

USDA Food Consumption Research: Parade of Survey Greats¹

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ABSTRACT This paper recognizes some of the scientists who conducted food consumption surveys and related methodology research for USDA over the past century. Information presented is drawn from published documents, interviews with scientists, and personal experiences of the author. "Survey greats" are identified for each of six time periods starting with W. O. Atwater in the period prior to 1900. Their activities are traced along several lines: The purposes and populations for which they sought food consumption information; the techniques they used to select survey participants and to collect and analyze data; the nature of the country's food supplies; and the understanding, at the time, of the nutritional composition of foods and of what constituted a good diet. Over the past century many creative and dedicated food consumption researchers have advanced their science to meet the demands for dietary information, taking advantage of new technologies and statistical procedures. *J. Nutr.* 124: 1836S-1842S, 1994.

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- food consumption
- survey methods
- history
- dietary surveys

Food consumption research over the past century reflects the interest and creativity of the scientists involved. Their activities can be traced along several lines: The purposes and populations for which they sought food consumption information; the techniques they used to select study participants and to collect and analyze data; the nature of the country's food supplies; and the understanding, at the time, of the nutritional composition of foods and of what constituted a good diet. Some items in these areas that were of special importance to food consumption studies during each of the six specified time periods are shown in **Table 1**.

PRIOR TO 1900

Day Monroe (1974) reviewed the origins of food consumption research in Europe. In the United States, W. O. Atwater, the first director of the U.S. Department of Agriculture's (USDA) Experiment Stations, is credited with the first food consumption studies in the late 1800's. He recognized the essential links between such studies and research on food composition, nutritional requirements, and dietary guidance and pioneered studies in all of these areas.

Atwater (1894 and 1895) sought food consumption information that would help him develop recommendations on what a working man should eat and how families could spend their food money wisely. By 1898, USDA investigators had made studies of food consumption by over 300 families.

A. P. Bryant (1898) described the data collection method, the food inventory record: Researchers determined the weight and cost of food used by the family from inventories of food on hand at the start and end of the survey period and records of foods brought into the home during the period.

To analyze the results of these studies, Atwater assigned factors for men, women, and children of different ages and activity levels that he believed related their food needs to those of a man at ordinary labor, whose factor was 1.0. As examples, a man at hard labor had a factor of 1.2, and a moderately active woman 0.8. He multiplied the factor for each

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TABLE 1
Summary of USDA Food Consumption Research

	Before 1900	1900-20	1920-40	1940-60	1960-80	1980-present
Leaders	Atwater, Bryant	Longworthy, Sherman, Gillett	Monroe, Stiebeling, Phipard	Stiebeling, Adelson, Clark	Clark, Adelson, Rizek	Rizek, Pao, Moshfegh, Harris
Purpose	Basis for advice on diet and spending for food	Basis for nutrient allowances, data on nutrient per dollar	Data on food use by households in U.S. regions, no. of poor diets	How diets differ—household location, income, size	Study household and individual diets and factors affecting them	How diets change year-by-year; how knowledge affects diet
Samples	A family willing to give information in a "study"	Families, healthy children and elderly (in homes)	Sampling techniques used first in 1935-36 Consumer Purchases Study	1942, urban and farm by income 1948, 4 cities 1955, all U.S., 1st sample selected by commercial firm	1965-66, 48 States 1977-78, 48 States, AL, HA, PR, low-income, elderly	1985-86, 1989-91 Continuing Survey; 1987-88, 48 States, low income; 1989-91, Diet and Health Knowledge
Methods	Food inventory record of food as purchased	Same	Food list recall introduced	Food list recall by households	Households, recall Individuals, recall, 1 day, record, 2 days	Same in 1987-88 Nonconsecutive days in CSFII 1985-86 Telephone in DHK
Technologies	Manual	Same	Desk calculators	Computers used first in 1948	Data sets provided for 1977-78 data	Data sets for all results
Food supplies	62 foods reported, most unprocessed	Some processed—i.e., bakery bread	Variety increased	168 foods on 1948 food list	1,705 foods on 1977-78 food list	2,900 foods on 1987-88 food list
Food composition	Data for refuse, protein, fat, CHO, "mineral matter," and fuel value	Some minerals added	Vitamins added	750 foods in 1950 table	2,500 foods in 1963 table	Over 6,000 foods and data for 27 nutrients on survey databases
Standards	Factors for needs related to man (estimated)	Tentative allowances for energy, protein, calcium, phosphorus and iron	Allowances for vitamins A, C, and some B added	First Recommended Dietary Allowances (RDA), 1941	RDA revisions	RDA and Dietary Guidelines for Americans
Problems	Food as purchased, not as eaten Factors and some food comp. data poor	Mineral content of diets differ widely, not representative	Need studies of survey methods	Data for individuals needed	Long questionnaire, response time excessive	Response rates in 1987-88 are unacceptably low
Innovations	Data collection analysis methods are models for decades	Allowances proposed—used with little change for 20 years	Sampling techniques first used; data used for food and agri. policy	Collection methods studied	Food intakes by individuals collected nationwide	Continuing survey; diet/health knowledge survey; activities coordinated with DHHS and others

person eating in the household by the number of meals eaten. He totalled the results for all in the household and divided by three (assumes 3 meals per day) to find the equivalent man-units per day for the family's food. He then calculated the food and nutrient consumption per man-unit for each family studied.

