Résumé

Le mesurage de l'apport alimentaire en recherche infirmière

Eileen R. Fowles, Bobbie Sue Sterling et Lorraine O. Walker

L'évaluation précise de l'apport alimentaire est une composante essentielle qui doit être intégrée à la recherche internationale en santé afin d'identifier les déviations nutritionnelles pouvant entraîner des risques de maladies chroniques chez les individus. Une incapacité à se pencher sur les problèmes connus qu'entraîne l'utilisation d'outils de mesurage alimentaire traditionnels peut entraver la réalisation d'une évaluation précise. Cet article décrit l'application ainsi que les avantages et les désavantages de cinq méthodes d'évaluation alimentaire fréquemment utilisées. Les auteures discutent également de la gestion des erreurs de mesurage associées à chacune d'elles et recommandent l'utilisation de ces méthodes dans le cadre de recherches communautaires portant sur la santé. L'utilisation de méthodes d'évaluation complémentaires à plusieurs étapes de mesurage améliore la fiabilité des résultats. Le recours à une évaluation de la qualité générale de l'apport alimentaire correspond à une approche d'intervention holistique conçue pour améliorer la santé. C'est aussi un outil méthodologique qui s'avère intéressant pour la recherche nutritionnelle. L'utilisation d'approches novatrices pourra permettre d'identifier avec plus de précision les tendances alimentaires contribuant à l'apparition de maladies. Bien que complexe, l'étude de l'apport alimentaire en recherche sur la santé s'avère une étape essentielle à l'identification du risque de maladie chez un individu et de sa réaction au traitement.

Mots clés : évaluation alimentaire, erreur de mesurage

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Measuring Dietary Intake in Nursing Research

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Accurately assessing dietary intake is an essential component of international health research to identify nutritional deviations that may place people at risk for developing chronic diseases. Accurate assessment may be hampered by failure to address known measurement problems with traditional dietary assessment tools. This article describes the application and advantages and disadvantages of 5 frequently used dietary assessment methods, discusses the management of measurement error common to each, and recommends use of these methods in community-based health research. Using complementary assessment methods at multiple measurement points enhances the reliability of the findings. Assessing overall dietary quality is consistent with a holistic approach to interventions designed to improve health and is a valuable methodology for nutritional research. Using innovative approaches may more accurately identify dietary patterns that contribute to disease development. Although complex, examining nutritional intake in health research is essential to determining an individual's disease risk status and response to treatment.

Keywords: Dietary assessment, food frequency questionnaires, measurement error, nutrition

Nutrition is an integral component of international initiatives aimed at improving health and preventing and managing chronic diseases (Muller & Krawinkel, 2005; World Heath Organization, 2000a). Recent findings indicate that poor diet along with a sedentary lifestyle is second only to smoking as the leading modifiable cause of mortality (Mokdad, Marks, Stroup, & Gerberding, 2004). Diet is a key factor in the prevention and management of obesity (World Health Organization, 2000b) and related chronic illnesses, such as type 2 diabetes (Schulze & Hu, 2005). Diet may also contribute to health outcomes related to life stages, such as pregnancy and childbirth (Institute of Medicine, 2003), adolescence (Chan, Hoffman, & McMurry, 1995), and aging (Battino & Ferreiro, 2004).

Within a research context, dietary assessments are conducted to determine overall dietary quality, total energy (kilocalorie [kcal]) intake, the level of a nutrient group, such as fat intake, or a particular micronutrient, such as calcium, to assess risk status or response to treatment (Willett, 1998). Accurate measurement of overall dietary quality as well as specific macro- and micronutrients is a crucial component of health status assessments. Nurses need to know how to effectively measure dietary intake in community-based studies designed to improve health and prevent or manage disease. However, little information regarding nutritional assessment methods is currently available in the nursing literature and nurse researchers may not be fully aware of innovations for enhancing the accuracy of dietary assessments. This article describes the advantages and disadvantages of various dietary assessment methods and discusses strategies for managing potential measurement error and enhancing the validity of selected dietary assessment tools in community-based health improvement and disease prevention research.

