts:									
Jams and jellies..	200	46	78	-3.2	-7.0	82	106	-24.2	116.6
Molasses or syrup.	148	23	26	-3.2	-14.0	32	44	-12.8	54.6
Gelatin salads....	60	23	22	8.2	36.0	27	50	-23.0	98.2
Pies, etc.........	146	23	26	19.6	86.0	38	34	3.6	63.6
Cakes.............	167	46	26	22.8	50.0	45	33	12.4	63.3
Cookies...........	196	68	78	-3.2	-4.7	82	91	-9.0	114.1
Ices..............	72	0	26	-24.2	([2])	15	42	-26.8	64.6
Chocolate candy...	170	46	26	19.6	43.0	63	61	1.7	109.3

See footnotes at end of table.

Continued

Table 10.4--Frequency of eating food items in a year derived from two data collection methods[1]--Continued

Food group	Individuals using[1]	Median: Food recall-record method	Median: Food frequency method	Median: Median difference	Median: Percent difference	Mean: Food recall-record method	Mean: Food frequency method	Mean: Mean difference	Mean: Standard deviation
	Number	Number of times	Number of times	Number of times	Percent	Number of times	Number of times	Number of times	Number of times
High-fat foods:									
Salt pork	17	0	78	-55.2	([2])	8	64	-56.3	71.7
Cream cheese	126	23	26	13.3	58.1	37	40	-3.1	92.7
Cream sauces	67	0	26	-26.0	([2])	13	40	-27.5	62.3
Gravy	145	23	26	-3.2	-14.0	29	57	-27.6	97.8
Sour cream	116	23	26	14.5	63.7	36	34	2.3	56.1
Mayonnaise	224	114	78	22.8	20.0	132	134	-2.6	156.0
Salad dressings	173	46	78	-26.0	-57.0	60	101	-40.4	109.1
Nuts	181	46	26	22.8	50.0	73	61	11.9	104.1
Peanut butter	157	23	78	-26.0	-114.0	55	103	-48.2	121.9
Whipped cream	92	23	0	22.8	100.0	32	27	5.2	101.8
Added sugar	203	160	78	42.4	26.6	276	273	3.1	273.7
Added butter	228	411	546	-76.5	-18.6	437	567	-129.8	357.7
Other foods:									
Other foods	228	456	0	433.9	95.1	577	52	525.3	366.0
Ingredients	216	205	0	182.5	88.9	306	35	270.5	321.5
Pizza	185	46	26	-3.2	-7.0	40	40	.5	39.4

[1] For subjects reporting consumption of the food group by either method.
[2] Less than plus or minus 0.1.

Table 10.5--Degree of agreement between frequencies of eating food groups derived from two methods, total sample

Food group	Respondents using	Respondents' recalls-records-- Below food frequency	In agreement with food frequency	Higher than food frequency
	Number	Percent		
Meat..................	227	17.2	55.9	26.9
Dairy foods...........	228	34.2	42.1	23.7
Eggs..................	221	33.9	32.1	33.9
Bread and cereal......	228	26.3	50.0	23.7
Vegetables............	228	26.3	50.0	23.7
Fruits and juices.....	228	53.1	27.6	19.3
Beverages, including alcoholic drinks...............	226	21.2	36.7	42.0
Desserts..............	227	29.5	35.7	34.8
High-fat foods........	228	38.6	34.6	26.8
Added sugar...........	203	24.1	16.7	59.1
Added butter..........	228	41.7	31.1	27.2
Other foods...........	228	.9	1.8	97.4
Pizza.................	185	25.9	34.6	39.5

two methods (25 percent for milk and 18 percent for cheese). The UM team pointed out that more detailed food groupings showed less agreement, whereas larger aggregates of foods covered up the variation.

These researchers concluded from this analysis of food frequency categories that most respondents could not report accurately the frequency of consumption in the preceding year as revealed by records using the seven frequency categories.

They pointed out that application of a factor to the FFQ data to make it consistent with recall-record data was not feasible because results were not consistently higher or lower. The least troublesome category was for foods eaten most frequently according to the FFQ data--more than once a day (exact agreement with recall-record data, 53 percent) and the most troublesome category was for foods eaten 5 to 6 times per week (exact agreement, 11 percent).

10.4.3 Average Portion Size

The next comparison was based on average portion sizes calculated from data obtained with the two methods for the 118 food groups. Only respondents who listed the food on both the food recall-record report and the FFQ were included in this analysis. Forty-three food groups were reported by 100 or more respondents and 12 food groups by 10 or fewer respondents; 2 food groups were not reported by respondents for either method. If a default value was used (such as 138 grams for a medium-size apple), it was the same for both the recall-record report and FFQ. This may have contributed to high agreement between methods for some food groups.

Generally, men reported larger serving sizes than women on both instruments (Table 10.6). There were no apparent differences in portion sizes between white and black men. Black women tended to report smaller portion sizes on recalls-records than did other groups, but this tendency was less noticeable on the FFQ. Overall, FFQ portion sizes exceeded those from recalls-records. This was most often true for black women.

For the total sample, median consumption for 25 percent of the food groups differed between methods by 10 percent or less (based on median difference divided by record median). Food groups with good agreement for portion sizes between methods tended to have standard size portions because of packaging (such as beer), coding definitions (such as an average muffin), or an assumed practice (such as having orange juice in a 4-ounce juice glass). Defining good agreement as varying by 10 percent or less between methods, 38 percent of the food groups for white men, 28 percent for black men, and 27 percent for white and black women showed agreement. Defined as a median percentage difference of 100 percent or more, poor agreement occurred in the total sample for nine food groups--shellfish, popcorn and pretzels, escalloped potatoes, cooked tomatoes, tomato sauce, fresh melon, canned berries, cream sauces, and nuts. The UM team noted that combining foods with disparate portion sizes may have contributed to differences for three groups--shellfish, popcorn and pretzels, and fresh melon. They pointed out again that food groups showing good agreement tended to be frequently eaten items.

Distributions of portion sizes reported by respondents on the food recalls-records were also examined. Portion

Table 10.6--Median estimates of average portion sizes for specified foods by sex and race[1]

Food group	Recalls-records					Food frequency				
		Men		Women			Men		Women	
	Total	White	Black	White	Black	Total	White	Black	White	Black
	Ounces					Ounces				
Ground beef..........	4.21	5.52	4.85	3.88	3.34	3.14	3.37	3.63	2.89	2.49
Chicken..............	3.29	3.67	3.58	3.06	3.03	3.58	4.00	4.01	3.48	3.43
Fish.................	4.44	4.58	4.72	4.39	3.95	6.02	6.02	7.41	5.01	5.01
Milk-drink...........	6.35	6.07	8.16	6.18	6.13	6.50	7.22	8.32	6.47	6.20
Cheese...............	1.28	1.51	1.35	1.17	.94	1.50	1.51	1.20	1.62	1.00
Eggs.................	2.02	2.61	2.31	1.82	1.83	2.36	2.80	2.36	2.08	2.21
Bread................	1.64	1.91	1.79	1.49	1.44	1.82	2.33	1.84	1.58	1.78
Pasta................	6.18	7.72	8.37	5.57	4.94	7.75	10.34	5.17	6.07	5.17
Fried potatoes.......	3.93	4.64	3.75	3.52	3.44	5.20	5.20	5.20	5.20	5.20
Carrots..............	1.47	1.50	2.03	1.44	1.24	2.53	2.53	2.53	2.53	2.53
String beans.........	2.98	3.31	3.13	2.58	3.40	4.81	3.61	4.81	4.80	4.81
Orange juice.........	7.98	8.95	9.33	7.00	6.66	8.81	8.81	8.81	6.60	8.81
Apples...............	4.87	4.87	5.05	4.62	4.43	4.88	4.88	4.88	4.88	4.88
Regular soda.........	13.05	14.65	13.26	11.90	12.49	13.08	13.08	13.08	13.08	17.44
Beer.................	16.01	16.37	17.53	12.71	17.04	12.73	19.10	16.98	12.73	12.73
Cookies..............	1.54	1.70	1.73	1.27	1.24	2.07	2.07	2.55	1.78	2.07
Chocolate candy......	1.20	1.14	1.54	.96	1.40	1.47	1.36	1.47	1.47	1.47
Mayonnaise...........	.66	.79	.73	.60	.56	.53	.61	.50	.82	.50
Salad dressing.......	.93	1.06	1.08	.74	1.00	1.06	1.06	1.06	1.06	1.06
Peanut butter........	.82	1.06	.79	.83	.53	1.14	1.14	.86	1.14	1.14

[1]For subjects reporting consumption of the food group by either method.

sizes for about one-fourth of the 118 food groups varied widely (Table 10.7). For example, over 1 percent of the respondents reporting ground beef specified portions of 14 ounces or more, and 16 percent of pizza eaters reported portions of over 18 ounces. However, for fast foods and most food combinations, the entire portion of food was assigned to the food group of the major component based on its caloric content. Thus, portion sizes for some food groups contained other foods, such as buns with fast-food hamburgers.

10.4.4 Amounts of Food Consumed in a Year

The researchers found that amounts of most food groups consumed for the year were higher by the FFQ than by the 16 food recalls-records. The exceptions were mainly meats and beverages including alcoholic drinks. There were also exceptions for detailed food groups. For example, chicken from FFQ was lower than amounts from recalls-records for white men but higher for other sex-race groups. Higher amounts consumed in a year for the FFQ compared with recalls-records generally resulted from greater frequency of consumption and of larger typical serving sizes reported in the FFQ than in recalls-records. The UM team mentioned that the effect of the statistical methodology utilized might be a factor. Means frequently show greater differences than medians because of the impact of extreme values.

The pattern of differences between methods for amounts consumed in a year varied among the 118 food groups. Within the broad meat grouping, median amounts of 13 of the 20 subgroups in the FFQ were lower than in the recalls-records. Generally, frequencies of consumption in the FFQ compared with the recalls-records were lower, but typical serving sizes were higher. Counterbalancing of these two components led to the close agreement in amount consumed for the meat group. In the dairy group, median amounts per year for five of nine subgroups were higher by the FFQ than by recalls-records. Typical serving sizes in the FFQ were larger than in the recalls-records for all subgroups except added milk. For the total sample, milk as a beverage showed a difference of 561 ounces for the year (about 11 ounces per week). Although all sex-race groups reported more milk as a beverage on the FFQ than on the recalls-records, blacks reported proportionately more than whites; and black men did so the most. The amount of eggs eaten was greater by the FFQ than by the recalls-records, a result of both greater frequency and serving size in the FFQ. The same thing occurred for 10 of the 14 subgroups within the bread and cereal group. Blacks consumed higher amounts of biscuits by the FFQ than by recalls-records, whereas pasta consumption was lower by all groups except white men. Vegetables were higher by the FFQ than by recalls-records for 16 of 24 subgroups and fruits and juices for 16 of 17 subgroups. For beverages including alcoholic drinks, differences between methods were small compared with other groups. High-fat foods were higher on the FFQ than on recalls-records, with the largest differences for peanut butter, especially for men. Added sugar was lower on the FFQ than on recalls-records reflecting both lower frequency and smaller serving size. Added butter showed little difference between methods, but the FFQ frequency was higher and serving size lower than from the recalls-records. Pizza was greater for the year from the FFQ, more from serving size than from frequency; amounts for black men were much greater from FFQ than from recalls-records.

Table 10.7--Distributions of portion sizes for specified foods reported in recalls-records

Food group	Number of portions	Percentage of food items in portion size category					
		<2 oz	2 to 6 oz	6 to 10 oz	10 to 14 oz	14 to 18 oz	>18 oz
		Percent					
Ground beef..........	990	26.3	45.5	21.6	4.9	0.9	0.8
Beefsteak............	449	20.3	52.1	19.2	5.6	1.3	1.6
Beef in mixes........	102	10.8	46.1	28.4	6.9	4.9	2.9
Broth soup...........	394	24.6	17.5	33.5	14.0	7.1	3.3
Milk to drink........	3,281	26.4	21.0	34.0	12.0	5.1	1.6
Creamed soup.........	166	15.7	33.1	28.3	18.1	3.6	1.2
Milk shakes..........	47	([1])	14.9	17.0	48.9	12.8	6.4
Yogurt...............	366	9.3	31.1	55.7	2.7	1.1	([1])
Pasta................	763	12.5	42.2	25.2	9.4	5.8	5.0
Rice.................	550	11.3	37.5	30.2	12.4	5.8	2.9
Tomato juice.........	97	19.6	22.7	43.3	11.3	([1])	3.1
Bean soup............	73	8.2	32.9	27.4	17.8	5.5	8.2
Dried beans..........	439	26.7	35.1	19.8	5.0	6.2	7.3
Sweet potatoes.......	49	20.4	53.1	20.4	6.1	([1])	([1])
Fried potatoes.......	551	11.4	77.5	7.3	3.3	.2	.4
Escalloped potatoes..	42	7.1	35.7	38.1	4.8	9.5	4.8
Citrus fruit.........	415	8.0	75.9	9.9	4.1	1.2	1.0
Orange juice, etc....	1,326	3.8	21.2	55.4	13.7	4.1	1.9
Fruit juices.........	735	10.1	28.3	33.7	14.6	8.7	4.6
Canned peaches.......	94	20.2	51.1	17.0	4.3	5.3	2.1
Fresh pears..........	76	7.9	75.0	1.3	15.8	([1])	([1])
Dried fruit..........	372	93.3	5.9	.8	([1])	([1])	([1])
Coffee...............	4,241	.8	4.9	57.0	17.9	10.4	9.1
Tea..................	821	4.9	3.8	39.8	26.9	19.9	4.8
Koolade, etc.........	596	3.5	11.1	45.5	23.5	11.2	5.2
Diet soda............	804	.5	6.1	37.6	24.8	27.9	3.2
Regular sodas........	1,651	.2	5.0	27.3	33.9	23.6	10.1
Beer.................	968	.4	.8	5.9	54.8	4.6	33.5
Wine.................	553	14.8	27.5	35.6	12.5	6.0	3.6
Pies.................	242	11.6	64.0	16.9	5.0	1.7	.8
Pizza................	327	1.2	19.0	32.1	20.5	11.3	15.9

[1]Less than 0.1 percent.

10.4.5 Food Energy and Nutrient Values from FFQ and Recalls-Records

The FFQ yielded higher estimates of total food energy, protein, fat, and carbohydrates per day than estimates based on the 16 food recalls- records. For all food groups combined, the medians of the differences for food energy, protein, fat, and carbohydrate were smaller for whites than for blacks within sex categories and smaller for men than for women within racial categories (Table 10.8). Percentage differences were largest for carbohydrate. Comparisons of mean values revealed somewhat different relationships; black men showed the greatest differences. Among the 13 food groups, median estimates of food energy and at least one macronutrient showed relatively good agreement between methods for meat, desserts, beverages including alcoholic drinks, and pizza; moderate agreement for vegetables, bread and cereal, added butter, added sugar, and dairy foods; and poor agreement for eggs, fruits and juices, and high-fat foods (Table 10.9). Nevertheless, there were considerable differences between methods in median food energy consumption patterns of food groups by sex and race (Table 10.10). Mean energy for the total sample was 2,766 kilocalories from FFQ data and 2,111 kilocalories from recall-record data (Table 10.8); however, the percentages of food energy from each broad food group on the FFQ and on the recalls-records were close except for fruits and juices (9 percent by FFQ, 5 percent by recalls-records) (Table 10.9).

Demographic characteristics of the sample were examined to determine whether they accounted for differences in food energy between methods. The UM team found that agreement between methods was best for women who were white, older, married, with at least 16 years of education, professional, and with an income of at least $20,000; surprisingly, agreement was poorest for black women with the same demographic characteristics. Among men, agreement between methods was greatest for black unmarried men and for white young men with at least 16 years of education, professional, and an income of at least $20,000. Black young men with less than 16 years of education, nonprofessional, and with low incomes had poorest agreement in caloric values between methods.

10.4.6 FFQ Estimates for Food Energy and Macronutrients Compared to Variability of Values from 16 Recall-Record Days

A key research question posed by the UM team was this: In what proportion of the sample was the FFQ estimate of daily intake a reasonable one considering the distribution of day-to-day variability reported in the food recalls-records? To study this question, each individual's FFQ estimates per day for food energy and macronutrients were compared with the distribution of the 16 recall-record days' estimates for that individual. Each respondent was then placed in one of six categories based on the relationship of the FFQ estimate to the 16-day recall-record mean.

FFQ estimates were within one SD of the mean food energy value for about half of the total sample and greater than two SD of the mean food energy for one-fourth of the sample (Table 10.11). Among sex-race groups, the category of white men had the highest percentage of respondents (58 percent) with close agreement on the two questionnaires (FFQ value within one SD of the recall-record mean). The categories of white women, black men, and black women had 52, 49, and 31 percent, respectively, with close agreement. FFQ estimates were within one SD of the recall-record estimates for protein, fat, and carbohydrate for 58, 57, and 51 percent of the sample.

Table 10.8--Food energy and nutrient intakes per day from total diet derived from two methods

Nutrient and sex-race group	Number of individuals	Median				Mean			
		Food recall-record method	Food frequency method	Median difference	Percent difference	Food recall-record method	Food frequency method	Mean difference	Standard deviation
Food energy (kcal):									
Men:									
White..........	64	2,646	2,869	-269.7	-10.2	2,714	3,182	-468.6	1,097.5
Black..........	43	2,095	2,576	-466.6	-22.3	2,167	3,179	-1,011.2	1,552.8
Women:									
White..........	73	1,839	2,092	-372.4	-20.2	1,897	2,376	-479.3	970.5
Black..........	48	1,515	2,248	-650.3	-42.9	1,585	2,437	-852.5	1,177.2
Total.............	228	2,019	2,519	-453.3	-22.5	2,111	2,766	-655.2	1,190.8
Protein (g):									
Men:									
White..........	64	93	99	-2.5	-2.7	99	112	-13.2	42.2
Black..........	43	81	97	-15.5	-19.1	79	110	-30.5	54.5
Women:									
White..........	73	71	85	-11.5	-16.1	73	92	-19.2	34.3
Black..........	48	60	80	-22.4	-37.4	60	87	-27.4	39.8
Total.............	228	77	90	-14.4	-18.7	79	100	-21.4	42.3
Fat (g):									
Men:									
White..........	64	116	127	-10.8	-9.3	119	140	-20.5	58.4
Black..........	43	93	105	-20.8	-22.3	93	136	-43.4	74.4
Women:									
White..........	73	82	89	-13.8	-16.9	83	102	-19.0	54.8
Black..........	48	66	93	-26.8	-40.7	70	101	-31.9	58.0
Total.............	228	91	104	-14.5	-16.0	92	119	-26.7	60.9
Carbohydrate (g):									
Men:									
White..........	64	283	320	-40.3	-14.3	290	356	-65.8	115.7
Black..........	43	222	330	-66.3	-29.9	233	367	-134.9	199.9
Women:									
White..........	73	202	248	-45.0	-22.3	210	273	-62.7	101.7
Black..........	48	166	265	-90.8	-54.6	179	304	-124.8	155.2
Total............	228	222	288	-59.5	-26.8	230	321	-90.3	142.9

Table 10.9--Median food energy and macronutrient intakes per day from specified food groups

Food group	Food energy: Food recall-record method	Food energy: Food frequency method	Food energy: Median difference	Food energy: Percent difference	Protein: Food recall-record method	Protein: Food frequency method	Protein: Median difference	Protein: Percent difference
	Kilocalories	Kilocalories	Kilocalories	Percent	Grams	Grams	Grams	Percent
TOTAL	2,019	2,519	-453.3	-22.5	77	90	-14.4	-18.7
Meat	389	365	-5.3	-1.4	31	32	- .7	-2.1
Dairy foods	215	283	-33.7	-15.3	11	15	-2.5	-22.0
Eggs	30	50	-11.0	-37.1	2	3	- .3	-15.6
Bread, cereal	386	516	-74.0	-19.2	11	13	-1.2	-11.1
Vegetables	150	156	-10.2	-6.8	5	6	- .7	-12.8
Fruits, juices	109	231	-85.0	-78.3	1	2	- .9	-78.9
Beverages, including alcoholic drinks	149	138	7.2	4.8	1	1	([1])	- .9
Desserts	100	120	.8	.8	1	1	.1	5.8
High-fat foods	100	146	-32.2	-32.3	1	3	- .9	-68.3
Added sugar	9	3	2.9	33.3	0	0	([1])	([1])
Added butter	88	75	7.1	8.1	0	0	([1])	([1])
Pizza	49	81	-3.9	-8.1	2	3	- .2	-7.3

Food group	Fat: Food recall-record method	Fat: Food frequency method	Fat: Median difference	Fat: Percent difference	Carbohydrate: Food recall-record method	Carbohydrate: Food frequency method	Carbohydrate: Median difference	Carbohydrate: Percent difference
	Grams	Grams	Grams	Percent	Grams	Grams	Grams	Percent
TOTAL	91	104	-14.5	-16.0	222	288	-59.5	-26.8
Meat	25	24	-1.2	-4.9	5	2	2.9	59.4
Dairy foods	11	12	- .2	-2.3	16	25	-7.2	-45.0
Eggs	2	4	-1.4	-65.5	0	0	([1])	([1])
Bread, cereal	10	12	- .5	-4.9	65	91	-14.1	-21.7
Vegetables	4	3	.7	16.6	23	28	-4.8	-20.6
Fruits, juices	0	1	- .4	-88.8	26	56	-20.9	-80.4
Beverages, including alcoholic drinks	0	0	([1])	([1])	24	21	.2	1.0
Desserts	4	4	.5	13.0	16	20	-1.6	-10.0
High-fat foods	10	14	-3.0	-30.4	2	4	-1.1	-47.9
Added sugar	0	0	([1])	(1)	2	1	.7	33.3
Added butter	10	8	.8	8.0	0	0	([1])	51.6
Pizza	2	4	- .7	-31.9	5	7	- .1	-1.6

[1]Less than plus or minus 0.1.

Table 10.10--Median food energy intakes per day from specified food groups

Food group	White men: Food recall-record method	White men: Food frequency method	White men: Median difference	White men: Percent difference	Black men: Food recall-record method	Black men: Food frequency method	Black men: Median difference	Black men: Percent difference
	-----Kilocalories----			Percent	-----Kilocalories----			Percent
TOTAL	2,646	2,869	-269.7	-10.2	2,095	2,576	-466.6	-22.3
Meat	481	419	.9	.2	492	475	15.8	3.2
Dairy foods	301	351	-4.5	-1.5	136	238	-37.5	-27.6
Eggs	39	54	-9.6	-24.5	27	51	-25.9	-95.6
Bread, cereal	511	582	-42.4	-8.3	425	555	-146.5	-34.4
Vegetables	210	182	12.8	6.1	159	157	-7.0	-4.4
Fruits, juices	122	224	-49.2	-40.4	92	234	-113.0	-123.5
Beverages, including alcoholic drinks	261	238	8.5	3.2	240	216	27.0	11.3
Desserts	135	148	1.4	1.0	99	149	-6.4	-6.5
High-fat foods	158	228	-72.8	-46.2	95	180	-47.1	49.3
Added sugar	14	3	3.7	26.5	11	6	2.4	22.2
Added butter	108	97	19.9	18.3	77	51	18.1	23.6
Pizza	95	114	-2.3	-2.4	0	81	-15.9	([1])

Food group	White women: Food recall-record method	White women: Food frequency method	White women: Median difference	White women: Percent difference	Black women: Food recall-record method	Black women: Food frequency method	Black women: Median difference	Black women: Percent difference
	-----Kilocalories----			Percent	-----Kilocalories----			Percent
TOTAL	1,839	2,092	-372.4	-20.2	1,515	2,248	-650.3	-42.9
Meat	300	302	-3.7	-1.2	375	382	-27.2	-7.3
Dairy foods	255	309	-25.7	-10.1	126	237	-61.1	-48.5
Eggs	30	50	-11.2	-37.2	21	32	-8.1	-38.8
Bread, cereal	355	428	-42.5	-12.0	288	478	-86.1	-29.9
Vegetables	131	145	-23.3	-17.7	121	133	-24.8	-20.5
Fruits, juices	112	216	-75.8	-67.9	83	278	-169.1	-203.4
Beverages, including alcoholic drinks	117	87	7.5	6.4	124	116	.4	.3
Desserts	104	109	8.7	8.3	66	79	-15.9	-24.1
High-fat foods	94	139	-34.9	-37.0	58	66	2.2	3.9
Added sugar	5	0	3.2	66.3	13	15	.5	3.6
Added butter	81	75	5.9	7.3	61	65	-10.9	-17.9
Pizza	48	74	-21.4	-44.6	41	39	([1])	([1])

[1]Less than 0.1.

Table 10.11--Distribution of respondents by relation of food frequency values to variability of mean food energy and macronutrient intake from 16 recall-record days

[SD=Standard deviation]

Nutrient and sex-race group	Individuals	Relation of food frequency value to mean of recall-record values: More than 2 SD less	Between 1 and 2 SD less	Between mean and 1 SD less	Between mean and 1 SD more	Between 1 and 2 SD more	More than 2 SD more
	Number	Percent					
Food energy:							
Men:							
White..........	64	([1])	12.5	25.0	32.8	14.1	15.6
Black..........	43	([1])	2.3	20.9	27.9	23.3	25.6
Women:							
White..........	73	([1])	5.5	27.4	24.7	20.5	21.9
Black..........	48	2.1	8.3	8.3	22.9	22.9	35.4
Total.............	228	.4	7.5	21.5	27.2	19.7	23.7
Protein:							
Men:							
White..........	64	1.6	10.9	29.7	34.4	9.4	14.1
Black..........	43	([1])	4.7	37.2	20.9	14.0	23.3
Women:							
White..........	73	([1])	1.4	30.1	32.9	19.2	16.4
Black..........	48	([1])	4.2	16.7	25.0	29.2	25.0
Total.............	228	.4	5.3	28.5	29.4	17.5	18.9
Fat:							
Men:							
White..........	64	([1])	12.5	29.7	32.8	10.9	14.1
Black..........	43	([1])	2.3	37.2	20.9	20.9	18.6
Women:							
White..........	73	([1])	8.2	32.9	28.8	15.1	15.1
Black..........	48	([1])	8.3	29.2	14.6	18.8	29.2
Total.............	228	([1])	8.3	32.0	25.4	15.8	18.4
Carbohydrate:							
Men:							
White..........	64	([1])	6.3	31.3	29.7	20.3	12.5
Black..........	43	([1])	4.7	20.9	34.9	9.3	30.2
Women:							
White..........	73	([1])	4.1	23.3	30.1	19.2	23.3
Black..........	48	2.1	4.2	10.4	18.8	20.8	43.8
Total.............	228	.4	4.8	22.4	28.5	18.0	25.9

[1]Less than 0.1.

Food energy values of the 13 food groups were examined to determine the extent of agreement between methods. For three food groups (beverages including alcoholic drinks, added butter, and vegetables), over 80 percent of the total sample showed close agreement. Fruits and juices had the smallest percentage (49 percent) in close agreement.

The UM team concluded that the FFQ could be used to estimate food energy intake relatively well for about half of white men and women. The food group that gave the least trouble was beverages including alcoholic drinks, and the group that gave the most difficulty was fruits and vegetables.

10.4.7 Characteristics of Respondents Categorized by Degree of Agreement Between FFQ and Recalls-Records for Food Energy

Respondents varied widely in the extent of agreement in food energy intake per day derived from the FFQ and from food recalls-records. Agreement between methods was very close for some respondents. For others, food energy values from the FFQ were several thousand kilocalories greater than mean values from the recalls-records. The UM team used several approaches to identify characteristics of individuals by level of agreement and to ascertain reasons for very good agreement between methods for some individuals and very poor agreement for others.

Individuals were distributed into four agreement categories based on the ratio of FFQ food energy to mean recall-record food energy. The distribution of individuals according to sex and race differed significantly ($p \leq 0.05$) (Table 10.12).

In the close agreement category ratios of 0.81 to 1.2), there were proportionately more men (38 and 40 percent for whites and blacks, respectively) than women (32 and 21 percent). In the most extreme or least agreement category (greater than 1.5), blacks predominated over whites (30 and 44 percent for men and for women).

Researchers also looked at differences in food energy estimates from the recalls-records and FFQ (recall-record mean minus FFQ value) in relation to variation in estimates from the FFQ, from the recalls-records, and from both. Three possible explanations for differences in the four ratio groups were considered: (1) Mean recall-record food energy values could be similar among ratio groups and FFQ mean food energy values would have to differ to explain the difference, (2) FFQ mean food energy values could be similar among ratio groups and recall-record values would have to account for the differences, or (3) both recall-record and FFQ values could differ and contribute to the difference. The UM team found that the recall-record mean food energy generally did not increase as the degree of agreement ratio of groups decreased, but a strong increasing relationship was shown for the FFQ mean food energy for all sex-race categories (significant at $p \leq 0.001$) by analysis of variance (Table 10.12). The UM team concluded that it was the difference in reporting on the FFQ that differentiated the ratio groups.

The sources of differences in reporting on recalls-records and on FFQ were investigated by partitioning the total difference in food energy into three mutually exclusive quantities from foods reported on the recalls-records only, on the FFQ only, and on both instruments. For the total sample, total mean food energy difference between methods was -655 kilocalories, indicating FFQ mean food energy was 655 kcal higher than the

Table 10.12--Mean food energy intakes from recalls-records and FFQ and distribution of respondents by degree of agreement between the methods

Degree of agreement ratio[1]	Men White	Men Black	Women White	Women Black	Significance level, statistical method
	Mean energy (kcal) from recalls-records				
0.8 or less............	2,666	1,838	1,859	1,783	p≤0.05, white women, analysis of variance
0.81 - 1.2 (close agreement).....	2,859	2,321	2,075	2,114	
1.21 - 1.5.............	2,581	2,075	1,733	1,629	
Greater than 1.5.......	2,645	2,114	1,862	1,489	
	Mean energy (kcal) from food frequency				
0.8 or less............	1,876	1,214	1,320	1,064	p≤0.001, all sex-race groups, analysis of variance
0.81 - 1.2 (close agreement).....	2,887	2,282	2,085	1,688	
1.21 - 1.5.............	3,434	2,717	2,324	2,229	
Greater than 1.5.......	5,004	5,759	3,848	3,295	
	------------Percent-----------				
0.8 or less............	20	7	16	13	p≤0.05, overall chi-square
0.81 - 1.2 (close agreement).....	38	40	32	21	
1.21 - 1.5.............	25	23	33	23	
Greater than 1.5.......	17	30	19	44	

[1] Ratio = FFQ mean energy (kcal) per day divided by recall-record mean energy (kcal) per day. Approximate conversion to food energy (kcal) for degree-of-agreement ratio:

0.8 or less ..... FFQ smaller than record by 400 kcal or more
0.81 - 1.2 ...... FFQ and record agree within 400 kcal
1.21 - 1.5 ...... FFQ greater than record by 401 to 1,000 kcal
more than 1.5 ... FFQ greater than record by more than 1,000 kcal

mean of food energy derived from the recalls-records (Table 10.13). Total mean differences were smaller for whites than for blacks. For foods on records only, sex-race differences were small; for foods on FFQ only, sex-race differences were somewhat greater; and for foods on both instruments, differences for all sex-race groups were greater but considerably more so for blacks than whites. Thus, the major sources of mean energy difference between methods came primarily from foods reported on both instruments and secondarily from foods reported on the FFQ only.

The UM team then examined three sources of possible disagreement between food energy values from foods reported on both instruments: (1) different frequencies of consumption, (2) different serving sizes reported, and (3) different energy values assigned to food items in data processing. Total food energy was a product of these three quantities. Effects of differences in these three quantities were ascertained by substituting recall-record values for corresponding FFQ values in calculation of food energy values (Table 10.14). When substitutions were made for both frequencies and serving size, difference values were very small, indicating that FFQ values for frequencies and serving size together were responsible for nearly all the difference between methods. Energy values assigned in data processing contributed little to the difference between methods.

The UM team then studied the sources of differences related to groups based on degree of agreement. In the agreement group with FFQ food energy less than 0.8 of recall-record energy, difference between methods was largely due to foods reported on recalls-records only. In the FFQ, low frequencies were partially offset by large serving sizes. Good agreement, in the 0.8 to 1.2 ratio group, was achieved by counterbalancing energy from foods reported on the recalls-records only with those on the FFQ only and by the combination of low frequencies with large serving sizes on the FFQ. In the next agreement group, with 1.21 to 1.5 ratios, food energy values were higher on the FFQ than on the recalls-records because more energy was reported from foods on the FFQ only than from foods on the recalls-records only and both frequencies and serving sizes were greater on the FFQ than on recalls-records. In the group with greatest disparity, degree of agreement ratios greater than 1.5, energy values from foods on the FFQ only were much higher than from the foods on the recalls-records only and frequencies and serving sizes were greater on the FFQ than on recalls-records.

10.4.8 Diet Diversity

The UM team hypothesized that the greater the variety of foods a respondent ate, the less likely it was that the two instruments would show good agreement, whereas those who ate a small variety of foods would show good agreement. In the latter case, it should be easier to remember how often each food was eaten and the usual portion size.