Prior to 1900 foods available to families of average means were few in number and most were unprocessed and locally produced. Atwater's food consumption table (1894) showed only 62 foods with values for a few components: refuse, protein, fat, carbohydrates, "mineral matters," and fuel value. Researchers made the many calculations required to estimate the quantity, nutritive value, and cost of foods consumed per man-unit without aid of even the desktop adding machine.

Atwater's methods for food consumption data collection and analysis served as models for future decades (Murray 1975). Problems in studies were identified as poor food waste measurement, inadequacy of food composition data, and the arbitrary nature of the factors for food needs.

1900–1920

C. F. Longworthy replaced Atwater as chief USDA nutrition investigator in 1906, after studying with scientists in Europe (Todhunter 1954). He compiled dietary records which he believed "should show the practice of those who are in health and vigor, whose lives are long and whose offspring are healthy, and that this will be valuable as a guide for others (Longworthy 1907)."

Longworthy's colleagues, H. C. Sherman and Lucy H. Gillett, sought information on food consumption to help in their establishment of nutritional requirements and to guide the poor in making economical food choices. For these purposes they conducted small studies of food consumption by families and by healthy children and elderly persons living in homes.

Sherman's studies were noteworthy for their nutritional evaluations. To judge adequacy, Sherman (1950) set tentative allowances for calcium, phosphorus, and iron as well as protein and food energy, which were used with little change over the next 20 years. Sherman and Gillett (1917) also calculated the nutrient return per dollar spent by 92 low-income families, most living in New York City.

A problem with procedures for selecting survey families was highlighted when analyses showed wide variation among families in the consumption of minerals. With such variation, there was concern that dietary levels for the few families surveyed might not be representative of levels for the population.

1920–1940

In 1923 the Bureau of Home Economics was established in USDA, with Louise Stanley as its chief. Day Monroe, Hazel Stiebeling, Esther Phipard, and others in the Bureau's Family Economics Division conducted food consumption surveys.

With the depression years of the 1930's came concern about the quality of American diets. To address this and other issues related to family economics, USDA and the Bureau of Labor Statistics (BLS) conducted several national studies.

The Consumer Purchases Study of 1935–36 provided findings separately for five regions of the country for urban, village, and farm families (Stiebeling et al. 1941). Stiebeling (1941) used results from this study to estimate that one-third of American diets were poor. Stiebeling and Phipard (1939) also analyzed 4000 records of food consumption by wage earners and clerical workers, collected by BLS in 1934–37.

Results from these large national surveys gave impetus to enrichment of white flour and bread, to establishment of the National School Lunch Program, and to expansion of nutrition education and research. USDA economists used results to project U.S. food consumption and to develop food budgets to help families select good diets. Later versions of the least costly of these food budgets, or food plans, are used in the Federal formulas for counting the nation's poor (Orshansky 1969) and for setting benefit levels in the Food Stamp Program (Peterkin et al. 1983).

Studies of the mid 1930's were the first to use statistical sampling techniques and to survey large numbers of households in relatively short periods. For such studies the food inventory record was found to be too intrusive, too time consuming, and too costly. Thus, with little preliminary study, a food list recall method was introduced. In this method, which remains popular today, an interviewer asks respondents to recall the amounts of listed foods that they used during a specified period. By the 1930's, researchers used newly available information about several vitamins in analysis of survey results.

This period marked several turning points in food consumption surveys. The first large scale surveys utilizing sampling techniques were conducted. The use of the food inventory record gave way to the more efficient food list recall for obtaining information on household food consumption. Results from these surveys, national in scope, were used to address national policy issues: to assess the nutrition of the nation and to design food and agricultural programs.

1940–1960

In 1943 the Bureau of Home Economics became the Bureau of Human Nutrition and Home Economics.

Hazel Stiebeling became its chief in 1944 and maintained a leadership role through several reorganizations during the 1950's and beyond (Murray 1975). Some of the survey research leaders of this period were Sadye Adelson, Faith Clark, and Margaret Reid.