Dietary Assessment Methods

The overarching goal in any dietary assessment is to maximize opportunity for accurate and reliable assessment while minimizing the effects of both random and systematic measurement error. Selecting the most appropriate assessment approaches for the research question and then instituting procedures to control within- and between-persons error can best meet this goal.

Direct observation of food intake conducted either alone or with weighed food records is one of the most accurate methods for quantifying dietary intake and is often used in controlled inpatient settings. However, subjects may alter usual eating behaviours when being observed, or may supplement weighed food records, which can produce an inaccurate picture of typical intake (Barrett-Connor, 1991). Although direct observations of food intake in a controlled hospital setting are possible, use of such methods may not be feasible or appropriate for large, community-based studies. Thus, the most frequently used dietary assessment approaches in community-based research are 24-hour dietary recall, food records, food frequency questionnaires, and biomarkers.

Several factors need to be considered in selecting an appropriate dietary assessment measure. These factors include the specific research question, including the exact planned use of the dietary data. For example, is the dietary variable of interest absolute energy intake (kcal), the level of a particular macronutrient (total grams of fat), change in intake over time, or a measurable physiological response to the level of dietary intake? A second consideration in selecting a dietary assessment measure includes characteristics of the targeted research population — that is, the setting for the assessment, age, literacy level, availability of assessment tools in a specific language, and cognitive abilities of the intended sample. It is also important to consider the availability of computer resources and trained personnel to gather data or to enter the data for analysis. Even though technology significantly expedites dietary intake entry and analysis, procedures for verifying accuracy of data gathering, entry, checking, and analysis may be both time-intensive and labour-intensive (see Table 1).

Most research approaches rely on self-reported food intake that may or may not be augmented by an interviewer trained to extract more complete intake information. The results of nutritional assessments, however, may be inaccurate because of underreporting of dietary intake despite construction of a thorough food frequency scale or the efforts of a trained interviewer (Willett, 1998). Understanding the advantages and disadvantages of the various dietary assessment methods and innovations for managing measurement errors may help the researcher to report nutritional outcomes that accurately reflect disease risk status or response to nutritional interventions (see Table 2).

24-Hour Dietary Recall

Twenty-four-hour dietary recall is one of the most frequently used methods for determining usual dietary intake. (See advantages and disadvantages in Table 2.) This assessment generally requires less than 30 minutes to complete and does not require participant literacy. Twenty-four-hour dietary recall can be completed via telephone (Johnson, 2002) and does not result in undue participant burden (Biro, Hulshof, Ovesen, & Cruz, 2002). The resultant dietary data can be entered into a food analysis program. Participants may be less likely to alter eating behaviours when responding to a 24-hour dietary recall because the nutrient information is collected after the fact (Willett, 1998).

Recalling intake, however, may be difficult for children and for some cognitively impaired or elderly persons. However, the major methodological concerns with recall are the inadvertent overreporting and underreporting of consumed foods, daily or seasonal variations between foods consumed on a weekend versus a weekday, and the possibility of the participant's providing socially desirable responses (Willett, 1998). These problems can be minimized by incorporating multiple, nonconsecutive 24-hour dietary recall (Willett) and by using a standardized approach, such as the calibration method employed in Europe (Slimani et al., 2000; Slimani, Valsta, & EFCOSUM Group, 2002) or the recently developed US-based "multiple pass" method to obtain more complete intake amounts (Moshfegh et al., 2001). These innovative methods have been found to enhance accuracy of food-intake assessment of young children (Johnson, Driscoll, & Goran, 1996), of men and women under controlled conditions (Conway, Ingwersen, & Moshfegh, 2004; Conway, Ingweren, Vinyard, & Moshfegh, 2003), and in large multinational populations (Slimani et al., 2000). Using modern computer-assisted programs, such as the EPIC-SOFT program developed in Europe or the US-based