Data were examined in two ways in this analysis, dividing respondents first on the basis of food recall-record data and then on the basis of FFQ data. Respondents were sorted into thirds according to the number of food groups reported on the recalls-records, then by the number of food groups reported on the FFQ. On the recalls-records, the low-diversity group reported 54 or fewer food groups and the high-diversity group reported 65 or more food groups. (Diet diversity was defined by the number of different food groups in the diet.) On the FFQ,

Table 10.13—Sources of difference in food energy between recalls-records and food frequency methods

Race-sex group	Total difference overall	Differences[1] from foods reported on-- Recalls-Records only	Food frequency only	Both instruments
	------------------------	Kilocalories	------------------------	
White men.......	-468.6	375.2	-401.1	-442.7
Black men.......	-1,011.2	314.2	-491.8	-833.6
White women.....	-479.3	344.0	-312.7	-510.5
Black women.....	-852.5	369.4	-478.9	-742.9
TOTAL........	-655.2	352.5	-406.3	-601.4

[1]Differences in mean food energy = recall-record value minus food frequency value.

Table 10.14—Effects on mean food energy of substituting parameter values from recalls-records for those in the food frequency

Race-sex group	Unadjusted difference	Difference[1] computed after adjusting food frequency for the recall-record values of-- Frequency	Portion size	Food energy per ounce	Frequency and portion size
	--------------------	--------------------	Kilocalories	--------------------	--------------------
White men.....	-442.7	-584.5	-159.6	-464.6	-60.8
Black men.....	-833.6	-315.2	-690.8	-881.0	-5.4
White women...	-510.5	-416.4	-274.6	-543.0	-45.4
Black women...	-742.9	-291.1	-603.1	-738.9	-51.9
TOTAL......	-601.4	-418.1	-390.0	-626.0	-43.5

[1]Differences in mean food energy = recal-record value minus food frequency value.

the low-diversity group reported 42 or fewer food groups and the high-diversity group reported 59 or more food groups. When the procedure was applied to the sex-race groups, the sex-race groups did not divide in the same way as the total sample. Whites predominated in the high-diversity group, whereas blacks predominated in the low-diversity group.

Agreement between the FFQ and the recalls-records was measured by examining differences in food energy per day obtained by the two methods. On food recalls-records, the UM team found that higher diversity was associated with higher agreement between methods, contrary to what had been expected (Table 10.15). For white men and women, as diversity on food recalls-records increased, median differences decreased. For black men and women, those in the low-diversity group had larger differences than those in the average- and high-diversity groups. However, on the FFQ, increased diversity was associated with decreased agreement, as was expected.

One explanation for the contrary findings for the recalls-records was that mixed dishes, especially those prepared at home, were often reported in terms of ingredients. If so, several food groups were identified. Fast-food combinations were likely to be coded as a single item. Consequently, respondents reporting more home-prepared foods were more likely to be in the high-diversity group for recalls-records than those reporting fewer such foods. This problem did not appear in the FFQ diversity analysis.

10.4.9 Mean Food Energy and Macronutrient Intake for Specified Number of Recall-Record Days

The mean food energy intake over 16 days was calculated. A 1-day food recall and a 3-day food record (consecutive days 1, 2, 3, and 4) were collected from each respondent during each quarter of 1 year. After calculating food energy intake for each day for each respondent, the mean caloric intakes for each day and for all 4 days were derived for each quarter and for all four quarters for each of the four sex-race categories.

The day 1 mean food energy intake (1 day recall) tended not to be higher nor lower than the mean food energy intake for subsequent days (Table 10.16); nor did day 4 within quarters tend to be lower than preceding days. However, except for black men, there was a consistent tendency for day 4 mean energy intake to become lower in each succeeding quarter. Also, mean energy intake for each day in the fourth quarter was lower than for the corresponding day in the first quarter, again except for black men. The researchers concluded that, over time, there was a discernable methodological effect on energy intake for the sex-race groups except for black men.

The first 3 recall-record days were compared with the remaining 13 recall-record days to indicate representativeness of mean intake of food energy and macronutrients. Each respondent's mean values for food energy and macronutrients from the first 3 recall-record days obtained in the first survey round were compared with variations in the distributions for the remaining 13 recall-record days. (The first 3 days rather than 4 days were chosen because they are the same as the NFCS 1977-78 method.) Each respondent was placed in one of six categories based on how well the 3-day value agreed with the 13-day value.

For over 80 percent of the sample, the first 3 days adequately represented the food energy and macronutrient values for

Table 10.15--Food energy per day by level of diet diversity by two methods

Levels of diversity, sex-race group	Food recalls-records				Food frequency			
	Individ-uals	Food recall-record	Food frequency	Median difference	Individ-uals	Food recall-record	Food frequency	Median difference
	Number	----------Kilocalories----------			Number	----------Kilocalories----------		
Low diversity:								
Men:								
White	24	2,402	2,905	-616	25	2,468	2,514	30
Black	17	2,095	3,411	-872	15	1,975	2,48	467
Women:								
White	25	1,624	2,520	-659	25	1,624	1,814	- 78
Black	17	1,326	2,427	-987	16	1,424	1,616	-287
Average diversity:								
Men:								
White	19	2,460	2,745	-250	20	2,678	2,899	-292
Black	12	2,394	2,503	-265	14	2,355	2,907	-380
Women:								
White	24	1,757	2,067	-368	24	1,815	2,265	-464
Black	15	1,355	1,649	-304	17	1,477	2,427	-614
High diversity:								
Men:								
White	21	3,002	2,902	-47	19	2,696	4,083	-748
Black	14	1,965	2,567	-317	14	2,136	2,952	-649
Women:								
White	24	2,231	2,249	-182	24	2,228	2,588	-464
Black	16	1,772	2,461	-409	15	1,695	3,026	-1,219

Table 10.16--Mean food energy intakes during 16 recall-record days by day and quarter

Race and sex	Day in each period: 1	2	3	4	All days
	Kilocalories				
White men:					
Quarter One....	2,809	2,672	2,732	2,883	2,773
Quarter Two....	2,780	2,620	2,820	2,805	2,756
Quarter Three..	2,605	2,612	2,840	2,760	2,704
Quarter Four...	2,769	2,546	2,553	2,614	2,620
All quarters...	2,740	2,612	2,736	2,765	2,714
Black men:					
Quarter One....	2,350	2,204	2,449	2,456	2,365
Quarter Two....	2,184	2,192	1,996	2,008	2,095
Quarter Three..	2,070	2,001	2,215	2,219	2,126
Quarter Four...	2,319	2,103	1,929	2,099	2,113
All quarters...	2,231	2,126	2,147	2,196	2,175
White women:					
Quarter One....	1,969	1,865	1,909	2,025	1,942
Quarter Two....	1,862	1,932	1,878	1,984	1,914
Quarter Three..	1,966	1,908	1,938	1,970	1,945
Quarter Four...	1,763	1,780	1,764	1,835	1,786
All quarters...	1,890	1,871	1,872	1,953	1,897
Black women:					
Quarter One....	1,690	1,733	1,769	1,625	1,704
Quarter Two....	1,722	1,541	1,576	1,663	1,626
Quarter Three..	1,492	1,473	1,511	1,700	1,544
Quarter Four...	1,456	1,418	1,516	1,534	1,481
All quarters...	1,590	1,541	1,593	1,631	1,589

the remaining 13 days (within one SD of the 13-day recall-record mean) (Table 10.17). The sex-race groups showed similar agreement, although the 3-day report for white women was somewhat less typical. The 3-day recall-record mean differed substantially (over two SD more than mean) from the 13-day mean for 1.3 to 2.2 percent of the total sample.

For the separate food groups, 3-day mean food energy values were generally in agreement (within one SD) with the 13-day means (Table 10.18). The 3-day mean for food energy was typical of the 13-day food energy mean for over 80 percent of the total sample for 8 of the 13 food groups, for 74 to 80 percent for 4 other food groups, and for 66 percent for pizza. Of all food groups, pizza had the most respondents in the top disagreement category. Findings were similar for the sex-race groups.

In comparison to the estimate of 3 recall-record days to the remaining 13 days, the FFQ showed that only 49 percent (Table 10.11) of the total sample had FFQ food energy estimates within plus or minus one SD of the recall-record mean. The UM team concluded that the FFQ had problems in representing dietary intakes for about 50 percent of the sample.

10.5 Summary and Conclusions

The UM team concluded that the FFQ data were nearly always higher than comparable data from the 16 days of food recalls-records which served as the standard for this study. However, there were some indications of underreporting in the food recalls-records, since mean food energy in the fourth quarter tended to be lower than in the first quarter. The degree to which data derived from the two methods agreed varied among 13 broad and 118 detailed food groups and among 4 sex-race groups. Some food groups, such as meat and beverages including alcoholic drinks, were substantially in agreement; whereas others, such as fruits and juices and dairy foods, were not. Broad food groups generally showed better agreement than detailed food groups. White men tended to have closest agreement in values derived from the two methods and blacks (both men and women) generally the least agreement. Comparisons based on medians and those based on means sometimes had different results because of the impact of extreme values on means.

Data were examined by a number of different approaches. Higher values by the FFQ than the recall-record method were not related to a single factor. Good agreement of data obtained from the two methods tended to result from counterbalancing of low and high estimates from frequencies of consumption and portion sizes and reporting or not reporting foods on the FFQ or recalls-records.

Frequencies of consumption. Foods eaten five or six times per week on the FFQ were least likely to conform with recall-record results, whereas foods eaten more than once a day or never appeared to conform best. For most respondents, the frequencies on the FFQ for the past year's consumption of foods eaten two to seven times a week did not match those indicated by recall-record reports.

Average portion size. Comparisons indicated that for about a fourth of the food groups average portion sizes derived from the two methods were in substantial agreement. These food groups tended to be reported by many respondents. Foods that came in standard size portions or packages or had common default portion sizes used in coding both instruments tended to yield closer estimates.

Table 10.17--Distribution of respondents by degree of variation between first 3-day mean and last 13-day mean recall-record values for food energy and macronutrients

[SD=Standard deviation]

Nutrient and sex-race group	Individuals	3-day mean compared to 13-day mean					
		More than 2 SD less	Between 1 and 2 SD less	Between mean and 1 SD less	Between mean and 1 SD more	Between 1 and 2 SD more	More than 2 SD more
	Number	Percent of respondents					
Food energy:							
Men:							
White........	64	0	4.7	57.8	29.7	7.8	([1])
Black........	43	0	4.7	46.5	37.2	9.3	2.3
Women:							
White........	73	0	13.7	34.2	41.1	9.6	1.4
Black........	48	0	12.5	45.8	35.4	4.2	2.1
Total...........	228	0	9.2	45.6	36.0	7.9	1.3
Protein:							
Men:							
White........	64	0	6.3	46.9	34.4	10.9	1.6
Black........	43	0	2.3	39.5	53.5	2.3	2.3
Women:							
White........	73	0	11.0	39.7	41.1	6.8	1.4
Black........	48	0	8.3	41.7	39.6	10.4	([1])
Total...........	228	0	7.5	42.1	41.2	7.9	1.3
Fat:							
Men:							
White........	64	0	1.6	56.3	32.8	7.8	1.6
Black........	43	0	4.7	48.8	39.5	7.0	([1])
Women:							
White........	73	1.4	6.8	43.8	35.6	9.6	2.7
Black........	48	([1])	10.4	47.9	35.4	2.1	4.2
Total...........	228	.4	5.7	49.1	35.5	7.0	2.2
Carbohydrate:							
Men:							
White........	64	([1])	6.3	50.0	34.4	7.8	1.6
Black........	43	([1])	2.3	58.1	30.2	9.3	([1])
Women:							
White........	73	([1])	4.1	41.1	42.5	9.6	2.7
Black........	48	2.1	6.3	47.9	37.5	2.1	4.2
Total...........	228	.4	4.8	48.2	36.8	7.5	2.2

[1]Less than 0.1.

Table 10.18--Distribution of 228 respondents whose 3-day recall-record mean food energy from 13 food groups falls in specified categories of their mean for subsequent 13 days

[SD=Standard deviation]

Food group	3-day mean compared to 13-day mean					
	More than 2 SD less	Between 1 and 2 SD less	Between mean and 1 SD less	Between mean and 1 SD more	Between 1 and 2 SD more	More than 2 SD more
	Percent of respondents					
Meat	0.4	5.3	52.6	31.1	8.8	1.8
Dairy foods	([1])	3.5	52.2	33.3	8.3	2.6
Eggs	2.2	1.3	58.3	25.0	5.7	7.5
Bread and cereal	([1])	7.5	48.2	29.8	12.3	2.2
Vegetables	([1])	3.9	53.5	25.4	10.5	6.6
Fruits and juices	.4	5.3	49.6	30.7	9.2	4.8
Other beverages including alcohol	.9	7.9	52.2	26.8	7.0	5.3
Desserts	([1])	.9	62.7	24.1	6.1	6.1
High-fat foods	([1])	.9	53.1	32.5	10.1	3.5
Added sugar	.9	3.5	54.8	19.7	11.0	10.1
Added butter	.4	2.2	55.3	28.9	8.3	4.8
Other foods	([1])	1.3	59.6	23.7	6.6	8.8
Pizza	6.6	5.3	53.9	12.3	8.3	13.6

[1]Less than 0.1.

Food energy and macronutrients. Mean food energy and macronutrient intakes derived from the FFQ were much higher than mean values estimated from food records. Among the 13 broad food groups, median estimates of food energy from the two methods were relatively close for meats, desserts, beverages including alcoholic drinks, and pizza; less close for vegetables, breads and cereals, added butter, added sugar, and dairy foods; and even farther apart for eggs, fruits and juices, and high-fat foods.

Comparison of daily variability of 16 recall-record days with FFQ values for food energy and macronutrients indicated that for about half of the total sample, means of the FFQ estimates were within one standard deviation of the record mean. For about a fourth of the sample, FFQ estimates greatly exceeded the record means.

Ratio of FFQ food energy to recall-record food energy indicated that agreement of data from the two methods was closer for a higher proportion of whites than of blacks, especially black women. Agreement between FFQ and recall-record values appeared to come from counterbalancing of effects.

Comparison of FFQ and food recall-record estimates of food energy per day as a function of diet diversity indicated that higher diversity as reported on the recalls-records was associated with higher agreement between methods. However, on the FFQ, higher diversity was associated with lower agreement.

The effects of collecting repeated sets of recall-record days on mean energy and nutrient intakes were studied and compared with FFQ intakes. The mean food energy for each day in the fourth quarter was less than corresponding days in the earlier quarters; within quarters, the mean for the fourth day did not tend to be lower than the mean for preceding days. For most respondents (80 percent), the mean of the first 3 days approximated the mean of the remaining 13 days within one standard deviation for food energy and macronutrients. Reports for the first 3 days provided better estimates of the longer period than did the FFQ.

10.6 Comment

The quantitative food frequency method has not been considered as a replacement for methods currently used by HNIS, but as a possible adjunct. Food frequency questions for specified foods may offer opportunities for linkage with other surveys. Nonetheless, this study demonstrated some drawbacks in trying to obtain precise estimates from respondents with such an approach. Data produced by the FFQ and the 16 recall-record days matched better for foods aggregated into a few broad groups than for many detailed groups, although the better match was often achieved by counterbalancing of low and high estimates. Methods of analysis and deficiencies in the "standard" itself--suspected under-reporting on recalls-records--may as well have contributed to the differences. A number of other factors also contributed to the discrepant estimates produced by the two methods.

The UM team suggested several additional analyses that might clarify the status of the FFQ as an epidemiological tool. These included a closer look at respondents with good and poor agreement between data obtained with the two methods, intraindividual variation, foods reported on one instrument and not on the other, foods with differences in reported frequencies or portion sizes on the two instruments, consistency of specific food consumption patterns, and the frequency categories used for reporting in the FFQ. An excellent analysis of research performed during this project has been provided by Flegal and coworkers (1988). An abstract and two summaries of this research have also been published (Larkin et al., 1987a, 1987b, 1989).

10.7 References Cited

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Chapter 11. Secondary Analyses and Other Extramural and Intramural Research

SUMMARY: Some methodological studies smaller than those reported in the earlier chapters have been conducted outside the Government under contract with USDA's Human Nutrition Information Service (HNIS) and others by HNIS staff. Most have dealt with data collection, either to evaluate effects of current procedures or variations in particular population groups or to consider possible alternatives, especially for continuing surveys. University of Missouri-Columbia researchers found considerable consistency from day to day in women's dietary intakes, and outside employment and level of education were related to variability. In University of Michigan research, expected differences between meals and intakes of food energy and nutrients on weekdays and weekend days were confirmed. Analysis of spring NFCS 1977-78 data by HNIS researchers found greater variation around group means for energy and nutrient intakes on the first day surveyed than for 3-day intakes but no significant ($p \leq 0.01$) difference between means for the 1-day recall and the 2-day record was found for most sex-age groups. Panel surveys to test methodology for continuing surveys experienced serious respondent attrition in repeated interviewing of the same individuals.

Tables

11.1 Introduction

In addition to the major research investigations which were completed under contract between USDA's Human Nutrition Information Service (HNIS) and nongovernment researchers, described in Chapters 2 to 10 and 13, a number of other methodological questions have been studied since 1975. Some were examined by HNIS staff and some by outside groups. For the most part, the studies were undertaken to evaluate data collection procedures or to explore the feasibility of changes in future surveys.

11.2 Extramural Studies

The extramural studies summarized here are secondary analyses of previously collected data. These research studies pertain to (1) evaluation of dietary intake data collection methods, (2) relation between number of days of data and persistence (correlation) in dietary intake patterns, (3) alcohol intake as reported in the Nationwide Food Consumption Survey (NFCS) 1977-78, (4) effects of method and effects of day of the week on reported dietary intake, and (5) food energy intakes from consecutive and random 3-day combinations.

11.2.1 Evaluation of Dietary Intake Data Collection Methods

Data available from the Exploratory Study for Longitudinal Measures of Individual Food Intake by National Analysts were analyzed further using regression analyses and an alternative standard reference to amplify findings from the study (Chapter 7). Dr. Stanley Johnson and Dr. Karen Morgan, then of the Department of Agricultural Economics and the Department of Human Nutrition, Foods, and Food Systems Management, University of Missouri-Columbia (UMC), carried out this study (Morgan et al., 1984).

This secondary analysis evaluated the quality of data derived from six of nine alternative methods of collecting individual food intake information. The effects of method on food intake data and food energy values and the significance of several socioeconomic variables on levels of food energy intake were determined.

Methods: The sample, data collection methods, and original research findings are described in Chapter 7. Briefly, the sample consisted of women 20 to 69 years of age who were the main meal planners-preparers in about 1,700 middle-income households of two or more persons. The women were randomly assigned to one of the nine data collection methods to produce matched panels. The initial contact with each respondent occurred during an in-person screening. Subsequently, during the 1-year study, each respondent was contacted quarterly in person, by telephone, or by mail. For eight methods, respondents were the same in all four quarters. For the control method, a new panel of respondents was inducted each quarter.

The researchers at UMC were provided with the data from the National Analysts' study. Response rates for the mail methods were so low that no further study of those three methods was undertaken. The six remaining methods were (1) in-person interview for 1-day recall, self-kept 2-day record, and interviewer pick-up and review for 3 consecutive days each quarter to provide 12 intake days (NFCS repeated method); (2) same as method 1 except for a new panel each quarter (NFCS control method); (3) in-person interview for 1-day recall monthly during the first quarter and once quarterly thereafter to provide 6 intake days; (4) same as method 3 except that a newly developed semistructured questionnaire was used; (5) in-person interview for 1-day recall in the first quarter and 1-day recall by telephone interview in each subsequent quarter to provide 4 intake days; and (6) same as method 5 except no in-person interview.

Quarterly data were examined using descriptive statistics--means and standard deviations for the numbers of food items reported and mean intakes of food energy--and regression analysis to compare energy intakes by survey method with intakes from a standard method. It was assumed that the respondents in all methods were similar because their selection had been based on like demographic characteristics and they had been assigned randomly to one of the methods. Therefore, intake differences could be attributed to method.

In the regression analysis of quarterly data, method 2 (NFCS control) was selected as the standard to evaluate the other four methods (methods 3, 4, 5, and 6). (Method 2 was selected to be the control method because it was used in NFCS 1977-78. Method 1 was excluded because the first quarter panel was also used for method 2.) The regression model was $M_j = a_j + b_j MI + e_j$ in which M_j was food energy estimate for survey method j; a, b, and e were intercept, slope, and error term, respectively, and MI (independent variable) was energy intake from the standard method 2. The univariate (one independent variable) regression was designed to test the hypothesis that the survey methods under consideration yielded dietary information identical with the standard method as evidenced by a = 0 and $b_j = 1$. For each method, food energy intake data for respondents were arranged by deciles and averaged to provide values for the independent and dependent variables in the regressions. The researchers summarized intakes using the decile approach because the number of respondents for the methods varied.

Annual data were evaluated using a different standard. According to the researchers, the NFCS method 2 was an appropriate standard for comparisons of quarterly data because panelists in the NFCS method 2 participated only in one quarter. But for the annual data, a standard for evaluation of continuous participation during all quarters was required. Therefore, the mean of data from all methods from all four quarters was identified as the "composite" standard. The results from each method were tested to determine which method produced results closest to the "composite" standard. For analysis of annual data, only panelists who participated during all four quarters were included, thus excluding method 2 which used a different panel each quarter. A mean day's intake of food energy for the year was computed from quarterly means for each panelist in each method. These means were pooled to calculate the "composite" standard. The numbers of panelists completing records for the year were about the same for each method--98 to 102. The deciles for food energy intake per day were computed for the year with the same procedures as in the analysis of quarterly data. The composite standard was substituted for the NFCS method 2 standard in the regression analyses.

A final analysis of annual data used 10 multivariate regression models with alternative combinations of qualitative variables handled as dummy variables. The dependent variable was the panelist's quarterly mean intake of food energy. Independent variables consisted of six sets of dummy variables for (1) method of data collection, (2) quarterly effect, (3) respondent's age category, (4) respondent's educational level, (5) respondent's employment status, and (6) respondent's household size; the bases for dummy categories were (1) method 1, (2) first quarter, (3) 59 to 69 years,

(4) more than high school graduate, (5) full-time employment, and (6) five or more persons in the household, respectively.

Main Findings: Results of the descriptive analyses of quarterly data revealed that the mean number of total food items reported per day ranged from 14.7 items (based on 3 days) in the last quarter for method 1 to 17.0 items (based on 1 day) in the first quarter for telephone method 5 (Table 11.1). The researchers found that the mean number of total food items per day for method 3, in all four quarters, was within the mean number of items for all methods, all quarters, plus or minus 15 percent of the mean of standard deviations. This led to the conclusion that method 3 had the most consistent reporting of number of total items. Method 5 produced consistently higher total numbers of items than the other methods, while methods 1 and 2 had the lowest reporting per day for three of the four quarters.

Mean intakes of food energy from total food were also compared across methods for each quarter (Table 11.2). The extent and direction of variation in a mean day's intake of food energy from a corresponding mean based on all methods indicated that the most consistent estimation of energy intake was obtained with method 5. The least consistency in estimating intake occurred with methods 1 and 4. Intake of energy was lower in method 1, but higher in method 4, than the standard (mean based on all methods). As a result of these analyses, the researchers identified methods 5 and 6 as promising data collection techniques because they yielded mean number of food items and mean energy intakes that were average or above.

The regressions using quarterly data revealed dissimilarities in results after the first quarter for methods 3, 4, and 5 compared with the standard. This indicated the possibility that underestimates at low levels of intake and overestimates at high levels of intake resulted from the choice of the standard. For the second and third quarters, results of the repeated NFCS method 1 were similar to those of the standard NFCS method 2 (the two data collection methods were identical in collecting 3 days of information, but panels in method 2 changed each quarter). The lack of agreement in results between the NFCS standard method and the other four experimental methods and the agreement among these four experimental methods indicated that the standard method produced results different from the four test methods. Therefore, a more discriminating standard (as used below for the annual data) was selected to reveal variations among the methods. However, the researchers found that when the quarterly data were adjusted for number of days to reflect method effects, results for the different methods were similar to the NFCS standard method.

The results of regression analyses of annual data showed that the mean day's intakes of food energy obtained with methods 5 and 6 were close to the mean energy intake produced by the composite (standard) method. Therefore, if results of the composite method are accepted as the standard for validity, methods 5 and 6 yielded the more nearly valid data. Method 1 and, to a limited extent, method 4 yielded total food energy intakes that were overreported at low levels of intake and underreported at high levels compared with the composite standard. Results for method

Table 11.1--Food items reported per day by method and quarter

Method[1]	Food items			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	Mean number ± standard deviation			
1.............	15.10±4.48	15.39±4.43	14.72±4.53	14.66±4.41
2.............	15.10±4.48	15.60±5.37	15.10±4.68	15.12±4.68
3.............	15.66±4.87	15.28±5.51	16.08±6.40	15.27±5.16
4.............	16.89±5.12	15.82±5.46	16.52±5.58	16.52±5.19
5.............	16.98±5.84	16.94±6.32	16.89±5.86	16.87±6.04
6.............	16.87±5.77	16.46±6.52	16.82±6.40	16.57±5.88

[1]Methods: (1) in-person interview for 1-day recall, self-kept 2-day record, interviewer pick-up and review for 3 consecutive days each quarter, 12 intake days (NFCS repeated method); (2) same as method 1 except for a new panel each quarter (NFCS control method); (3) in-person interview for 1-day recall each month during first quarter and once in subsequent 3 quarters, 6 intake days; (4) same as method 3 except that a newly developed semistructured questionnaire was used; (5) in-person interview for 1-day recall in first quarter and 1-day recall by telephone interview in subsequent 3 quarters, 4 intake days; and (6) same as method 5 except for no in-person interview. The first quarter panel in methods 1 and 2 were the same.

Table 11.2--Intake of food energy per day from all foods by method and quarter

Method[1]	Food energy			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	Mean kilocalories ± standard deviation			
1.............	1,496± 527	1,443±449	1,340±466	1,382± 438
2.............	1,496± 527	1,446±524	1,350±495	1,496± 466
3.............	1,661±1,207	1,468±659	1,520±728	1,496±1,097
4.............	1,653± 573	1,418±585	1,595±610	1,533± 563
5.............	1,572± 621	1,440±698	1,493±614	1,433± 548
6.............	1,555± 738	1,470±724	1,588±865	1,458± 529

[1]See Table 11.1 for description of methods. The first quarter panel in methods 1 and 2 were the same.

3 were the opposite of method 1; method 3 yielded food energy intakes that were underreported at low levels and over-reported at high levels of intake.

Multivariate regression analysis designed to ascertain the effects of four demographic variables on intake of total food energy showed that (1) the youngest group, women 20 to 28 years of age, had significantly higher mean energy intakes from total food than the oldest group, women 59 to 69 years; (2) women in one- or two-person households had significantly higher energy intake than women in large households (five or more persons); and (3) women with less than a high school education had significantly lower energy intakes than those with more than a high school education. The multivariate analyses also produced evidence that total food energy intakes for the first quarter were significantly greater than for subsequent quarters. Employment status was not significantly associated with food energy intake of the middle-income women.

In summary, the UMC results supported the conclusions reached by National Analysts. UMC researchers agreed with the assessment by National Analysts that data produced by the two personal methods were of high quality; however, the UMC team concluded that the quality of data in personal methods 3 and 4 were no better than the data obtained using telephone methods 5 and 6. Telephone methods 5 and 6 were found by both teams to be the "most promising" approaches for the monitoring system. UMC found that the counts of food items and mean food energy intake data provided by these two methods were average or better than average based on comparisons with data derived from the composite of all test methods. The repeated NFCS method 1 appeared to produce the lowest food energy intakes per day followed, in ascending order, by methods 5, 6, 4, and 3. (Number of days per method were 12, 4, 4, 6, and 6, respectively.) Thus, the telephone approaches (methods 5 and 6) were intermediate in the level of mean intakes produced. After considering results of the analyses, UMC researchers recommended method 5 (1-day recall by in-person interview with subsequent interviews by telephone) for use in a continuous monitoring survey. Detailed results of this study have been reported elsewhere (Morgan, Johnson, Rizek et al., 1987).

Comment: Method 5--1-day recall with the first interview conducted during a home visit and followup interviews by telephone--was the approach implemented in the Continuing Survey of Food Intake by Individuals (CSFII) 1985 to monitor the dietary status of the U.S. population. CSFII 1985 and 1986 collected six 1-day recalls bimonthly (instead of four 1-day recalls quarterly as in the National Analysts' study) from a sample of women 19 to 50 years of age and their children 1 to 5 years. However, six separate interviews per panelist appeared to have been too burdensome to sustain acceptable response rates through the year (USDA, HNIS, 1987). The finding that after adjusting for number of days, results for the different methods were similar to the NFCS method was important for planning future surveys.

11.2.2 Number of Days and Persistence in Dietary Intake Patterns

Data collected in 1982 by National Analysts in the Exploratory Study for Longitudinal Measures of Individual Food Intakes (Chapter 7) were used in another study by Drs. Stanley Johnson and Karen Morgan (Morgan et al., 1985). The purpose of this analysis was to examine day-to-day patterns in food energy and nutrient intakes by individuals and to relate these patterns to the reliability with which mean intakes could be estimated. Regression models were developed to study intraindividual correlation or "persistence" present in multiple days of dietary intake by an individual and to determine the effect on estimating a day's mean intake. The number of intake days needed to estimate mean intake per individual per day with a specific level of reliability is important information for planners of dietary surveys.

Methods: Dietary intake reports by 100 participants in the NFCS data collection method 1 of the National Analysts study provided the 12 days of data--3 consecutive days in each of four quarters--for this analysis. The participants were the middle-income women, 20 to 69 years of age, described in Chapter 7 and the preceding section.

The UMC team had deduced from earlier analyses that individuals' dietary intakes on consecutive days showed day-to-day correlation, not independence. The team noted that when other variables were held constant this correlation made it necessary to include more days in order to attain a specified level of reliability in estimates of mean energy and nutrient intakes per day than would be necessary if the days were independent.

In this study, estimators were derived to reflect day-to-day intake patterns by incorporating a measure for persistence. The researchers developed an autoregressive model for calculating a coefficient of autocorrelation which served as the measure of persistence. This measure, encompassing a component of intraindividual variation, can contribute to increased understanding of patterns of dietary intake by individuals. The basic assumption was that the reported intake for the specified day was equal to the individual's true mean intake plus an error. Under assumptions of the model, formulas for the generalized least squares estimators for mean, standard deviation, and standard error of the mean were generated. A formula was also derived for predicting the intake for day i, based on the assumed structure for persistence and given the intakes up to day i-1. Analysis showed that the mean of intakes through day i-1 was the best predictor of day i intake.

These formulas did not take into account the time period between the sets of 3-day dietary intake reports obtained in the four quarters. The last day of the first set of 3 days in the first quarter was assumed to be correlated with the first day of the second set in the second quarter in the same way as the first and second days of the first set were related. To take into account such time gaps, the team derived a special formula.

For each of the 100 participants, autocorrelation coefficients were calculated from 12 intake reports for food energy, fat, iron, and vitamin A. Then the expected intakes for the following days were calculated for each participant; from intakes for 3 days, 6 days, 8 days, and 11 days, intakes were predicted for days 4, 7, 9, and 12, respectively. Predictions were made with and without the persistence factor and under two different assumptions for persistence (whether days were consecutive or not). Difference between the reported intake for each respondent on day 3 (or day 6, 9, or 12) and the predicted intake up to the specified day was the amount of "error." Absolute error was determined for the difference between the generalized least squares prediction and the generalized least squares estimated mean, including the added day. These absolute errors for estimated intakes were averaged across the sample to obtain mean absolute error estimates of food energy, fat, vitamin A, and iron for the total sample. Error estimates were calculated using generalized least squares and ordinary least squares predictions.

In an additional analysis, the sample was divided into two groups--those whose autocorrelation coefficients were greater than 0.3 and those whose autocorrelation coefficients were 0.3 or less. The hypothesis that persons having high dietary intake had larger standard deviations of mean intakes than persons having low dietary intake was tested. Respondents were ranked from highest estimated mean energy intake to lowest, and the top and bottom quartiles became the subsamples for the test. Generalized least squares estimates for mean intakes per day and mean absolute error values for generalized least squares and ordinary least squares predictions were calculated for the two subsamples.

An analysis for effects of four socioeconomic characteristics on prediction of energy intake levels was carried out. The four variables were age category, household size, employment status, and educational level.

Main Findings: Results of the analyses disclosed that 27 of the 100 respondents had estimated autocorrelation coefficients for food energy greater than 0.3, indicating a high level of persistence in energy intake. Forty-five respondents had negative autocorrelation coefficients for food energy, indicating intake patterns alternated between high and low levels. Over one-half (55) of the respondents showed consistency (positive autocorrelation values) in energy intakes. Fat, iron, and vitamin A values showed less consistency (fewer positive values). Under the model that took time gaps into account, more individuals had high levels of persistence.

Mean absolute errors for estimated individual intakes per day indicated that after 6 days--two sets of 3 consecutive days--more sets of 3 consecutive days (based on 9 or 12 days) added relatively less to accuracy of the estimates. However, under the assumption that days were independent, the mean absolute errors of estimated intakes were larger. Knowledge of earlier dietary patterns improved prediction of the next day's intakes and diminished the importance of an additional set of 3 days in improving the estimated mean intake.