Surveys of the period were diverse in size and purpose. In 1942 a survey of spending and saving in wartime (USDA 1944) measured the early effects of World War II on food consumption in urban, rural, and farm families at different income levels. A 1948 survey (USDA 1949) studied food and nutrient consumption in four cities after the war. In 1955 a large nationwide household survey of food consumption (USDA 1956-63) measured the quantities and costs of foods used by households in the country as a whole and in population segments classified by where they were located, their incomes and the number of household members.

Smaller studies (Adelson et al. 1961, Clark and Fincher 1954, Murray et al. 1952, and USDA 1954) addressed survey methodology issues, such as the use of the food inventory record versus the food list recall, food discard measurement, questionnaire design and wording, and interviewer training. Other studies (Adelson 1960 and Adelson and Keys 1962) explored techniques for collecting dietary data from individuals.

Some studies evaluated methods and collected useful data as well. For example, Velat et al. (1951) evaluated clinical, biochemical, and dietary methods and assessed the effects of school lunches in Cumberland, Maryland. The dietary segment of this study compared diets of school children receiving and not receiving school lunches, diets of children and diets of their families, and family diets measured by food inventory record and food list recall methods.

My survey experience began with the Cumberland study, under the guidance of Sadye Adelson. This experience in all aspects of the survey, from planning to analysis, gave me a special appreciation for food consumption research that I would have missed had I come to the field a few years later, when many survey activities were conducted under contract.

In 1948 computers were first used in the analysis of data. USDA's Ennis Blake applied this new technology to food consumption data, using computers at the Bureau of Mines. On this basis alone, she ranks as a "survey great."

The 1955 Household Food Consumption Survey was the first in which a commercial firm selected the sample and collected and edited the data. USDA retained responsibility for overall planning and monitoring of all survey operations, provision of support data for analysis, and the interpretation and publication of results.

Food supplies of this period were more varied than in previous periods. Composition tables, revised in 1950, contained 750 foods compared with Atwater's 65 foods. Recommended Dietary Allowances, first

published in 1941, provided generally accepted standards of diet quality.

During this period two studies, in 1942 and 1955, provided data for all regions and sections of the United States. Smaller studies focused on methodology to improve procedures for collecting information on household diets and to develop procedures for monitoring diets of individuals. Computer technologies were used in analysis for the first time.

1960-1980

In the 1960's, food consumption surveys were conducted by staff of the Consumer and Food Economics Research Division, a part of USDA's Agricultural Research Service, with Faith Clark and Sadye Adelson continuing leadership roles. Early in the 1970's, Robert Rizek became division director with support in survey research from Daniel Swope, Eleanor Pao, Marguerite Burk, and others.

Two nationwide surveys dominated this period. In the 1965-66 Household Food Consumption Survey (Clark 1974 and USDA 1969-75), homemakers in households in the conterminous States recalled their food use and cost for a week. Also, for the first time in a national survey, homemakers recalled, on behalf of individual household members, their intakes of food at home and away from the home for one day.

Information on food intakes by individuals is more precise than household food use for the assessment of diet quality. It reports foods as eaten, excluding food discard, and includes both food eaten at home and away from home. Also, intakes are for persons who can be identified by sex and age and appropriate Recommended Dietary Allowances.

In the 1977-78 Nationwide Food Consumption Survey (USDA 1979-85), data were collected on individual intakes for three days, one day by recall and two by record methods, as well as the usual household information. About 15,000 households and 34,000 individuals, more than any in any survey before or since, were surveyed. In addition, data were gathered from special samples of low-income households and households with elderly persons and from households in Alaska, Hawaii, and Puerto Rico.

These expanded data facilitated studies of factors affecting food consumption and diet quality among groups eligible for some of the Department's food assistance programs and for locations outside the conterminous States, not previously studied.

Methods used in the 1977-78 survey were based on experience in past surveys and methodology studies conducted in this and earlier periods (Burk and Pao 1976). As in the 1965-66 survey, data were collected under contract with a commercial firm. Some studies of issues important to the Department's agriculture,

food assistance program, and dietary guidance activities were conducted through cooperative agreements with universities.

The large number of foods available to families and the growing trends toward eating meals away from home complicated the data collection and analysis. Composition tables, revised in 1963, showed values for 2,500 foods; updated and expanded tables and data bases initiated in 1978 contained well over 6,000 foods. Also, more information about the households and individuals surveyed was collected to help define the many factors believed to be associated with food and nutrient consumption.

Evidence of links between diet and chronic diseases, especially dietary fat intake and heart disease, added a new dimension to dietary studies. In 1971-74, the Department of Health and Human Services (USDHHS) conducted the first of three surveys to monitor health status in the country. In these surveys information on food intakes by individuals was collected as one indicator of health status. In the late 1970's Congress asked the USDA and USDHHS to develop a joint plan for nutrition monitoring in the country (USDHHS and USDA 1981).

The main innovation of this period was the gathering of information on food intakes by individuals. However, information on household food use and cost remained important, especially for the management and evaluation of food and agricultural policy and programs.

