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# FOOD CONSUMPTION BY INDIVIDUALS IN THE UNITED STATES: Two Major Surveys

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Knowledge is power.
Francis Bacon

I know no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion.
Thomas Jefferson

Public instruction should be the first object of government.
Napoleon

## INTRODUCTION

The habitual food consumption of individuals within a nation has important consequences for the health of those individuals and the economy of that nation. It follows that national economic and health programs should be based on a knowledge of national food consumption. To obtain such knowledge with



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a desirable degree of accuracy is both difficult and costly. Several types of data form the current basis for understanding food consumption in the United States. Among these, the data obtained from two recent large-scale national surveys of the food consumption of individuals are of prime importance. These are the Nationwide Food Consumption Survey (NFCS) conducted by the United States Department of Agriculture (USDA), and the National Health and Nutrition Examination Survey (NHANES), conducted by the United States Department of Health and Human Services (HHS). This review focuses on these two surveys: their history, design, data, interpretation, and their usefulness to governmental planners as well as to those engaged in research and teaching in human nutrition.

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## HISTORY

The two major surveys of food consumption in the United States grew from different reasons for needing knowledge of food consumption. Their status today can best be understood from an historical perspective.

Small surveys of food consumption by selected populations in the United States have been conducted for over a century (9, 22, 44). The results of some of these have been aggregated so that a more comprehensive picture could be obtained (37). These small surveys continue to be a useful means of examining in more detail a small population than is possible in a large survey. However, a truly national picture of the food consumption of individuals in the United States requires a national sample, statistically designed to represent the United States population. Admittedly, such a sample can never represent adequately all of the subpopulations that comprise the heterogeneous national population. Even a sample representing the major subpopulations must be very large, making the survey quite costly. Both the NFCS and NHANES employ large national samples statistically drawn to represent the United States population, with special emphasis on selected subpopulations.

The USDA has a long-standing interest in food consumption that dates from the time of Wilbur O. Atwater, and has grown out of its major programs in support of food production (5, 34, 83). USDA interest and involvement in food consumption surveys have been reviewed by Clark (9) and by Burk & Pao (6). During the 1930s, the Department began periodic national surveys of food consumption by households. From the beginning, these surveys provided information about the quality of United States diets and the amount of money being spent on food. Surveys were conducted in 1936–37, 1942 (spring only), 1948 (urban areas only), 1955 (spring only), 1965–66 and 1977–78 (57–71). In 1965–66, a survey of food consumption by individuals in the spring was added to the household survey (61), and in 1977–78 the survey of individuals was conducted in each season of the year (63). Thus the NFCS and its predecessor

surveys have provided over 40 years of information about food consumption in the United States. The data obtained have been an important basis for planning food programs (particularly with regard to costs), for developing nutrition information and education programs, and for helping to define research questions. However, they do not provide information about the nutritional status of individuals, although the household data obtained over a week provide useful data on the dietary status (food use compared to standards) of housekeeping groups.

The United States Department of Health and Human Services (HHS) began a National Health Survey in the late 1950s. In 1968, a nutrition component was added to this survey (73). The sample used in this component, usually known as the Ten-State Nutrition Survey, was selected to overrepresent certain subpopulations that were believed to be at greater nutritional risk. In 1971–74, the NHANES I included information on food consumption in a probability sample of the United States population 1–74 years of age (74, 77). Differential sampling of high-risk groups was employed in order to detect problems in these smaller segments of the population. Individuals in the sample were given a general medical and dental examination, including anthropometric and biochemical measurements, designed to detect nutritional deficiencies. The surveys were planned to provide a basis for assessing the nutritional status of these individuals and to examine the relationship of diet to nutritional status (13).

Interest in the health of the United States population leads HHS to an interest in the assessment of food consumption. This perspective results in a different, but potentially complementary, survey from that conducted by the USDA. Like the NFCS, the NHANES is designed as a periodic survey. The second NHANES was conducted in 1976–80 (81). Thus, NHANES I and II covered ten years, with data collection occurring during most of those years.