The researchers found that the larger the autocorrelation coefficient (persistence factor), the fewer the days required for predicting the next day's intake. Mean absolute errors indicated slight decreases in accuracy between day 3 and day 6 with autocorrelation coefficients greater than 0.3, but not coefficients equal to or less than 0.3. Accuracy was evaluated by the relationship between the prediction based on the mean intake for preceding days and the reported intake for the day. Respondents with low intakes had more predictable intake patterns than those with high intakes. Although accuracy improved little after day 6 for the former group of respondents, it did increase for the latter.

Of the four socioeconomic variables studied, two did not improve the accuracy of predicted food intake--age category and household size--whereas two characteristics did--employment status and educational level. Full-time employees had more variable intake patterns; consequently, their intakes were harder to predict than those of the unemployed or part-time employees. Less educated homemakers varied their intakes less than the more educated homemakers.

The researchers concluded that, after 6 days, the contribution of an additional set of 3 days to reliability or reproducibility of mean estimates of individual intakes decreases for food energy and the nutrients studied. Consecutive days of dietary intake are not independent. Taking account of persistence in day-to-day dietary patterns appears to contribute to greater reliability in predicting the next day's intake, given the same number of days. The analysis assumed the pattern was a first order autoregressive form, but the researchers caution that this assumption requires further investigation. Incorporating information on separation between the 3 consecutive days of intake made a small difference in the results. A more detailed account of this study has been published (Morgan, Johnson, and Goungetas, 1987).

11.2.3 Alcohol Intake in NFCS 1977-78

The NFCS 1977-78 3-day food intake data for individuals were used by a University of Michigan (UM) research team led by Dr. Frances Larkin (Larkin et al., 1983) to examine 3-day intakes of alcohol by the 19- to 74-year-old respondents in conjunction with their intakes of total energy and 11 nutrients and their body mass.

The study determined the relationships of three levels of alcohol (ethanol) consumption to total food energy; nonalcohol energy, nonalcohol protein, nonalcohol fat, and nonalcohol carbohydrate; two minerals--calcium and iron; five vitamins--vitamin A, thiamin, riboflavin, niacin, and vitamin C; and body mass index as measured by weight/height^2.

The sample of men and women was divided into five age groups--19 to 22, 23 to 34, 35 to 50, 51 to 64, and 65 to 74 years. Individual intakes were classified into three levels of alcohol consumption: (1) no alcohol, (2) below the median grams of alcohol for the individual's sex-age group (light drinkers), and (3) at or above the median for the sex-age group (heavy drinkers). Self-reported height and weight were used to calculate a body mass index. Significances of differences between means were not computed.

Main Findings: Alcohol consumption level overall was positively related to total food energy intake by men and women. Mean total energy intake increased with increased level of alcohol consumption, except for men and women aged 19 to 22 years and women aged 65 to 74 years (Table 11.3). However, among men 23 to 74 years of age, mean nonalcohol energy decreased with increased alcohol consumption. Among female drinkers 23 to 64 years of age, there was no reduction in the mean nonalcohol energy intake with increased alcohol intake, but the heavy drinkers had lower nonalcohol energy intake than the light drinkers. Heavy drinkers generally had the lowest intakes of nonalcohol carbohydrate. Nonalcohol protein intakes by most groups of men tended to be lowest for heavy drinkers. Except for the oldest women, nonalcohol protein intakes by women were highest for heavy drinkers. Nonalcohol fat intakes did not appear to show a consistent pattern relative to alcohol level.

Male drinkers generally had higher mean intakes of niacin and vitamin C and lower intakes of calcium, iron, thiamin, and vitamin A than nondrinkers except for the 19- to 22-year-olds. In this

Table 11.3--Intakes per day of total food energy, nonalcohol food energy and macronutrients by level of alcohol consumption, 3 days in NFCS 1977-78

Sex and age (years), level of alcohol consumption	Respondents[1]	Food energy: Total	Food energy: Nonalcohol	Food energy: Difference	Nonalcohol: Protein	Nonalcohol: Fat	Nonalcohol: Carbohydrate
	Number	----Mean kilocalories----			-----Mean grams-----		
Males							
19-22:							
None.............	505	2,330			97.8	109	244
Below median.....	75	2,323	2,247	76	93.0	103	237
At or above median	79	2,894	2,511	383	108.2	126	228
23-34:							
None.............	1,119	2,354			97.8	111	243
Below median.....	311	2,400	2,318	82	97.9	113	227
At or above median	320	2,662	2,267	395	95.3	115	205
35-50:							
None.............	1,102	2,232			94.2	108	224
Below median.....	274	2,237	2,154	83	92.6	110	199
At or above median	279	2,448	2,058	390	90.3	108	172
51-64:							
None.............	1,028	2,115			89.6	102	214
Below median.....	180	2,143	2,067	76	88.7	103	199
At or above median	180	2,409	2,056	353	91.0	107	177
65-74:							
None.............	569	1,895			78.8	88	203
Below median.....	60	1,952	1,884	68	79.8	88	196
At or above median	57	2,030	1,734	296	76.1	83	168
Females							
19-22:							
None.............	685	1,583			65.3	72	171
Below median.....	66	1,529	1,477	52	60.4	71	151
At or above median	63	1,853	1,618	235	68.8	78	160
23-34:							
None.............	1,924	1,564			65.4	72	165
Below median.....	234	1,681	1,627	54	67.5	78	167
At or above median	236	1,844	1,607	237	67.6	79	155
35-50:							
None.............	1,923	1,485			63.9	70	152
Below median.....	198	1,589	1,537	52	66.0	76	148
At or above median	201	1,717	1,503	214	67.4	78	132
51-64:							
None.............	1,674	1,498			64.2	70	157
Below median.....	145	1,635	1,580	55	66.7	74	164
At or above median	144	1,747	1,531	216	70.6	79	134
65-74:							
None.............	964	1,416			60.3	63	157
Below median.....	48	1,589	1,552	37	66.7	71	165
At or above median	45	1,540	1,381	159	59.9	65	139

[1] Unweighted sample sizes are reported; however, individual values were weighted prior to calculating intakes.

age group, the highest intakes of all nutrients were found among those with the highest level of alcohol intake (Table 11.4). Female drinkers generally had higher intakes of calcium, iron, niacin, and vitamin C and lower intakes of thiamin than nondrinkers. There were less clear relationships between level of alcohol consumption and intakes of riboflavin by males and females and vitamin A by females.

The relationship between alcohol consumption and occupation was examined in cross-tabulations and percentage distributions using data for male and female heads of households who were 19 to 74 years of age. Homemakers generally had the lowest mean intakes of alcohol. The percentage of drinkers was substantially higher among white-collar workers than among blue-collar workers (26 to 46 percent versus 20 to 33 percent among men and 15 to 28 percent versus 6 to 16 percent among women, respectively). The percentage of homemakers who drank alcoholic beverages was intermediate between white- and blue-collar employed women except for 19- to 22-year-olds (who had the smallest percentage of drinkers). Among male drinkers, blue-collar workers consumed as much or more alcohol (mean grams of ethanol) than their white-collar counterparts, except for the 19- to 22-year-olds. Among female drinkers, blue-collar workers had the same or greater intakes compared with white-collar workers, except for older women (over 50 years of age). Male and female drinkers had lower body mass indexes than nondrinkers, and the relationship was stronger for women than men. Among drinkers, level of drinking was not related to body mass index. Although drinking was negatively related to the body mass index, total energy consumption was positively related. This inconsistency might be explained by smoking status, but no data on smoking habits were obtained in NFCS 1977-78.

11.2.4 Effects of Method and Effects of Day of Week on Reported Dietary Intake

The NFCS 1977-78 data were analyzed by Dr. Frances Thompson (1984) to investigate the nature and stability of dietary patterns and implications for nutritional epidemiology. This research is reported in a comprehensive dissertation undertaken while Thompson was part of the research team at the University of Michigan that compared data from two national dietary intake surveys (Chapter 5). Among the analyses reported are the effects of data collection method and the effects of day of the week on dietary intakes. Weighted data (response and sampling rates adjusted to maintain representativeness) were used in the analyses, which took into account season, region, and income.

The effects of data collection method: The effects of data collection method on reported dietary intake by adults aged 23 to 74 years were studied using intakes of food energy and energy-providing nutrients. Differences between any two days of reported intake, controlling for day of the week, were defined as "method effects" and they varied with age, sex, and nutrient. Energy intakes by men 23 to 50 years of age on the day 1 recall administered by an interviewer were significantly higher ($p \leq 0.01$) using t-tests than intakes for the self-administered day 3 record; however, method effect on energy intakes by women was not significant. Method effects for day 1 versus day 3 intakes for elderly adults (65 to 74 years of age) were not statistically significant, although day 3 intakes (record) were frequently slightly higher than for day 1 (recall). Intakes for the combined recall-record on the day of the interview (day 2) tended to be lower than for the other two methods (day 1, day 3) for most sex-age groups. Method effects were most pronounced for food energy and

Table 11.4--Intakes per day of two minerals and five vitamins by level of alcohol consumption, 3 days in NFCS 1977-78

Sex and age (years), level of alcohol consumption	Respondents[1]	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
	Number	Mean Milligrams		Mean IU	------Mean milligrams------			
Male								
19-22:								
None................	505	930	15.6	5,906	1.60	2.19	22.7	88
Below median........	75	955	14.0	4,757	1.46	2.05	22.1	81
At or above median..	79	1,037	16.9	7,009	1.61	2.55	29.3	93
23-34:								
None................	1,119	865	15.9	5,645	1.57	2.01	23.1	85
Below median........	311	853	15.8	5,673	1.53	1.97	23.8	87
At or above median..	320	834	15.8	5,825	1.46	2.08	27.0	88
35-50:								
None................	1,102	756	15.9	6,305	1.50	1.88	23.1	84
Below median........	274	752	15.3	5,441	1.47	1.81	23.0	84
At or above median..	279	723	15.0	5,390	1.33	1.84	25.4	81
51-64:								
None................	1,028	754	15.6	7,335	1.50	1.94	22.7	91
Below median........	180	732	14.9	6,381	1.36	1.78	22.5	98
At or above median..	180	686	15.5	6,448	1.42	1.94	25.1	93
65-74:								
None................	569	719	14.1	7,394	1.38	1.83	20.0	91
Below median........	60	693	14.7	6,804	1.39	1.73	21.2	105
At or above median..	57	628	14.9	6,874	1.35	1.87	23.3	92
Females								
19-22:								
None................	685	620	10.7	3,935	1.08	1.40	15.5	70
Below median........	66	613	9.7	3,762	.89	1.30	13.8	64
At or above median..	63	698	10.6	3,865	1.04	1.48	16.8	89
23-34:								
None................	1,924	597	10.7	4,615	1.05	1.37	15.8	72
Below median........	234	674	11.2	4,787	1.04	1.45	16.4	81
At or above median..	236	665	11.4	5,260	.97	1.46	17.1	87
35-50:								
None................	1,923	525	10.8	5,111	1.01	1.30	16.0	74
Below median........	198	550	11.1	5,525	.96	1.33	16.7	79
At or above median..	201	552	11.3	5,659	.99	1.40	17.6	83
51-64:								
None................	1,674	553	11.3	6,154	1.08	1.40	16.7	87
Below median........	145	568	11.6	5,980	1.06	1.40	17.5	106
At or above median..	144	563	11.7	5,709	.93	1.37	18.0	94
65-74:								
None................	964	559	10.8	6,641	1.06	1.42	15.7	91
Below median........	48	656	11.9	6,924	1.11	1.52	16.9	124
At or above median..	45	518	10.8	5,602	.97	1.33	16.5	95

[1]Unweighted sample sizes are reported; however, individual values were weighted prior to calculating intakes.

carbohydrate, less for fat, and negligible for protein. More meals tended to be reported for day 3 than for day 2 or day 1, but differences were not statistically significant. However, method effects were more noticeable for number of snacks reported--highest number on day 1 and lowest number on day 3. Differences in number of snacks between day 1 and day 3 were statistically significant ($p \leq 0.01$) for men 35 to 50 and women 23 to 64 years of age.

Effects of day of the week: The effect of day of the week on reported dietary intakes by individuals 23 to 74 years was studied by comparing intakes on weekend days (Saturday and Sunday) and weekdays (Monday through Friday). To estimate weekend-weekday differences independent of method effects, seven day-of-the-week cohorts were computed using a model based on the first day of the 3-day reports. For each cohort, each day's intake for each participant was weighted by 0.5 for weekend days and -0.2 for weekdays; then the mean and standard deviation were calculated. Means for all cohorts were then summed and divided by three (weights summed to 3) to provide a mean weekend-weekday difference (effect) for individuals.

Distinct differences were found between weekend and weekday intakes of food energy and energy-providing nutrients, the number of meals and snacks reported per day, the distribution of energy intake during the day, and the types of foods eaten. Differences in intakes between weekend days and weekdays varied with sex, age, and intake of food energy and the energy nutrients. However, significant differences were less frequent for respondents aged 65 to 74 years than those aged 23 to 64. Mean energy, protein, and fat intakes tended to be greater on Sundays than on other days of the week. For men and women aged 23 to 50 years, mean intakes of energy, protein (except men aged 23 to 34), and fat were significantly ($p \leq 0.01$) higher on weekends than on weekdays. For men aged 51 to 64 years, carbohydrate intake was significantly lower on weekends than on weekdays; for women of the same age group, intakes of fat and energy were higher on weekends than weekdays. For men and women aged 65 to 74, mean intakes on weekends did not differ significantly ($p \leq 0.01$) from those on weekdays.

The number of meals reported for weekends was significantly ($p \leq 0.01$) smaller than for weekdays, except for adults 65 to 74 years of age. The number of snacks, although generally smaller on weekends than weekdays, was not significantly different except for women 65 to 74 years of age. Interestingly, mean intakes of food energy and most energy nutrients were higher on weekends despite fewer meals and snacks reported on weekends than on weekdays.

For most adult groups other than the oldest, intakes of food energy from morning meals, midday meals, and snacks were significantly ($p \leq 0.01$) higher on weekends than on weekdays for adults who ate the meals all three days. Fewer respondents ate their main meal (highest in food energy) in the evening on weekends compared with weekdays; more respondents had their main meal in the morning or at midday on weekends.

The differences between foods eaten on weekdays and weekend days in terms of energy value were greatest for alcoholic beverages, eggs, and bacon. More of these foods were eaten on weekends than on weekdays. For alcoholic beverages, differences were significant ($p \leq 0.01$) for all age groups, except adults 65 to 74 years of age. Mean energy intake from meats, especially beef, was higher on weekends than on weekdays, whereas energy intakes from cereals and milk, and for desserts in several age groups, were lower on weekends than on weekdays.

Thompson's findings emphasize the importance of surveying all days of the week when evaluating dietary intakes. Clearly, weekend diets differed significantly from weekday diets. The effects of collecting only weekday diets could lead to bias in dietary evaluation. Findings from this study of weekend-weekday effects on dietary intake estimates have been published (Thompson et al., 1986).

11.2.5 Food Energy Intakes from Selected 3-Day Combinations

An earlier study of validation of a food frequency report by Dr. Frances Larkin at the University of Michigan (Chapter 10) examined 16 days of food recalls and records obtained from participants (Larkin et al., 1986). The recalls-records included 4 consecutive days (1-day recall and 3-day record) in each of four quarters of 1 year. Dr. Larkin used the four sets of 4 consecutive days in each season to compare estimates of dietary intake provided by consecutive and random 3-day combinations. The NFCS method collects 3 consecutive days of food intake from each respondent. Potential differences between estimated intakes on consecutive days and nonconsecutive days have important implications for survey methodology.

The first analysis compared the mean food energy intake of a variety of 3-day combinations to determine which combinations came closest to approximating the 16-day mean energy values. The data were provided by 228 individuals, 107 men (64 white and 43 black) and 121 women (73 white and 48 black). Food energy values calculated in the earlier study were used in these analyses.

Selected 3-day combinations: For a variety of 3-day combinations, mean food energy values were examined to determine which combination best represented the mean of all 16 recall-record values. Eight alternative 3-day combinations were selected. Three were random days and five were consecutive days as follows: (1) random sample of the entire 16 days, (2) stratified random sample such that two were weekdays and one a weekend, (3) stratified random sample such that there was 1 day from each of three quarters of the year, (4) the first 3 days from one randomly selected round such that the four quarters were about equally represented within sex-race groups, (5) first 3 days from quarter 1, (6) first 3 days from quarter 2, (7) first 3 days from quarter 3, and (8) first 3 days from quarter 4. Mean energy intake per day for all 16 recalls-records was the standard for comparison.

For the total sample, all 3-day combinations had mean values for food energy within 5 percent of the 16-day mean values (Table 11.5). However, values from random 3-day combinations (alternatives 1 to 3 above) were closer to the 16-day mean than were values from the first 3-day combinations (alternatives 4 to 8 above). The means of absolute differences in energy between each respondent's 16-day mean and 3-day mean were generally less for 3 random days than for 3 consecutive days.

Mean 3-day energy values in relation to 16-day values were computed for four sex-race groups. Blacks, especially men, had mean values with more than a 5 percent difference from the 16-day mean, more often than whites, especially women. The first 3 days from the first round of interviewing tended to yield the highest estimate of the 16-day mean intake.

Table 11.5--Food energy from 16-day mean intakes compared with random and consecutive 3-day mean intakes and means of absolute differences between 16- and 3-day means

Number and selection of intake days	Sample groups: Total sample		White men		Black men		White women		Black women	
	Mean	Mean of absolute difference	Mean	Mean of absolute difference	Mean	Mean of absolute difference	Mean	Mean of absolute difference	Mean	Mean of absolute difference
	Kilocalories									
All 16 days..........	2,114	--	2,714	--	2,175	--	1,897	--	1,589	--
Random 3 days:										
(1) 3 days[1].......	2,103	249	2,727	294	2,124	278	1,898	213	1,566	219
(2) 2 weekdays and 1 weekend day[1]...	2,112	274	2,706	277	2,213	307	1,888	278	1,571	235
(3) 3 days, 1 from each of 3 rounds[1]..........	2,120	269	2,665	300	2,233	313	1,885	217	1,648	265
First 3 consecutive days from:										
(4) Random round[1]	2,074	327	2,666	415	2,163	275	1,845	297	1,552	300
(5) Round 1.......	2,186	316	2,738	329	2,334	343	1,914	266	1,731	348
(6) Round 2.......	2,115	324	2,740	421	2,124	368	1,891	270	1,613	240
(7) Round 3.......	2,084	328	2,685	434	2,099	325	1,937	260	1,492	293
(8) Round 4.......	2,010	320	2,622	314	2,117	429	1,769	305	1,463	250

[1]Days or rounds or both were randomly selected.

Comment: The "standards" selected for comparison of methods in this section and in section 11.2.1 include means based on 3, 12, or 16 days of intake information. Mean energy intakes tended to be highest for the first day of collected information and to show a decrease for additional days (Chapters 7 and 8). Therefore, "standard" as used in these sections was unlikely true intake.

11.3 Intramural Studies

One USDA-HNIS intramural study used NFCS spring 1977 data to determine whether there were significant differences between 1-day and 2-day and 3-day mean energy and nutrient intakes for specified sex-age groups. In another study, data from the 1985 Continuing Survey of Food Intakes by Individuals (CSFII) were examined to determine participation by respondents contacted repeatedly. A third effort concerned identification of ways in which closer linkage between the NFCS and other surveys could be achieved. Linkage with other surveys has long been seen as a means to expand usefulness of data from individual surveys (National Research Council, 1984). The HNIS-NCHS (National Center for Health Statistics) Nutrition Monitoring Coordinating Committee appointed two joint working groups to examine and report on feasible methods for enhancing comparability between NFCS and NHANES (National Health and Nutrition Examination Survey), since both surveys are major components of the National Nutrition Monitoring System.

11.3.1 Similarities Between 1-Day and 3-Day Mean Nutrient Intakes

Data derived from NFCS spring 1977 were used to compare estimates of nutrient (including food energy) intakes based on 1 day of data with those based on 3 days of data. For most nutrients and for most sex-age groups, mean intakes based on 1 day were not significantly different ($p \leq 0.01$) from those based on 3 days. Earlier research indicated that 1 day intakes provided reliable means for large groups (at least 50 individuals) (Young et al., 1952; National Research Council, 1981). Whether the additional 2 consecutive days of data would yield the same information merited further investigation.

As noted frequently in this report, the NFCS dietary collection method obtained information on 3 consecutive days with a combination recall-record method. The 1-day intake data used in this intramural research were the day-1 recalls, and the 3-day intakes were the means of the day-1 recall plus the recall-record for day 2 and the record for day 3. Data were available for a weighted count of 8,779 individuals (7,914 unweighted).

The statistical analysis of data for all individuals and for 22 sex-age groups included means with their standard deviations and coefficients of variation (standard deviation divided by the mean, converted to a percentage) for 3-day and day-1 intakes. The data investigated were intakes of food energy, the three energy-yielding nutrients, four minerals, and six vitamins. Differences between the mean day-1 intake and the mean intake for days 2 and 3 were tested for significance ($p \leq 0.01$) using the t-test for correlated data. Coefficients of determination (r square) were calculated with simple regression to determine the degree to which intake on day 1 could predict intake on subsequent days.

Results of this study indicated that mean food energy and nutrient intakes based on day 1 and days 2 and 3 diets were similar for nearly all sex-age groups. Significant differences ($p \leq 0.01$) between the mean nutrient intake for day 1 and the mean intake for days 2 and 3 combined occurred in fewer than 6 percent (N=18) of the total comparisons (N=308) among the 22 sex-age groups. Most of these differences could have been due to chance alone. No significant differences between mean intakes for the two time periods for any sex-age groups were shown for protein, thiamin, riboflavin, and niacin. Statistical differences between the 1-day and 2-day averages were found for one sex-age group only for five nutrients (calcium, iron, magnesium, phosphorus, and vitamin A), for two sex-age groups for three nutrients (fat, carbohydrate, and vitamin C), for three sex-age groups for one nutrient (vitamin B-6), and for four sex-age groups for food energy. Mean intakes of food energy for days 1, 2, 3, combined 2 and 3, and all 3 days are shown in Table 11.6.

Variations around means were greater for day 1 intakes than for 3-day intakes, as anticipated. Coefficients of variation indicated greatest variation around the means for vitamin A (109 percent and 136 percent for 3-day and day 1 means, respectively), vitamin C (72 percent and 90 percent, respectively), and calcium (56 percent and 65 percent, respectively) (Table 11.7). The least variation occurred for food energy (40 percent and 47 percent, respectively).

Using simple regression analysis, day 1 intake was shown to be a stronger predictor of day-2 intake than of day-3 intake (Table 11.8). Day 2 was a stronger predictor of day 3 intake than was day 1 for all nutrients except riboflavin. Day 1 intake was better in predicting the mean of days 2 and 3 combined than in predicting either day alone. However, prediction of vitamin A intake was virtually impossible. Prediction was much better for food energy, carbohydrate, and calcium (r^2 = 0.40 to 0.42). The differences in data collection methods between day 1 (recall), day 2 (recall-record combination), and day 3 (record) and their administration may have had some impact on the predictive values shown. A more detailed report of this study has been published (Pao et al., 1985).

11.3.2 Continuing Survey of Food Intakes by Individuals, 1985 and 1986

The CSFII, fielded initially in 1985, involved the first use of a panel-type survey by HNIS (USDA, HNIS, 1985). A panel of women 19 to 50 years of age and their children 1 to 5 years selected from a national sample of households made up the core sample of respondents. Interviews for CSFII 1985 were scheduled bimonthly between April 1985 and March 1986 and for CSFII 1986 between April 1986 and March 1987. The first interview was an in-person home interview; the five subsequent contacts were telephone interviews. In-person interviews were continued for households without telephones. Comparable samples of women and young children in low-income households were also surveyed bimonthly in 1985 and in 1986, and a sample of men aged 19 to 50 years was surveyed once in the summer of 1985. Since the 1985 panel survey was the first such effort by HNIS, the results were examined by staff members.

As data from CSFII 1985 core sample became available, response rates were examined and found to be similar to those in the National Analysts (Chapter 7) and Westat (Chapter 8) studies. In CSFII 1985, 1,459 women participated at least once (wave 1) and 692 women (47 percent) completed all six waves (Table 11.9) (USDA, HNIS, 1987). The biggest drop-off occurred between wave 1 and wave 2; 1,221 women (84 percent) responded in wave 2. But the drop-off between wave 2 and wave 3 was also considerable (down to 71 percent at the end of wave 3). The number of respondents interviewed continued to

Table 11.6—Intakes of food energy for days 1, 2, 3, days 2 and 3 combined, and all 3 days, spring 1977 NFCS

Sex and age (years)	Food energy intake on--				
	Day 1	Day 2	Day 3	Days 2 and 3	3 Days
	Mean kilocalories ± standard deviation				
Males and Females:					
Under 1........	797± 271	795± 269	805± 350	800± 290	799±271
1-2............	1,185± 448	1,157± 410	1,190± 404	1,173± 352	1,177±343
3-5............	1,429± 505	1,426± 470	1,459± 499	1,442± 417	1,438±388
6-8............	1,723± 537	1,699± 546	1,738± 597	1,718± 500	1,720±453
Males:					
9-11...........	2,022± 748	1,941± 655	2,006± 722	1,973± 602	1,989±578
12-14..........	2,355± 869*	2,195± 842	2,268± 883	2,231± 752*	2,273±698
15-18..........	2,693±1,045	2,624±1,081	2,543± 977	2,584± 882	2,620±853
19-22..........	2,611±1,161	2,503±1,183	2,510±1,100	2,507±1,007	2,541±935
23-34..........	2,462±1,059*	2,314± 929	2,395± 987	2,354± 825*	2,391±784
35-50..........	2,306± 899*	2,173± 886	2,250± 896	2,212± 759*	2,243±699
51-64..........	2,139± 836	2,085± 759	2,104± 854	2,095± 718	2,110±668
65-74..........	1,986± 742	1,878± 662	1,931± 706	1,904± 615	1,932±600
75 + ...	1,828± 736	1,884± 887	1,922± 785	1,903± 774	1,878±695
Females:					
9-11...........	1,853± 629	1,791± 609	1,892± 699	1,842± 553	1,845±488
12-14..........	1,892± 816	1,819± 679	1,875± 775	1,847± 638	1,862±619
15-18..........	1,798± 818	1,788± 812	1,732± 730	1,760± 679	1,773±655
19-22..........	1,625± 740	1,572± 661	1,582± 679	1,577± 581	1,593±561
23-34..........	1,621± 767*	1,543± 664	1,575± 741	1,559± 609*	1,580±583
35-50..........	1,516± 632	1,439± 617	1,534± 664	1,487± 556	1,497±506
51-64..........	1,528± 632	1,477± 572	1,515± 586	1,496± 507	1,507±476
65-74..........	1,459± 564	1,444± 530	1,457± 535	1,450± 475	1,453±449
75 + ...	1,366± 478	1,364± 520	1,387± 538	1,375± 484	1,372±444
All individuals...	1,870± 884	1,800± 830	1,840± 850	1,820± 755	1,837±728

*Difference between means for day 1 and for days 2 and 3 combined was significant (p≤0.01).

Table 11.7--Variability in 3-day and day 1 energy and nutrient intakes by individuals, spring 1977 NFCS

Nutrient	Coefficient of variation[1]			
	3 days		Day 1	
	Mean	Range[2]	Mean	Range[2]
	Percent			
Food energy	40	26-37	47	31-47
Protein	41	28-44	51	36-52
Fat	46	33-45	58	40-59
Carbohydrate	44	29-56	51	36-55
Calcium	56	39-63	65	47-69
Iron	43	29-88	52	38-90
Magnesium	42	33-50	50	38-57
Phosphorus	42	30-50	50	37-52
Vitamin A	109	58-147	136	77-174
Thiamin	47	31-60	58	42-63
Riboflavin	50	32-60	59	41-79
Niacin	44	30-71	57	41-74
Vitamin B-6	46	33-79	59	44-102
Vitamin C	72	60-82	90	63-107

[1]Coefficient of variation = standard deviation divided by mean, expressed as a percentage. Only individuals providing 3 days of dietary intake were included (N = 8,779, weighted count).

[2]Range of coefficients of variation of the 22 sex-age groups.

Table 11.8--Coefficients of determination from simple regressions for energy and nutrient intakes on days 1, 2, and 3 by individuals[1] spring 1977 NFCS

Nutrient	Coefficient of determination[2]			
	Day 1 with day 2	Day 1 with day 3	Day 2 with day 3	Day 1 with mean of days 2 and 3
Food energy.......	0.35	0.30	0.37	0.40
Protein...........	.22	.20	.22	.29
Fat...............	.22	.19	.24	.28
Carbohydrate......	.37	.30	.41	.41
Calcium...........	.37	.31	.37	.42
Iron..............	.22	.21	.24	.29
Magnesium.........	.31	.27	.35	.36
Phosphorus........	.31	.28	.34	.37
Vitamin A value...	.02	.00	.01	.02
Thiamin...........	.20	.18	.26	.25
Riboflavin........	.16	.17	.15	.24
Niacin............	.15	.14	.17	.21
Vitamin B-6.......	.20	.16	.19	.25
Vitamin C.........	.25	.18	.24	.28

[1]Excludes infants under 1 year of age.
[2]Coefficient of determination (r^2) indicates the proportion of the variation in the dependent variable that is explained by the independent variable (Ezekiel and Fox, 1959, p. 130).

Table 11.9--Food energy intakes and food items coded for participants in specified waves, CSFII 1985

Wave number	Individuals participating in--					
	All six waves			Specified wave		
	Individuals	Mean per day: Food energy	Mean per day: Food items coded	Individuals	Mean per day: Food energy	Mean per day: Food items coded
	Number	Kilocalories	Number	Number	Kilocalories	Number
Children:						
1	171	1,467	15.1	489	1,450	14.6
2	171	1,383	14.8	383	1,375	14.3
3	171	1,376	14.7	304	1,357	14.5
4	171	1,360	14.8	280	1,403	14.9
5	171	1,391	14.8	246	1,391	14.7
6	171	1,405	13.9	255	1,406	14.2
Women:						
1	692	1,740	15.0	1,459	1,663	14.3
2	692	1,567	14.3	1,221	1,493	13.7
3	692	1,503	14.0	1,042	1,459	13.6
4	692	1,488	13.8	995	1,462	13.5
5	692	1,476	13.6	910	1,458	13.3
6	692	1,467	13.6	902	1,444	13.4

NOTE: Data in this table are unweighted and cannot be generalized to the population.

decline in each later wave, although a number of women rejoined the panel after missing one or more interviews. One-fifth of the attrition was the result of participants moving out of their areas during the survey.

Examination of variations in mean energy intakes and mean number of food items coded from wave to wave indicated a progressive decline in mean intakes and mean number of items from wave 1 through wave 6 (Table 11.9). Between waves 1 and 2, food energy intake for women declined about 10 percent. The change from in-person to telephone interview method did not appear to be responsible for the drop because women interviewed in-person showed a drop similar to that for those interviewed by telephone. Subsequent evaluations may indicate that differences among means of the intakes were statistically significant only between waves 1 and 2 and negligible after wave 3.

Characteristics of respondents were studied to learn more about respondents who did and who did not complete all waves in the continuing survey. The estimated regression models included about 40 available independent variables. Results showed that respondents who tended to complete the largest number of interviews had these characteristics: were from nonmetropolitan households, participated in food assistance programs, had high body mass for given height, were older, and were in good to excellent health. Respondents who tended to participate in fewer waves had at least some of these characteristics: were younger, did not report income, were from larger households, and had one or more children. These results suggest that response rates in CSFII 1985 were partly associated with respondent characteristics. A more detailed summary of the study is available (Basiotis and Pao, 1987a, 1987b).

11.3.3 Methodology for Linkage Between Two Federal Surveys

On occasion, researchers and others have sought to use jointly data from more than one Federal survey, but their efforts have been hampered by nonuniformity in survey design, survey methods, variable definitions, and data treatment (Chapter 5). Therefore, expert committees have recommended development of a common core of demographic, socioeconomic, personal, family, and household descriptors that would contribute to greater comparability or linkage between surveys, thus expanding the usefulness of the data bases (National Research Council, 1981, 1984).

Because NFCS (including CSFII) conducted by HNIS of USDA and NHANES conducted by NCHS of the U.S. Department of Health and Human Services have been designated as major components of the National Nutrition Monitoring System (Chapter 1), facilitating the joint use of data from the two surveys has become a matter of increasing importance. The NCHS-HNIS Nutrition Monitoring Coordinating Committee appointed two interagency working groups to make a comprehensive review of variables and procedures relevant to both diets and health. Subsequently, the joint working groups recommended ways to build useful linkages that would achieve greater comparability of data from the two surveys. It was recognized that each survey had unique, as well as common, objectives, which were reflected in the survey design, sampling, and data collection procedures.

The NCHS-HNIS Nutrition Coordination Variables Joint Working Group (NCHS and HNIS, 1986) examined a number of demographic variables for comparability of definitions, structure of questions, administrative procedures, intended respondents, and other pertinent elements. The group suggested ways to increase linkage where feasible. Nine variables were considered identical in both surveys or potentially so if suggested revisions, such as change in wording or administration, were made. These variables were education, ethnic identification, urbanization, sex, age, pregnancy status, reported height, respondent-reported health status, and presence of complete kitchen facilities. Ten variables were judged to be somewhat different in character but having similar concept or intent, so they could be linked through such techniques as incorporation of common questions, specification of common categories or common reference periods, an alteration in appropriate respondent, or similar coding conventions.