Table 1 *Sample of Products and Programs for Nutritional Assessment*

Dietary Intake Collection Products[a]	
BalanceLog (http://www.healthetech.com)	PDA-based software to track and analyze food intake and activity; Windows- and Mac-compatible.
DietMax for a Pocket PC, 2003 (http://www.sparklesolutions.net/index.html)	PocketPC-based software to track food intake.
DietMate Pro (http://www.dietmatepro.org/)	Palm-based tracking of food intake that can provide feedback to client. Client sync's intake data into a Web site for analysis that is accessible to researchers and clinicians.
EPIC-SOFT (see Slimani et al., 2000; contact N. Slimani for information: Slimani@iarc.fr)	Computer-based software developed to collect interactive dietary information in 11 European countries.
Dietary Analysis Programs[b]	
CAFÉ: Compositional Analyses from Frequency Estimates (see Welch, Luben, Khaw, & Bingham, 2005; contact A. Welch for information: ailsa.welch@phpc.com.ac.uk)	• Based on UK food composition tables. • Developed to analyze data from the EPIC study. • Modifies nutrient intake according to type of fats used in food preparation. • Updateable.
WISP: Intake, Recipe and Menu Analysis (http://www.tinuvielsoftware.com/wisp.html)	• Over 4,500 food items. • Can store 100,000 recipes. • Uses UK or US food composition tables. • Analysis of 120 (UK) or 125 (US) nutrients.

Food Processor (http://www.esha.com)	• Over 29,000 foods in database. • Analysis for 133 nutrients and nutrient factors. • Database updates offered twice yearly.
Diet Balancer for Windows (http://www.xkee.com/home-education/diet-balancer/)	• 4,500 foods, including fast foods, in database. • Allows for the addition of foods to list.
FoodWorks 7.0 (http://www.nutritionco.com/)	• Over 16,000 foods in database. • Unlimited database expansion — add new foods. • Analysis for 113 nutrients and food components.
Minnesota Nutrition Data System (http://www.ncc.umn.edu/)	• Over 18,000 foods in database. • Analysis for 136 nutrient, nutrient ratios, and food components. • Interview prompts to guide data collection using multiple-pass approach for 24-hour recall.
Nutritionist Pro (http://www.firstdatabank.com/specialty_software/nutritionist_pro/)	• Over 20,000 foods, including brand-name foods, fast foods, ethnic foods, and enteral products. • Analysis for 90 nutrients and nutrient factors. • Database updates offered twice yearly.
Food/Analyst Plus (http://www.hoptechno.com/faplus.htm)	• Over 23,000 foods, including fast foods and common restaurant meals. • Allows for the addition of foods and label information. • Analysis for 100 nutrients.

[a] Product costs vary from US$14 to $179.
[b] See Lee, Nieman, and Rainwater (1995) for a discussion of dietary analysis programs. Costs vary from US$200 to $8,500.

Table 2 *Advantages and Disadvantages of Dietary Assessment Methods*

Description of Assessment Method	Advantages	Disadvantages
Direct Observation with Weighed Food Records • Weigh each item of food on plate before and after meal.	• Valid measure of amount of food consumed.	• May not reflect typical intake. • Costly; impractical for large studies.
24-hour Dietary Recall • Trained interviewer elicits foods, portion size, place, and timing of meals eaten within past 24 hours.	• Easy to complete. • By phone or in person. • Some computer programs provide prompts to foster more complete dietary intake information and rapid analysis.	• Relies on short-term memory. • May not reflect typical intake. • Data entry may be time-intensive.
Food Records • Trained interviewer instructs person to make detailed list of foods consumed, including preparation methods and brand names.	• Does not rely on short-term memory. • Accurate estimate of portion sizes with use of food models. • Can include culture-specific foods.	• Requires motivation for prolonged period of record-keeping. • Person may alter typical diet. • Cost of carefully training participants is high.