## DESIGN

The NFCS and NHANES provide different data. However, in the most recent surveys there was some limited coordination of the survey plans. Generally, the surveys complement each other, but because of differences in design and data bases employed there are not many direct comparisons that can be made between them.

The NFCS gathers information on food consumption in households and on individuals within those households. The 1977–78 sample was a stratified area probability sample of about 15,000 households and 34,000 individuals surveyed in 48 states from April 1977 through March 1978 (51, 63). Supplemental samples included the following: 1100 urban households (2400 individuals) in Alaska in winter 1978; 1250 households (3100 individuals) in Hawaii in winter 1978; 3100 households (900 individuals) in Puerto Rico the last six months of

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1977; and in the 48 states, 5000 households with at least one member 65 years or older (7500 individuals) sampled throughout the year, and 4700 households eligible for food stamps (13,000 individuals) sampled from November 1977 through March 1978. The information obtained included the location of the household; household income; participation in food programs; education, occupation, and employment status of the male and female heads of households; size of household; race; food produced at home; monetary value of food used at home; cost of food eaten away from home; and individual characteristics including sex, age, estimated height and weight, and a self-appraisal of health and physical handicaps. Food use data for households was obtained for a seven-day period. Individuals gave a 24-hour dietary recall and most kept food intake records for the following two days. Dietary calculations include intakes of energy, protein, calcium, iron, magnesium, phosphorus, vitamins A, C, $B_6$, $B_{12}$, thiamin, niacin, and riboflavin. Preliminary results are available in printed form for household data obtained in spring 1977 (62, 64) and for the 24-hour recalls given by individuals at that time (63). Preliminary results are also available for the special surveys (65, 67–71). Tapes are available for data obtained in all seasons.

NHANES II examined over 20,000 noninstitutionalized persons ages six months through 74 years in 64 locations within the United States (81). About 75% of the desired sample participated (38). A national population probability sample was drawn. The survey, originating from the National Health Survey that was without a nutrition component, incorporates several anthropometric measures, a clinical (medical) examination, and several biochemical determinations. Among the measurements made in NHANES II were serum cholesterol, triglycerides, and protein; hematocrit, hemoglobin, cell count, serum iron, iron binding capacity, and protoporphyrin; and on a subsample, ferritin, copper, zinc, serum and red-cell folate. The dietary calculations, based on 24-hour recalls, include intakes of cholesterol, linoleic acid, vitamins A and C, thiamin and riboflavin, protein energy, fat, and carbohydrate. They also include calcium, phosphorus, iron, sodium, and potassium. Details of the survey plan are published (81) and discussed elsewhere (20, 38, 39, 86). Descriptions of the techniques used in NHANES I (27, 28) are generally applicable to NHANES II, though some tests have been added, eliminated, or modified.

## RESULTS FROM NHANES AND NFCS

Although only preliminary results are available, the 1977–78 NFCS provides interesting data about food consumption in the United States (62–71).

Forty-four percent of all individuals giving a 24-hour dietary recall ate some of their food away from home; 60% of the men ages 23–34 reported eating food

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obtained and eaten away from home (14). Eighteen percent of all eating occasions and 25% of the money spent involved food obtained and eaten away from home (62). The data indicate that the dietary status of many individuals is influenced by commercial sources of prepared foods, and that this influence is increasing.

Meat, poultry, or fish items were used by over 90% of the individuals reporting a 24-hour recall (46, 63). Beef was most popular—reported by 35%, with the average user eating 5.4 ounces in the day, or the equivalent of 2 servings each of 2.5 ounces. The consumption of poultry was reported by 18%, with an average use of 5.2 ounces per user. The eating of fish or shellfish was reported by 9% of the individuals, with an average intake of 4.4 ounces. This obviously popular group of foods makes a major contribution to protein intake. Consumption of milk and milk drinks was reported by 69% of the sample, with an average daily use of slightly over one cup. Cheese (average of 0.5 ounce) was reported by 25%. [The elderly have increased their use of milk and milk products since 1965 (61, 63).]