This group of variables included race, employment status, occupation, farm, lactating female, breastfeeding child, reported weight, cigarette smoking, self-reported chronic health conditions, and surrogate respondents. In addition, queries about Food Stamp Program participation were expected to have overlapping questions to provide linkage between the two surveys.

A third group of variables differed substantially in basic concepts between the two surveys. These differences precluded attaining comparability through modification of existing questions or addition of a simple linkage or overlapping questions. Variables in this group included region (sampling frame of 48 States in the NFCS and 50 States in the NHANES), income (which refers to household income in the NFCS and to family income in the NHANES), household (differences in inclusion of group quarters), and household member relationships to household head in the NFCS and to head of family (which may be a subunit within a household) in the NHANES.

The HNIS-NCHS 24-hour Recall Methodology Joint Working Group (1986) reviewed for comparability background references, manuals, and questionnaires relevant to the 24-hour recall methodology and related questions used in the NFCS-CSFII and the NHANES. The working group categorized specific procedures or questions as completely comparable, comparable in intent but not completely comparable, and not comparable. They explored possibilities for making the 24-hour recall methods in the two surveys more comparable in the future. The specific topics considered were (1) meal and eating occasion descriptors; (2) 24-hour recall interview--location, day of week of interview, length, automation, qualifications and training of interviewers, editing and quality control measures, and food composition data base; (3) food descriptions, coding system, guidelines for handling inadequate or missing information, probing for use of fat and salt, automation, and nutrient data base; (4) food quantities, measurement aids, coding, default values for inadequate or missing amounts; (5) surrogate respondents; eating patterns such as how typical the day's intake, special diets, and frequency of skipping meals, snacking, and buying meals out; and interviewer evaluation of participant's responses; and (6) drinking water, vitamin-mineral supplements, table salt, recall imputation, alcohol consumption, and present and past frequency of consuming dairy foods.

The efforts of the two interagency working groups provided needed information concerning areas of similarities and differences. Suggestions for changes have been implemented where feasible to improve comparability between the surveys. Future NFCS and NHANES will be using a common food composition data base.

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Chapter 12. USDA Food Composition Tables

SUMMARY: The opening section of the chapter traces the historical development of food composition research in the late 19th century. Next comes a description of several major food composition tables issued, from the first comprehensive Bulletin No. 28 in 1896 to Agriculture Handbook No. 8 (AH-8) in 1950. The first revision of AH-8 in 1963 contained composition values for 2,483 foods. In the 1970's, growing demands for nutrient data, partly because nutrition labeling was introduced, led to the development of automation in the form of a system of computer programs to produce the USDA Nutrient Data Bank (NDB). The three levels of data base incorporated the results of uniform food classification procedures, improved coding, and summarized analytical data. The second revision of AH-8 began concurrently with development of the NDB. The first section of revised AH-8--Dairy and Egg Products--was issued in 1976. Of the total 22 food group sections scheduled, 17 were completed by the end of 1988. Underway also was creation of the Nutrient Data Bases for Food Consumption Surveys. The Nutrient Data Base for Standard Reference is the basic source of nutrient data for food surveys. Three computer data files are used in deriving these data bases for surveys--the Primary Nutrient Data Set for Food Consumption Surveys, a recipe file, and a Table of Nutrient Retention Factors file. Extramural research, including cooperation with the USDA Agricultural Research Service Nutrient Composition Laboratory, contributes to filling gaps in current food composition tables. Participation in national Nutrient Data Bank Conferences and international cooperation by USDA's Human Nutrition Information Service are also mentioned.

12.1 Introduction

Food composition values are essential for evaluation of the nutrient content of food supplies and of household food use and individual food intake reported in food consumption surveys. This chapter describes the major compilations of food composition values by specialists at the USDA, Human Nutrition Information Service (HNIS), who provide leadership and staff for the development of standard reference tables on food composition. Over the last 100 years, the information summarized and published by USDA has increased, from food energy and 4 nutrients (protein, fats, carbohydrates, and ash or mineral matters) in the first major compilation (Atwater and Woods, 1896) to food energy and about 60 nutrients in the most recent tables. This reflects tremendous advances in scientific knowledge of food composition based on research in laboratories of universities, private research organizations, food manufacturers and processors, and local, State, and Federal agencies. The demand for such information has increased as awareness of the importance of the relationship between diet and health has grown, as public and consumer interest has focused on food problems, and as the relevance of food composition data to marketing has become clear.

The main objectives of this chapter are (1) to trace the history of the major USDA food composition data compilations, identifying the stages of scientific development reflected in each; (2) to convey the importance of the shift to a computerized system that can process massive amounts of data to create food composition data bases that can meet varied requirements; and (3) to describe USDA activities that promote the development, exchange, and appropriate uses of food composition data.

12.2 Historical Development of Food Composition Tables

Food composition tables in the U.S. have evolved from 47 pages in the first major publication by Atwater and Woods in 1896 to over 3,000 pages when the latest revision of Agriculture Handbook No. 8 is completed in 22 separate sections.

12.2.1 Beginnings

Around 1864 at the Agricultural Experiment Station in Weende, Germany, an accurate and reproducible method for chemical analysis was devised in which moisture, fats, nitrogen, ash, crude fiber and, by difference, a fraction called nitrogen-free extract (carbohydrate) were determined (McCollum, 1957). W. O. Atwater was among the first scientists in the U.S. to use the Weende method, reporting analysis of Indian corn in 1869 as part of his doctoral research (Maynard, 1962). In 1894, the U.S. Congress appropriated money for the Secretary of Agriculture to determine nutritive values of foods for humans (Atwater and Bryant, 1906). The USDA Office of Experiment Stations, under Atwater, was directed to carry out those investigations.

12.2.2 Bulletin No. 28: 1896, 1899, and 1906

The first comprehensive compilation of food composition values in the U.S. was Bulletin No. 28, issued in 1896 by the USDA Office of Experiment Stations (Atwater and Woods, 1896). A revised and expanded version was released in 1899 (Atwater and Bryant, 1899). A slightly revised edition (Atwater and Bryant, 1906) continued to be the standard reference for the U.S. until 1940 (Chatfield and Adams, 1940).

The tables in Bulletin No. 28 presented minimum, maximum, and average values for water, protein, fat, carbohydrate, and ash in terms of percentages for each food item (Atwater and Bryant, 1906). Energy (fuel) values were expressed as kilocalories in the edible portion of 1 pound of food in its "as purchased" form. Percentage of refuse in a pound as purchased and number of analyses were also given for each food. Energy values of foods were calculated based on Rubner factors--4.1 kilocalories per gram of protein, 4.1 kilocalories per gram of carbohydrate, and 9.3 kilocalories per gram of fat (Atwater and Bryant, 1906). Energy value referred to the number of kilocalories of heat equivalent to the energy the body would obtain from 1 pound of food if completely digested. Protein was computed as the product of total nitrogen times the factor 6.25. Values for fats were given in terms of total ether extract and thus included some substances other than true fats, such as lecithins. Carbohydrate was determined by difference; that is, the sum of percentages for water, protein, fat, and ash was subtracted from 100 and the difference represented the percentage of carbohydrate. The value for carbohydrate included crude fiber, the substance in vegetable foods that was insoluble in dilute acid and dilute alkali--cellulose, hemicellulose, and lignin. (A history of Bulletin 28 was published by Todhunter in 1960.)

Scientific knowledge about nutrition was in its early stages at the time Bulletin No. 28 was compiled. Protein, fat, and carbohydrate were the well-known nutrients. Adjusting the supply of energy to needs of the individual and determining the amount of protein needed to maintain tissues were considered the two prime factors to think about when planning a diet (McCollum and Simmonds, 1929). Mary Swartz Rose (1926), a pioneer professor of nutrition at Columbia University, recalled her first assignment as a student in nutrition at the turn of the century. She had to plan food costing no more than 10 cents for a man for a day to yield 150 grams of protein, 150 grams of fat, and 360 grams of carbohydrate. Rose related that she "wrestled" with cornmeal, flour, beans, salt pork, fat beef, and molasses to furnish a "balanced" ration that was appetizing yet secured at low cost. Minerals were in the form of ash; values for individual minerals were unavailable. However, Sherman (1907) was studying the importance of iron in food and metabolism. The word "vitamin" was unknown.

During the 1920's and 1930's, several special tables were compiled. These included the proximate composition of beef (Chatfield, 1926), of fresh fruits (Chatfield and McLaughlin, 1928), and of fresh vegetables (Chatfield and Adams, 1931) and the iron (Stiebeling, 1932) and vitamin (Daniel and Munsell, 1937) content of foods.

12.2.3 Circular No. 549: 1940

In 1940, USDA's Circular No. 549 (Chatfield and Adams, 1940) superseded Bulletin No. 28. New varieties of fruits and vegetables, changes in commercial methods of processing, and progress in the development of food standards contributed to the need for a revision. Demand for a more comprehensive table of foods, but with less detail, led to reporting only an average (or representative) value for each item. However, several forms of an item were sometimes reported. Information about variability (maximum and minimum) as in earlier tables was not included. Otherwise, the kinds of information provided for each food were similar to those in Bulletin No. 28--percentages of refuse, water, protein, fat, ash, and carbohydrate, with energy values in terms of kilocalories in the edible portion of 1 pound of food "as purchased." For the first time, energy values per 100 grams of the edible portion of foods were reported. Percentage of refuse was used with values for "edible portion" to derive the values "as purchased." Values were originally based on direct chemical analyses from State agricultural experiment stations and other Government laboratories. As work progressed, analyses from many other laboratories became sources of data. Some values were based on calculations from recipes or commercial formulas and others on judgment and knowledge of similar foods.

Advances in knowledge of nutrition during the nearly 40 years since Bulletin No. 28 had been issued were tremendous and included a large number of important discoveries. New concepts and data changed perceptions about the nature of an adequate diet. In 1914, a new experimental approach with results of great significance to the science of nutrition was conceived to study essentiality of nutrients in the diet (McCollum, 1957). Experimental feeding diets for animals, composed of known simplified chemical substances and known to be nutritionally inadequate, were supplemented stepwise with known nutrients or extracts of natural foods until normal physiological measurements were restored. Differences in the amino acid composition of proteins were studied. Understanding of the great importance of the inorganic (ash) moiety of the diet unfolded. Vitamins were discovered in this period, and the causes of deficiency diseases were traced to inadequate amounts of one or more essential nutrients in the diet. Laboratory scientists undertook feeding investigations to determine what essential nutrients each food provided. Emphasis in meal planning turned to the combining of foods so that what was lacking in one food would be contributed by another in order to provide adequate amounts of essential nutrients in the diet (McCollum, 1957). Food plans that met dietary requirements at various cost levels were presented by Stiebeling at USDA early in the 1930's (Stiebeling and Ward, 1933). Nutrient values were used to calculate dietary levels for households that participated in the 1936-37 Consumer Purchases Study. According to Stiebeling et al. (1941), computations were based on average figures for food composition compiled from many sources and were probably of unequal validity.

12.2.4 Miscellaneous Publication No. 572: 1945

The next major revision of food composition data tables, published in 1945 as Miscellaneous Publication No. 572 (USDA, BHNHE, 1945), contained values for minerals and vitamins for the first time. The need to assess adequacy of food supplies during wartime hastened compilation of data. Early in World War II, the War Department had requested that the Food and Nutrition Board establish a Committee on Food Composition (Elvehjem, 1946; Watt and Merrill, 1950). The Committee (Pavcek and Elvehjem, 1944) compiled a preliminary table with values for water (percent), food energy (kilocalories), and 11 nutrients--protein, fat, and carbohydrate (grams); calcium, phosphorus, iron, thiamin, riboflavin, niacin, and ascorbic acid (milligrams); and vitamin A value (International Units). Values were supplied by State agricultural experiment stations and Federal, commercial, and other laboratories through efforts of the National Research Council.

Miscellaneous Publication No. 572 was a revision and expansion of the Committee's preliminary table and included 275 foods. The publication provided values on the basis of 100 grams edible portion and on the basis of edible portion in 1 pound as purchased, derived by applying factors for refuse to the 100-gram values. No losses occurring during preparation of food, such as in cooking, were deducted from values. For the first time in USDA composition tables, foods were arranged in 10 major food categories, which were mainly commodity groups with subdivisions of the largest categories: milk and milk products; fats and oils; eggs; meat, poultry, and fish; dry beans and legumes; nuts; vegetables; fruits; grain products; and sugars and sweets.

Several conventions were adopted in the tables to convey additional information. The word "trace" designated small values that would round to zero. Parentheses denoted imputed values (such as protein, fat, and carbohydrate in dried eggs) or nutrients covered by specifications for enrichment (such as vitamin A value in margarine and iron, thiamin, riboflavin, and niacin in flour and bread). Dashes signified lack of reliable data whenever there was reason to expect a measurable quantity of a nutrient to be present. Asterisks identified Army ration components. Footnotes alerted users to diminished biological availability of calcium in foods high in oxalic acid or phytic acid and iron that was only partially available from some foods. No adjustments were made to the denoted food values.

Increases in scientific knowledge during the 5 years prior to the release of Miscellaneous Publication No. 572 (1945) evolved from wartime efforts to supply the U.S. population with adequate diets, while at the same time very large food supplies were allocated to our allies and armed forces. A Committee on Food and Nutrition, later to become the Food and Nutrition Board, was set up in 1940 at the National Research Council (1941) to advise on nutrition problems in connection with National Defense. In 1941, to provide guidelines for achieving more nutritious diets, the Committee issued the first set of Recommended Dietary Allowances (RDA) for a number of dietary essentials (Roberts, 1944, 1958). Promoting good nutrition to maintain body fitness was stressed as one way every citizen could support the war effort. The Committee provided, along with the RDA, a dietary pattern to meet the recommended allowances and food values of a low-cost diet. In order to estimate the adequacy of diets and food supplies, food composition work received new emphasis. A compilation of vitamin values of foods in relation to processing and other variants was issued during this period (Booher et al., 1942).

After the end of World War II, analytical procedures and food technology advanced substantially. Numerous studies of malnutrition and its prevention required updated food composition data. Effects of preparation and cooking on the vitamin and mineral content of certain foods were determined and reported by USDA specialists (Hewston et al., 1948).

12.2.5 Agriculture Handbook No. 8: 1950

A few years later, in 1950, Agriculture Handbook No. 8 (AH-8) (Watt and Merrill, 1950) took the place of Miscellaneous Publication No. 572 as the standard food composition reference, providing data for 751 foods. Cooked foods, prepared dishes, and frozen foods were included in the tables for the first time because these forms more closely approximated nutrient content of many foods as eaten. The 11 nutrients (and food energy) included were the same as those in the 1945 food composition tables.

Two tables continued customary presentation of food composition values for 100 grams of edible portion and for the edible portion of 1 pound as purchased. A third table gave values for foods in common household units, such as 1 cupful, and their weights in grams. Common household units of measure were introduced to simplify calculations of nutrient content of food portions in diets as reported by individuals.

Weights of the common household units of foods and their approximate measures were taken from a number of sources or were calculated from the density of the food. Watt and Merrill (1950) pointed out that the weights for many items were less than exact for the volume or measure specified. Extensive use of footnotes signified alterations in a nutrient value that were brought about by variations in a food item, such as in vitamin A value if butter instead of lard were used in a home-prepared recipe.

In AH-8, a departure from earlier tables was the modification in the procedure for calculating the energy value of foods. Formerly, the general caloric factors--4, 9, 4--as developed by Atwater and applied to the percentage composition of protein, fat, and carbohydrate, respectively, were considered to provide satisfactory estimates of available energy for typical American mixed diets. Atwater's general caloric factors--4, 9, 4--included a correction for digestibility loss and replaced the Rubner factors (Atwater, 1910), which were based on caloric values assuming complete digestion (Atwater and Bryant, 1906). The Atwater general caloric factors had limitations if applied to types of diets that were different from the mixed American diet or to individual foods. The procedure for calculating energy values of foods in Canada and Great Britain differed from that followed in the United States (Merrill and Watt, 1955). After World War II, in 1947, the Food and Agriculture Organization of the United Nations convened a Committee on Caloric Conversion Factors and Food Composition Tables to study the problem of properly assessing energy values of food supplies in the war-devastated-countries. The Committee endorsed the Atwater system if properly applied, but recommended that more specific caloric factors be used for individual foods.

In AH-8, more specific factors were used for individual foods or food groups in order to take into account the latest findings on digestibility and physiological energy values of foods. Protein values were calculated from nitrogen content (usually total nitrogen) by applying suitable conversion factors, which might differ from 6.25 (Jones, 1941). Total carbohydrate was measured as the difference between 100 percent and the sum of the percentages of the other proximate components (protein, fat, ash, and water).

Vitamin values had initially been determined by a number of different methods (Watt and Merrill, 1950). Gradually, the earlier methods were replaced by improved procedures, but analyses using the newer methods were not available for all foods. Vitamin A values were based on biological assay and on chemical determinations of vitamin A and its precursors. Physiological equivalence of vitamin A and the carotenes with vitamin A activity was unclear. Methods for extraction and assay of the B vitamins--thiamin, riboflavin, and niacin--were still being developed. Ascorbic acid values reported were mainly for the reduced form most prevalent in fresh products, even though stored and processed products had been found to contain significant quantities of the oxidized form, dehydroascorbic acid. Although both forms had vitamin C activity, total ascorbic acid activity was not always reported; this is still true.

Food composition specialists at USDA sought values that would be representative of food consumed in the country year-round. However, the number and coverage of analyses reported varied among foods and among nutrients with the result that some values were more representative than others. Decisions about the form of a food item to include in tables were based partly on common usage, as in selecting meat of medium fatness because that was the type of meat consumed most frequently. Other properties of a food were based on common practice either by manufacturers or homemakers, as in selecting a minimum or maximum level of enrichment for bread and in selecting a cooking method for vegetables recommended because it conserved nutrients --a moderate time in a moderate amount of water.

Five references were developed and published to provide background information necessary for specification of food items before nutrient values can be derived. These handbooks delineated basic assumptions and derivations relative to values reported in AH-8. These resource publications included one on calculations of food yields for different stages of preparation, such as after removal of bone, skin, trimmed fat, and cooking losses, and provided data for refuse in Table 2 of AH-8 (Pecot and Watt, 1956). Another reference on procedures for calculating nutritive values of home-prepared foods from recipes, such as those used in AH-8, was published shortly after the 1963 revision (Merrill et al., 1966). Several special reports were compiled for nutrients not available in the 1950 edition of AH-8 to meet needs of researchers until more definitive data could be provided. These nutrients included folic acid (Toeper et al., 1951), fatty acids in food fats (Goddard and Goodall, 1959), amino acids (Orr and Watt, 1957), and vitamin B-12 (Lichtenstein et al., 1961).

From 1950 to 1963, the needs for food composition data multiplied. The most comprehensive USDA nationwide food consumption survey of households to that time was carried out in 1955 with sampling of households planned to provide regional information for the first time (USDA, AMS and ARS, 1957). This period also saw the development of international surveys concerned with evidence of increased malnutrition in developing countries. Nutrition surveys by the U.S. Interdepartmental Committee on Nutrition for National Defense were conducted in 24 countries between 1956 and 1964 (Stiebeling, 1964; Wilson et al., 1964). Many studies and reviews of methodologies concerned with food consumption and dietary intake surveys appeared attempting to improve procedures. State agricultural experiment stations used funds provided through the 1946 Research and Marketing Act to undertake a number of important nutrition and dietary surveys (Young et al., 1952; Eppright et al., 1955; Morgan, 1959). Preparation for epidemiologic studies of cardiovascular diseases was under way (Pollack and Krueger, 1960).

12.2.6 Agriculture Handbook No. 8: Revised, 1963

To take into account the growing body of knowledge, AH-8 was revised and expanded in 1963 by Watt and Merrill (1963). It included composition values for 2,483 items, more than triple the number in the 1950 edition. New data reflected major changes in values for fruits, vegetables, and meats. Additions included various kinds of nuts, fish, and poultry products; prepared and partially prepared foods; and some tropical and subtropical products. Sodium and potassium were reported for the first time in the main tables. Magnesium, cholesterol, and fatty acids--total saturated and two unsaturated fatty acids--were also reported for selected foods in three special tables, indicating their less-firm experimental basis.

Data on foods in common household units, which had appeared in the 1950 AH-8 as the third table, were excluded from the revision but were issued separately as Agriculture Information Bulletin 36 (USDA, 1951). This bulletin was used by extension workers, nurses, clinicians, and students as a reference to compare quickly the nutritive values of foods and to compute nutritive values of diets. The table proved to be so useful to a broad spectrum of users that it was expanded and issued in 1960 as Home and Garden Bulletin No. 72 (HG-72) (USDA, IHE, 1960). HG-72 has been revised and updated regularly--in 1964, 1970, 1971, 1977, 1981, and 1985. Its coverage rose from 512 items in 1960 to 908 items in 1985 (Gebhardt and Matthews, 1985).

Before the 1963 revision of AH-8 was published, Watt (1962) presented an extensive discussion of the concepts and philosophy which guided formulation of the USDA food composition tables. After release of the revision, Watt (1964) and Merrill (1964) described the problems that the food specialists had to face while updating tables.

12.3 Development of USDA Nutrient Data Bank and Second Revision of Agriculture Handbook No. 8

Little more than a decade had passed before it was apparent that AH-8 needed to be greatly expanded--both the number of foods and the number of nutrients and components. To accomplish such a large expansion rapidly, a computerized nutrient data bank was designed and implemented in the late 1970's when the second revision of AH-8 was initiated.

12.3.1 Development of USDA Nutrient Data Bank

Groundwork had been laid in the early 1970's for the second revision and update of AH-8 (Watt and Murphy, 1970; Murphy et al., 1973, 1974; Watt et al., 1974). Revision required a new approach because of the vast array of new foods on the market; the advent of food labeling, which was expected to produce many new values; and interest in a greater number of nutrients than ever before. To process such a large volume of food composition data, the USDA staff considered the advantages of a computerized system to be indisputable (Rizek and Butrum, 1975). With an automated system, not only could calculations be accomplished in a fraction of the time taken by manual methods, but computations earlier found to be impractical could be undertaken. For example, data could be used to test the impact of an individual factor, such as variety or storage, on the content of a particular nutrient in a food. An automated system would also facilitate statistical evaluation of the data.

To carry out this plan, a system of computer programs was developed for storage and retrieval of data on foods (Rizek and Butrum, 1975; Butrum and Gebhardt, 1977). This was called the Nutrient Data Bank (NDB). Implementation necessitated uniform procedures for classifying foods, a coding scheme for data entry, and means for evaluating and summarizing the analytical data on foods in the system. Standardized nomenclature was imperative for identifying foods, since many items are known by several different names around the country. A computerized list of scientific names was prepared with cross references to preferred and synonymous common names. A coding scheme of food names and qualifiers (descriptors) was developed to fully describe or qualify each food item within the system. Standardized terminology and coding were necessary to avoid confusion and to assure validity of the system.

The processing of information on the nutrient composition of a food begins before its entry into the NDB. First, all relevant data must be collected. Major sources of information are published research and unpublished data obtained from food industries, USDA laboratories, and contracted research (Perloff, 1978; Hepburn and Perloff, 1979; Hepburn, 1982). Food scientists on the HNIS staff critically evaluate all data for adequacy of descriptions of food items, selection and handling of samples, and analytical methods. Then each food sample is coded according to a two-part food code--(1) the food name and (2) the qualifiers, which are descriptive terms covering factors such as stage of maturity, processing techniques, and cooking method. Although as many as 32 qualifying terms may be coded for each food item, 4 or 5 terms are usually sufficient for most foods except mixtures. The number of nutrients or food components that can be linked to the food item entered into the system is unlimited but is restricted to those available from source documents. Sampling techniques and analytical methods are also coded to permit reevaluation of the data if necessary.

After analytical data have been judged reliable and appropriate codes have been assigned to food samples, the individual analyses are entered into Data Base I, the first of three data base levels in the NDB (Figure 12.1) (Butrum and Gebhardt, 1977; Hepburn and Perloff, 1979; Hepburn, 1982). Data Base I is a huge storage file with thousands of nutrient values for many food items.

For entry into Data Base II, values for like-items in Data Base I are summarized. This mid-level data base is a smaller storage file which contains averages, standard errors (if appropriate), number of observations, and ranges of values. Impact of factors, such as variety, on nutrient values may be studied; if these factors are significantly different, items are not combined further. For example, vitamin C in raw California navel oranges is considerably greater than in raw California Valencia oranges, so the two varieties are retained as separate items. The same applies to avocados; those grown in California have about twice the total fat content as those grown in Florida.

Data Base III is the smallest file and is derived from Data Base II by a final combination of data. Data Base III yields the single set of most appropriate values to go into the second revision of AH-8 and into the USDA Nutrient Data Base for Standard Reference (described in Section 12.3.3). During the summarization process, weighting factors based on production statistics may be applied to Data Base II items in order to provide one representative nutrient profile suitable for the whole country and for all seasons.

The Survey Statistics Branch at HNIS supplied essential and innovative programming and other support which continues to undergird the operation of the NDB. The NDB was revised recently to take advantage of newer technological advances and to increase the capacity of the system.

12.3.2 Revision of Agriculture Handbook No. 8, First Section Issued in 1976

The second revision of AH-8 paralleled the development of the NDB, which provided procedures for statistical

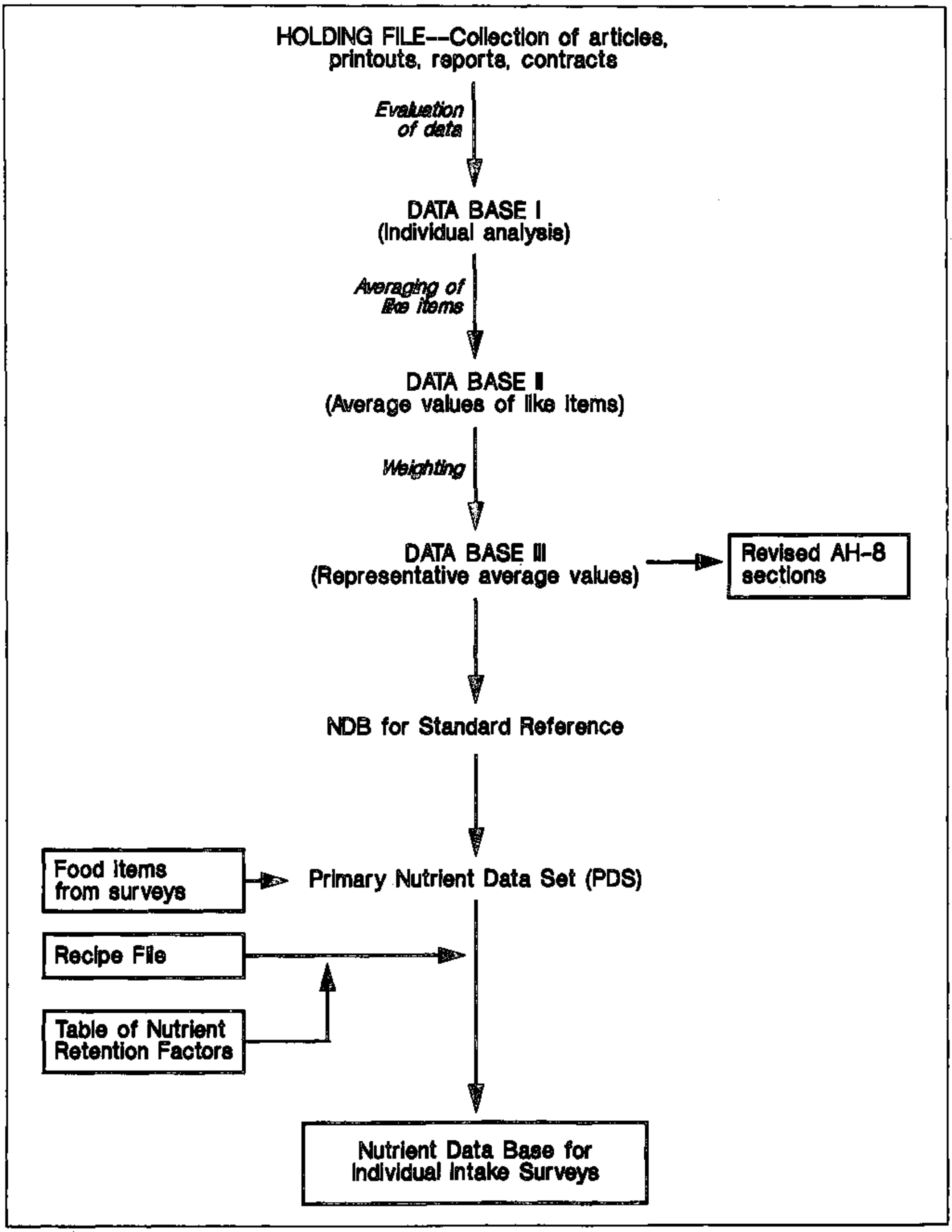

Figure 12.1--General flow of data through Nutrient Data Base system and creation of nutrient data bases for food consumption surveys

expression of food composition data (Watt et al., 1974; Murphy et al., 1974; Hepburn, 1982). Revision of AH-8 (USDA, 1976-) was organized so that composition data for each of 22 food groups would be released when completed. Accordingly, some food group data became available much sooner than if held until all food groups were finished. The sections of AH-8 are listed below with principal investigators, release dates, and the number of food items in each section.

AH-8-1	Dairy and egg products (Posati and Orr, 1976), 144 items.
AH-8-2	Spices and herbs (Marsh, Moss, and Murphy, 1977), 43 items.
AH-8-3	Baby foods (Gebhardt, Cutrufelli, and Matthews, 1978), 217 items.
AH-8-4	Fats and oils (Reese and Weihrauch, 1979), 128 items.
AH-8-5	Poultry products (Posati, 1979), 304 items.
AH-8-6	Soups, sauces, gravies (Marsh, 1980), 214 items.
AH-8-7	Sausages and luncheon meats (Richardson, Posati, and Anderson, 1980), 80 items.
AH-8-8	Breakfast cereals (Douglass, Matthews, and Hepburn, 1982), 142 items.
AH-8-9	Fruits and fruit juices (Gebhardt, Cutrufelli, and Matthews, 1982), 263 items.
AH-8-10	Pork products (Anderson, 1983), 186 items.
AH-8-11	Vegetables and vegetable products (Haytowitz and Matthews, 1984), 470 items.
AH-8-12	Nut and seed products (McCarthy and Matthews, 1984), 117 items.
AH-8-13	Beef products (Anderson, Lauderdale, and Hoke, 1986), 360 items.
AH-8-14	Beverages (Cutrufelli and Matthews, 1986), 153 items.
AH-8-15	Finfish and shellfish products (Exler, 1987), 174 items.
AH-8-16	Legumes and legume products (Haytowitz and Matthews, 1986), 133 items.
AH-8-17	Lamb, veal, and game (Anderson, 1989), 221 items.
AH-8-18	Baked products (In preparation)
AH-8-19	Snacks and sweets (In preparation)
AH-8-20	Cereal grains and pasta (Drake, Gebhardt, and Matthews, 1989), 118 items.
AH-8-21	Fast foods (Dickey and Weihrauch, 1988), 166 items.
AH-8-22	Mixed dishes (In preparation)

Each food group section is in a loose-leaf format with a single food item per page. Each page carries its publication date. This arrangement allows addition of pages for new items or replacement of pages with revised or new nutrient data for existing items. Annual supplements are planned to update this standard reference manual continually.

Each page of AH-8 provides food composition values for amounts of food (1) in 100 grams of edible portion (mean and standard error), including number of samples reported; (2) in edible portion of two common measures (if possible) with weights of the common measures reported in grams; and (3) in edible portion of 1 pound as purchased with percentage of refuse.

Values for about 60 nutrients and other food components are provided, if available, for each food item. The food components given in current AH-8 tables are listed below with the unit of measurement used.

Proximate:
- Water (g)
- Food energy (kcal, kj)
- Protein (N x 6.25; g)
- Total lipid (fat) (g)
- Carbohydrate, total (g)
- Crude fiber (g)
- Ash (g)

Minerals (mg):
- Calcium
- Iron
- Magnesium
- Phosphorus
- Potassium
- Sodium
- Zinc
- Copper
- Manganese

Vitamins:
- Ascorbic acid (mg)
- Thiamin (mg)
- Riboflavin (mg)
- Niacin (mg)
- Pantothenic acid (mg)
- Vitamin B-6 (mg)
- Folacin (mcg)
- Vitamin B-12 (mcg)
- Vitamin A (RE, IU)

Lipids:
- Fatty acids:
  - Saturated, total (g):
    - 4:0
    - 6:0
    - 8:0
    - 10:0
    - 12:0
    - 14:0
    - 16:0
    - 18:0
  - Monounsaturated, total (g):
    - 16:1
    - 18:1
    - 20:1
    - 22:1
  - Polyunsaturated, total (g):
    - 18:2
    - 18:3
    - 18:4
    - 20:4
    - 20:5
    - 22:5
    - 22:6
- Cholesterol (mg)
- Phytosterols (mg)

Amino acids (g):
- Tryptophan
- Threonine
- Isoleucine
- Leucine
- Lysine
- Methionine
- Cystine
- Phenylalanine
- Tyrosine
- Valine
- Arginine
- Histidine
- Alanine
- Aspartic acid
- Glutamic acid
- Glycine
- Proline
- Serine

The first two food groups--dairy and egg products and spices and herbs--were issued in 1976 and 1977, respectively, before programs for Data Base I, II, and III were operational. By the end of 1988, 17 of the planned 22 sections were released.