Food Frequency Questionnaires • Consists of a list of foods with options to select for the amount and frequency of consumption on a weekly or monthly basis within a specified period from 3 to 12 months.	• Optically scanned into computer analysis program. • Does not require trained interviewer. • Assesses dietary patterns over an extended period.	• Needs a comprehensive list of foods that identify health risk of interest, including culturally sensitive foods. • Prone to response-set biases if too long. • Inconsistent estimates of portion sizes (small, medium, large) and frequency. • May be insensitive to foods in culturally diverse populations. • Uncertain validity. • High cost for some analysis programs.
Biomarkers • Estimates of nutrient of interest obtained from blood, urine, saliva, and hair samples.	• Estimates availability of some nutrients that are difficult to assess with questionnaire data. • May have less error than dietary assessments.	• Absorption rates vary among nutrients and individuals. • Influenced by individual metabolic differences. • Nutrient availability affected by food-preparation methods. • Logistic and cost concerns.

Source: Information compiled from Johnson (2002) and Willett (1998).

Minnesota Nutrition Data System, may reduce systematic bias, which often develops when interviewers obtain the information. These programs may improve the reliability of the nutrient analysis (Slimani et al., 2000) (see Table 1).

Collecting 24-hour dietary recall information across 3 to 5 non-consecutive days, one of which is a weekend day, or for multiple days over a 1- or 2-week period, maximizes the probability of capturing daily variations and provides dietary information that more closely reflects usual eating habits than assessing intake over 2 days consisting of 1 weekday and 1 weekend day (Willett, 1998). Differences in average intake within a population may be determined by a single 24-hour intake only if sample sizes are very large. The research question guides the number of required 24-hour intake records and needs a balance of weekday and weekend days (Margetts & Nelson, 1997; Willett). This assessment strategy better captures intake of cultural foods and is useful in determining average nutrient intake levels.

Food Records

Food records or food diaries, another commonly used open-ended dietary intake approach, requires the participant to complete a description of food intake either shortly after eating or at the end of the day. This approach requires consistent participant motivation to complete the record accurately. When using written food records, dietary information is typically collected for 3 to 7 days, which encompasses a variety of work and non-work and weekday and weekend days. One of the advantages of food records as well as 24-hour dietary recall is that they allow research participants to describe what they actually are eating. This is a great advantage for cultural groups that may have dietary foods not typically listed on food frequency questionnaires. Similar to 24-hour dietary recall, food records are useful in research projects to determine changes in average intake and macro- or micronutrient levels over a brief period.

Comparing the accuracy of assessments using 24-hour dietary recall and food records is revealing. One study in which dietary data were collected by 24-hour dietary recall and food records noted that unannounced 24-hour dietary recall (conducted by telephone) more accurately assessed changes in fat intake during a low-fat diet intervention than 4-day food records (Buzzard et al., 1996). In this study, several areas of measurement error were noted. First, underreporting of fat intake was noted at baseline using 24-hour recall and in multiple 4-day food records, when compared to unannounced 24-hour dietary recall. Second, a compliance bias was noted, in which participants tended to report more favourable fat intakes when recording intake for 4 days than during a spontaneous 24-hour dietary recall (Buzzard et al.). Other researchers have noted that estimates of nutrient intake varied by 70 to 80% when compared to observed food intake (Emmons & Hayes, 1973; Krantzler et al., 1982; Schnakenberg, Hill, Kretsch, & Morris, 1981). This difference resulted primarily from omitted foods.