Almost 50% of the people surveyed consumed white potatoes. Dark green vegetables were used by 9% and deep yellow vegetables by 8% during the day reported in the 24-hour recall. Citrus fruits were consumed by about one third of those persons surveyed. The use of whole grains has increased from 6% in 1965 to 16% in 1977 (45).

The consumption of soft drinks increased, as has the consumption of alcohol. From the nutritionist's perspective, consumption of these beverages is of interest because they supply calories while not supplying significant amounts of most other nutrients. Since the use of alcohol may take on moral or religious implications when viewed from nonnutritional perspectives, it is difficult to get accurate data on alcohol consumption. Systematic under-reporting is assumed. The proportion of the food dollar spent for alcohol did not change from 1965–1977 (62), but the reported amount consumed increased. In 1977, 10% of the sample reported alcohol consumption in their 24-hour recall (45, 63).

Eating patterns of individuals can be viewed in at least two ways: *(a)* the frequency and spacing of eating occasions; and *(b)* the types of foods most characteristic of the diet. Both aspects have been examined using NFCS data (47, 54, 63). Three eating occasions a day was the most frequent pattern, being reported by 39% of the sample. Twenty-eight percent reported eating four times a day and 14% reported eating five times. Eight percent reported only one or two eating occasions in the 24-hour recall. The NFCS data have been grouped into several different food patterns, and the adequacy of those patterns has been analyzed (50, 53). None of the food consumption patterns met the nutrition guidelines suggested by USDA and HHS (50). Similar food patterns obtained in the Ten-State Survey, NHANES I, and NFCS (50, 54). It has been suggested that identification of these patterns and their nutritional adequacy could be used as a basis of dietary status assessment.

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Analysis of the food intake of various age and sex groups reveals remarkably similar average quality (85). With the exception of only two or three nutrients (vitamins A, C, and perhaps $B_{12}$) most of the variation in the nutritional quality of the diets of groups of differing age or sex is due to differences in the quantity of food consumed, and not to differences in food choices (4, 85).

Lack of data for many nutrients and for several foods limits analysis of the nutrient composition of diets. However, data are more inadequate for folacin, $B_6$, $B_{12}$, and the trace minerals than for many other nutrients. Considerable variation exists in nutrient intake from day to day and from person to person. Table 1 shows some measure of this variation for energy and vitamin A intakes recorded in NHANES II. It records a four-fold range in energy intakes, a variation seen within one age group as strongly as within the entire sample. Males consume more energy than females, but the distribution of energy intakes of both males and females is skewed toward high intakes. There is a twenty-fold range in vitamin A intakes, with men consuming more than women. The distribution is strongly skewed toward high intakes. Beaton (2) pointed out the extreme variability of vitamin A intake. A preliminary analysis has been made of the extent to which an individual's 24-hour recall agrees with his three-day average intake (H. Guthrie, personal communication). For the 21,579 individuals included, a large proportion of their one-day nutrient intakes deviated by more than 25% from the mean for three days. The greatest variation was for vitamins A, C, and $B_{12}$, and the least for energy. The findings for vitamins A and C agree with observations made by others. It is not immediately apparent why so much variation exists in $B_{12}$ intakes in the NFCS data.

Table 2 gives mean intakes obtained in NHANES I for energy, iron, calcium and vitamin A (75, 76, 78–80). Energy consumption was higher by males than

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**Table 1** NHANES II: Variation in nutrient intakes (1976–80)[a]

| | Number | Mean | Estimated percentile | | |
|---|---|---|---|---|---|
| | | | 5th | 50th | 95th |
| Energy (Kcal/day) | | | | | |
| Males (0.5–74 yrs) | 9,983 | 2,381 | 976 | 2,187 | 4,400 |
| (25–34 yrs) | 1,067 | 2,734 | 1,213 | 2,577 | 4,749 |
| Females (0.5–74 yrs) | 10,338 | 1,579 | 683 | 1,493 | 2,769 |
| (25–34 yrs) | 1,170 | 1,643 | 677 | 1,547 | 2,889 |
| Vitamin A (IU/day) | | | | | |
| Males (0.5–74 yrs) | 9,983 | 5,690 | 779 | 3,709 | 15,510 |
| (25–34 yrs) | 1,067 | 5,910 | 546 | 3,559 | 17,293 |
| Females (0.5–74 yrs) | 10,338 | 4,637 | 596 | 2,948 | 13,306 |
| (25–34 yrs) | 1,170 | 4,665 | 425 | 2,782 | 13,140 |