Most of the revised sections of AH-8 have more than double the number of items in each food group as in the 1963 edition. When completed, the second revision will include over 4,000 food items. Some of the products in the earlier tables were omitted because they were no longer marketed commercially. Most of the nutrient data for processed products were obtained since 1973 from analyses conducted for nutritional labeling, which began in 1973. Data were derived from unpublished sources--analyses carried out under contract and by industry and government agencies--as well as from published sources--journal articles, technical reports, conference proceedings, and other scientific and technical literature. Analytical methods used to determine the nutrient content of foods are described in the text preceding the tabular data. Reliability of the methods has been examined by Stewart (1978, 1981, 1983), Beecher (1983, 1985) and Beecher and Vanderslice (1984).

Food energy is expressed in terms of both kilocalories and kilojoules; one kilocalorie is equivalent to 0.239 kilojoules. Data are for physiological energy values, which are the energy values after losses in digestion and metabolism have been deducted from the gross energy. Caloric factors are based on the Atwater system (Merrill and Watt, 1955, 1973; Allison and Senti, 1983). Values for protein are calculated from nitrogen by using appropriate nitrogen-to-protein conversion factors (Jones, 1941).

Amino acid values are obtained by ion exchange chromatographic, gas chromatographic, and microbiological methods. For lipids, only data determined by gas-liquid chromatographic analyses are used. The total carbohydrate value is the difference between 100 and the sum of the percentages of water, protein, total lipid, and ash. The value for total carbohydrate includes fiber. Mineral data have usually been determined by atomic absorption, emission spectroscopy, colorimetric methods, or flame photometry.

Vitamin A data have included chemically determined preformed vitamin A and carotenoid precursors of vitamin A. Vitamin A activity is expressed both in international units (IU) and in retinol equivalents (RE). One IU is equivalent to 0.3 micrograms of retinol or 0.6 micrograms of beta-carotene. One RE is equal to 3.33 IU of retinol or 10 IU of beta-carotene. Ascorbic acid value is reported in terms of reduced ascorbic acid or total ascorbic acid. Thiamin has usually been measured chemically by the fluorometric thiochrome procedure or microbiologically, and riboflavin by fluorometric or microbiological procedures. Niacin has been determined both chemically and microbiologically. Niacin values are for preformed niacin only and do not include the niacin that could be contributed by tryptophan, a niacin precursor. Pantothenic acid, folacin, and vitamin B-12 have usually been determined microbiologically, and vitamin B-6 by microbiological or chromatographic methods. Folacin values represent total folate activity after releasing bound folacin by enzymatic treatment. Vitamin E values have usually been analyzed by colorimetric and gas chromatographic methods. In the fats and oils section of AH-8, vitamin E is reported as milligrams of both alpha-tocopherol, the most active form of vitamin E, and total tocopherol. In other food groups, alpha-tocopherol is reported for a limited number of foods.

In each revised section of AH-8, supplementary information about the foods in the section and explanations about development of the nutrient values are presented. Such information increases understanding of the factors and problems faced in deriving nutrient values representative of a food on a year-round, nationwide basis. Therefore, users may more fully appreciate the basis of the values and appropriately apply the food composition data.

In the interim between the first (1963) and the beginning of the second (1976) revisions of AH-8, the food composition specialists of USDA provided new or updated handbooks for researchers' use. Pecot et al. (1965) worked on proximate composition of beef; Orr (1969) compiled tables on pantothenic acid, vitamin B-6, and vitamin B-12 in foods; Merrill and Watt (1973) updated their work on the basis and derivation of energy value of foods; and Matthews and Garrison (1975) updated the earlier bulletin by Pecot and Watt (1956) on food yields summarized by different stages of preparation. Provisional tables were compiled on content of cholesterol (Feeley et al., 1972) and zinc (Murphy et al., 1975) in foods.

Also very important was the publication of Agriculture Handbook No. 456 (AH-456) with nutritive values of American foods in common household units (Adams, 1975). The source of values for most foods in this handbook was AH-8 (1963). In some instances, AH-456 contained composition values for several forms or measures of a food item. Its use as a reference was facilitated by retaining the numbering of food items as given in the 1963 edition of AH-8.

12.3.3 Nutrient Data Base for Standard Reference

The USDA Nutrient Data Base for Standard Reference is the computerized data set corresponding to AH-8 (USDA, HNIS, 1987a). It contains all the data that have been published in the revised sections of AH-8; for those food groups for which revision is incomplete, it includes data from the 1963 AH-8. However, values for enriched flour and for bread and other products made with enriched flour reflect revised standards of identity for higher iron and some B-vitamin levels. Updated versions of the Nutrient Data Base for Standard Reference are released periodically as new sections of AH-8 are released; Release 3 (1983) included information from revised AH-8 sections 1 through 9 (Perloff, 1983). Nutrient Data Base for Standard Reference, Release 7, was issued in 1988 and included updated values for AH-8 sections 1 through 16 (Perloff, in press).

12.4 Nutrient Data Bases for Food Consumption Surveys

Food composition specialists at USDA have long been and continue to be responsible for developing the nutrient data bases used to convert USDA household food consumption and individual food intake survey information on foods into energy and nutrient equivalents. A series of nutrient data bases--USDA Nutrient Data Bases for Individual Food Intake Surveys--was developed for use in USDA food consumption surveys (Perloff, 1987). The first nutrient data base of this series, Release 1 (USDA, HNIS, 1980), was used to process food items reported by individuals in the 1977-78 Nationwide Food Consumption Survey (NFCS) for their content of energy and 14 nutrients (protein, fat, carbohydrate, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, and vitamin C).

The second nutrient data base in the series, Release 2 (USDA, HNIS, 1986), was used to process food items from the 1985 Continuing Survey of Food Intakes by Individuals (CSFII). The nutrient data bases for CSFII 1985 and 1986 included 14 additional nutrients and food components not covered in NFCS 1977-78. These additions considered use of salt and various types of fat in home-prepared foods (USDA, HNIS, 1985). The additional 14 nutrients and food components were copper, potassium, sodium, zinc, alcohol, cholesterol, dietary fiber, vitamin E in alpha-tocopherol equivalents, vitamin A in retinol equivalents, carotenes, folacin, and three classes of fatty acids--saturated, monounsaturated, and polyunsaturated. However, USDA food scientists recognized that the experimental bases for some of these nutrients and food components had limitations (Table 12.1) (Hepburn, 1986; USDA, ARS, 1986; Beecher, 1985; Perloff, 1983).

Differences between the Nutrient Data Base for Standard Reference and the data bases for the surveys included food descriptions and food codes, as well as the number of nutrients and food components and their values. In preparation for CSFII 1985, a nutrient data base of about 4,500 items was compiled and data for new foods were added during the survey (Perloff, 1987). Release 2 included data for the new foods reported during the first quarter of CSFII 1985. Release 2.1 (USDA, HNIS, 1987b) was issued after all foods in the 1985 survey had been coded and included 500 additional items. This nutrient data base was used when processing of items in CSFII 1986 began. Release 3 includes all nutrient values used for CSFII 86 and Release 4 will be the version used for NFCS 87-88 (Perloff, 1988).

Development of nutrient data bases for earlier surveys had required a heavy time commitment by the food composition staff, as also was the case for revision of AH-8. Consequently, to make steady progress on both a new survey data base and revised sections of AH-8 and to ensure accuracy, consistency, and computerized documentation, a more comprehensive approach was devised for construction of the USDA Nutrient Data Base for Individual Food Intake Surveys used for CSFII 1985. This approach involved the development of an automated computer procedure which would ultimately save time because of its applicability to future surveys--CSFII 1986 and NFCS 1987-88 (Hepburn, 1985, 1986, 1987; Perloff, 1983, 1985, 1987).

The Nutrient Data Base for Standard Reference is the basic source of data for survey nutrient data bases (Perloff, 1987). Nutrient data bases for USDA surveys must contain all foods that are reported by survey participants. However, some of the foods reported are not in the Standard Reference file, and not all the foods in the Standard Reference file are reported in surveys. Accordingly, not all are found in a survey nutrient data base.

Three computer data files were constructed for use in deriving final survey nutrient data bases--(1) a Primary Nutrient Data Set for Food Consumption Surveys (PDS), (2) a recipe file, and (3) a Table of Nutrient Retention Factors file (Figure 12.1). If foods reported in the survey were not described by items in the Standard Reference file, the required items were added to the PDS. The PDS contained information for all foods reported in the survey either as the item itself or in terms of ingredients for the item. The recipe file was developed to calculate energy and nutrient values for mixed dishes, because values were not available for many such items. To account for losses in cooking, general retention factors were applied to items in the recipe file. The PDS, the recipe file, and the Nutrient Retention Factors File together serve as documentation for the release of a specific nutrient data base.

12.4.1 Primary Nutrient Data Set for Food Consumption Surveys

The PDS contains nutrient values for all food items needed to create a survey nutrient data base including all ingredient items used in recipe calculations (Perloff, 1987; USDA, HNIS, 1985). If analytical data are not available, the values are imputed from other forms of the food or from similar foods. A code indicates whether each value was from the Standard Reference file and whether

Table 12.1--State of development of methods for nutrients in foods

Nutrient category	State of methodology[1] Adequate	Substantial	Conflicting	Lacking
Carbohydrates, fiber and sugars		Individual sugars Fiber (AOAC)[2] Starch	Fiber components	
Energy	Bomb calorimetry		Calculated	
Lipids		Cholesterol Fat (total) Fatty acids (common)	Sterols Fatty acids (isomers)	
Minerals/inorganic nutrients	Calcium Copper Magnesium Phosphorus Potassium Sodium Zinc	Iron Selenium	Arsenic Chromium Fluorine Iodine Manganese	Cobalt Molybdenum Silicon Tin Vanadium Molecular species
Proteins and amino acids	Nitrogen (total)	Amino acids (most)	Amino acids (some) Protein (total)	
Vitamins		Niacin Riboflavin Thiamin Vitamin B-6 Vitamin E	Vitamin A Vitamin B-12 Vitamin C Vitamin D Pantothenic acid	Biotin Carotenoids (pro-vit. A) Chlorine Folacin Vitamin K
Other			Phytate	Carotenoids (non-vit. A)

[1]Description of state of methodology:
Adequate--Excellent accuracy; fast analysis; modest cost per analysis ($100);
Substantial--Good accuracy; moderately fast analysis; modest to high cost per analysis; Development needs include method modification, extraction procedures, applications;
Conflicting--Fair accuracy; slow analysis; high cost per analysis; Development needs include method development and modification, extraction procedures, applications;
Lacking--Poor accuracy; slow analysis; unknown cost per analysis; Development needs include method development, extraction procedures, applications.

[2]AOAC = Association of American Chemists

the value was based on analytical data or was imputed. A date is included to indicate when a value was added if it were not from the Standard Reference file. Items from the Standard Reference Data Base have Standard Reference identification numbers (NDB numbers). Added food items have special NDB numbers.

On the PDS, sources of nutrient values from the Standard Reference file were documented as (1) from data set 456-3, (2) from revised sections of AH-8, (3) imputed, or (4) label claim data. Data set 456-3 contains nutritive values from Agriculture Handbook No. 456 (Adams, 1975) converted from common household units to 100 grams of edible portion (Hepburn, 1982). Values from sources other than the Standard Reference file were documented as analytical or derived directly from analytical data or as imputed (Hepburn, 1985). Posati (1985) has described several criteria for imputing values; such values are regarded as less firm than analytical values. The label claim data on the PDS have been provided by manufacturers, not taken from labels, and are the values upon which manufacturers base their label claims. The proportion of analysis-based values to imputed values in the data set provided a way to appraise the quality of the data base. Hepburn's (1985, 1987) analysis of the PDS as of spring 1985 revealed that the percentage of analytical data was high for the 10 nutrients followed in past surveys but was much lower for the dietary components being monitored for the first time in CSFII 1985 (Table 12.2). In 1985, the PDS contained about 2,400 food items, and more have been added for more recent surveys.

The nutrient data base for use with data on household food consumed at home during 1 week in the NFCS has been updated for the NFCS 1987-88 with a specially developed computer system that also uses data from PDS. New food products and new food components have been added to the list of items reported

Table 12.2--Predominance of analytical data in Primary Data Set

Nutrient or component	Foods with analytical data[1]	Nutrient or component	Foods with analytical data[1]
	Percent		Percent
Calcium..........	97	Cholesterol......	80
Protein..........	97	Magnesium........	75
Fat..............	96	Zinc.............	73
Thiamin..........	91	Copper...........	67
Riboflavin.......	91	Vitamin B-6......	64
Niacin...........	91	Vitamin B-12.....	64
Sodium...........	90	Vitamin A (RE)...	61
Potassium........	90	Folacin..........	56
Phosphorus.......	90	Carotene.........	54
Iron.............	90	Dietary fiber....	29
Vitamin C........	83	Vitamin E........	28
Vitamin A (IU)...	80		

[1]Excludes assumed zero and nutrient label data.

in the household food component in the NFCS 1977-78.

12.4.2 Recipe File

The recipe file contains over 5,000 items, one for each food item in the survey data base (Perloff, 1985, 1987). In this file, each survey food code was linked to one or more PDS items. About half of the foods were single-item recipes, and the remainder required recipe calculations. Perloff (1985) has provided a comprehensive explanation with further details about recipe calculations for the survey data base.

The development of the automated recipe system contributes greatly to formulation and update of survey nutrient data bases by HNIS because it provides for updating nutrient data bases automatically as the Standard Reference Nutrient Data Base is updated (Perloff, 1985). Another benefit to HNIS and users of the USDA food consumption data base is the availability of computerized documentation for the recipes used in calculations. This approach also permits use of the PDS when constructing homogeneous food groups for study of food sources of nutrients in the diet. For example, the mixture "spaghetti with meatballs and tomato sauce" can be separated into its ingredients--beef, pork, eggs, bread, flour, onions, tomatoes, spaghetti, and so on--which can then be classified in the different food groups.

The recipe system used when constructing a survey nutrient data base has opened up new opportunities for examining interrelationships between food consumption and food composition data bases (Hepburn, 1987). Using the recipe file and the PDS, Hepburn identified the foods that were the largest contributors of specific nutrients in diets consumed by the women surveyed in CSFII 1985. For each nutrient, a computer program sorted foods in the PDS by descending order of the total amount of nutrient supplied by the food item. Items which accounted for 80 percent of the intake of the particular nutrient were then examined for the bases of their values. Hepburn's analysis indicated that the lowest (less than 10 percent) percentages of imputed and label claim values were for protein, fat, cholesterol, carotene, phosphorus, and potassium. The highest percentages (20 percent or more) occurred for total dietary fiber, vitamin B-6 and vitamin E, and folacin. Values other than those indicated as based on imputed or label claim data had an analytical basis (Table 12.3).

12.4.3 Table of Nutrient Retention Factors

The Table of Nutrient Retention Factors for use in computing retention for 18 vitamins and minerals during cooking was based on information from an HNIS provisional table (USDA, HNIS, 1984; Perloff, 1985, 1987). Vitamin retention factors were formerly (in NFCS 1977-78) applied to values for the total recipe (Merrill et al., 1966). In the new system for CSFII and NFCS 1987-88, retention factors for both vitamins and minerals are applied separately to each recipe ingredient.

12.5 Food Consumption Extramural Research

In recent years, an extensive extramural research program has contributed substantially to the comprehensive revision and update of AH-8, begun in the 1970's. These sponsored studies have helped meet the demand for more and improved food composition data with emphasis on direct analysis of food products as prepared and eaten. The research contracts and cooperative agreements between HNIS and universities, Government and private laboratories, and trade associations

Table 12.3--Number of food items in Primary Data Set needed to contribute 80 percent of the total intake of 19 food components

Nutrient	Number of items		
	Total[1]	Imputed values	Label claims
Protein................	150	6	0
Total dietary fiber....	120	46	0
Fat....................	107	3	0
Cholesterol............	49	4	0
Vitamin B-6............	175	23	20
Thiamin................	168	5	17
Riboflavin.............	165	5	15
Niacin.................	159	9	17
Folacin................	129	20	14
Vitamin E..............	100	50	0
Vitamin A (RE).........	60	5	9
Vitamin B-12...........	58	9	5
Carotene...............	33	0	0
Iron...................	217	21	18
Copper.................	209	30	0
Magnesium..............	187	27	0
Phosphorus.............	180	5	0
Zinc...................	169	20	6
Potassium..............	159	5	0

[1]Includes values coded as "analytical" as well as those coded "imputed" or "label claim." Label claims have an analytical basis but safety factors have been built in.

have added greatly to the scope and scientific basis of the latest food composition tables. Cooperation with various food industries has also broadened the knowledge base. The analyses have generated nutrient data to fill gaps in knowledge of particular foods and forms of foods. These contracts have permitted HNIS food composition staff to specify study designs that use statistical sampling principles in the collection of food specimens, precision in the preparation of samples to be evaluated, and selection of reliable standardized analytical methods. Such research findings can be interrelated and integrated with increased confidence. For example, in one project to obtain vitamin and mineral values for seven vegetables, products were sampled three times during one season, and analyses run before and after cooking, canning, freezing, and preparation for the table. With this design, it was possible to compare the effects of cooking methods, canning, and freezing on nutrient retention and yields (Rizek, 1980).

Hepburn (1983, 1985) has reported a number of food composition studies that were undertaken for a variety of foods. Among foods analyzed were baked products and cereal grains--sampled from eight cities; fish--6 raw and 8 processed forms; fruits--6 kinds sampled from six cities; legumes--several kinds of raw and processed in all seasons; meat--beef, pork, lamb, veal, and variety meats; vegetables--12 items from six regions in raw and cooked forms; frozen prepared dishes; mixed dishes--50 items in raw and cooked forms; fried foods; fast foods; and miscellaneous foods--150 items. Recently, a special report on sugar content of selected foods was issued (Matthews et al., 1987). Matthews (in press) reported results of testing the reliability of values of recipe calculations. Among foods being studied currently (cooperatively with industry for some) are ground turkey meat, chicken eggs, red meats and fat trim, specialty fruits, and "wild" versus "cultured" fish. Also, CSFII data were used to identify several areas where food composition data were needed and research projects have been planned accordingly.

Studies of specific nutrients were also conducted to provide food composition values for additional foods. These nutrients and components included dietary fiber and other carbohydrate fractions, beta-carotene and other vitamin-A-active substances, amino acids, cholesterol (in mollusks), selenium, folacin, copper, magnesium, manganese, and zinc. The researchers recognized, of course, that analytical values would have to be updated as better methods became available. For example, Hepburn (1983) reported that folacin values were highly variable among replicate determinations and between laboratories. Exler (1983) provided a special report on iron content of 277 foods commonly eaten in this country and included a confidence code to indicate the level of reliability based on critical evaluation of the sources of data.

The Atwater system for estimating energy value of foods was reviewed by the Life Sciences Research Office (Allison and Senti, 1984) at the request of HNIS.The reviewers concluded that the Atwater system was a practical approach to assigning energy values to represent normal diets consumed by healthy individuals. Several recommendations for improvement were made, including determination of the energy values of dietary fiber. Also mentioned were the changes in methods of fat extraction that may affect specific Atwater factors for lipid fractions. Research was recommended on methodologies to determine the quantity of energy available from protein and the quantity of true protein so that corrections can be made for nonprotein nitrogen-containing compounds such as choline, purines, nitrites, and pyrimidines. Specific nitrogen-to-protein conversion factors are needed for proteins in fruits and vegetables. A variety of other research activities have also been underway to improve food composition tables.

In 1975, another step in the search for more accurate analytical methods was taken with the establishment of the USDA-Agricultural Research Service Nutrient Composition Laboratory (NCL). Goals of the NCL are to develop better analytical procedures for analysis of nutrients in foods and to provide nutrient composition data for foods commonly eaten along with an assessment of the variability in foods (Beecher, 1985). The NCL is comprised of two groups--a laboratory analysis group and a food sampling group. The latter group is responsible for developing and carrying out food sampling plans. The complexity of work carried on by the food sampling group is illustrated by a recent project. Fast-food chicken was sampled in the Baltimore-Washington area to determine variability for such parameters as brand, cooking method, and cut of meat (Beecher, 1985). After statistical appraisal of those data, a nationwide sampling plan was developed and executed. About 100 samples of the most common brands of fast-food chicken were obtained and analyzed for starch, moisture, fat, and fatty acids. NCL, in cooperation with HNIS, selected a contractor to complete analyses of the chicken samples for other nutrients. This is only one example of many major research activities HNIS funds in close cooperation with NCL (Hepburn, 1985). Two recent collaborative projects were a study of selenium in foods and study of the nutrient composition of cookies and sweet snack bakery products.

12.6 Uses and Users of USDA Food Consumption Tables

The uses of USDA food composition tables have multiplied during recent years (Rand et al., 1987). Traditionally, the tables have been used to plan and assess the nutrient content of diets for individuals and groups, as well as of food supplies for households and the nation (Watt, 1980). The food composition tables are necessary for establishing nutrient goals for programs of food distribution and food plans at several cost levels (Cleveland and Peterkin, 1983; Kerr et al., 1984). The planning of diets for weight control and of other modified diets also requires reliable and accurate energy and nutrient values; so does the development of educational materials for food guidance for the general public. A comprehensive nutrient data base is essential for realizing the full potential of food consumption and dietary intake surveys. Many restaurants and institutions make use of nutrient data bases as they develop menus, revise recipes, and evaluate their food inventories. Nutrient data are used in product development by the food industries. Food composition tables are widely used to trace changes in nutrient contents of foods consumed over time (Watt, 1980). However, representative or average values, such as those in food composition tables, are not appropriate for use in metabolic studies or in other situations where the content of a nutrient in a specific food sample or diet must be known precisely (Stewart, 1983; Watt, 1980).

Many different nutrient data bases have been created for special purposes or with special features. The USDA food composition values form the core of many used in the United States (Rizek, 1978). Users of food composition data include Government agencies and private organizations; food producers, processors, and retailers; consumers; researchers; educators; medical, health, and welfare professionals; food editors and writers; economists; and epidemiologists. Their objectives encompass planning policies and programs, assessing and predicting market demands, planning agricultural production, assessing economic impacts, and developing new products, food labels, and food packaging.

In April 1976, the first Nutrient Data Bank Conference convened in Seattle, Washington (Hoover, 1985). Approximately 30 invited users of computers in nutrition applications based on USDA food composition data attended. Participants were nutritionists, dietitians, physicians, economists, and computer programmers from health-care organizations, universities, and Federal agencies. The purpose of the conference was to share information on the development of nutrient data and data bases, actual and potential uses of the data, and relevance of such information. Robert L. Rizek, Director of Nutrition Monitoring within HNIS, described the establishment of the USDA computerized Nutrient Data Bank (Karkeck, 1976). Promotion of appropriate use of nutrient data by users has been a major goal of subsequent conferences (Rizek, 1980).

The annual Nutrient Data Bank Conferences continue to provide a forum for those interested in nutrient data and analysis systems and related issues (Hoover, 1985). Meetings since 1976 have been held in Logan, Utah (1977); Arlington, Virginia (1978); Cleveland, Ohio (1979); East Lansing, Michigan (1980); Omaha, Nebraska (1981); Philadelphia, Pennsylvania (1982); Minneapolis, Minnesota (1983); Amherst, Massachusetts (1984); San Francisco, California (1985); Athens, Georgia (1986); Houston, Texas (1987); and Framingham, Massachusetts (1988). Participants at these meetings review data quality and analytical techniques, discuss methodological issues concerned with dietary data collection and computers, and describe numerous applications for nutrient data bases. HNIS staff describe the generation and availability of USDA nutrient data. Developers of data bases other than USDA describe their products. A Nutrient Data Bank Directory was compiled in 1980 and has been updated periodically; 112 systems were listed in the seventh edition (Hoover, 1988). An educational session to provide basic information at a relatively elementary level to newcomers to the field has been popular since 1982. International visitors attend in order to learn about developments in the United States. HNIS participates in planning and supporting the Nutrient Data Bank Conferences.

Over the years, food composition tables have been expanded by the inclusion of more foods and more nutrients. Composition values for foods are updated for a number of reasons. Analytical methods have improved and become more specific. Food handling and processing techniques, which change with advances in food technology, affect the composition of foods. Development of new varieties of fruits and vegetables and breeds of animals requires reappraisal of composition data. Changes in lifestyles and consumer demand for more nutritious foods to achieve or maintain optimum health and prevent illness can lead to new products or formulations (Miller, 1987). Examples are reduced- calorie foods and the recent addition of calcium to flour and other products. The Dietary Guidelines (USDA and USDHHS, 1985) have inspired labeling of foods to highlight nutritional benefits. For example, part of a label statement for bread reads, "Whole-grain breads are important sources of B-vitamins and fiber. Enriched breads are good sources of iron and some B-vitamins. Bread is low in fat and provides some protein as well" (Stewart, 1986).

Some users of food composition tables may be unaware of such changes in nutrient values over time and changes in data bases that result. Study of trends in food and nutrient consumption and comparisons among food consumption and dietary surveys must take into account the impact of food composition changes along with other factors. Efforts are now being made to document such changes. It is interesting to note that the composition of some commonly used foods have varied little in energy value since the 1940's (Table 12.4). Whole cow's milk had 4.0 percent fat in the 1906 table (Atwater and Bryant) and 3.3 percent in the most recent (1976) table, reflecting the value based on an all market average (USDA, 1976, AH-8-1). Current minimum standards for fat in whole milk vary in different states. The fat content is achieved by combining milk from various sources which have varying contents of butterfat. On the farm-production basis, whole milk had 3.7 percent butterfat in tables for 1963 and 1976. For other nutrients in other foods, large changes have occurred. The current vitamin A values of eggs and carrots are quite different from earlier values. For eggs, new practices in feeding hens or improved analytical

Table 12.4--Food composition values for specified foods in major USDA tables since 1906

Nutrient and food	Bulletin 28 (1906)	Circular 549 (1940)	Misc. Pub. No. 572 (1945)	Agr. Handbook No. 8 (1950)	Agr. Handbook No. 8 (1963)	Agr. Handbook No. 8 (1976, 1984, or 1986)
	Per 100 grams					
Energy (kcal):						
Whole milk[1]........	72	69	69	68	65	61
Sirloin beef steak, raw[2]............	249	293	293	254	281	260
Chicken, broiler[3]..	111	140	194	151	124	215
Egg, hen, uncooked.	159	158	158	162	163	158
White bread........	268	261	261	276	269	270[4]
Apple, fresh.......	66	64	64	58	58	59
Potato, raw........	85	85	85	83	76	79
String beans, raw..	43	42	42	35	32	31
Almonds............	669	640	640	597	598	587
Vitamin A (IU):						
Whole milk.........	([5])	([5])	160	160	140	126
Egg................	([5])	([5])	1,140	1,140	1,180	520
Carrots............	([5])	([5])	12,000	12,000	11,000	28,129
Iron (mg):						
Whole milk.........	([5])	([5])	.07	.1	trace	.5
Sirloin beef.......	([5])	([5])	2.5	2.6	2.7	2.24
Egg................	([5])	([5])	2.7	2.7	2.3	2.09
Calcium (mg):						
Whole milk.........	([5])	([5])	118	118	118	119
Egg................	([5])	([5])	54	54	54	56
Fat (g):						
Sirloin beef.......	([5])	25	25	20	22.7	20.2
Egg................	([5])	11.5	11.5	11.5	11.5	11.15

[1]The percentages of fat content corresponding to the energy values for milk are 4.0, 3.9, 3.9, 3.9, 3.5, and 3.3, respectively. Minimum standards for fat content of milk have varied considerably by state.
[2]Cut may have differed over time with change in practice.
[3]Broiler was a separate item in 1906, but was broiler-fryer thereafter.
[4]Source: USDA Nutrient Data Base for Individual Food Intake Surveys, 1986.
[5]Values for the nutrient were not included in the food composition tables.

methods may account for some of the decrease; whereas for carrots, the development of new, deeper orange varieties more than doubled the value for this nutrient.

12.7 International Cooperation

USDA has contributed to the development of food composition tables for other countries for many years. Chatfield (1949, 1954) compiled food composition tables for international use at the request of the Food and Agriculture Organization (FAO) and later headed up the FAO staff concerned with such data. Leung, Pecot, and Watt (1952) produced a handbook of food composition values for foods used in Far Eastern countries. The Interdepartmental Committee on Nutrition for National Defense (ICNND) collaborated with Flores of the Institute of Nutrition of Central America and Panama (INCAP) to provide an INCAP-ICNND food composition table for use in Latin America (1961). Difficulties were encountered because of variations in terminology among countries and in evaluation of analytical data, which lacked uniformity in presentation (Leung, 1962). More recently, USDA cooperated with FAO in preparing a food composition table for the Near East (Polacchi et al., 1982).

USDA has also participated in the International Network of Food Data Systems (INFOODS), organized in 1983 as an outcome of a conference held in Italy and hosted by the Rockefeller Foundation (Rand and Young, 1984; Harris et al., 1984). The conference assessed the status of food data bases. Representatives from over 10 countries attended, including Hepburn from USDA. The meeting was sponsored through the United Nations University and supported by various U.S. Government departments and agencies (including USDA), private foundations, and food industries. Subsequently, the INFOODS secretariat was established at the Massachusetts Institute of Technology in Cambridge, Massachusetts, in 1984 (Rand, 1985). It promoted worldwide acquisition and interchange of high quality food composition data. Its tasks have included developing standards and guidelines for collecting food composition data; developing standardized nomenclature and classification systems; compiling an international directory of existing data bases; fostering linkage through regional groups such as NORFOODS (for Scandinavia), EUROFOODS (for Western Europe), MEDIFOODS (for Mediterranean countries), ASIAFOODS (for Asia), LATINFOODS (for Latin America), and NOAFOODS (for U.S. and Canada); and describing users' needs (Rand, 1985). Updates on INFOODS' activities have been reported at Nutrient Data Bank Conferences (Rand, 1985, 1986; Rand et al., 1987). USDA contributed through a grant for the revision and expansion of an international directory of food composition tables; under another grant, the statistical treatment of food composition data was studied.

12.8 Current Status and Near Future

The current priority of the HNIS food composition staff is to complete the revision of AH-8 and then to update the tables in sections released earlier. CSFII 1989-96 and NHANES III 1989-94 will require the HNIS staff to provide nutrient data for new foods reported in those surveys. More nutrients are expected to be included as reliable analytical methods are developed and applied. Numerous provisional tables have been and will likely continue to be released for use until more extensive data become available for compilation in full tables (Table 12.5).

Table 12.5--Provisional tables issued by USDA[1]

Date	Title and author(s)
1981	Nutrient Content of Bakery Products and Related Items, McQuilkin and Matthews
1981	Nutrient Content of Beverages, Cutrufelli and Matthews
1983	Amino Acids in Fruits and Vegetables, Hoke
1984	Percent Retention of Nutrients in Food Preparation, Garland and Matthews
1988	Fatty Acid and Cholesterol Content of Selected Foods (HNIS/PT-101), Weihrauch
1984	Nutrient Content of Fast Foods (HNIS/PT-102), Marsh and Weihrauch
1988	Omega-3 Fatty Acids and Other Fat Components of Selected Foods (HNIS/PT-103), Exler and Weihrauch
1986	Vitamin K Content of Foods (HNIS/PT-104), Weihrauch
1986	Sugar Content of Selected Foods (HNIS/PT-105), Matthews and Pehrsson
1988	Dietary Fiber Content of Selected Foods (HNIS/PT-106), Matthews and Pehrsson
1988	Stearic Acid, Total Fat, and Other Fatty Acids in Selected Foods (HNIS/PT-107), Weihrauch

[1]Provisional tables have also been published in journals for cholesterol (Feeley et al., 1972), zinc (Murphy et al., 1975), folacin (Perloff and Butrum, 1977), vitamin E (McLaughlin and Weihrauch, 1979), and omega-3 fatty acids and other fat components (Hepburn et al., 1986).

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Chapter 13. Two Studies of Reduced Nutrient Data Bases

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SUMMARY: This chapter begins with a background review of the designing of the data base for the Nationwide Food Consumption Survey (NFCS) 1977-78, including its coding system. The procedures used in the investigations by Hoover of three alternative reductions in nutrient data bases and their effects on nutrient intake averages for large population groups are described. The first study began with computer tabulations and analyses of the number of times food items were reported in the spring quarter of NFCS 1977-78 by all individuals and 22 sex-age groups. Based on the listings of frequencies and printouts of similarities in nutrient profiles among food items in the data base, researchers selected food clusters and the representative food items to be retained in the reduced data bases and whose nutrient profiles would replace those of the other items. Then, energy and nutrient intakes were calculated using the original data base with about 4,500 items which were compared with intakes calculated using reduced data bases for sex-age groups. The reduction to 396 items and 200 items from the original had the greatest effects on vitamins A and B-12 and on estimates of nutrient intakes by infants. The second study utilized all four quarters of NFCS 1977-78, but basically used the same procedures as in the first study directed toward a 50 percent reduction to a 2,371-item data base. This reduction had a minimal effect on mean intakes for any of the large sex-age groups. However, construction of a small nutrient data base without detailed and recent information about the food practices of the population would be risky.

