

Measurement of food consumption—past, present, future^{1, 2}

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Introduction

Food consumption has been measured by a variety of methods in the United States since the early 1900's. The United States Department of Agriculture has been responsible for measuring and appraising trends and variations in food consumption since about 1930. These studies have provided a cross-sectional view of food consumption as well as a historical perspective on changes in food patterns. Researchers have used a variety of methods to make estimates of food consumption with varying degrees of aggregation. A detailed description of alternative procedures used by the USDA and other investigators has been published by Burk and Pao (1).

The various measures of food consumption may be classified as those derived from national accounts, per capita consumption data, household food surveys, and surveys of individual diets. These methods differ greatly in the degree of aggregation of the data and the conclusions that may be drawn from them.

Measurements derived from national accounts provide the most highly aggregated measure. A measure of the change in overall food consumption in a country may be derived from such data as national consumption expenditures for food. These data are obtained from the United States Department of Commerce based on expenditures for food, excluding business expenditures but including farm and home-produced food.

Per capita consumption data are reported by the Economic Research Service (ERS) of the USDA. These data are derived from food balance sheets or supply and distribution tables by dividing estimates of total disappearance into civilian distribution (calculated on a residual) by the total civilian population. Since the data are derived from residuals from American data only, the aggregate cannot be divided among end users without special surveys. Also, they cannot be disaggre-

gated by area. These annual estimates are reported in the ERS publication, "Food consumption, prices, expenditures" (2).

A third level of aggregation are the household data obtained in surveys. Data collection procedures include records or recall of purchases and other current acquisitions; inventory-record method, which records acquisitions plus changes in inventory; list-recall procedures; and weighed or measured records of supplies to be used each day. The USDA has used the list-recall method since the 1930's for its household food consumption survey.

The lowest level of aggregation of food consumption data is that obtained by surveys on individuals obtaining information on the quantities of different food consumed by individuals. Several methods have been used to gather these data, namely: 1) records based on weighing of food; 2) records based on measuring or estimating amounts eaten in household units; 3) recall over various spans of time, such as 24 h or several days; 4) dietary history based on recall over a longer period, possibly even a year; 5) frequency of intake estimated for past or current consumption; and 6) combinations of the various methods presented above.

There has been a trend in recent years to place emphasis on the measurement of food consumption of individuals using combinations of the above techniques. The methods most often used have been 24-h recall combined with either 2- or 3-day written food records, as in the most recent USDA Nationwide Food Consumption Survey, or food frequency information, as in the HANES I and II surveys. This has been due to the desire to obtain information which would permit cal-

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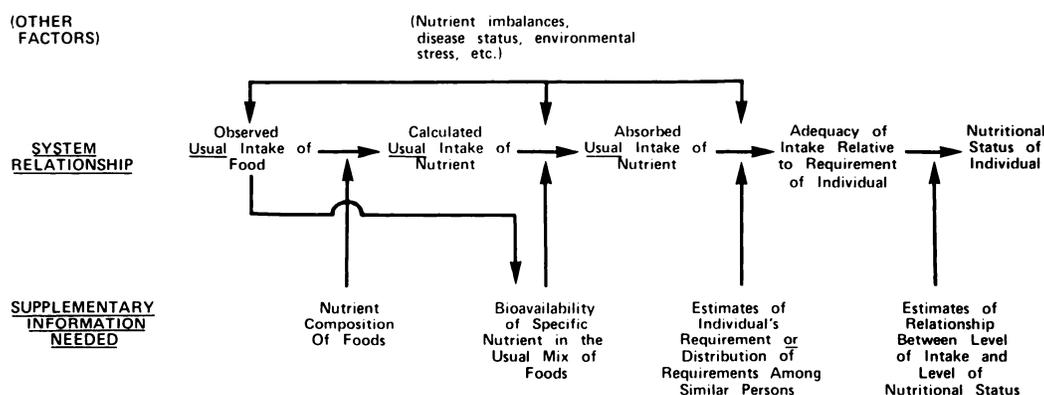
ulation of nutrient intake from food recall data at the level of the individual aggregated into various population groupings.