[a]Based on 24-hour dietary recalls (82)

**Table 2** NHANES I: Nutrient intake by US adults (1971–74)[a]

| Age in years | Number | Energy (kcal) | Iron (mg) | Calcium (mg) | Vitamin A (IU) |
|---|---|---|---|---|---|
| Females: | | | | | |
| 25–34 | 1,896 | 1,638 ± 715 | 10 ± 5 | 659 ± 496 | 4,328 ± 7,235 |
| 45–54 | 836 | 1,533 ± 618 | 11 ± 5 | 592 ± 406 | 5,319 ± 10,494 |
| 65–74 | 1,822 | 1,307 ± 522 | 9 ± 4 | 468 ± 359 | 5,190 ± 9,326 |
| Males | | | | | |
| 25–34 | 804 | 2,739 ± 1,045 | 17 ± 7 | 1,049 ± 800 | 5,350 ± 7,858 |
| 45–54 | 765 | 2,301 ± 858 | 15 ± 6 | 838 ± 605 | 5,172 ± 7,509 |
| 65–74 | 1,657 | 1,805 ± 738 | 12 ± 6 | 714 ± 467 | 5,480 ± 8,264 |

[a]Mean ± standard deviation; based on 24-hour dietary recall (78)

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by females, but in both groups consumption declined with age. Iron and calcium intakes followed the pattern for energy, whereas mean vitamin A intakes were reasonably constant except for females age 25–34, who ate less vitamin A.

Table 3 gives average intakes for similar age groups surveyed in NFCS. The data are quite similar to those obtained in NHANES I, although an exact comparison is not possible owing to differences in age categories, food composition data used, and sampling. The remarkably low energy intakes found in these surveys raises questions about the ability of these diets to meet the needs for other nutrients. They also raise questions about sedentary life-styles and their effects on nutritional status. Iron intakes and calcium intakes for women seem low. Vitamin A intakes are somewhat higher in the NFCS survey than in NHANES I, except for the lower intake by women ages 23–34. Data on $B_6$ intakes are included in Table 3, and the intakes seem low. However, better information about $B_6$ content and availability from foods is needed to evaluate such data.

Table 4 gives preliminary nutrient intake data from NHANES II. Energy intakes are similar to those reported from NHANES I and NFCS. Calcium and energy intakes of young males in NHANES I and II may appear somewhat higher than in NFCS. There may be some indication of slightly increased vitamin A intakes in the two most recent surveys as compared with NHANES I. All things considered, there is remarkably close agreement between the findings in the three surveys.

The frequency distributions of the individual means for three days of intake in NFCS data were compared to the RDA (48). For protein, 88% of the individuals met or exceeded their RDA. However, for magnesium only 25%, for $B_6$ 20%, for iron 43%, and for vitamin A 50% met their RDA. Probably a three-day intake is insufficient to assess vitamin A intake, but may more closely approximate usual intakes of protein and iron. Analytical data on $B_6$ and

**Table 3** NFCS: Nutrient intake by US adults (1977–78)[a]

| Age in years | Number | Energy (kcal) | Iron (mg) | Calcium (mg) | Vitamin A (IU) | $B_6$ (mg) |
|---|---|---|---|---|---|---|
| Females: | | | | | | |
| 23–34 | 949 | 1616 | 11 | 604 | 4335 | 1.2 |
| 51–64 | 792 | 1522 | 11 | 532 | 6044 | 1.3 |
| 75+ | 197 | 1367 | 10 | 591 | 5931 | 1.2 |
| Males: | | | | | | |
| 23–34 | 770 | 2449 | 16 | 830 | 5278 | 1.8 |
| 51–64 | 634 | 2148 | 15 | 702 | 6945 | 1.7 |
| 75+ | 127 | 1808 | 13 | 679 | 6693 | 1.5 |

[a]Averages based on 24-hour dietary recalls in Spring 1977 (63)

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magnesium contents of food may limit the reliability of this evaluation. The basis for estimating the RDA for these two nutrients is limited as well.