Underreporting of food intake and compliance bias are common sources of error when 24-hour dietary recall or food records are used. These errors occur when participants do not fully understand how to estimate portion sizes or when they provide socially desirable responses (Biro et al., 2002). To minimize such sources of measurement error, nurse researchers should use careful and consistent instructions from a trained interviewer, supplement these with printed instructions given to study participants for home use, emphasize the importance and value of the participant's actual intake, and follow up with telephone or mail reminders. In addition, use of food models during face-to-face interviews may clarify participant's perceptions of a serving size. Providing participants with a standard set of measuring devices, weighing scales, and pictures can ensure a more accurate estimate of portion size. Offering incentives and asking participants to keep food records for the minimum time necessary to obtain the nutrient information may result in a better response rate (Willett, 1998). Finally, a trained interviewer can review food records to explore any apparent omissions or overestimations.

A number of recent innovations go beyond the traditional manner of collecting food records in research. These may help to extend the reach of nutrition research and may address some of the methodological concerns related to 24-hour recall and food records. For example, mailing participants a booklet (Kolar et al., 2005) or a videotape (Timmerman & Stuifbergen, 1999) containing detailed instructions for recording food intake, questions about food-use patterns, and photographs of serving sizes, in addition to mailing measuring spoons and cups, can effectively eliminate the need for intensive in-person participant training and extensive review of records. Newer technologies, such as Web-based records or personal digitial assistants (PDAs), have been used effectively to collect 24-hour dietary recall and food records (Bälter, Bälter, Fodnell, & Lagerros, 2005; Beasley, Riley, & Jean-Mary, 2005).

Food Frequency Questionnaires

Food frequency questionnaires (FFQs) are used in large epidemiological studies to assess "typical" dietary intake over a designated period. Typical FFQs consist of a detailed list of foods and a section for reporting how often each food was eaten over the selected period. The numbers and variety of foods listed in commercially available FFQs vary from only foods related to a single nutrient to more than 190 food items (Nelson

& Bingham, 1998). Examples of FFQs include the European Prospective Investigation of Cancer FFQ (EPIC FFQ; McKeown et al., 2001), the Harvard Semiquantitative FFQ (Willett FFQ; Willett et al., 1985), the NCI/Block Health Habits and History Questionnaire (Block FFQ; Block et al., 1986), and the Diet History Questionnaire (DHQ; Subar et al., 2001).

FFQs have many advantages as well as several inherent methodological drawbacks. In addition to the concerns listed in Table 2, the food items listed in FFQs must be sufficiently comprehensive to include foods containing nutrients of interest or pertinent to the disease under study and cultural or ethnic foods representative of the research population. Even with these inclusion requirements, the list must not be so long that respondents become overburdened and fail to complete the form in a thoughtful manner. Respondents must be literate in the language of the FFQ. FFQs are considered semiquantitative because perceptions of portion sizes listed (e.g., small, average, large) vary among respondents. Consumption of unlisted foods and frequency of eating seasonal foods, such as summer fruits, can lead to an inaccurate assessment of "usual" daily caloric or nutrient intake over 12 months (Willett, 1998).

FFQs developed for adult populations may not reflect typical intake during nutritionally critical periods such as childhood, adolescence, pregnancy, or chronic illness. Several instruments have been developed to assess dietary intake during childhood and adolescence (Hammond, Nelson, Chinn, & Rona, 1995; Rockett et al., 1997), during the preconception period and pregnancy (Brown et al., 1996; Forsythe & Gage, 1994; Greeley, Storbakken, & Magel, 1992; Wei et al., 1999), and in cancer patients (Ambrosini et al., 2003, Kristal, Feng, Coates, Oberman, & George, 1997). Careful validation studies must be conducted when developing a population-, disease-, or culture-specific FFQ (Margetts & Nelson, 1997; Willett, 1998). Such validation is also needed when an FFQ developed for one country is adapted for use in another.

FFQs have been used for several research purposes. Brief FFQs have been developed to screen for specific food or nutrient intake. These instruments include a limited number of items targeting different food groups such as fruits and vegetables (Jansen et al., 2004; Ling & Horwath, 1999), fat intake (Howell, McNamara, Tosca, Smith, & Gaines, 1998), or individual nutrients such as calcium (Angus, Sambrook, Pocock, & Eisman, 1989). FFQs have also been used to track usual dietary intake over a prolonged period, but these may not be useful for determining changes in dietary patterns before or after a nutritional intervention.