Tables

13.1 Background and Introduction

Nutrient data bases are used to estimate the nutrient contents of diets and to study many aspects of dietary practices. Computer technology has made possible the use of comprehensive nutrient data bases. Very detailed information can be retained in nutrient data bases if the numbers of food items and of nutrients are not limited. However, it may not be realistic in large-scale surveys to expect to be able to code reported intakes using all the detail that the coding system provides. Survey participants often cannot report detailed descriptions of foods. The reporting task might be simplified if a less extensive data base would suffice to provide estimates of nutrient intake similar to those provided by the large data bases.

13.1.1 Preliminary Considerations

Using a large nutrient data base often requires inspecting numerous food codes before the most appropriate one is found. Nonuniformity in selecting appropriate codes for reported food items may significantly affect the nutrient values calculated from food intake reports. Food items that are highly specified tend to be used less frequently than food items with a more general description. Uneven specificity may influence computation of nutrient contents of diets, but in what ways is uncertain.

The two investigations by Hoover (1982, 1985) of reduced nutrient data bases, described in this chapter, were prompted by perceived disadvantages of using large nutrient data bases and the fact that many food items in the large data bases were reported relatively few times in dietary intake surveys. A decreased number of food items (codes) to consider could reduce the burden on respondents, interviewers, and coders as well as reduce the cost and time for processing and delivering survey results. However, the level of detail about individual foods needed by many users, such as market researchers and health professionals, can be provided only by a comprehensive nutrient data base such as that used in the Nationwide Food Consumption Survey (NFCS) 1977-78 (National Research Council, 1984). Hoover studied the effects of reducing the NFCS 1977-78 nutrient data base by over 90 percent as reported in the first study (1982) and then by a less extreme reduction of about 50 percent as reported in the second study (1985). Before summarizing Hoover's two studies, however, detailed background information on the comprehensive NFCS 1977-78 nutrient data base is described.

13.1.2 Description of the NFCS 1977-78 Nutrient Data Base

To process and analyze food intake information collected in NFCS 1977-78, a comprehensive nutrient data base was developed that included several types of information. These included (1) names and descriptions of food items reported, (2) a system for organizing and coding the food items to facilitate data processing and analyses, (3) factors to convert reported measures or amounts of food to their gram-weight equivalents, (4) rules for handling inadequately reported descriptions and amounts, and (5) food composition values for food energy and 14 nutrients per 100 grams of each food reported. As HNIS researchers developed the data base, they kept in mind the objectives of the survey, the expected characteristics of the survey responses, and plans for use of the data base.

In NFCS 1977-78 data collection, respondents were instructed to describe each food or beverage item in detail, providing information such as kind, form, preparation, and brand name of well-known products. Such information is necessary for estimating the nutrient values of food intake and for indepth analysis of variations and relationships in food and nutrient intakes. The quality of responses in surveys is greatly affected by data collection procedures. Considerable attention was given to avoid overburdening respondents in order to prevent fatigue and loss of interest, which could lead to poor recall and careless reporting.

After questionnaires were completed, they were carefully reviewed, edited, and coded to retain the integrity of information about the respondents' food intakes. Coding of the NFCS 1977-78 was done manually by trained coders, who followed guidelines to maintain uniformity. The coded food intake information was keyed and transferred to data tape, which became input for subsequent application of the nutrient data base and execution of analyses. The quality of responses and of food code assignments in a survey materially affects how well the nutrient data bases can perform.

Several major factors were considered in designing the NFCS 1977-78 nutrient data base. These factors included (1) the nutrients of interest for which suitable food composition data were available, (2) nonnutritive substances of current or likely future concern (such as caffeine), (3) quality and detail of collected food intake information, (4) expected analyses, (5) maintenance of linkage to data from the 1965 survey for study of changes or trends, (6) use of brand names (such as ready-to-eat cereals) versus generic identification, and (7) kind and amount of nonnutritive information to be carried by the code (such as packaging material or toxic substance).

A number of tenets guided the organization of the NFCS 1977-78 coding system. Essentially, several levels of subcategories within nine major food groups formed hierarchies which permitted regrouping on different dimensions. Subgroups could be collapsed to yield more highly aggregated data. The coding system was designed to allow for the addition of new foods without disrupting existing food groups. The codes were assigned to permit extracting important information for study of food and nutrition problems. Each food item was uniquely identified by its code and was described in sufficient detail to allow assignment of appropriate energy and nutrient values. As the level of subgrouping became more detailed, the foods in each subgroup became more homogeneous.

Criteria for formation of food groups and subgroups were specified. Among the criteria were--

- --an abundant source of a particular nutrient such as calcium in milk and vitamin A in deep-yellow vegetables,
- --the varieties of a food, such as varieties of cheese,
- --a common stage of preparation, such as raw for vegetables,
- --a common method of processing, such as drying for fruits,
- --a common method of cooking, such as baking white potatoes,
- --a common form of the food, such as juice of citrus fruits,
- --the preparation or use, largely for a particular age group, such as commercial baby foods and baby formulas,
- --an accessory role of an item, such as pickles, relishes, olives, and table fats,
- --a traditional role in meals, such as desserts (milk desserts),

- --a similarity in supplying mainly energy in the diet, such as fats and oils,
- --a common usage of an item, such as salty snacks,
- --an imitation, substitute, or formulated food intended to replace a natural food, such as meatless meat substitute or soy-based milk,
- --the addition of a particular nutrient to a food, such as vitamin C to fruit drinks,
- --the modification of energy content of a type of food, such as low-calorie salad dressings and diet beverages,
- --a common type of mixture, such as soups,
- --common components of mixtures comprised of several ingredients, such as beef with starch and vegetables,
- --the presence of a major common component, such as alcohol in alcoholic beverages,
- --a common cut of meat or poultry, such as steak or chicken breast,
- --the presence of inedible parts in portions served requiring computation of yield.

The food codes identified 9 major food groups, 48 major subgroups, and 226 minor subgroups. The first digit in the food code identified the major food groups, most of which are viewed as basic food commodities. These were (1) milk and milk products; (2) meat, poultry, and fish; (3) eggs; (4) legumes, nuts, and seeds; (5) grain and cereal products; (6) fruits; (7) vegetables; (8) fats and oils; and (9) sweets, sugars, and beverages. A tenth category, identified by zero (0), was created to include substances for which no nutritive values were provided in the nutrient data base, such as certain flavorings and seasonings. The second digit identified the major subgroups within the major food groups, and the third digit was planned to expedite sorting the food items into minor subgroups. The next two digits further subdivided minor subgroups, and the last two digits usually carried detailed information unique to the food item such as type of liquid (heavy or light syrup, water, juice) for canned peaches. Generally, the fewer zero digits in the last four positions, the more detailed was the description. Conversely, the more zeros in those four positions, the more general was the description.

Sometimes respondents were able to provide only the name of a food item (such as "milk") or a minimum of description. To denote the absence of more detailed information, such a food item was assigned a default description code (defined as "not further specified" or NFS). Each NFS food item was assigned an identity based on the form of the food that was most frequently consumed, had the largest market share, or was representative of several such items (for example, "whole fluid milk"). Respondents were usually able to provide enough information to code at least the first two or three digits. Portion sizes that were inadequately specified were similarly assigned default values following guidelines for their use. Knowledge of what food items were least well reported is essential in evaluating the quality of data collected.

Some food items could be classified into more than one food group, depending on the element selected for classification. Because only one element could be used, subjective decisions were made in order to group those foods. Mixtures often required such decisions. A mixture could be assigned either a single code, which included it in the food group of its major ingredient, or it could be assigned several codes, one for each component of the mixture, especially if the components were reported separately.

For a few products, individual brands were assigned unique food codes; but most codes represented more broadly specified food items. Ready-to-eat cereal brands were often assigned individual codes because formulations tended to be unique and many were highly fortified. The identity of some food items was retained for later reference or retrieval even though the current nutrient configurations were not unique. Once a food item was assigned an existing food code, any detail not mentioned in its description was lost. Liquid protein diet is an example of an item about which there was concern and which was given a unique code in order to track its usage without having to retrieve original records.

In preparation for shortening the NFCS 1977-78 nutrient data base, which required reducing specificity of food items, Hoover reviewed the systematically organized hierarchies of food groupings described above. She examined the performance of the system by looking at how frequently each food item code was used and how similar each item's nutrient profile was to another.

13.2 Purpose

Hoover's two studies determined the effect on the analytical results of a food intake survey of using small- or moderate-size nutrient data bases rather than the large comprehensive NFCS 1977-78 nutrient data base of about 4,500 food item codes. In her first study (1982), Hoover tested two small nutrient data bases, one with 396 food item codes and the other with 200 food item codes. In her second study (1985), she tested a moderately reduced nutrient data base comprising 2,371 food item codes.

13.3 Methods

The plan of work for each of the two studies specified four phases: (1) data preparation, (2) tabulation and analysis of frequencies of food item (code) usage by all individuals and by sex-age groups, (3) the reduction process, including the development of a file of food code replacements to use in reducing the size of the data base with cross-references to original data base codes and the nutrient profiles, and (4) testing of the effects of the nutrient data base reduction for statistical significance. Each food item in the data base was unique in description and was assigned a unique code to preserve its identity. USDA data tapes from the NFCS 1977-78 provided the basic information for these studies.

13.3.1 First Study, 1980-82

In the first study, 3-day food intakes by 8,778 participants in the first quarter (spring) of NFCS 1977-78 were processed using Statistical Analysis System (SAS) (1979) programs. A number of individuals were excluded, primarily nursing infants and persons with incomplete records or missing days, leaving 7,914 individuals in the study. The nutrient data base had been specially developed for use with NFCS 1977-78 (Section 13.1.2). It included about 4,500 food items listed in sequence by food item code number. The nutrient data base also included the food item name and amounts of food energy and 14 nutrients per 100 grams. The 14 nutrients were protein, fat, carbohydrate, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, and vitamin C. Nutrient intakes were calculated for the 7,914 individuals and for the 22 sex-age groups for each of 3 days and for an average of 3 days to serve as the baseline nutrient data. Weighting factors that had been developed to achieve sample representativeness were not used. Therefore, energy and nutrient values in this study differed slightly from those reported for the 1-day recalls in the NFCS 1977-78 spring quarter (USDA, SEA, 1980).

The number of times food items were consumed and the nutrient similarity of food items were the major factors used in determining which food items to retain and which ones would have nutrient values replaced. The second phase focused on the analysis of the number of times food items were consumed, which was defined as the number of times each food item (code number) was reported during the 3 days surveyed.

Three sets of computer-generated listings provided data for the analysis of number of times an item was reported. They were (1) a listing of food items in the nutrient data base by food item name and food code number arranged in descending order of total times the item was reported with total number of persons reporting the item (Table 13.1); (2) a rank-order listing of all food items in the nutrient data base in sequence by food code number with total number of persons reporting the item, the total number of times the food item was reported, the number of times the food item was reported expressed as a percentage of the total number of times for all food items in its major food group, relative ranking of the item within its major food group, and the relative rank-order of the 600 most reported items (Table 13.2); and (3) a printout listing food items within major subgroups in descending order according to number of times reported within major sex-age groups.

In Phase 3, the reduction of the nutrient data base involved identifying which food items to retain and which ones would have nutrient values replaced. Computer printouts were generated showing the similarities in energy and nutrient composition among food items in the nutrient data base. Food items with identical energy and nutrient profiles or differing no more than plus or minus

Table 13.1--The 10 most reported items in the NFCS 1977-78 nutrient data base in descending order, 7,914 individuals[1]

Food item code	Food item name	Times reported	Persons reporting
		-------Number-------	
111-1100	Milk, cow's, fluid, whole..............	14,142	3,767
911-0101	White sugar, granulated or lump.........	10,081	3,203
924-1031	Soft drink, cola type..................	7,671	3,115
811-0200	Margarine, not further specified (NFS)..	7,252	3,214
111-0000	Milk, NFS..............................	6,367	2,104
921-0101	Coffee, from ground, black.............	6,011	1,657
811-0100	Butter, regular or melted, salted or unsalted..........................	5,241	2,524
511-0110	Bread, white, enriched.................	5,199	2,440
751-1330	Lettuce, NFS...........................	4,446	2,711
511-0100	Bread, white...........................	4,268	2,275

[1]Spring quarter, 1977.

Table 13.2--The first 22 food items in the NFCS 1977-78 nutrient data base in sequence by food item code, total reportings and rankings[1]

Food item code[2]	Food item name	Persons reporting	Times reported	Rank order of times reported	Reportings in food group	Rank of times reported in food group
		--------Number------			Percent	
110-0000	Milk, human.......................	0	0	600	0	61
111-0000	Milk, not further specified (NFS)..	2,104	6,367	5	19.95	2
111-1100	Milk, cow's, fluid, whole..........	3,767	14,142	1	44.31	1
111-1110	Milk, cow's, fluid, whole, low-sodium......................	5	5	600	.02	56
111-1200	Milk, cow's, fluid, lowfat.........	404	1,487	46	4.66	5
111-1211	Milk, cow's, fluid, lowfat 2%......	983	3,864	11	12.11	3
111-1212	Milk, cow's, fluid, acidophilus....	18	51	600	.16	27
111-1221	Milk, cow's, fluid, lowfat 1%......	46	166	316	.52	13
111-1300	Milk, cow's, fluid, skim or nonfat..........................	451	1,730	35	5.42	4
111-1310	Milk, cow's, fluid, skim, NFDMS[3] added.....................	1	1	600	0	60
111-1400	Milk, cow's, fluid, filled, vegetable oil....................	0	0	600	0	61
111-1410	Milk, cow's, fluid, filled, vegetable oil, whole.............	0	0	600	0	61
111-1420	Milk, cow's, fluid, filled, vegetable oil, lowfat............	0	0	600	0	61
111-1500	Buttermilk, fluid.................	96	170	309	.53	12
111-1600	Milk, goat's, fluid, whole.........	8	39	600	.12	32
111-2000	Milk, dry, reconstituted, NFS......	63	172	305	.54	11
111-2110	Milk, dry, reconstituted, whole....	6	17	600	.05	46
111-2121	Milk, dry, reconstituted, lowfat...	21	75	551	.23	20
111-2130	Milk, dry, reconstituted, nonfat...	88	282	200	.88	8
111-2200	Buttermilk, dry, reconstituted.....	0	0	600	0	61
111-2300	Milk, goat's, dry, reconstituted...	0	0	600	0	61
112-1000	Milk, evaporated, NFS.............	142	425	140	1.33	7

[1] Spring quarter, 1977.
[2] The food group "milk and milk drinks" contained about 160 items, of which only 22 are shown.
[3] NFDMS = Nonfat dry milk solids.

10 percent in values for energy and each of the 14 nutrients were considered similar and listed in clusters. Each cluster had one key food item, usually with high consumption, designated as the retained item. Sometimes the key food item retained had a nutrient profile identical with a high consumption item but a more general (less specific) description. The nutrient (including energy) profile of this retained food item replaced the nutrient profiles of all other food items in the cluster.

Also in Phase 3, a worksheet was set up which listed food item code numbers and food descriptions (names) in the original nutrient data base and provided space to record food item code numbers that replaced nutrient profiles of original food items and the rationale for the changes. A computer cross-reference file was created to store the code numbers and descriptions of all food items in the original nutrient data base and the code numbers and descriptions of retained food items assigned as replacements in the reduction to 396 items. Updates could be entered if a replacement code number was changed. Researchers had to exercise judgment in the formation of food clusters and in assessing the appropriateness of the replacements. A food item was generally retained if it were consumed many times, unique in nutrient content, or representative of a cluster of foods with similar nutrient content.

A reduction to 200 items was also undertaken. In the reduction to 200 items, food clusters were based on similarity of nutrient content and type, but with less consideration given to preparation methods, combination dishes, ethnic foods, or baby foods than in the larger nutrient data base. For example, more baby foods were combined with other foods than were formed into separate clusters. Nutrient contents of foods within a food cluster were considered to be similar if they did not differ by more than 10 percent. This criterion, however, had to be relaxed in the reduction to 200 items.

In the last phase of the study, the effects of reducing the number of food items in the nutrient data base were appraised. Similarity of foods within a cluster was evaluated by computing the percentage differences in energy and nutrient values between the retained items and each of the replaced items. (The percentage difference equalled the replaced item nutrient value minus the retained item nutrient value divided by the retained item nutrient value and expressed as a percent.) A negative percentage difference indicated that the replaced food item contained less of the nutrient than did the retained food item. The retained item was listed first in the cluster with its nutrient profile, followed by items whose nutrient profiles were replaced. The objective was to minimize the percentage difference between the nutrient profile of the retained item and that of each replaced item.

The clusters were also evaluated using regression analysis to determine goodness-of-fit between the retained value and each replaced value. The RSQUARE model by SAS (1979) was used to calculate R-square and beta with the no-intercept option since an intercept term was inappropriate for comparison of two food items. Each nutrient in the retained food item was paired with its corresponding nutrient in the replaced food item. The value for R-square (the ratio of the sum of squares attributable to the regression to the corrected total sum of squares) and beta (the slope of the regression line) were printed, as well as the number of times each replaced food item was consumed. If nutrient values for a retained food item and a replaced food item were identical, R-square and beta would both equal 1.00; therefore, the closer the two values were to 1.00, the better the fit. This evaluation was performed only on clusters formed in the more drastic reduction to 200 items and for items with a frequency of use ranking below 500.

Finally, the consequences of data base reduction were tested by comparing the nutrient intakes computed before nutrient data base reduction with the intakes computed after reduction. Differences for each nutrient were expressed as percentages of the nutrient data base before reduction.

Comparisons were made between mean nutrient values for each of the 3 days and the 3-day average for each sex-age group. The absolute percentage differences for the 3-day average between baseline and reduced nutrient data base indicated the magnitude of differences when small nutrient data bases were used. An analysis of variance procedure (General Linear Model in SAS) was used to evaluate the variation associated with the nutrient data base type (original versus reduced) and the 22 sex-age groups for each reduction level. A more detailed explanation of methods used in this study has been published (Hoover et al., 1985).

13.3.2 Second Study, 1983-85

Methods used in the second study (1985) were similar to those used in the first study with some exceptions. Two of the main exceptions were the inclusion of data from all four seasons of the NFCS 1977-78 instead of spring only and the increased involvement of USDA professional staff in determining which food item codes to retain in the reduced data base.

In the first phase of the second study, NFCS 1977-78 data tapes with 3-day records of food intake by individuals for summer, fall, and winter were obtained from USDA and entered into the University of Missouri-Columbia computer files along with the spring data that had been processed in the earlier study. Only respondents with complete records for 3 days and nonnursing infants--27,920 individuals--were retained for the study. The number of individuals in each of 22 sex-age groups for each season are shown in Table 13.3.

The NFCS 1977-78 nutrient data base for the year, containing 4,569 food items and their content of energy and 14 nutrients per 100 grams, was also put into the file. This formed the basis for the cross-reference file set up to store original food item codes and food item code changes as the nutrient data base was reduced.

The second phase, as in the first study, involved counting the number of times items were reported and determining similarities in nutrient profiles of food items and food clusters. Mean food energy and nutrient intakes by 22 sex-age groups were computed for the four quarters, using the original comprehensive NFCS 1977-78 nutrient data base to serve as baseline data for calculation of the effects of data base reductions. The rationale and criteria developed by the University of Missouri-Columbia research team for assignments in the reduction of the nutrient data base are shown in Section 13.7. Baby foods were among retained items because the first study indicated that baby foods had unique vitamin and mineral fortifications that could not be accommodated by replacing them with similar foods. Food items with identical or similar energy

Table 13.3--Individuals after exclusions[1] in each of 22 sex-age groups by quarter

Sex-age group	Quarter			
	Spring	Summer	Fall	Winter
	Number			
Males and females:				
Under 1.............	72	115	114	134
1-2.................	219	238	285	312
3-5.................	239	267	358	288
6-8.................	508	576	706	677
Males:				
9-11................	183	220	298	260
12-14...............	260	268	331	309
15-18...............	327	303	358	411
19-22...............	239	126	146	148
23-34...............	639	326	365	420
35-50...............	638	330	318	369
51-64...............	524	247	281	336
65-74...............	247	122	153	164
Over 74.............	103	68	73	82
Females:				
9-11................	200	250	273	311
12-14...............	262	280	323	294
15-18...............	338	361	398	382
19-22...............	272	176	176	190
23-34...............	772	479	595	548
35-50...............	754	459	571	538
51-64...............	643	396	492	432
65-74...............	313	216	273	255
Over 74.............	162	131	158	147
TOTAL............	7,914	5,954	7,045	7,007

[1] 2,850 individuals were deleted from study; those deleted were nursing infants and persons with incomplete records or missing days.

and nutrient values (less than a 10 percent difference) were identified and listed in clusters.

The third phase of the project consisted of several steps in reducing the nutrient data base. Food similarity, prevalence in the diet, and uniqueness of nutrient composition were the important criteria considered in forming the clusters within food groups. USDA staff participated in proposing clusters of similar foods for entry into the cross-reference file and in identifying foods to be retained and foods to be represented in data analyses by one of the retained foods. Although some subjective judgment was required, replacement assignments were made in line with the criteria specified and recorded on worksheets. A frequently used food item was usually the retained food item, its values replacing those of associated items designated as replaced.

After the replacement assignments were made, each food cluster was evaluated for the percentage deviation per nutrient and the goodness-of-fit between the retained item and each replaced item as done in the first study. Based on the values for R-square and beta, corrections or adjustments were entered as required into the cross-reference file and re-evaluated. An example of results from a goodness-of-fit regression analysis is shown in Table 13.4 for the legumes, nuts, and seeds group.

The final phase measured the consequences of the nutrient data base reduction and compared nutrient intakes computed from the reduced nutrient data base with the nutrient intakes computed from the full NFCS 1977-78 data base. Differences between the mean nutrient

Table 13.4--Retained and replaced food items and goodness-of-fit regression results for the legumes, nuts, and seeds group

Variable	Number	Percent
Food items in food group....................	164	100.0
Retained food items........................	71	43.3
Replaced food items........................	93	56.7
Frequency of less than 10 in every season:		
All items..............................	111	67.7
Retained items.........................	41	57.8
Replaced items.........................	70	75.3
Replaced items with frequency 10 or more in any season.............................	23	24.7
Frequency less than 5 in every season:		
All items..............................	85	51.8
Retained items.........................	30	42.3
Replaced items.........................	55	59.1
Replaced items with frequency 5 or more in any season.............................	38	40.9
R-square comparisons, replaced items:		
R-square between 0.9 and 1.0............	59	63.4
Of items with frequency 10 or more in any season.......................	13	56.5
Of items with frequency 5 or more in any season.......................	26	68.4
Beta comparisons, replaced items:		
Beta between 0.7 and 1.3................	61	65.6
Of items with frequency 10 or more in any season.......................	19	82.6
Of items with frequency 5 or more in any season.......................	32	84.2
Beta less than 0.7.........................	20	21.5
Beta more than 1.3.........................	12	12.9

values for each day and the 3-day average were compared for each sex-age group and for each of four quarters. The differences for each nutrient were expressed as a percentage of the base-line value. An example of the analysis for males 15 to 18 years in the spring quarter is shown in Table 13.5. Using the SAS (1979) procedure for analysis of variance, a completely randomized factorial model based on a repeated measurement design was specified to evaluate variation in mean nutrient values associated with two factors--data base type and sex-age group--first for each quarter, then for all quarters. Baseline nutrient intakes and those from use of the reduced nutrient data base were compared with the 1980 Recommended Dietary Allowances (RDA) for 13 nutrients (as adapted for use with NFCS 1977-78) to determine effects of any differences in computed nutrient values on conclusions concerning nutrient quality.

13.4 Main Findings

The results of the first study conducted from 1980 to 1982 are presented in Section 13.4.1. Results of the second study carried out between 1983 and 1985 are presented in Section 13.4.2.

13.4.1 First Study

Preliminary analysis of the number of times food items were consumed during 3 days as reported for 7,914 individuals revealed that most food item codes were used infrequently. Of the 4,404 food item codes in the spring nutrient data base, 1,371 were not used for any individual during the first (spring) quarter of the survey; 2,574 food codes were used between 1 and 99 times for the total sample; and only 459 food codes were used 100 or more times. The 500 food item codes used most often were ranked with the lowest number (1) assigned to the most frequently reported item (whole milk, reported 14,142 times) and the highest number (500) assigned to the least frequently reported food item (ready-to-eat cereal, presweetened corn puffs, reported 88 times) among the 500 most often reported. Food item codes with the greatest frequency were those for foods eaten several times in a day, such as beverages, fats, sugar, and breads. These most-reported food items were obvious candidates for retention in the reduced nutrient data base.

Food item codes in the nutrient data base having identical nutrient values but different descriptions were generally combined, regardless of the number of times reported. The counts of food item codes having nutrient values identical with another food item code are shown in Table 13.6 for the nine major food groups.

The numbers of food items and percentage reduction in each of nine food groups resulting from reduction of the nutrient data base from 4,404 food items to 396 food item codes and to 200 food item codes are shown in Table 13.7.

In constructing the 200-item data base, the goodness-of-fit between the retained and the replaced items in each cluster was examined for all items ranking less than 500 in number of times reported in the original data base.

Most items with high frequency of consumption were noted as having a good fit. For 80 percent of the items, R-square ranged between 0.90 and 1.0, indicating that for most items nearly all of the variation was explained by the item retained in the reduced data base. For 83 percent of the items, beta ranged between 0.70 and 1.30.

Computation of percentage differences between nutrient intakes for 22 sex-age

Table 13.5--Nutrient intake differences using the original and moderate size nutrient data bases, males 15-18 years, spring quarter

Variable	Energy	Protein	Fat	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin B6	Vitamin B12
	kcal	g	g	mg	mg	IU	mg	mg	mg	mg	mcg
Day 1:											
NFCS data base.....	2,691	106.2	122.0	1,213	17.0	5,679	1.83	2.58	24.3	1.95	5.75
Reduced data base..	2,688	106.5	121.5	1,219	17.0	5,643	1.84	2.58	24.4	1.96	5.78
Percentage difference........	- .1	.3	- .4	.5	0	- .6	.5	0	.4	.5	.5
Day 2:											
NFCS data base.....	2,631	104.7	118.6	1,200	17.1	7,240	1.91	2.71	24.9	1.97	8.03
Reduced data base..	2,626	104.9	118.1	1,201	17.2	7,210	1.91	2.71	25.0	1.98	8.06
Percentage difference........	- .2	0.2	- .4	.1	.6	- .4	0	0	.4	.5	.4
Day 3:											
NFCS data base.....	2,554	103.8	116.8	1,140	16.7	6,130	1.80	2.60	24.6	1.92	7.63
Reduced data base..	2,552	104.0	116.3	1,142	16.8	6,110	1.80	2.60	24.7	1.93	7.65
Percentage difference........	- .1	.2	- .4	.2	.6	- .2	0	0	.4	.5	.3
3-day average:											
NFCS data base.....	2,625	104.9	119.1	1,185	17.0	6,350	1.84	2.63	24.6	1.95	7.14
Reduced data base..	2,622	105.2	118.7	1,187	17.0	6,324	1.85	2.63	24.7	1.95	7.16
Percentage difference........	- .1	.3	- .3	.2	0	- .4	.5	0	.4	0	.3

Table 13.6--Food items having nutrient values identical to those of another food item

Food group	Food items
	Number
Milk, milk products............................	76
Meat, poultry, fish............................	384
Eggs...	5
Dry legumes, nuts, seeds.......................	3
Grain products.................................	200
Fruits...	135
Vegetables.....................................	129
Fats, oils,....................................	19
Sugars, sweets, beverages......................	94
TOTAL..	1,045

Table 13.7--Food items in the original and two small nutrient data bases by food group[1]

Food group	Data base				
	Original	First reduction		Second reduction	
		Items retained	Reduction from original	Items retained	Reduction from original
	Number	Number	Percent	Number	Percent
Milk, milk products........	321	36	89	24	92
Meat, poultry, fish........	1,307	107	92	60	95
Eggs.......................	51	8	84	3	94
Legumes, nuts, seeds.......	157	13	92	10	94
Grain products.............	956	68	93	47	95
Fruits.....................	473	38	92	14	97
Vegetables.................	677	67	90	23	97
Fats, oils.................	70	11	84	5	93
Sugars, sweets, beverages..	392	48	88	14	96
TOTAL..................	4,404	396	91	200	95

[1]Spring quarter, 1977.

groups utilizing the original data base and the 396-item data base showed variation among nutrients (Table 13.8). Reduction of the nutrient data base affected food energy, protein, calcium, phosphorus, thiamin, and vitamin C the least and vitamin A and vitamin B-12 the most. Percentage differences for vitamin A and vitamin B-12 were greater than 5 percent for five and seven sex-age groups respectively. For four other nutrients (carbohydrate, iron, magnesium, and vitamin B-6), only one sex-age group had values that exceeded 5 percent. The remaining nine nutrients had maximum percentage differences between 1.9 and 4.4 percent. Of all sex-age groups, children under 1 year of age had the highest percentage difference for six nutrients.

For the 200-item nutrient data base, the greatest impact of data base reduction was on nutrient intakes by children under 1 year of age (Table 13.9). This was a result of combining baby foods with other foods. Percentage differences were highest for this age group for all nutrients studied except protein, fat, vitamin A, and vitamin B-12. Infants' percentage differences for the other 11 nutrients ranged from 7.9 percent for food energy to 51.2 percent for iron. Excluding infants, maximum percentage differences were less than 5 percent for eight nutrients and less than 10 percent for five more (fat, iron, thiamin, vitamin B-6, and vitamin C). As in the 396-item reduction, the 200-item reduction affected the values of vitamin A and vitamin B-12 the most.

Analysis of variance revealed that variation associated with nutrient data base reduction from the large original data base to 396 food items was statistically significant ($p \leq 0.05$) for nine nutrients--fat, carbohydrate, calcium, iron, magnesium, vitamin A, thiamin, niacin, and vitamin B-6. For the reduction to 200 food items, the effect of the nutrient data base reduction was less clear because of the interaction between the type of data base and sex-age group for seven nutrients--calcium, iron, magnesium, phosphorus, riboflavin, and niacin. The other nutrients, except vitamin B-6, were significantly ($p \leq 0.05$) affected by the nutrient data base reduction. Significant relationships ($p \leq 0.05$) evidenced varying effects of nutrient data base reduction on nutrient values for sex-age groups.

13.4.2 Second Study

In the second study (Hoover, 1985), the number of times food items were reported and the extent and the effects of nutrient data base reduction were analyzed. Fewer than 500 food items were reported more than 100 times in the four quarters of NFCS 1977-78. The reduction of the original 4,569-item nutrient data base by 48 percent (to 2,371 items) had a minimal effect on the calculated mean intakes of energy and nutrients.

The number of times food codes were used in the NFCS 1977-78 original nutrient data base for all four quarters are shown by food group in Table 13.10. About one-fourth of the food code items had nutrient values in common with another item. A ranking of food items in descending order of prevalence of use revealed that the most reported food item in all four quarters was whole cow's milk (Table 13.11). Foods ranked below 500 on the order list were reported fewer than 100 times each (Table 13.12).