Fat was the source of forty-one percent of the estimated energy intake in the NFCS study (48). Meat, poultry and fish constituted twenty-eight percent of the energy intake (63). Twenty percent of the individuals reported energy intakes from fat of less than 35%, and 25% had fat intakes providing over 45% of their total energy consumption.

Preliminary data only are available from NHANES II on cholesterol and fat intakes (82). These will be more valuable when they can be examined as they correlate with clinical and biochemical findings. Mean cholesterol intakes for males (all ages) were 405 mg/day, and 266 mg/day for females. The mean fat intake for males was 98 g/day, and 64 g/day for females.

Traditionally, surveys of food consumption have been designed to reveal differences in food intake associated with income or geographic location (1,

**Table 4** NHANES II: Nutrient intake by US adults (1976–80)[a]

| Age in years | Number | Energy (kcal) | Iron (mg) | Calcium (mg) | Vitamin A (IU) |
|---|---|---|---|---|---|
| Females: | | | | | |
| 25–34 | 1,170 | 1,643 ± 733 | 11 ± 6 | 636 ± 453 | 4,665 ± 9,147 |
| 45–54 | 763 | 1,439 ± 638 | 10 ± 5 | 676 ± 478 | 5,219 ± 8,631 |
| 65–74 | 1,416 | 1,295 ± 503 | 10 ± 5 | 542 ± 336 | 5,486 ± 8,090 |
| Males: | | | | | |
| 25–34 | 1,067 | 2,734 ± 1,140 | 17 ± 10 | 968 ± 702 | 5,910 ± 11,598 |
| 45–54 | 690 | 2,361 ± 1,029 | 16 ± 8 | 841 ± 540 | 6,198 ± 9,396 |
| 65–74 | 1,199 | 1,828 ± 753 | 14 ± 8 | 698 ± 443 | 6,572 ± 12,535 |

[a]Mean ± standard deviation; based on 24-hour dietary recall (82)

**Table 5** NFCS: Relationship of income to money value of food used at home[a]

| Income before Taxes[b] | Average $ Value[c] | Percentage households using food worth[c] Under $8.00 | $12.00 to 15.99 | $16.00 to 19.99 | Over $30.00 |
|---|---|---|---|---|---|
| Less than $5,000 | 15.42 | 9 | 24 | 18 | 6 |
| $5,000–$9,999 | 15.17 | 9 | 25 | 24 | 6 |
| $10,000–$14,999 | 15.39 | 6 | 26 | 21 | 7 |
| $15,000–$19,999 | 16.04 | 6 | 28 | 22 | 7 |
| $20,000 + | 18.46 | 2 | 25 | 24 | 12 |

[a]Data collected in Spring 1977 (62)
[b]Household income in 1976
[c]Per person (7 days × 3 meals per day)

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63). However, those associations seem less in recent surveys than formerly. Table 5 shows the effect of income on the monetary value of food used at home. The amount spent per person increases as income increases, but the differences in monetary expenditures are much less than the differences in income. There is a tendency for a larger percent of lower income households to report unusually low expenditures and for a higher percent of high income households to report unusually high expenditures. Interestingly, lower income households get more nutrients for their food dollar than do higher income households (Table 6). Thus there is no evidence of excessively wasteful food expenditures in the lower income household. In contrast, the highest-income households make less efficient food purchases when viewed solely from the standpoint of the nutrients purchased (49). Of continuing concern, however, is the fact that 3% of all households surveyed reported they did not have enough food (51). A higher proportion of lower income households, 9%, reported lack of food.

Analysis of the special survey of households eligible for participation in the food stamp program reveals that when households receive a relatively higher proportion of their income from food stamps, they spend relatively more for food (21). However, preliminary attempts to relate participation in the food stamp program to the quality of the diet in a household illustrated the difficulty of defining diet quality and the inappropriateness of the use of the RDA for this purpose (21).