The uncertain validity of FFQs is perhaps the most pressing problem with this dietary assessment method. FFQs are reported to overestimate energy and nutrient intake when compared to directed and undirected

24-hour dietary recall (Castor, 1985; Sorenson, Calkins, Connolly, & Diamond, 1985), 2-day weighed food records (Sorenson et al.), 16-day weighed food records (Bingham et al., 1994), interviewer-conducted diet histories (Jain, Howe, & Rohan, 1996; Sorenson et al.), and 7-day food records (Jain et al.).

More recently, nutrient analysis using FFQs has been compared to quantitative biochemical markers. Seven-day (McKeown et al., 2001) and 4-day (Rothenberg, 1994) food records are more closely associated with urinary nitrogen levels than FFQs. In a recent epidemiological study, FFQs performed less accurately than 24-hour dietary recall in assessing energy expenditure when compared to doubly labelled water measures and to nutrient intake measured by biochemical markers (Subar et al., 2003).

In an effort to overcome underreporting and overreporting energy intake assessed with FFQs, adjustments can be applied by using the cut-off values established by Goldberg and colleagues (1991). These values are based on a ratio between the observed energy intake and estimated basal metabolic rate (EI/BMR) for a known activity level that reflects a "reasonable intake" for the individual (Becker & Welten, 2001). Data for persons reporting low levels of energy intake based on EI/BMR or "unreasonably low intake" should be excluded from analysis. Employing cut-off values may not be useful to adjust for measurement errors for within-person variations on individual nutrients and should not be used to adjust energy intake levels assessed with 24-hour dietary recall.

Biochemical Markers

In recent years, biochemical markers have been used in nutritional research as a proxy measure of energy and nutrient intake. However, several problems have been found with this approach. Availability of the nutrients is influenced by individual metabolic variations in absorption and utilization rates. For example, the amount of calcium absorbed is affected not only by calcium intake but also by current levels of calcium within the tissues (Potischman, 2003) — that is, serum calcium levels may be within normal limits despite inadequate intake if calcium deposits within the body tissues are adequate; similarly, serum calcium levels may be low despite adequate or excessive intake when calcium levels in the tissues are low, indicating greater absorption. One of the most limiting features, however, is that there is no easily applied biomarker for energy intake or the macro-nutrient composition of the diet (Winkler, 2005).

Biomarker assays can also be affected by the existence of concurrent physiological processes, such as infections, and by the presence of other nutrients that may alter absorption rates. For example, serum ferritin levels, a reliable measure of physiological response to iron supplementation in developing countries, is affected by the presence of infection, a common occurrence in anemic populations. Furthermore, ferritin levels do not accurately indicate the degree of iron deficiency in persons lacking iron stores (Mei et al., 2005). Similarly, high fibre content in foods can decrease the absorption rate of carotenoids (Potischman, 2003). (See Margetts & Nelson [1997] and Willett [1998] for a detailed discussion of biomarkers in nutritional research.)

Anthropometric assessments, such as weight, body mass index, and mid-arm circumference, also have been used in international research as proxy measures of overall energy intake (World Health Organization, 1995). Whilst these measures provide a gross estimate of total caloric intake, they do not reflect intake of specific foods and nutrients and thus cannot be used to determine precise nutrient deficiencies (World Health Organization, 1995). For many nutrients, self-report methods will continue to constitute the primary means of dietary assessment. As a result, greater attention to managing measurement error in self-report methods is warranted in research.