The extent of reduction in the nutrient data base by food group is indicated in Table 13.10. The original nutrient data base was reduced 48 percent, from 4,569 items to 2,371 items. Reduction was greatest for the sugar, sweets, and beverages group (74 percent) and smallest for the meat, poultry, and fish group

Table 13.8--Nutrient intake differences using the original and 396-item nutrient data bases by sex-age group

[Nutrient intakes were 3-day averages]

Sex and age (years)	Food energy	Protein	Fat	Carbohydrate	Calcium	Iron	Magnesium	Phosphorus	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin B_6	Vitamin B_{12}	Vitamin C
	Percent difference														
Children:															
Under 1..	1.9	3.8	4.4	5.1	1.4	0	10.1	.9	2.5	-1.2	-4.0	1.1	3.0	8.0	-1.3
1-2......	.4	.2	2.4	- .8	- .3	0	1.3	.9	1.6	0	- .7	-1.0	0	.6	-1.5
3-5......	.2	- .2	2.4	-1.2	- .9	-1.1	.6	0	2.2	1.9	0	- .8	0	1.5	-1.4
6-8......	.5	.3	2.3	- .8	- .7	.9	1.4	- .3	2.7	2.4	1.1	.6	.8	4.5	0
Males:															
9-11.....	.5	.4	2.4	-1.0	.7	1.5	0	- .4	1.5	- .7	- .5	0	- .7	-3.2	0
12-14....	.5	.9	2.2	-1.3	- .3	2.7	1.5	.2	4.0	2.4	.4	.5	.6	- .4	-1.1
15-18....	.3	.4	1.4	- .9	- .6	2.4	.3	- .3	6.1	3.8	1.9	1.2	1.5	5.2	-1.9
19-22....	.2	- .2	1.3	- .9	-1.2	4.3	.3	- .4	3.6	2.4	1.3	1.6	2.7	6.4	-1.1
23-34....	.5	.1	1.9	-1.2	- .7	3.2	0	- .3	3.3	3.9	1.5	1.7	2.8	3.9	-1.1
35-50....	.4	- .2	1.8	-1.3	-1.1	1.9	1.0	- .4	4.5	2.8	1.1	.4	1.8	3.2	-1.2
51-64....	.3	- .1	2.0	-1.3	-1.1	2.6	1.3	- .5	8.4	1.4	1.1	.4	2.9	5.0	-1.1
65-74....	.5	- .5	1.7	- .5	-2.5	5.5	.4	-2.2	12.0	3.6	2.7	4.4	8.2	6.5	1.0
75 and over....	- .1	- .4	2.3	-2.2	-3.1	2.8	1.4	-1.4	.9	1.4	- .6	.5	4.4	4.1	-2.0
Females:															
9-11......	.4	.6	2.4	-1.3	- .8	3.4	1.3	.5	3.1	3.8	1.6	2.3	2.1	4.2	-1.2
12-14.....	.4	.3	2.1	-1.1	- .7	2.6	1.3	- .6	3.8	2.3	1.1	1.2	.8	3.5	-2.4
15-18.....	.6	.1	2.4	-1.0	- .3	2.7	1.9	.3	3.9	2.5	1.2	.6	2.4	5.0	-1.3
19-22.....	.3	.8	2.2	-1.6	- .2	2.9	1.0	1.0	2.2	2.9	.0	1.9	3.3	0	-1.4
23-34.....	.6	.2	2.8	-1.6	- .3	1.9	.9	.4	4.1	2.9	.7	1.3	2.5	4.3	-1.4
35-50.....	.3	- .3	2.0	-1.7	- .6	1.9	.9	- .3	4.0	2.0	.8	1.2	2.5	.2	-1.3
51-64.....	.2	- .3	2.1	-1.8	-1.1	3.6	.4	-1.1	8.0	2.9	1.4	1.8	3.9	9.0	0
65-74.....	- .1	- .3	1.8	-2.0	-1.9	3.6	.9	-1.1	5.9	2.7	.7	1.2	3.9	7.9	-2.1
75 and over.....	.1	0	2.5	-1.5	-1.9	1.0	0	- .6	2.2	2.9	0.7	2.1	4.2	2.0	0

Table 13.9--Nutrient intake differences using the original and 200-item nutrient data bases by sex-age group

[Nutrient intakes were 3-day averages]

Sex and age (years)	Food energy	Protein	Fat	Carbohydrate	Calcium	Iron	Magnesium	Phosphorus	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin B_6	Vitamin B_{12}	Vitamin C
	Percent difference														
Children:															
Under 1...	7.9	.7	5.0	10.6	10.8	51.2	24.8	13.0	9.4	36.5	14.0	34.1	13.6	5.2	-20.3
1-2.......	.3	0	4.5	-2.7	1.8	9.9	2.5	.6	7.6	-1.1	.7	3.9	0	.9	-6.0
3-5.......	.3	- .6	5.0	-2.7	- .3	-4.4	0	-1.5	11.3	-3.9	-1.4	.8	-1.9	3.6	-4.3
6-8.......	.5	.2	4.9	-2.8	- .1	-1.9	1.4	-1.3	12.4	-1.6	1.1	1.9	- .8	6.7	-1.2
Males:															
9-11......	.9	- .3	5.5	-2.3	1.1	-2.3	-1.2	-1.4	10.0	-4.7	0	1.0	-2.0	-3.6	0
12-14.....	1.1	.3	5.8	-2.7	.5	-1.4	1.5	- .6	12.9	-2.4	.9	1.4	-1.1	1.6	3.3
15-18.....	.6	- .8	4.2	-2.2	0	0	-1.3	-2.0	18.1	-2.2	2.3	1.6	- .5	10.6	-1.0
19-22.....	.6	-1.9	4.0	-2.4	- .6	1.9	-1.3	-3.1	14.1	-3.7	1.3	1.2	0	9.3	-2.2
23-34.....	1.0	-1.8	4.9	-2.8	- .6	.6	-2.0	-3.5	15.6	-3.9	1.5	.8	0	6.1	-2.2
35-50.....	1.1	-2.0	5.0	-3.2	- .7	- .6	- .3	-3.1	18.8	-4.8	.5	0	- .6	5.7	-1.2
51-64.....	1.5	-2.1	6.6	-3.4	- .9	.6	.7	-2.9	20.7	-6.2	1.1	0	.6	10.2	1.1
65-74.....	.7	-2.2	4.8	-2.4	-2.1	4.1	0	-4.3	17.2	-1.4	2.2	3.9	5.7	6.0	1.0
75 and over.....	1.1	-2.5	6.7	-3.0	-2.9	0	.7	-3.6	12.0	-5.7	-2.3	0	1.3	3.1	-2.0
Females:															
9-11......	.8	.4	6.3	-3.3	.6	0	.9	- .6	13.6	-1.5	2.1	4.0	.7	6.9	-1.2
12-14.....	.5	- .3	5.2	-3.2	- .1	0	0	-1.6	16.4	-2.3	1.7	2.4	- .8	5.1	-1.2
15-18.....	.8	- .9	5.7	-2.9	.3	.9	.9	-1.4	9.8	-3.4	1.2	0	0	6.0	2.7
19-22.....	1.0	- .9	6.3	-3.6	- .2	1.0	-1.0	-2.0	18.1	-4.8	0	1.9	0	3.4	1.4
23-34.....	1.3	-1.7	6.8	-4.2	0	0	-1.4	-3.0	15.4	-3.9	.7	0	- .8	4.5	-1.4
35-50.....	1.4	-1.9	7.0	-4.5	0	0	- .9	-3.0	14.2	-5.0	0	.6	0	1.4	0
51-64.....	1.1	-2.3	7.3	-4.7	-1.1	1.8	- .9	-3.9	19.3	-3.8	1.4	1.2	1.6	12.4	0
65-74.....	.8	-1.9	7.5	-4.6	-2.6	2.7	.4	-3.6	18.1	-2.7	- .7	1.2	2.3	8.2	-2.1
75 and over.....	.9	-2.2	7.5	-3.6	-1.7	-1.0	- .5	-2.7	10.3	-1.9	- .7	1.4	1.7	2.0	-1.1

Table 13.10--Food items retained in moderately reduced nutrient data base

Food group	Foods in original data base	Items with values in common with another item	Reduced data base: Items retained	Reduced data base: Reduction from original
	Number			Percent
Soy sauce..................	1	0	1	0
Milk and milk products......	330	76	135	59
Meat, poultry, fish.........	1,365	384	859	37
Eggs.......................	57	5	26	54
Legumes, nuts, and seeds....	164	3	71	57
Grain products.............	997	200	476	52
Fruits.....................	476	135	230	52
Vegetables.................	704	129	434	38
Fats, oils.................	71	19	33	54
Sugars, sweets, beverages...	404	94	106	74
TOTAL....................	4,569	1,045	2,371	48

(37 percent) and the vegetables group (38 percent).

The goodness-of-fit between nutrient values of retained and replaced food items was evaluated with regression analysis. The R-square and beta values for 83 percent of the 2,198 replacement assignments met the criteria specified (between 0.9 and 1.0 for R-square and between 0.7 and 1.3 for beta) (Table 13.13). This was close to a target of 85 percent of the items meeting the criteria. When the replaced items were combined with the retained key items (which had a perfect fit since they were original items), 92 percent of the items met these evaluation criteria. Fewer than 400 of the 4,569 original food items were outside the ranges set for R-square and beta.

The effects of nutrient data base reduction were assessed in terms of the absolute percentage differences between intakes of energy and 14 nutrients calculated using the original NFCS 1977-78 data base for 1 year and those calculated using the reduced nutrient data base. Percentage differences were less than 2 percent for 12 of the nutrients (Table 13.14). Those for three nutrients--thiamin, riboflavin, and vitamin C--ranged between 2.0 and 3.7 percent in one or two seasons. Those small differences indicated to the research team that reducing the NFCS 1977-78 nutrient data base by almost half had a minor effect on computed mean nutrient intakes for this large sample.

Analysis of variance computations disclosed that interaction between type of nutrient data base and sex-age group was not significant ($p \leq 0.05$) for any nutrient in any quarter. Variations associated with sex-age group differences were significant ($p \leq 0.001$) for all nutrients, but variations associated with data base type without sex-age group taken into account were not significant.

The percentage differences between the 1980 RDA and mean nutrient intakes based on the comprehensive nutrient data base as baseline and the reduced nutrient

Table 13.11--Most reported food items in spring, ranked by reporting of each by quarter

Food item code	Food item name	Quarter: Spring Times reported	Spring Rank[1]	Summer Times reported	Summer Rank	Fall Times reported	Fall Rank	Winter Times reported	Winter Rank
1111100	Milk, cow's, fluid, whole..........	14,142	1	11,916	1	16,401	1	14,718	1
9110101	White sugar, granulated or lump..........................	10,081	2	6,842	2	7,649	3	7,529	3
9241031	Soft drink, cola type.............	7,671	3	5,816	3	6,288	5	5,922	5
8110200	Margarine, NFS[2]....................	7,252	4	5,746	4	7,410	4	7,437	4
1110000	Milk, NFS..........................	6,367	5	5,436	5	7,847	2	8,754	2
9210101	Coffee, from ground, black.........	6,011	6	3,399	10	4,511	9	4,671	7
8110100	Butter, regular or melted, salted or unsalted...............	5,241	7	3,644	9	4,774	6	4,335	9
5110110	Bread, white, enriched............	5,199	8	4,618	6	4,700	7	4,421	8
7511300	Lettuce, NFS......................	4,446	9	2,740	13	2,764	15	3,427	12
5110100	Bread, white......................	4,268	10	3,932	8	4,683	8	4,900	6
1111211	Milk, cow's, fluid, lowfat 2%......	3,864	11	2,767	12	3,797	10	3,586	11
9210000	Coffee, NFS.......................	3,651	12	1,948	23	3,217	11	3,764	10
9210301	Coffee, from powdered instant, black...........................	3,539	13	2,545	14	2,900	13	3,007	13
9230100	Tea, NFS..........................	3,382	14	2,807	11	2,868	14	2,795	15
9230200	Tea, leaf.........................	3,372	15	2,111	21	2,181	23	2,181	21
7410100	Tomatoes, raw	3,203	16	4,130	7	1,897	28	2,116	22
6121062	Orange juice, frozen, unsweetened (reconstituted with water)........	3,164	17	2,131	18	2,528	20	2,329	19
3110500	Eggs, whole, fried................	2,961	18	2,102	22	2,551	19	2,342	18
5110111	Bread, white, enriched, toasted....	2,840	19	1,900	24	2,280	21	2,002	27
2260100	Bacon, smoked or cured, cooked.....	2,782	20	2,118	20	2,557	18	2,391	17

[1]The most reported food in each quarter was assigned a rank of 1.
[2]NFS means "not further specified."

Table 13.12--Times consumption was reported for food items with selected rank by quarter

Rank	Number of reports			
	Spring quarter	Summer quarter	Fall quarter	Winter quarter
1....................	14,142	11,916	16,401	14,718
25..................	2,241	1,772	2,119	2,019
50..................	1,417	1,099	1,145	1,130
75..................	944	623	762	759
100.................	580	431	509	548
200.................	282	204	261	268
300.................	176	127	156	156
400.................	122	88	103	102
500.................	88	60	76	74

NOTE: The number of foods reported 100 or more times in a quarter were: spring, 459; summer, 361; fall, 414; and winter, 409.

data base were less than 1 percent for more than half (57 percent) of the 22 sex-age groups in all quarters. The differences were in the same direction (plus or minus) for all nutrients except for thiamin intakes by women 35 to 50 years of age in the winter quarter. Their thiamin intake computed with base-line data was 1 percent higher than their RDA, but with the reduced data base the mean intake was 1 percent lower than RDA. The maximum difference was 4 percent for vitamin B-12 intake by infants in the summer quarter. Accordingly, use of the comprehensive and the moderate-size nutrient data bases led to about the same conclusions concerning quality of nutrient intake for the relatively large sex-age groups.

13.5 Conclusions and Recommendations

In the first study, the investigators concluded that small nutrient data bases, such as those with 396 or 200 items developed for the first study, may be adequate for estimating nutrient intakes for large population groups, but they have not been shown to be adequate to analyze diet records of individuals or small groups, to monitor specific food consumption practices of a heterogeneous population, to study nutrient intakes of specific subpopulation groups, or to provide a basis for giving nutritional guidance to individuals. The investigators viewed the loss of item specificity in such small nutrient data bases to be disadvantageous for monitoring trends and changes in food consumption. Aggregating foods into a few large groups hinders identification of specific food practices associated with geographic, ethnic, and socioeconomic subgroups in the population. The study of intakes by subsets of the population requires a nutrient data base large enough to identify the foods used by the particular subset.

After the first study, the researchers recommended further research to determine effects of reduced nutrient data bases on food intakes during other seasons

Table 13.13--Food items meeting R-square and beta criteria for good fit by food group

Food group	R-square[1]				Beta[2]			
	Replacement items		Total group[3]		Replacement items		Total group[3]	
	Times reported	Percentage	Times reported	Percentage	Times reported	Percentage	Times reported	Percentage
Soy sauce............	0	--	1	100	0	--	1	100
Milk, milk products...	149	76	284	86	158	81	293	89
Meat, poultry, fish...	491	97	1,350	99	485	96	1,344	98
Eggs.................	29	94	55	96	13	42	39	68
Legumes, nuts, seeds..	59	63	130	79	61	66	132	80
Grain products........	433	83	909	91	466	89	942	94
Fruits................	208	85	438	92	207	84	437	92
Vegetables............	236	87	670	95	210	78	644	91
Fats, oils............	29	76	62	87	31	82	64	90
Sugar, sweets, beverages...........	188	63	294	73	199	67	305	75
TOTAL.............	1,822	83	4,193	92	1,830	83	4,201	92

[1]Criterion for R-square required values to be between 0.9 and 1.0.
[2]Criterion for beta required values to be between 0.7 and 1.3.
[3]The total is the sum of the replaced items and the retained items. The retained items had no variation, and R-square and beta were not calculated for those items; the fit was perfect for those items and equivalent to R-square of 1.0 and beta of 1.0.

Table 13.14--Maximum nutrient intake absolute differences between original and moderate size nutrient data bases by quarter

[Nutrient intakes were 3-day averages]

Nutrient	Quarter: Spring	Summer	Fall	Winter
	Percent			
Energy................	0.4	0.4	0.2	0.3
Protein...............	.4	.4	.3	.3
Fat...................	.8	1.2	.6	.9
Carbohydrate..........	.3	.4	.2	.2
Calcium...............	.7	.7	.7	.5
Iron..................	1.0	1.0	1.1	1.0
Magnesium.............	1.4	.9	.8	.5
Phosphorus............	.6	.4	.5	.5
Vitamin A.............	1.2	.8	1.4	1.3
Thiamin...............	1.2	1.9	3.7	2.0
Riboflavin............	.7	1.4	2.8	3.0
Niacin................	.6	1.1	1.2	1.1
Vitamin B-6...........	1.0	.9	1.7	1.7
Vitamin B-12..........	.8	1.5	1.3	.6
Vitamin C.............	1.5	1.4	2.3	1.4

(quarters) of NFCS and nutrient intakes of subsets of the population including ethnic, cultural, regional, and socioeconomic subgroups. They also recommended an investigation of the effects of a less extreme reduction in the data base. Two of these recommendations were addressed in the second study.

In the second study, the reduction of the number of food items in the NFCS 1977-78 nutrient data base by almost half (48 percent) resulted in no statistically significant ($p \leq 0.05$) differences between mean nutrient intakes computed using the moderately reduced data base and corresponding mean intakes using the original comprehensive data base. The food items in the reduced data base were meticulously selected to be representative of diets of the U.S. population based on the most prevalent items reported in the survey. Consequently, it was not surprising that intakes computed from the reduced nutrient data base were similar for all sex-age groups to those computed from using the comprehensive data base. Therefore, with detailed and recent information about food practices of the population, a data base can be reduced in size. However, such information is generally not available, making reduced nutrient data bases risky. Therefore, the conclusion from this study of a reduced nutrient data base cannot be assumed to translate to use of other small nutrient data bases. Likewise, the conclusions concerning effects of this data base reduction on specified nutrients cannot be assumed to apply to nutrients not included in this study.

Comparisons of results using the moderate-size nutrient data base in this second study with the very small data bases of 396 and 200 food items developed in the first study revealed less effect on nutrient intakes by the moderate-size data base than by the small data bases. In the second study, no statistical differences were found. In the earlier study, statistical differences were found for 9 nutrients with use of the 396-item data base and for 14 of 15 nutrients with use of the 200-item data base. An abstract and short summary of this work have been published (Hoover, 1987a, 1987b).

After the second study, Hoover recommended that more research be undertaken to clarify uncertainties remaining in the study. These included the effects of using a small data base for (1) special population subgroups, (2) analysis of the dietary intake of an individual, (3) analysis of other nutritional components, (4) reliability of selected foods to represent actual foods consumed, and (5) cost-effectiveness in coding diet records.

13.6 Comment

The use of the greater than 90 percent reduction from the large NFCS 1977-78 nutrient data base in the study of detailed eating patterns by subpopulation groups could produce questionable results because of omission of the variations in preparation, cooking, and other characteristics of specific foods. It should be emphasized that the small nutrient data bases used in this study were derived from a painstaking analysis of foods eaten by the population studied. The researcher had already identified the foods most frequently eaten and the similarities in their nutrient profiles. If a small nutrient data base were created before a survey without knowledge of foods commonly eaten by the population to be studied, the results would not be as good as those in these studies.

Rather than a reduction in the nutrient data base, many data users have expressed the need for even greater detail. Introduction into the nutrient data base of new dietary components and nutrients also requires increasing rather than decreasing the number of food items.

Another aspect to consider in plans to work with a small data base is the matter of precision of weight conversion factors. Although a data base with fewer food codes may simplify the coding task, fewer food codes would require more weight conversion factors per code. Food items reported in amounts or units other than "as ingested" often require a special weight conversion factor that has a yield factor taken into account. An example is raw steak with bone, for which the weight conversion factor would include deduction for weight of the bone and for cooking loss. Weight conversions to acceptable units critically affect accuracy of calculating the energy and nutrient content of food intake. Nor was food density (weight per cup) considered. Combining foods having differing cup weights would lead to errors that this study did not have to face because the data were already in gram weights of reported items, not the reported measures.

Current users of NFCS data indicate preference for greater detail, which means a larger, rather than a smaller, nutrient data base. With the increased diversity of data base users comes an increased demand for more variables in the data base. Even larger data bases will result from the addition of more nutrients, brand name items, and types of fat in mixed foods, for example. For research purposes, the comprehensive data base appears most appropriate. Even a moderately reduced nutrient data base could not yield such good results as in this study if it were constructed before the survey rather than afterward.

It should also be pointed out that Hoover used a large sample in her analysis to determine the effects of reducing the nutrient data base. Using reduced nutrient data bases with smaller samples might be expected to produce greater differences than were shown in the two studies reported by Hoover.

13.7 Appendix: Rationale and Criteria for Replacement Assignments to Reduce the Size of the Nutrient Data Base

The following rationale and criteria were developed by the University of Missouri-Columbia research team for assigning food items in the reduction of the nutrient data base.

I. Designate food item as retained if it is--

   A. Frequently consumed
   B. Unique in nutrient profile
   C. Described in such a way as to become a representative food item for a group of similar foods
   D. Baby food
   E. Needed to represent ethnic foods consumed by subcultures of the population
   F. Has high consumption in any single season of the year

II. Designate the food item as replaced by--

   A. Grouping it with a retained food item that is similar in nutrient content
   B. Grouping it with retained food items that are similar by description and in a cluster which would be a logical place to locate the replaced item
   C. Assigning some items as replaced items under a retained item in another major food subgroup when similar in type of food and in nutrient composition

III. Evaluate replacement assignments as acceptable (good fit) if--

   A. R-square values are between 0.9 and 1.0 for 85 percent of the replaced food items
   B. Beta values are between 0.7 and 1.3 for 85 percent of the replaced food items

IV. Refine replacement assignments by--

   A. Minimizing percentage differences between the nutrient values of retained and replaced food items
   B. Reassigning replaced items to achieve R-square and beta values within the acceptable ranges (indicating good fit)

13.8 References Cited

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Chapter 14. Research Findings Incorporated in Dietary Intake Survey Methods and Emerging Needs

SUMMARY: In this concluding chapter, the research studies summarized earlier are reviewed for their contributions to dietary intake survey methodology, and topics for further research are discussed. The increase in survey activities at USDA's Human Nutrition Information Service (HNIS) is noted. The survey process is outlined in terms of eight basic stages, each of which encompasses many activities; interrelationships among stages and flow of activities are emphasized. Particularly relevant publications by survey experts are cited. Incorporation of HNIS research findings into its survey methods is described in chronological order beginning with a basic methodological study in 1975 and covering five subsequent studies concerned with the validity of data from the Nationwide Food Consumption Survey 1977-78. Research on longitudinal or panel dietary intake survey approaches in the early 1980's before introduction of the Continuing Survey of Food Intakes by Individuals 1985 is also reviewed. Additional insights were provided by an exploratory study using the food frequency method. Food composition research has been considerably expanded and computer technology incorporated in order to keep pace with new products and developments in analytic methodology. Suggestions for further research which may lead to improved methods or which may address emerging needs conclude the report.

Tables

Figure

14.1 Introduction

Each of the studies in the Human Nutrition Information Service (HNIS) methodological research program summarized in this publication has advanced in some way the attainment of valid and reliable dietary intake data in the decennial Nationwide Food Consumption Survey (NFCS) and the Continuing Survey of Food Intakes by Individuals (CSFII). These surveys have become increasingly intricate since the dietary intake component was initiated in 1965 with the collection of 1-day food intakes during one quarter of the year. In NFCS 1977-78, 3-day food intakes were collected across one whole year. The third dietary intake survey conducted in 1985 (CSFII) introduced methodology to provide continuous monitoring of the dietary status of individuals in the nation. CSFII 1986 followed. NFCS 1987-88 had both household food use and individual food intake components, and 3-day food reports were again collected. CSFII is now scheduled to continue in 1989-96. Therefore, starting in 1985, a dietary intake survey (NFCS or CSFII) is expected to be in the field every year.

To support its survey operations, HNIS directs a number of survey processes that go on simultaneously. For example, in 1987, data from CSFII 1985 were being analyzed and reported; data from CSFII 1986 were being processed; data for NFCS 1987-88 were being collected; and plans for CSFII 1989-96 were being made. Through such efforts, HNIS survey specialists have gained experience in large-scale survey planning, data collection, data processing, data analysis, and data reporting. Accretion of improvements in the survey procedures continues, as well as introduction of new approaches resulting from research such as that described in the preceding chapters.

This concluding chapter includes an overview of the general survey process (Section 14.2) and identifies recent research results that have been incorporated in survey procedures (Section 14.3). Topics and activities seen as requiring further research are identified, as well as emerging needs likely to claim attention in the near future (Section 14.4).

14.2 Overview of the Survey Process

Nationwide food intake surveys more and more resemble a complex business operation, which can be depicted with a flow chart indicating inputs, processes, and products. To survive, their products must meet the needs of public and private consumers, be of the highest quality, incorporate the latest knowledge and technologies within cost constraints, and be delivered in a timely manner. Toward these ends, the survey methods research program at USDA has included work on all stages of the survey process. Five of the 10 major investigations reported in the preceding chapters were small but complete surveys in themselves and tested a number of procedures that were not the primary focus of the study.

Surveys are carried out to obtain answers to questions, so the survey process itself is a research process. Much can be learned from the books by expert survey investigators describing their experiences and their recommendations regarding procedures for conducting research through surveys.

The essence of sample surveys is that they gather current information about a large number of people or cases by interviewing relatively few of them; strictly defined procedures are followed in selecting respondents to make up a sample that is representative of the population under study (Backstrom and

Hursh-Cesar, 1981). The information to be sought and how it is to be obtained are meticulously specified. The stages in the survey process from the planning and collection of a structured set of data from a selected set of cases through analysis and reporting of results form a systematic progression (de Vaus, 1986). A common view is that, although key stages may be outlined sequentially, the entire process must be considered when the survey is planned. Each stage influences and is influenced by the others. Survey activities are interrelated so that the first stage largely determines what can be done in later stages; the end product must be kept in mind during planning and activities in the early stages (Warwick and Lininger, 1975; Jolliffe, 1986). The primary focus of attention shifts from one stage to the next as the survey progresses, but no stage can be disregarded.

Major stages in food consumption surveys are identified in Figure 14.1. Decisions and activities in every stage influence and are influenced by the other stages. The lines in the figure indicate the interdependence of these activities. Some of the tasks included in each stage are mentioned below. Work on a survey usually begins with the gathering of background information about topics and cases to be covered, the methods available, results of earlier surveys, and other relevant developments. Next, the overall purpose and objectives are stated explicitly; the data required to meet objectives are specified; concepts are defined and working (operational) definitions of concepts are established; and hypotheses are formulated if any are to be tested. The objective of survey design is to identify and specify methods for obtaining the information with minimum bias and maximum accuracy within cost and time limits. Choices among methods to be selected include the type of survey--cross-sectional or a longitudinal approach; desired respondent; type of information--present, past, or both; type of administration--manual, automated, or combination; and mode of interview--in-person, telephone, mail, or a combination. Different types of survey design have been described (Jolliffe, 1986; Subcommittee on Federal Longitudinal Surveys, 1986; Kidder, 1981; Backstrom and Hursh-Cesar, 1981; Goldstein, 1979; Warwick and Lininger, 1975). Sample design and sampling procedures have been delineated by a number of experts (Jolliffe, 1986; Fowler, 1984; Rossi et al., 1983; Jessen, 1978; Kish, 1965; Hansen et al., 1953).

In developing questionnaires, careful consideration must be given to the wording and order of questions, to the format and length of the instrument, and to the reliability and validity of measures derived from answers. Questionnaire construction has been described in detail by de Vaus (1986), Fowler (1984), Converse and Presser (1986), Subcommittee on Questionnaire Design (1983), Sudman and Bradburn (1982), Backstrom and Hursh-Cesar (1981), and Kidder (1981).

The data collection stage entails attention to interviewer training and supervision and sample enrollment. Instruction of respondents, quality control measures to minimize unit and item nonresponse, and debriefing of interviewers and respondents are also important at this stage (de Vaus, 1986; Backstrom and Hursh-Cesar, 1981; Babbie, 1973).

The data processing stage involves review, editing, coding, and checking; data systems for conversions to equivalents such as common measures to gram weights and foods in terms of nutrient content; treatment of nonresponse and

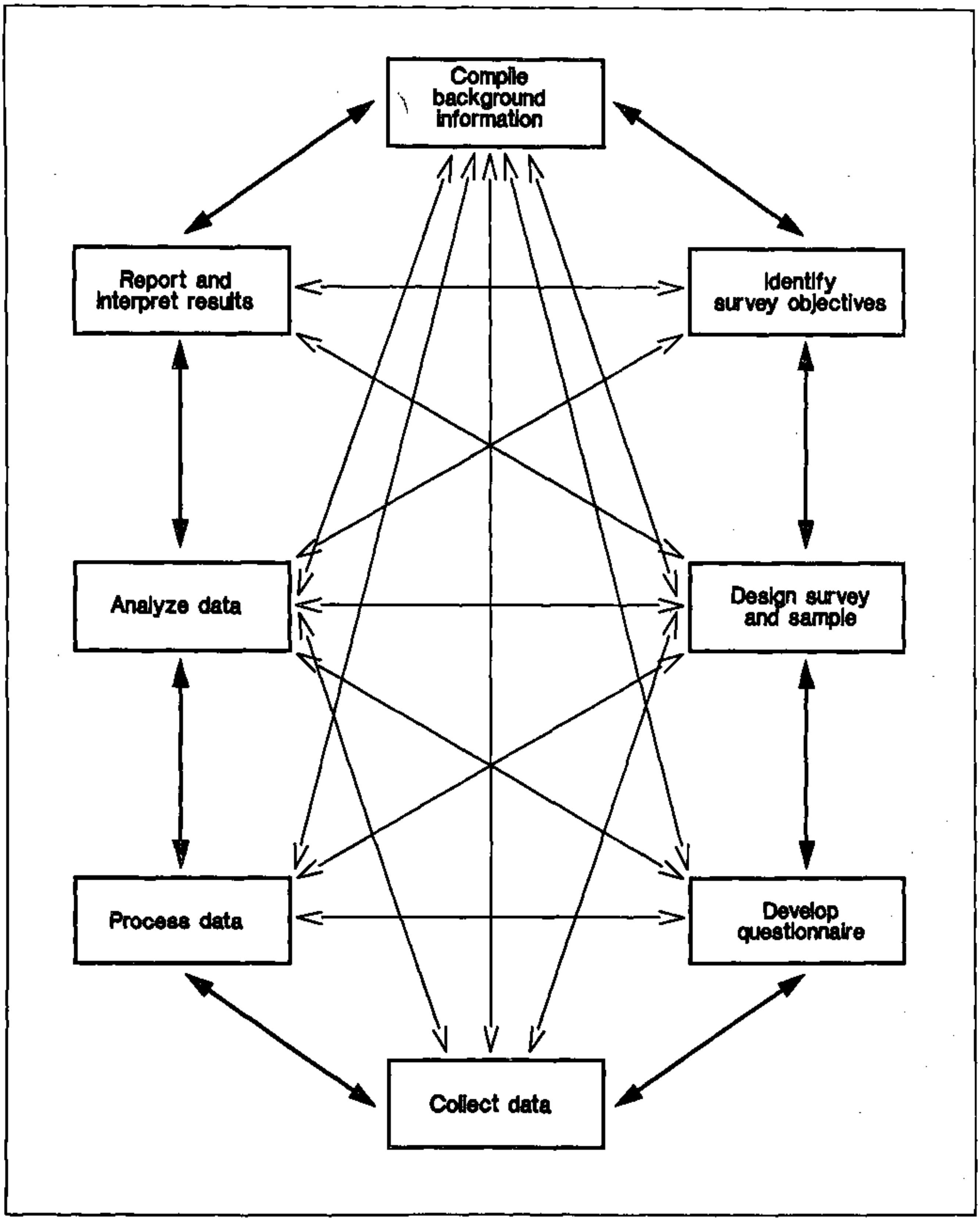

Figure 14.1--Stages in the food consumption survey process and their interdependence

incomplete or missing data; and verification (de Vaus, 1986; Fowler, 1984; Backstrom and Hursh-Cesar, 1981). The data analysis stage includes construction of tables and computation of descriptive and inferential statistics, hypothesis testing, testing of relationships, and accuracy checks (Jolliffe, 1986; de Vaus, 1986; Kidder, 1981; Goldstein, 1979). The reporting and interpretation of findings is the final stage. Major findings are summarized with tables presenting supporting evidence and documentation of procedures.

All stages in the survey process are exemplified in the national food consumption surveys conducted by USDA. Methodological issues which were included in research studies described in this publication are listed below by stage in the survey process. The chapters in this publication that discuss each issue are also listed in Table 14.1.

14.3 Incorporation of Research Findings in Survey Methods

Dietary intake survey methods have evolved or been altered over the years as the nature of the surveys has changed, as new technologies and more sophisticated sampling and analytical statistical procedures have become available, and as the uses of survey results have expanded. For maximum usefulness of results, the conduct of USDA surveys needs to be compatible or coordinated with other national surveys which collect information about diet, health and nutritional status, perceptions of diet-health relationships, food expenditures, food program participation, and socioeconomic and demographic factors. At the same time, methods now utilized carefully build upon experience and the results of methodological studies. How these results have been incorporated in HNIS surveys is set forth below in chronological order.

Development of dietary intake methodology for large-scale national surveys began at HNIS with the protocol used in the 1965 Household Food Consumption Survey (Chapter 1). A pilot test conducted during 1963 in the Washington, D.C., area demonstrated the willingness of household respondents to provide a 1-day food recall for each member of the household in addition to information about the food used in the household. Dietary intake data for sex-age groups in all parts of the nation and for subpopulation groups were in considerable demand for many purposes, such as planning food assistance and nutrition education programs and food market research.

Planners of NFCS 1977-78 studied the 1965 dietary intake procedures to see whether changes were warranted. Several limitations of the 1965 method were noted: (1) the respondent was not prepared for the interview because the interviewer arrived at the household without advance notice; (2) the one household respondent, who was asked to provide a 1-day food recall for all household members, did not always have the required information; (3) the respondent sometimes had difficulty describing the size of portions without reference to measurement guides; (4) a food intake report for only 1 day was not representative of usual intake; and (5) information collected for only the spring was not known to be representative of other seasons. Procedures were planned for NFCS 1977-78 to overcome these shortcomings.