One of the most puzzling observations coming out of the large surveys of the food consumption of individuals has been the very low energy intakes compared to the amount of energy per capita available in the total food supply. These discrepancies suggest either a failure to record all of an individual's intake or a great deal of waste of food, or both. Recent data suggest that there are about 3500 kcal available in the United States food supply for each person each day (72). The household food use data (64) indicate that only about 2900

**Table 6** NFCS: Nutrients per dollar's worth of food used at home[a]

| Income before taxes[b] | Energy (kcal) | Protein (g) | Iron (mg) | Vitamin A (IU) |
|---|---|---|---|---|
| Under $5,000 | 1280 | 45 | 9.1 | 3720 |
| $5,000–$9,999 | 1310 | 45 | 9.1 | 3630 |
| $10,000–$14,999 | 1300 | 45 | 9.1 | 3200 |
| $15,000–$19,999 | 1220 | 42 | 8.1 | 2860 |
| Over $20,000 | 1140 | 41 | 7.7 | 2930 |

[a]Data collected in Spring 1977 (62)
[b]Household income in 1976

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kcal per person per day actually come into the kitchen, or a loss in the food marketing system of about 600 kcal per person per day. This represents about a loss of 15%. Household food waste would appear to be even greater, as the consumption of individuals is somewhat less than 1900 kcal per person per day (63). Compared to the 2900 kcal that were brought into the kitchen, this indicates an apparent loss of over 30%. Waste in institutional and commercial food operations varies (84), but in some it may be quite significant. Accounting for food waste in studies of household food use is important (26). However, studies of waste, based on analysis of garbage, would suggest household wastage of around 10% of the kcal (17). This agrees with other studies based on food records (12, 84). Estimates of total waste in the United Kingdom range up to about 25% (56). The definition of waste needs to be clear before precise analyses of these apparent losses can be made (12, 56), but this is an interesting and important area for further studies.

Ultimately, it would be useful to relate food consumption to nutritional status. Data based on one day of food consumption cannot be used to correlate an individual's dietary status with his nutritional status because data for one day do not reflect dietary status (2). However, the existence of dietary, clinical, anthropometric, and biochemical measures for individuals participating in NHANES (28–30) has given rise to exploration of correlations (23, 28, 36).

Attempts to correlate mean food intakes of groups with means of indices of their status are confounded by the great variation within the groups. Problems also exist in accurately detecting clinical, biochemical, and anthropometric signs of marginal malnutrition. A concerted effort has been made in NHANES II to evaluate the relationships between dietary status and anemia. It will be interesting to see if clear relationships can be distinguished.

## USEFULNESS OF NFCS AND NHANES RESULTS

The foregoing review of current results from these surveys makes their potential usefulness to governmental agencies and to nutrition scientists and educa-

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tors obvious. However, it is important to make a critical examination of the quality of the data obtained and the validity of interpretations being placed on it. Further, one must ask if the necessary information is being sought or made available from these surveys. Any critical examination of the usefulness of food consumption data must take into consideration the ways in which data have been employed in the past. Clark (9) reviewed the uses made of USDA food consumption data. Among these, she lists decisions about food enrichment; rationing and price controls during wartime; governmental food and nutrition programs—who needs them and what they need; nutrition research involving human feeding studies, studies of food habits, smaller studies of food consumption and factors affecting it; identification of potential food hazards; justification for more intensive studies of certain problem nutrients; and projection of consumer demand and marketing decisions. Food consumption data are also useful in education programs for health professionals. When food consumption studies are coupled with clinical, biochemical, and anthropometric measures, some inferences may be drawn about the relationships of dietary to nutritional status in the population (40, 52). Experience with the *Ten-State Nutrition Survey* (73) suggested that data relating food consumption to health can be politically explosive. Yet, public policy represents a major justification for obtaining the data.

Habicht (15) described the components of a nutrition monitoring and surveillance system. He argues that nutrition assessment, nutrition monitoring, and nutrition surveillance are three different types of activities. These terms are not always employed in the same sense, but considerable discussion of the need for a more comprehensive system of nutrition monitoring and surveillance has occurred in recent years (18, 35, 41, 43). The panel on Nutrition and Government, reporting at hearings sponsored by a Senate Committee (55), advocated a surveillance system that includes studies of food purchases and food consumption patterns (based on updated nutrient analyses of food); analyses of foods and diets for food additives, contaminants (7), and key nutrients; and a coordinated system to monitor nutritional status, particularly of high-risk groups.