Strategies to Enhance Accuracy of Dietary Intake Measurement

Sample biases, systematic errors in reporting, and measurement errors complicate nutritional research. Use of complementary assessment methods at multiple measurement points may lead to findings that are more reliable when considering nutritional effects on a health outcome. For example, an age- and culture-sensitive FFQ to assess typical intake, combined with concurrent 24-hour dietary recall to assess current intake, will strengthen the reliability of the findings. Creating an atmosphere that encourages respondents to report complete dietary intake without judgement is critical to maximizing honest and thoughtful participation. Incorporating innovative computer-based technology, such as the Minnesota Nutrient Data System, for data collection may increase accuracy of dietary information and enhance participant motivation (see Table 1).

In addition, use of innovative statistical approaches may more accurately identify dietary patterns that contribute to disease development. For example, in an epidemiological study designed to identify dietary patterns associated with the incidence of type 2 diabetes in Germany, Hoffman, Schultze, Schienkiewitz, Nothlings, and Boeing (2004) compared traditional principal components analysis (PCA) with the reduced rank regression (RRR) statistical approach. The researchers noted that PCA, as an exploratory data analysis approach, ignores dietary patterns that are known risk factors for a particular disease. In contrast, the RRR analytical approach evaluates variation in dietary patterns that have known links to the disease of interest. By subjecting the same data set to these two different statistical approaches, Hoffman and colleagues explained 93% of the variation in responses to the intake of nutrients related to type 2 diabetes using the RRR method, versus only 41.9% of the predictor variance using PCA. When examining the combined effects of foods, the RRR approach identified a dietary pattern that posed a significant risk for diabetes more effectively than the more traditional PCA.

Measurement of Dietary Quality in Health Research

Emerging research suggests that, in addition to studying nutrient intakes, examining human nutrition from a food-based paradigm may be an important innovation in health research (Kant, Schatzkin, Graubard, & Schairer, 2000; McCullough et al., 2002). Assessing the effect of overall dietary quality, in addition to specific nutrient levels, is consistent with a holistic approach to interventions that improve health and is a valuable approach for research in nutrition, for several reasons (Kant, 1996). First, free-living individuals have complex diets consisting of combination foods with multiple nutrients such as stews. Second, the interaction effect of nutrients, such as calcium and phosphorus or iron and folate, obscure the ability to isolate the effects of any single nutrient. Third, the metabolism of many nutrients is interdependent. Finally, dietary changes necessary to prevent disease are not isolated but involve multiple nutrients; for example, one might decrease fat intake while increasing intake of whole grains to offset colon cancer (Kant et al.). The health effects of overall dietary quality need further study; this could result in a more thorough explanation of the relationship between diet and health (Bodnar & Siega-Riz, 2002).

Estimates of individual nutrient levels are complicated by the typical intake of nutrients that are consumed in combination with others in foods, and by individual metabolic variations in nutrient absorption. Examining the effects of overall dietary quality that incorporates culture-specific foods could clarify the relationship between these foods and health. Researchers examining the influence of overall dietary quality to identify nutrition-related risk factors might consider using food-based tools such as the Canadian Healthy Eating Index (Shatenstein, Nadon, Godin, & Ferland, 2005), the US Healthy Eating Index (US Department of Agriculture, Center for Nutrition Policy and Promotion), or the Dietary Quality Index (Patterson, Haines, & Popkin, 1994). These instruments assess dietary quality within a food-based framework that acknowledges complex interrelationships among nutrients rather than the influence of specific nutrients. Applying dietary quality indices has the potential not only to respond to issues of excessive or inadequate intake of individual nutrients or energy intake but also to improve overall health and well-being.

In conclusion, measuring nutritional intake is an essential yet challenging component of research aimed at improving overall health and disease prevention. Nurses need to be knowledgeable about the limitations of the different dietary measurement methods when involved in research that includes nutritional assessments for determining disease risk and response to treatment. Incorporating methodological innovations designed to strengthen and enhance the measuring of nutritional intakes and patterns is vital for nurse researchers involved in clinical and research programs designed to manage chronic diseases and promote health.

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