1980 TO THE PRESENT

In the early 1980's, responsibility for research on food consumption, food composition tables, and dietary guidance development was moved to a new agency—the Human Nutrition Information Service. Robert Rizek, with Robert Reese, Eleanor Pao, and Mary Hama, led food consumption research during most of the 1980's; and Alanna Moshfegh and Ellen Harris have lead roles in the 1990's.

The early 1980's was a period of assessment. A National Research Council (NRC) committee examined the uses of food consumption data and made recommendations (NRC 1984). It found food consumption survey data being used to address traditional questions about food and nutrition and about agricultural production and the distribution of food; to determine how socioeconomic factors and food assistance programs participation affected food consumption and the nutritional quality of diets; to address food safety and toxicology issues; and to assess the design, marketing and consumption behavior for various food products. The Committee recommended that surveys which gave "continuous" (year-by-year) data on food consumption be conducted to keep pace with the fast changes in food consumption behavior.

A second NRC committee (1986) studied the standards and procedures used with survey data for measuring dietary adequacy. USDA conducted methodology studies in its effort to incorporate recommendations of these two NRC committees into survey operations, including the recommendation for continuous data (Pao et al. 1989).

In 1985 the Continuing Survey of Food Intakes by Individuals (CSFII), the first nationwide dietary survey on a year-to-year basis, was initiated (USDA 1985-89). CSFII was designed to monitor the dietary status of relative small national samples in the general and low-income populations in the years between the larger decennial surveys.

As part of the 1989-91 CSFII, follow-up telephone interviews were conducted to measure the attitudes and knowledge about diet and health among Americans (Cleveland and Tippet 1990). Thus, information on a person's attitude and knowledge could be directly linked to that on his food consumption behavior. Results from this survey help educators understand how well concepts of the Dietary Guidelines for Americans (USDA and USDHHS 1990) are being communicated and how knowledge of the guidelines affects food choices.

In 1987-88, the sixth large food consumption survey since the first in 1935-36 was conducted (Peterkin et al. 1988). As in the previous such survey in 1977-78, data were collected on food use and food cost for a week by the entire household and the intake of food, both at home and away, by individual household members over three consecutive days.

New automated technologies were adapted for use in survey operations. For example, in 1987-88 laptop computers were used to collect household data, and all survey results and food composition data sets used in analyses of 27 food components were provided electronically for use by others through the National Technical Information Service. Automated systems have been designed to code dietary data, update the coding system, and monitor the data collection contractor's performance.

Non-response was a major problem in the 1987-88 survey, partly due to heavy respondent burden. To help reduce this burden, the large nationwide food consumption surveys of previous decades may be replaced in the 1990's by two separate surveys—the Continuing Survey of Food Intakes by Individuals and the Household Food Consumption Survey. The objective of the surveys remains the same—to monitor the food consumption behavior and dietary status of the American people.

USDHHS and USDA (unpublished report 1987) sent an Operational Plan for the National Nutrition Monitoring System from 1987 to 1996 to Congress. This plan included USDA activities such as the 1987-88 survey and the CSFII with its diet and health knowledge follow-up, a program of food composition

research, and the U.S. food disappearance (food supply) statistics generated by the USDA's Economic Research Service. The plan called for periodic reports on the dietary and nutritional status of the U.S. population. USDHHS and USDA (1986 and 1989) sent two such reports to Congress, and a third is in preparation.

In recognition of the need for strong, sustained, and coordinated Federal efforts to monitor the nutritional status of the American people, an Interagency Committee on Nutrition Monitoring was established in 1988. The Committee, renamed the Interagency Board for Nutrition Monitoring and Related Research in 1991, with membership from 22 agencies, publishes a directory of Federal and State nutrition monitoring operation, currently over 45 of them (1992). The National Nutrition Monitoring and Related Research Act was enacted in 1990. The Act requested a ten-year plan for nutrition monitoring (USDHHS and USDA 1993).

Innovations of the period since 1980 were the CSFII, the Diet and Health Knowledge Survey, and the application of new technologies in the handling of survey data. The sixth large national survey was conducted and methods for improved surveys in the 1990's are being devised. Interest in nutrition monitoring is widespread in the public and private sectors.

OVERVIEW

Dr. Atwater is credited for his vision. He recognized the importance of information on food consumption, as well as on food composition and nutritional requirements, in the development of dietary advice for the public. His approaches to data collection and analysis were innovative and long lasting.

Many creative and dedicated food consumption researchers since Atwater's time deserve credit as well. They advanced their science to meet the increased and more diverse demands for dietary information and to take advantage of new technologies and statistical procedures. In the present period of unprecedented interest in diet, the ever increasing food choices available, and the disinclination of people to take part in surveys of any kind, the difficult job may have just begun.

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