Forbes (11) concentrated attention on a National Monitoring system, in which he includes surveillance of food production, food composition, food consumption, marketing of specific food products, clinical nutrition status of people, consumer attitudes and practices, effectiveness of nutrition information and education materials, and improvement of methodology for monitoring. Recent testimony at Congressional hearings indicates that USDA and HHS officials are considering all of these aspects as they try to respond to charges from Congress and urging from the scientific community (42) that they develop a comprehensive national system of monitoring and surveillance, including the two food consumption surveys and the appropriate portions of the HHS health survey (43).

The food consumption surveys must be viewed in a larger perspective and in relationship to many other data sources, including USDA studies of food disappearance (8, 72, 83), certain marketing data (32), and the HHS Total Diet Study (16). Nevertheless, these studies of nutritional status and food consumption play an important and unique role within this larger scheme, and the quality of their results can be examined critically apart from the other data.

The difficulties in accurately measuring an individual's food behavior (24–26, 87) limit the quality of food consumption data. Most measures run the risk of altering behavior because the subject is aware of being observed or of having to record intake (17). Subjects are frequently concerned about possible negative judgments about their food behavior and, even in recalling previous intake, may alter the facts to receive a more favorable judgment from the observer. The most commonly used technique, that of having the subject recall the previous 24-hour food intake, requires skilled interviewers and may even then contain errors due to forgetfulness and inability to judge accurately the quantity of food eaten (31, 33, 41). It has been demonstrated that the mean food consumption for large groups is fairly stable from day to day (with the possible exception of weekends), but that the intakes of individuals within the group vary considerably from day to day. In fact, more of the variance in data obtained from repeated 24-hour recalls stems from individual variation than from variations between individuals (2, 3, 87). However, the means of food intake obtained from the NFCS or NHANES remain reasonably good estimates of the mean food intake in the United States.

From a single 24-hour recall, little information can be drawn about the usual variation in dietary practices among individuals within the population. Thus, the data contained in Table 1 indicate variation in intake on any one day. They do not indicate variation in the usual energy intakes of individuals. Presumably, energy intakes averaged over a period of several days will vary less than they do on any one day. When the complete three-day records of food intake become available from the NFCS, a better estimate of variation among individuals will be possible. Preliminary indication is that individuals with consistent meal patterns have less variable nutrient intakes (H. Guthrie, personal communication). It is regrettable that no information on variation has been published from the NFCS as yet.

Even if the food consumption of each individual subject were accurately known, this would not necessarily translate into accurate information about nutrient consumption. Many factors alter the nutrient content of a food so that an actual analysis is required for maximum accuracy. Even then, analytical techniques for many nutrients are inadequate for measuring the nutrient in the complex mixture of chemicals comprising most foods. Finally, the presence of a nutrient in a food does not guarantee its availability to meet the nutritional needs of the person consuming it. For example, more information is required

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concerning the forms of folacin in foods and their bioavailability, the trace mineral contents of food, and factors affecting the bioavailability of these nutrients.

When the nutrient availability from the food consumed by a participant or a group of participants in a survey is known, conclusions can be drawn about its adequacy in relationship to needs for that nutrient. A standard or set of standards, such as the Recommended Dietary Allowances (RDA), aids in evaluating the adequacy of the nutrient consumption. The NFCS has traditionally compared nutrient intakes to the RDA or to some percentages of it. The RDA are not useful standards for evaluating the average intake of a group because the RDA are set as a goal to be met by each individual within a group. If habitual intake were known, it would be appropriate to compare that intake for each individual to the RDA. It is not useful to evaluate a single day's intake by the RDA. Further, it is misleading to evaluate diets by a constant percentage of the RDA for each nutrient because greater margins of safety exist in the RDA for some nutrients. The evaluation of household data by the RDA is inappropriate unless some additional consideration is given to waste. The RDA are goals for consumption, not for purchase of nutrients (19).