Significant problems of interpreting food consumption data in terms of nutrient intake are apparent. The problems of translating food consumption information to estimates of nutrient intake are well known. Twenty-four-hour recall data on the individual frequently do not represent the usual pattern of food and hence nutrient intake. While the single 24-h recall may give a reasonable estimate of nutrient intake for the total population sample, the values for many nutrients may vary significantly as the population is segmented due to the extreme variations that can occur from day to day. Therefore, although data obtained in 24-h dietary recall are frequently used to assess the nutritional adequacy of food intake relative to some standard, such as the Recommended Dietary Allowances of the Food and Nutrition Board (FNB), National Academy of Sciences (NAS), this is not a valid method for assessing nutritional status. Improved methods of estimating nutritional status from dietary data are desired. This requires improved methods of measuring food consumption of individuals and relating this to nutrient intake.

The Food and Drug Administration contracted with the FNB of the NAS for a study of the sources of data on food consumption

and to suggest a system for integrating food consumption data with data on health and nutritional status. The purposes of the study were to evaluate current means of determining food consumption patterns and nutritional status and to devise alternative methods for obtaining information on food consumption, food consumption patterns, and nutritional status. The Committee on Food Consumption Patterns of the FNB has completed the study, and a report entitled "Assessing Changing Food Consumption Patterns and Their Effect on Nutritional and Health Status Indicators" has been published (3). The principal recommendations are summarized herein.

A schematic flow of a system that could be used to relate food consumption to nutritional status taken from the NAS report is shown in Figure 1. It should be understood at the outset that it is not possible to determine the nutritional status of individuals from dietary data alone. However, from measures of the usual food intake of a population it is possible to assess the probability that individuals may or may not meet certain nutritional standards. The prevalence of individuals who may have intakes below an established standard can be computed. It is not possible, however, from dietary data alone, to identify which individuals in a population may be at risk of inadequate nutrient intake. To use such an ap-



Note: For energy, information would be needed about usual level of physical activity (work and leisure)

FIG. 1. A system for analysis and interpretation of dietary data.

proach requires knowledge of the distribution of usual food intake, distribution of usual nutrient requirements, and the correlation between intake and requirement among individuals.

Measurements of food consumption of individuals must be designed in such a manner to obtain estimates of the usual food intake. Using food composition tables, the usual nutrient intake can be calculated, and its variance, based on the usual observed intake, can be determined. Information on individuals' actual nutrient requirements and their variability are required. From information on usual nutrient intake and its variability and nutrient requirements and variation among individuals, it is possible to estimate the number of individuals (but not which individuals) in a population with intakes below requirements.

Relating food consumption to health status has many problems. Predicting health status from dietary data alone is not possible. The role of certain foods and dietary components in the development of several chronic diseases is not well documented. In addition there is a wide variation in the susceptibility of individuals within a population to such chronic diseases as diabetes, coronary heart disease, atherosclerosis, hypertension, and cancer. Knowledge concerning the relationship of food consumption patterns to susceptibility to chronic disease can better be determined from a careful examination of food consumption patterns of population groups with known unusual incidences of these chronic diseases. Care must be taken to carefully control for environmental and genetic factors.

A number of the health data bases in existence could be used in conjunction with food intake data to develop an appropriate monitoring system. Data from current health data bases need to be identified, summarized, and evaluated in those population subgroups used for food intake data analyses.

The Committee on Food Consumption Patterns of the FNB proposes a system for measuring usual food intake and relating it to health status, including nutrition. The proposed system has the following elements.

Subsystem I

A continuous collection, processing, and review of food intake data from a stratified

probability sample of the United States population.

Subsystem II

The collection of health status indicator data from currently available sources and their correlation for population strata analogous to that from which the dietary information is derived.

Subsystem III

The ongoing examination of available aggregate data from commercial and governmental sources on market food disappearance from regional and economic strata comparable to the above.

Subsystem I, food intake of individuals, proposes the establishment of data collection, processing, and analyses as an ongoing operation which will permit the responsible lead agency to develop and maintain a highly qualified unit operating on a continuous basis. For the purposes of sampling design, it is suggested that a time frame for collection of a statistically adequate sample of the stratified United States population be 5 yr. It is recommended that the design provide for the collection and processing of these data at the rate of 20% of the full sample per year. The analyses and interpretation of the data should be updated each year on the basis of data accumulated for the preceding five years (a moving 5-yr average). The annual analysis can provide trend information for the 12-month period as an early warning of possible developing problems.