In 1985, the CSFII was initiated to monitor the dietary status of population groups during the interim between the large periodic nationwide surveys. A repeated panel method that included the

Table 14.1--Methodological elements by survey stage

Survey stage and methodological element	Chapter reference
Compile background information:	
Survey data from past and present NFCS	4, 5, 11
Other Federal surveys	1, 5, 11
Methodological investigations	2-11, 13
Identify survey objectives:	
Formulation of objectives and data requirements	2-11
Populations to be included	1, 8
Methodological and other issues to be researched	2-11, 13
Questions to be answered, methodological concepts	2-11, 13
Design survey and sample:	
Type of survey--cross-sectional, longitudinal approaches	1, 7, 11
Number of days to be surveyed	2, 3, 11, 14
Spacing of days--consecutive, intermittent	7, 8, 11, 14
Days of the week covered	5, 7, 8, 11
Location of interview--in home, away from home	2, 5
Method of data collection--record, recall, combination	2, 4-11, 14
Mode of interview--in-person, telephone, mail	1, 2, 4, 7, 8, 11, 14
Measure of "usual" intake--food frequency, multiple days	1, 3, 7, 10, 11
Cost	7, 14
Nonresponse	2, 3, 5, 7
Linkage with other surveys	1, 3, 5, 11
Sample, listing	2-5, 7, 8
Sample loss	3
Develop questionnaire:	
Format of questionnaire	2, 3
Anthropometric measurements--measured, self-reported	1, 5, 8, 11, 14
Validity, reliability of measures/questions	3, 4, 6, 10, 11, 14
Instructions for respondents, interviewers--booklet	2-4, 7
Memory aids--checklist, probes	1, 6
Pretest of questionnaire and protocol	2, 7, 8
Measurement aids for portion-size estimation	2, 4, 6, 7, 8
Intended respondent, recorder	2
Linkage with other surveys	1, 3, 5, 11
Procedures for administration	2-4, 6-10

Continued

Table 14.1--Methodological elements by survey stage--Continued

Survey stage and methodological element	Chapter reference
Collect data:	
Interviewers--qualifications/selection, training, supervision	2-4, 6, 8, 11, 14
Advance notification of interview	2, 4
Respondent preparation, training	2-4, 7
Interview situation--privacy	2, 5
Data recording--interviewer, respondent	2, 4, 7
Problem foods to recall, quantify	6
Surrogate reporting	1, 2, 6, 8, 11, 14
Quality control measures in reporting food items to minimize omissions, inadequate descriptions, and amounts reported; interviewer review of completed questionnaire	6, 11, 12
Respondent burden--length of time to complete questionnaire	3, 7, 8, 14
Interviewer pick up and review of completed records	2, 4
Incentives for respondents	2-5, 14
Respondent debriefing	2-4
Interviewer debriefing	2-4, 14
Process data:	
Review/editing of questionnaires, callbacks	3, 7
Food coding system, conversion of measures to gram-weight equivalents	1, 5, 8, 11-13
Rules for a food report to be accepted	7
Assessment of data quality--number of food (line) items; incomplete food descriptions and amounts, use of default codes and amounts	2-8, 14
Food composition data base used, size	12, 13
Imputation for missing values	1, 12, 14
Analyze data:	
Standards used for assessing dietary quality	4-6, 8, 14
Descriptive statistics	2, 5, 7, 8, 11
Cross-tabulations	4, 11
Variation and relationships between groups	2, 5
Response rates	2, 3, 7-9, 11, 14
Surrogate reporting	1, 2, 6, 8, 14
Report and interpret results:	
Integrity of sample, compare with population	5
Evaluating methods, quality of data, and validity of results	1-4, 7
Intersurvey comparisons	5
Representativeness of data	3

collection of 6 nonconsecutive days of food intake was developed for use in this survey. This method was based on results from two experimental research studies. CSFII 1985 and 1986 themselves were experimental, and the results were evaluated carefully. Analyses of energy and nutrient intakes and response rates provided evidence that the NFCS 1977-78 dietary intake method of 3 consecutive days achieved a better response rate than the CSFII method of 6 intermittent days. Therefore, the 3-consecutive-days method was used in NFCS 1987-88 and is planned for use in CSFII 1989-96 and NFCS 1997.

14.3.1 NFCS 1977-78 Dietary Intake Method and Validation Studies

This section reviews those studies that contributed to selection of the method used for the NFCS 1977-78, and procedures developed to assess validity of the dietary data obtained. A research firm (Response Analysis) planned and implemented an experimental study of several promising dietary survey methods to ascertain an appropriate protocol for NFCS 1977-78. Recognized authorities (Survey Design, Incorporated) recommended a variety of procedures for assessing validity of survey results. Their recommendations were incorporated where possible in final or followup stages of the survey by the contractor (National Analysts). Between 1980 and 1983, investigators at three universities examined the validity of reported dietary data. The University of Maryland team compared dietary recalls by male volunteers with observed food intake unobtrusively recorded. The University of Michigan researchers compared 1-day dietary intake recalls collected in two national surveys. The University of Arizona compared reported food use by households and reported food intake by individuals with evidence from household refuse.

14.3.1.1 Methodological Study

Evidence to support and justify the data collection procedures utilized in NFCS 1977-78 emanated mainly from the Response Analysis study (Chapter 2). This research firm examined for possible use in collecting NFCS dietary intakes several alternative variations of two basic methods--recall and record--that had been developed by food and nutrition researchers over the years. The methods were reviewed by a panel of experts, final versions were prepared, and the methods were field tested to ascertain the quality of data produced. Data collection procedures that worked well and were consonant with funding, temporal, and practical considerations were incorporated in the NFCS 1977-78 final survey plans.

Among the procedural aspects evaluated were (1) the type of data to collect--recall, diary, and combination recall-diary; (2) the number of days' intake to include--1, 2, and 3; (3) the respondent --subject and knowledgeable surrogate; (4) the recorder--trained interviewer, subject, and knowledgeable surrogate; (5) the return of completed diaries--interviewer review and pick-up and return by mail; (6) the quality of food intake reports as indicated by number of food entries; completeness and adequacy of food descriptions and quantities reported; legibility, consistency, and reasonableness of answers; (7) respondent burden; (8) the household interview--with and without advance notice; and (9) techniques for training respondents in keeping diaries-- written instructions and examples on forms, verbal instructions by interviewer to subject, and verbal instructions by interviewer to household informant for transmittal to subject.

In line with findings and recommendations by Response Analysis, the 1-day recall administered by a trained interviewer followed by a respondent-kept 2-day diary (record) was selected as the method most likely to provide valid data. Rationale for the combination recall-diary, 3-consecutive-day method was the minimal demand on respondent memory and recording with reporting begun in the middle of the 3-day period. The 1-day recall, with its emphasis on accuracy, also prepared the respondent for the diary-keeping task. The 1-day recall administered and recorded by a trained interviewer tended to provide more complete information than diaries because of expert probing by the interviewer. Each member in a household was interviewed independently to increase validity of the data. However, a knowledgeable surrogate, usually the household respondent, reported for children and others unable to answer for themselves. It was apparent that respondents needed assistance in providing complete and accurate information in diaries.

An advance letter--telling about the survey, its importance, how households were selected, and how the household could prepare for the interview by keeping notes and other reminders of household food use--was found to improve participation. Rate of returning completed diaries was higher and quality of entries was better when interviewers returned to the household to review and pick up the diaries than when diaries were returned by mail. Return by mail did not provide an opportunity for the interviewer to review the diaries while still in the respondent's presence. Consequently, the advance letter and the interviewer's return visit became part of the NFCS 1977-78 procedures.

Although not tested, Response Analysis recommended payment of an incentive to respondents in appreciation for their time in completing each diary. Several assumptions were made but not tested. These assumptions were that accuracy was greater when a person reported his or her own diet; that error due to memory lapse was diminished when food was recorded soon after being eaten; and that reporting foods eaten did not change customary intake.

Several advantages were seen in collecting dietary intake information for 3 days rather than 1 day. Three-day intake reports provided a more representative measure of an average day's intake for an individual than 1 day because low intake on 1 day tends to be balanced by high intake on another day. The day-to-day variation in intakes by individuals could be assessed. Also, over 3 days, individuals select a greater diversity of foods than in 1 day; therefore, in 3-day intakes, foods less frequently consumed were more likely to be reported and their use could be studied. HNIS subsequently specified that four pages of printed instructions (food instruction booklet) and a set of measuring cups, measuring spoons, and ruler be given to respondents in NFCS 1977-78 to improve reporting in the diaries.

14.3.1.2 Validation Studies

Between 1977 and 1983, a series of investigations at HNIS addressed the validation of results from NFCS 1977-78 and of its survey methods. That no one technique was considered adequate to validate results in food studies was evident from the diverse opinions of experts consulted in the study by Survey Design, Incorporated (SDI) (Chapter 3). Consequently, SDI suggested a variety of techniques for assessing validity of survey results, including some activities that could be implemented while the survey was still in the field without undue risk to the satisfactory completion of the survey.

One such activity, debriefing of interviewers and respondents, included questions about the perceived accuracy of answers in the survey. Debriefing was scheduled soon after respondents had been interviewed. National Analysts (Chapter 4) reported results of the debriefings, and current survey questionnaires incorporate some debriefing-type questions for interviewers. Answers to these questions provide some feedback about the credibility of respondents' answers. Interviewers and respondents are now routinely debriefed following completion of a survey.

Another action recommended by SDI to increase confidence in the validity of the data from the NFCS 1977-78 was providing a detailed description of the survey processes and statistical measures documenting quality. Documentation included the sampling plan, nonresponse rates, sampling error, definition of variables, and processing procedures and problems. It is expected to become customary for survey staffs to provide such documentation on survey data tapes and in published reports of results. Furthermore, the Office of Management and Budget has advanced some guidelines for surveys to ensure quality and usefulness of statistical data. SDI recommended that USDA establish a continuing program of research to improve survey methodology. Such a program is now carried out by a methodological research group at HNIS.

Debriefing by National Analysts of interviewers and respondents about their experiences in NFCS 1977-78 data collection and about the validity of data collected revealed ways in which procedures for the next survey could be improved. Debriefing brought out the following needs:

--more training of interviewers and respondents in the use of the set of measuring devices,

--additional probing for overlooked foods including addition of a checklist to the questionnaire,

--increased effectiveness of incentives by earlier introduction,

--more advance preparation of respondents for reporting tasks,

--more detailed and easy-to-use printed instructions for keeping food records including improved format, content, and method of introduction to respondents,

--more information in the advance letter to induce respondents to participate,

--stronger motivation of respondents to enter foods into diaries immediately after eating when possible,

--increased helpfulness of the interviewer's introductory remarks,

--a standard procedure to obtain "maximum informed response" when the intended respondent is unavailable.

Action was taken to incorporate improvements into survey procedures which answered these needs.

An experimental study at the University of Maryland was carried out to investigate several aspects of methodology believed to affect validity of dietary intake reporting (Chapter 6). The research team led by Caliendo studied the accuracy of recalls of lunch items by men whose lunches on the preceding day had been unobtrusively recorded at their workplace cafeteria. Also studied was the relative effectiveness of two types of measurement aids for helping subjects estimate portion sizes of foods eaten--measuring utensils and food models. The validity of surrogate reporting was assessed by comparing food recalls by each subject and by a knowledgeable member of his household. Foods often overlooked or erroneously reported were identified.

Men recalled, on average, about 85 percent of the total number of foods eaten at lunch. Although omitted items were partially offset by reporting items not observed to have been eaten, omitted items were more of a problem than reporting of foods not eaten. To reduce omissions and erroneous additions, recent HNIS surveys include more specific probing by interviewers, a checklist to remind respondents of foods often overlooked, and more detailed instructions for the respondent in keeping the 2-day diary-record both by the interviewer, who helps start it, and in an easy-to-use food instruction booklet left with the respondent.

The use of the measurement aids in the University of Maryland study of food eaten at lunch away from home led to a higher proportion of portion sizes being overestimated than underestimated, regardless of whether measures or models were used. However, the subjects using measuring utensils tended to overestimate to a greater degree the quantities of food items eaten at lunch compared with subjects using models. These results suggest that the two types of measurement aids may not be equally effective for estimating portions away from home. However, the location of the interview is an important factor in selection of the type of measurement aid. That is, measuring utensils are potentially more helpful for an interview in the home than in other locations because they can be used to measure portions or capacity of dishes and spoons used in the home. Moreover, for surveys conducted in the home, interviewers must carry all materials and equipment needed; the measuring cups and spoons are lightweight and compact, whereas the set of models are heavy and cumbersome to transport. For these reasons, HNIS continues to use measuring utensils in their surveys. Training of interviewers and respondents in the proper use of the measuring cups and spoons in estimating portions has been improved in response to needs expressed by the debriefings in the National Analysts' study (Chapter 4).

In the assessment of surrogate reporting of men's lunches at work by household members (usually wives), the surrogates often declined to report because they did not know what foods the men had eaten. However, most surrogates did report the men's evening meals because they were present at the meal. These results indicate the increasing problems with surrogate reporting when fewer meals are eaten together by household members. Although surrogate reporting remains necessary in national surveys in order to maintain acceptable response rates and to control costs, surrogates are asked to consult with the persons for whom they are reporting and are given special training in order to provide as accurate information as possible. To gain new knowledge about surrogate reporting, the surrogate's identity is now obtained on questionnaires.

Foods identified as most often omitted in the men's recalls were auxiliary foods such as accompaniments, salad dressings, crackers, salty snacks, gravies and sauces; desserts such as fruits; and items such as cheese, breads, and vegetables. A checklist, interviewer probes, and the food instruction booklet remind respondents of such foods, and these are now part of the dietary intake protocol.

In a study at the University of Michigan, Larkin compared results from two national surveys in which dietary intake information was collected by the 1-day recall method (Chapter 5). Since both surveys--NFCS 1977-78 and the National Health and Nutrition Examination Survey (NHANES) 1971-74--derived dietary intake estimates for the population, similarities in results were expected despite the difference in the time period. Among procedural aspects that were dissimilar were definition of certain variables, measurement aids used during the interview, the system of coding foods, and the data base used to calculate the nutrient content of food intakes. Height and weight information was collected by both surveys, self-reported in NFCS and clinically measured in NHANES.

Differences between surveys for iron, thiamin, and niacin are possibly explained by a change in bread and flour enrichment standards during the interim between the two surveys. Other differences in the nutrient data bases affected the nutrient intake comparisons in undetermined ways. Nutrient levels also reflect the foods reported in the two surveys. Differences in the ways food items were described and organized into food groups in the two surveys precluded precise comparisons of food intakes. Dissimilar definitions hindered comparisons relative to eating-occasion and meal-pattern data from the two surveys. In the last few years, considerable effort has been expended by planners of the NFCS and the NHANES to develop identical or comparable definitions for food and other dietary variables. Both surveys now use the USDA food and nutrient data base.

Alcoholic beverage use reported in both surveys is much lower than would be expected from Federal tax information. Questions to obtain more detailed information about alcoholic beverage consumption have been added to the NFCS 1987-88 dietary intake questionnaires.

The differences between NFCS self-reported and NHANES clinically measured heights and weights were small. This helps confirm the usefulness of continued collection of the self-reported measurements in NFCS.

The study of household discard of food including an archeological approach to measure household refuse was undertaken at the University of Arizona to increase understanding of differences between reported household food use and reported individual food intake (Chapter 9). Ethnological interviews gave insight into the handling of leftovers and avenues of food loss. However, efforts by Harrison and Rathje to track food loss in the home by several methods proved disappointing, even when respondents were consciously involved. Comparisons between quantities of refuse (or garbage) and household food use explained relatively little of the gap between quantities of household food used and individual food intake. The archeological study of household refuse has been suggested by experts as a means of validating food consumption survey data. This University of Arizona study indicates that substantial modifications in the method for measuring refuse would be necessary before an attempt at such a validation would be useful.

14.3.2 Longitudinal or Panel Dietary Intake Survey Approaches

By the early 1980's, the demand for timely and continuous information about dietary status of individuals in the population was so great that HNIS methodological research was focused on developing ways to meet these objectives. Ways to identify and trace unexpected or sudden shifts in food practices and dietary quality were viewed as essential for a national nutrition monitoring system under consideration. Because of the lack of recent food and nutrition research using longitudinal or panel approaches, HNIS undertook exploration of several continuous survey methods, first by National Analysts (Chapter 7) with secondary analyses by Johnson and Morgan (Chapter 11), and by Westat

(Chapter 8). Also, conferences with data users both inside and outside government indicated that more specific information was needed about sodium and fat in the diet, as well as health-related practices concerning smoking and physical activity. Subsequent questionnaires reflected these new directions.

The exploratory study by National Analysts was designed to test eight panel methods for collecting dietary intake information from middle-income women aged 20 to 69 years during 1 year using approaches that varied by mode of interview and by type and number of contacts (Chapter 7). Only one respondent per household was allowed. Data were collected in each of the four quarters of the year.

In the eight test methods, the same panels were kept throughout the year, while in a control method using NFCS 1977-78 procedures, a new panel was selected each quarter. Methodological elements examined included (1) the mode of interview--in-person, telephone, and mail; (2) the number of days surveyed--3, 4, 6, 8, 9, and 12; (3) the spacing of days during the year; (4) the format of questions to elicit food intake information--unstructured and semi-structured; (5) the way data is collected--recall, diary record, and combination; (6) the recorder--interviewer and respondent; (7) respondent burden--interview plus callback time; (8) the quality of data produced by test methods--number of food entries per day, number of inadequate food descriptions, number of missing or imprecise portion sizes, and mean quantities of food energy and nutrient intakes; (9) response rates; (10) data processing time--review, editing, coding, and checking; and (11) cost per intake day. Secondary analysis by Johnson and Morgan concerned the number of days and the increase in precision of estimating energy and nutrient intakes.

A pilot study of methods to measure the dietary status of low-income populations in the United States on a continuing basis was conducted by Westat (Chapter 8). The research focused on comparing two modes of data collection--telephone and mail. Each mode was used to obtain 3 consecutive days of dietary intake in each quarter of 1 year for all members of each household. Ten low-income samples were surveyed--urban and rural whites, blacks, and Mexican-Americans; urban elderly persons; American Indians; households without telephones; and households inducted for one quarter only. Methods were compared using measures similar to those used in the exploratory study by National Analysts. Results of this pilot study provided valuable insight into problems faced in surveying special low-income populations.

The studies by National Analysts and Westat provided the experimental basis for the CSFII 1985 and 1986 procedures. The method selected was essentially a telephone approach following an in-person contact for the initial interview. This repeated panel method had generally produced the highest response rates in both studies. Respondent burden was found to be excessive in the Westat study; therefore, a 1-day dietary recall every 2 months, rather than a quarterly 3-day dietary report, was specified for CSFII. Respondent burden was also reduced by limiting respondents in the sample to women 19 to 50 years of age and their 1- to 5-year-old children. Men proved harder to contact than women in the Westat study, and surrogate responses were fewer for women than for men. Women in households with no telephone were contacted in person for all six dietary recalls because mail response was so low.

The 1-day recall by in-person or telephone interview permitted interviewer probing and recording for all days reported, which enhanced the quality of data. Six days were selected as the optimum number to survey. Twelve days were found to be too many in both studies, evidenced by the decline in quality of dietary reports. The mean number of food (line) items and the mean level of energy intakes tended to decrease as more days were reported.

The Johnson-Morgan study indicated that 9 days of reports improved accuracy of energy and nutrient estimates relatively little over 6 days. Collection of 6 intermittent days during 1 year would meet expert committee recommendations for obtaining a measure of "usual" intake. The unstructured questionnaire format was retained because it took less time to administer and resulted in less respondent burden.

Despite the perceived advantages, analyses of data collected in the CSFII 1985 and 1986 disclosed some shortcomings in the repeated panel method. Only half of the respondents participated in all six waves of the surveys. Moreover, in the CSFII 1985, the mean energy intake and mean number of food (line) items per day tended to decline as the number of reporting days increased. For women 35 to 50 years of age, mean energy intake per day based on 4 nonconsecutive days was 144 kilocalories less than for day 1 in the CSFII 1985; the corresponding difference based on 3 consecutive days in NFCS 1977-78 was 19 kilocalories. The drop-off in mean energy intake was less for the shorter than for the longer time commitment. The NFCS 3-consecutive-day method is planned for use in the CSFII 1989-96 and NFCS 1997. Experience with alternative numbers of days provided evidence supporting the continued use of 3 days for future surveys.

14.3.3 Exploration of the Food Frequency Method

The food frequency method has often been suggested for obtaining information more representative of "usual" dietary intake than a 1-day recall or a 1- to 7-day record because it usually covers a longer time period. In a study at the University of Michigan, Larkin developed and evaluated a food frequency procedure (Chapter 10). That study obtained 4-day food intake reports each quarter during 1 year using an in-person interview for a 1-day recall and a self-administered 3-day record, which was subsequently collected and reviewed by the interviewer. The quantified food frequency instrument was administered about 3 months after the 16 food recalls-records were completed. Information on the food frequency questionnaire was compared with summary information from the 16 days of food intake reports. Each individual's 16-day food report served as the standard against which the food frequency report was compared for validity. The sample included 228 men and women about equally divided by sex and by race (whites and blacks).

Results of this study showed that the food frequency data often indicated higher intakes than comparable data from the food recall-records. Use of the 16-day recall-records for comparison may have limitations because the mean energy intake for each day in the fourth quarter was less than for corresponding days in the earlier quarters, which suggests underreporting in later reports or overreporting in early reports. The food frequency and 16-day recall-records were in closer agreement for white men than for the other race-sex groups. The food frequency approach may provide supplementary information valuable for validation of information in the 1-day or 3-day food intake reports obtained in large-scale surveys. For example, a food frequency report of calcium-rich foods may be compared with frequency of reporting the same foods on 1- or 3-day reports in NFCS 1987-88. NFCS 1987-88 includes a series of questions on frequency of alcoholic beverage consumption to yield insight concerning the usually lower consumption reported in NFCS than in other surveys.

14.3.4 Food Composition Data Bases

Food composition research programs at HNIS are basic to much of the research on dietary intakes in the United States (Chapter 12). To meet ever increasing demands, this ongoing research has been broadened to cover many new foods and additional food components and has been computerized using new technical developments.

A comprehensive nutrient data base (food composition data base) was developed for use in NFCS 1977-78 individual food intake survey. It was updated for use in CSFII 1985 and 1986 and for NFCS 1987-88. The full food composition data base requires development and maintenance of data for a large number of food items and often includes several variations for the same basic food, such as for different cooking methods and commercially processed forms. Hoover (Chapter 13) investigated the effects of reducing the number of foods in the data base.

The small and moderate-sized nutrient data bases were carefully developed after examining food intakes of the population. When constructed after the fact, they appeared adequate to calculate mean intakes by large groups of individuals but were considered inadequate for many other frequently needed analyses. With the loss of specificity in small data bases, monitoring changes and trends in food consumption would be difficult. Many users of the nutrient data base ask for more detail, not less, about foods and their composition. Consequently, HNIS found that use of a reduced nutrient data base in the national food consumption surveys was not practical for many users. However, further development of the HNIS recipe file in the nutrient data base system for use in individual intake surveys allows substitutions of kind for ingredients in standard recipes, expanding use without adding to the number of items in the data base.

14.3.5 Recurring Themes

From the results of the methodology studies just described, it is apparent that some major issues were addressed in more than one investigation and common conclusions were reached. For example, it is clear that mail survey approaches were found unsuitable for national food consumption surveys partly because of low response rates and the high number of callbacks required to clarify or complete responses. Also, surveying several days of food intake led to a drop-off in participation rate, which tended to be worse with additional days. The largest drop-off usually occurred between the first and second days. Furthermore, when several days were surveyed, a gradual decline in reported mean intake of energy (and some nutrients) tended to show up as more days were surveyed. The drop-off in response rates and decline in energy intake generally occurred regardless of the data collection method. The advantages of having trained interviewers administer and record dietary recalls were pointed out in the assessment of data quality. Having interviewers pick up and review food records kept by respondents enhanced response rates, as well as quality of the records. An interviewer is able to ease respondent burden by skillful probing for more precise information, which is important for proper interpretation, processing, and analysis. Also, personal contact between the interviewer and respondent either face-to-face or by telephone tended to elicit reports of acceptable quality. Personal contact with interviewers in some form appeared to be needed by many respondents to achieve satisfactory response rates. It should be mentioned that the quality of interviewer training has been enhanced by improved training methods and manuals including the Food Instruction Booklet for use by interviewers, as well as by respondents. The Food Instruction Booklet was expanded from 4 pages in the NFCS 1977-78 to 18 pages in the NFCS 1987-88 while retaining ease-of-use features.

Collection of 3 days of intake was found to be less costly in time and funds if the days were consecutive rather than widely separated. Two interviewer visits produced 3 days of data in the NFCS method. This recall-diary record method resulted in the smallest number of imprecise descriptions and amounts and required the least time per intake day for review, coding, and checking. However, mean energy values and mean number of line items per day were lower for the 3-day method than for the 1-day method because of the fall-off on second and third day reports.

Several problems were identified in more than one study as needing special attention. Surrogate reporting merits further study. Procedures to help surrogates perform more effectively need to be developed. Respondents in general appear to want more information about the survey and a better understanding of what is expected of them. Validation of dietary intake data continues to have limited success. Efforts to improve completeness of listing, description, and quantification of foods eaten, especially for foods obtained and eaten away from home, have to be continued.

14.4 Continuing Research to Improve Methods and Meet Emerging Needs

The search for better dietary intake survey methodology and for improvements in those already in use is certain to continue because every method has shortcomings and data needs continue to expand. New methodological approaches to cope with some of the recognized problems are being developed, and results must be evaluated. For example, automation of the 1-day recall has been proposed for future surveys, but advantages and disadvantages are still to be appraised. Whether one structured questionnaire can take the place of thoughtful, supportive interviewers, and be understood by all people is a question that has yet to be answered. Or perhaps the automated interview procedure could assist interviewers, rather than supplant them.

Improvements in the validity of the data collected are required in order to meet the needs of many different users. Valid data are necessary to measure differences in food and nutrient intakes of individuals in different demographic groups. Data quality measures are desired by users, and the quest for methods that will produce improved data remains a challenge to survey researchers. Maintaining acceptable response rates will be a big consideration here.

The variation in food and nutrient intake is not as well explained by the variables currently measured in national surveys as researchers would like. Additional variables reflecting variations in lifestyle; knowledge, attitudes, and concerns about diet-health relationships; and other influences on dietary behavior are likely to appear in future surveys. Such variables may lead to greater understanding of changing determinants of dietary patterns for use in study of agricultural, marketing, and health problems and related program planning. A diet and health knowledge questionnaire supplements the CSFII 1989 and will provide new insights for future planning.

Efforts under way to promote greater comparability among surveys focus particularly on the NFCS/CSFII and NHANES since these survey systems are major sources of data for the National Nutrition Monitoring System. Greater linkage between these surveys requires attention to sample design and to definitions of variables, wording of survey questions, data collection methods, and data processing procedures. At the same time, continuity with earlier surveys must be maintained in order to expedite study of overall trends and changes in patterns. But all of these concerns with comparability cannot override the needs to fulfill the distinctive purposes of the two survey systems.

The recently established HNIS Methodology Research Group will spearhead efforts to improve survey methods. Multidisciplinary approaches can be expected to develop increasingly sophisticated techniques for in-depth study of dietary habits and food patterns. For example, applying econometric methods to the investigation of persistence in socioeconomic behavior promises to contribute to understanding of persistent patterns in individual dietary intakes. Such new knowledge opens avenues for progress in refining and elaborating current survey procedures. Several additional cooperative research projects concerning methodology in dietary intake surveys have been completed, and results will be reported soon. Results of a recently completed "bridging survey" are being analyzed to determine whether differences in reported intakes in NFCS 1977-78 and NFCS 1987-88 may result from actual changes or may be confounded by changes in procedure.

Investigations by HNIS of methods for collecting information on dietary intakes by individuals in national surveys between 1975 and 1988 concentrated on alternative data collection methods including longitudinal or panel approaches, validation of survey methods, intersurvey comparisons, and reduced nutrient data bases. However, emerging social, economic, and demographic changes will necessitate some changes in survey methods. Methods that worked well 10 years ago no longer appear to be adequate because people seem less willing to participate, more women are working outside of the home, or individuals are fearful of strangers knocking on their doors. Methodology studies must find better ways to obtain needed information in this changing situation. Survey researchers are recognizing that, because fewer respondents are inclined to devote time and attention to answering long questionnaires, current methods must be retailored to minimize respondent burden and maximize results. Possibilities for improving linkages between national surveys should be examined continuously. Individual surveys will require a unified framework in which more complex sample designs are integrated with more sophisticated analyses. Such a framework can compensate for data collection constraints in order to meet survey objectives. Survey respondents will need to be convinced of the major significance of their participation in providing data necessary for planning policy and administering programs that deal with changing problems of food, nutrition, health, and disease.

A number of other problem areas also merit careful consideration. A few topics for further research are outlined in Table 14.2, which is organized according to the survey stages and activities outlined in Figure 14.1.

Table 14.2--Topics for methodological research

Stage of survey and topic	Aspect for further research
Survey design:	
Sample design	--Explore sample designs that promote comparability with other studies.
	--Investigate differences in precision of estimates between 3 consecutive days (such as in NFCS 1977-78 and 1987-88) and 3 nonconsecutive days (such as in CSFII 1985 and 1986).
Nonresponse	--Explore extent of and reasons for nonresponse or incomplete participation such as failure to make contact or refusal to participate or failure to complete survey because of time involved, other stated reasons, or no stated reason.
	--Determine characteristics of non-respondents for comparison with those of respondents.
	--Explore techniques for improving response rates and quality of participation.
	--Consider various types and levels of incentives and test their effects on participation rates.
	--Investigate effects of adjustments for nonresponse such as weighting, imputation for units, items.
	--Examine nonresponse on specific items.
Questionnaire development:	
	--Examine internal consistency among questions and answers.
	--Construct and test questions about new and potentially important variables such as life styles.

Continued

Table 14.2--Topics for methodological research--Continued

Stage of survey and topic	Aspect for further research
Questionnaire development: (continued)	
	--Investigate introduction of new variables that may influence dietary behavior, such as attitudes and knowledge about diet and health relationships, possibly in a followup survey.
	--Test comprehension of selected questions by different population groups as by age, sex, race, and ethnic origin.
	--Compare responses among population subgroups to questions with variations in wording.
Data collection:	
Measurement aids	--Explore techniques and different types of measurement aids to help respondents estimate portion sizes with increased accuracy.
	--Explore effect of using various sizes of a measurement aid to help respondents estimate common portion sizes.
	--Examine reported use of measurement aids in NFCS 1987-88 by identifying how quantity was measured for specific foods, by specific sex-age groups.
	--Improve procedures for training interviewers and respondents in use of measurement aids and the booklet of instructions for reporting food intakes.

Continued

Table 14.2--Topics for methodological research--Continued

Stage of survey and topic	Aspect for further research
Data collection: (continued)	
Surrogate reporting	--Develop procedures to obtain "maximum informed response."
	--Investigate quality of surrogate reports versus respondent self-reports in NFCS 1987-88 using number of line items and number of inadequate descriptions and portions.
	--Set up experiment to test reports by two surrogates--such as mother and older sibling--for the same child.
	--Examine NFCS 1987-88 survey questionnaires for identity of surrogates, respondents for whom they report, and level of surrogate reporting.
	--Compare food and nutrient intakes from reports by surrogates with those by respondents themselves.
	--Explore techniques for more accurate reporting of dietary intake by children under 12 years.
	--Hold group sessions with survey respondents to develop guidelines for improving surrogate reporting within families.
Respondent burden	--Examine NFCS interview completion time of respondents by demographic, household, and personal characteristics.
	--Evaluate NFCS 1987-88 respondent difficulties as indicated by interviewer comments on questionnaire regarding quality of information provided by the respondent.
	--Investigate ways to prepare respondents so they are willing and able to give dietary data for the 1-day recall and 2-day diary-record.

Continued

Table 14.2--Topics for methodological research--Continued

Stage of survey and topic	Aspect for further research
Data collection: (continued)	
Interviewer performance	--Determine effect of interviewer by comparing foods and energy or nutrient intakes for 1-day recall versus 1-day diary-record.
	--Compare performance of interviewers for length of interview time, number of line items, missing or inadequate information, and level of food and nutrient intakes.
New procedures	--Compare data reported on recall or record with data reported on food frequency questions for calcium-rich foods, NFCS 1987-88 questionnaire.
	--Compare automated versus manual interview methods for respondent burden (length of interview) and quality of resulting data.
	--Investigate effect of microcomputer-assisted household interview on length of time for individual interview.
Probes	--Test responses to variations in probes to determine degree of probing that leads to more complete and accurate reporting.
	--Compare effects of probing versus not probing on 1-day recall and identify foods most needing probes.
	--Appraise effectiveness of specific probes by comparing 1-day recalls administered by trained interviewers and 1-day diary-records kept by respondents.
	--Determine types of non-sampling errors and ways to prevent or reduce them.

Continued

Table 14.2--Topics for methodological research--Continued

Stage of survey and topic	Aspect for further research
Data processing:	
Quality control	--Identify the questions requiring most frequent callbacks to respondents and develop suggestions for improvement.
	--Examine the use of default descriptions and portions of food and effect on mean results.
Data analysis:	
Family meals	--Determine with whom individuals eat meals and snacks and prevalence of family meals; relationship to surrogate reporting.
	--Investigate intraindividual and interindividual variation in food and nutrient intakes within households using NFCS 3-day reports for sampling implications.
	--Determine similarities among household members in eating patterns, such as breakfast skipping and kinds of foods eaten away from home, for sampling implications.
Change in procedures	--Examine effects of changes in NFCS procedures between surveys, such as in probing, changes in reporting food mixtures, volume to weight conversions, and nutrient data bases.
	--Compare quantity of calcium intake derived from 3-day reports in NFCS 1987-88 with that from quantified food frequency questions for specified calcium-rich foods.
	--Investigate level of autocorrelation in 3 consecutive versus 3 nonconsecutive days of energy and nutrient intakes.
Validation study	--Explore methods for validation of survey data such as replication and use of split samples.

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