The NFCS nutrient intake data have also been evaluated in terms of the amount of nutrients supplied by each 1000 kcal in the diet (85). This gives a measure of diet quality, but not a measure of the dietary status of individuals consuming that diet because dietary status will depend upon the total amount eaten and other variables. The NHANES used a special set of nutrient standards for evaluating food consumption (78). However, these standards did not circumvent the problems encountered in drawing conclusions about adequacy of individual diets from a singe day's food intake. No analysis of the adequacy of a diet will provide a valid assessment of nutritional status (52). However, groups with poor quality diets can be recognized as being at risk and in need of further examination for possible nutrition problems.

Unavailability to most potential users restricts the use of the results obtained from NFCS and NHANES. Data from both surveys are now being made available to researchers in the form of data tapes, a laudable change from earlier practices that should increase the use of the data. Interesting analyses might be expected from the work of several different groups of workers using the same data (39). There is, however, an undesirable delay in the availability of the tapes after the survey is completed, and an even greater delay in making the data available in print form. Every means must be sought to decrease these delays (10) that are reducing the usefulness of these surveys to the broader community of nutrition researchers and educators and their timeliness for determination of policy. In the summer of 1982, preliminary data were available from one portion of the NFCS, and only very preliminary nutrient intake data were available from NHANES II. Data from all seasons and for three

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consecutive days of food intake will add much to the value of the NFCS. Certainly, the clinical, biochemical, and anthropometric findings from NHANES II—when they become available—will greatly increase the value of the NHANES results.

## CONCLUSIONS

In the quest for knowledge of food consumption in the United States, the Nationwide Food Consumption Survey and the Health and Nutrition Examination Survey make important contributions. However, the accuracy of information about food consumption is limited because of the poor techniques available for measuring the habitual food consumption of individuals. More suitable techniques should be developed. The translation of information about food consumption into information about nutrient consumption is hindered by inadequate measurements of the nutrient composition and availability from foods. Attempts to relate nutrient consumption to an individual's nutritional status are limited by an inability to assess an individual's nutrient requirements and to identify and measure indicators of marginally inadequate nutritional status. All of these limitations point to necessary research on techniques for the development of better data bases.

Information available from the NFCS and NHANES suggests that nutrient consumption is limited more by low food intakes now than in previous years—particularly for women and especially elderly women. The seemingly low consumptions of iron and calcium by much of the population raise questions as to the presence of signs of poor nutritional status relating to these essential nutrients. Information yet to come from NHANES II may answer some of these questions. More information is required about the amount and bioavailability of nutrients such as folacin, vitamin $B_6$, magnesium, zinc, and other trace elements in foods. The surveys to date provide only very limited information about the consumption of these nutrients.

People with low incomes tend to consume less food, but the food they consume has more nutritional value per calorie than food consumed by people with higher incomes. Differences in diet quality due to income are small on the average, but limited ability to purchase adequate amounts of food appears to limit the dietary status of some individuals. Variation in nutrient intake within the groups of individuals in these surveys is very large. Better information is needed from the surveys about variations in a single individual's food intake over days, weeks, or years.

Even though they make important contributions to our understanding of food consumption, the NFCS and NHANES need to be improved. The two surveys should be more closely coordinated in order to increase their usefulness as a system for monitoring food consumption and nutritional status in the United States. More careful planning and coordination will increase the value of data

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obtained from the NFCS and NHANES for governmental decisions, and as sources of fundamental knowledge useful in nutrition teaching and research. Improvements in data processing and publication are necessary to shorten the time between obtaining the data and making it widely available. More attention should be given to the validity of interpretation of the survey data when conclusions are to be drawn as to the dietary or nutritional status of individuals in the United States. Particularly, greater distinctions need to be made between conclusions that can be drawn legitimately from the average nutrient intake of groups versus conclusions about individuals within the group who are underconsuming or overconsuming certain nutrients on the day of the survey. Improved standards are required for using dietary data to identify groups of individuals at risk of poor nutritional status.

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