The proposed measurement of food intake involves a data collection system providing for replicated 1-day observations of the same individuals in sufficient number and stratification to provide an estimate of the distribution of usual intakes among the selected strata of the population. The recommended data collection technique is a 24-h recall by trained interviewers. This recall may be supplemented with a 3-day food record and/or food frequency questionnaires to provide additional data concerning frequency of food use. Four replicated observations on the same individual within the 1-yr sampling period may be necessary to provide a measure of the usual food intake of that individual and of the variation currently experienced to provide adequate data for use in determining the



usual food intake pattern of the population group.

The proposed system has certain data base requirements. These include distribution of nutrient requirements, distribution of food component tolerances, and food composition data including both nutrients and nonnutrients. A cooperative effort by government, academia, and industry will be necessary to establish the requisite data bases. It is to be expected that in time the current data bases will improve in quality.

Subsystem II involves health status indicator data. The objective of this system is to yield information that may be valuable in maintaining or improving the state of health, including nutritional status of the United States population. Therefore, it is necessary to relate food consumption patterns to nutritional and health status. It is recognized that knowledge of the relationships between food consumption, nutritional status, and general health status are limited, and many areas are controversial. Careful examination of the factors to be studied and the data to be collected is required to ensure relevance to the issues under examination and to permit appropriate interpretation.

Existing health data bases can be used in conjunction with food intake data. While it is not necessary to collect both types of information from the same individuals, the collection, transfer, and summarization of health data according to population characteristics that can be duplicated in food consumption studies will be necessary.

In order to increase the potential for identifying relationships between food consumption and health status, available statistics should be examined to identify population segments whose health indicators appear to be abnormal relative to the population average and to the averages of other subgroups. Special studies of food consumption should be carried out among these population segments, and/or an appropriate sampling of this population subgroup should be included in a regular monitoring program that combines information on diet and health.

Subsystem III deals with aggregate food data. A number of sources of aggregate data concerning food disappearance and food purchases now exist within the government and private sector. Some data are available at a

national level only. Others provide data grouped according to regional or consumer characteristics. Comparisons of aggregate food disappearance or food purchase data with the measurement of food intake data over a time period may provide a basis for predicting relationships between these data bases. Aggregate data bases may prove to be very useful as an early warning component of a system by detecting changes in foods reaching the consumer. Since it is much more economical to obtain data from aggregate systems as opposed to measurement on individuals, it is important that where possible data from the aggregate data systems be used to meet monitoring needs.

In summary, the proposed system is based on the continuous determination of the usual pattern of food intake of individuals and population groups. This information, plus information on variation of food intakes and food composition data can be used to determine the usual pattern of nutrient intake and its variation. While it is not possible from dietary data alone to assess nutritional status, it is possible, with current knowledge of human requirements, to assess the individual's risk of inadequate status based on intake of certain nutrients and to predict for a normally distributed population the prevalence of individuals who have intakes below requirements.

The health and nutritional status of individuals cannot be predicted from dietary data alone. However, if dietary data can be linked to existing health data, health status indicators believed to be associated with food or nutrient intake can be identified. Data from appropriate studies of the food consumption patterns of individuals in a group could then be used to predict the prevalence of individuals with increased risk to health from a particular pattern of food or nutrient intake.

Food consumption studies in the future are likely to yield more useful information by carefully deciding for what purpose the data are to be used and developing the most appropriate method to obtain the requisite information. 

References

1. Burk MC, Pao EM. Methodology for large-scale surveys of household and individual diets. Home Ec Res Rep no 40. Washington, DC: United States



- Department of Agriculture, Agricultural Research Service, 1976.
2. United States Department of Agriculture, Economic Research Service. Food consumption, prices, expenditures. Statistical bull 672. Washington, DC: United States Department of Agriculture, Economic Research Service, 1981.
 3. National Research Council, Food and Nutrition Board, Committee on Food Consumption Patterns. Assessing changing food consumption patterns and their effect on nutrition and health status indicators. Committee on food consumption patterns, Food and Nutrition Board, National Research Council. Washington, DC: National Academy of Sciences, 1981.

