# A Dietary Screening Questionnaire Identifies Dietary Patterns in Older Adults[1]

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## Abstract

Dietary patterns reflect habitual exposure of foods and nutrients and are a preferred means to assess diet and disease relations. Our objective was to design a screening tool to assess diet quality and dietary patterns among older adults and to relate the patterns to markers of general health and nutrition status. We used a population-specific data-based approach to design a diet screening instrument that was tested among subjects sampled from the Geisinger Rural Aging Study cohort ($n = 205$). All participants attended a local clinic and had biochemical, anthropometric, and other health data collected. Dietary information was obtained via 24-h recall. We used principle components analysis to derive dietary patterns, which were then compared with nutritional outcomes using Pearson partial correlations, controlling for energy, age, BMI, and supplement use. Two dietary patterns were derived; 1 represented by more healthful foods and 1 by less optimal food choices. The healthy pattern was associated with more favorable biomarkers, more nutrient-dense diets, and lower waist circumference, whereas the converse was true for the second pattern. A screening tool can be used by older adults to identify dietary patterns that may relate to nutritional risk. J. Nutr. 137: 421–426, 2007.

## Introduction

Many older adults may have compromised intakes of foods and nutrients that place them at nutrition risk without evidence of clinical malnutrition (1–3). Older adults residing in rural areas face special issues that preclude optimal healthcare, and reportedly have inadequate intakes of many key nutrients (4–6). Compromised nutritional status has been associated with increased risk for morbidity and mortality (7). Dietary intervention has been effective in treating and reducing risk of multiple diseases, and as a result, dietary intervention may reduce medical expenditures (8). Nutrition screening is essential for identifying older adults at nutrition risk.

The Mini-Nutritional Assessment and the Nutrition Screening Initiative (NSI)[7] are widely recognized screening instruments for older populations (9,10). The use of the NSI screening tools with limited validation testing has been problematic (11,12). Specifically, the Level II NSI tool has major limitations for assessing dietary intakes and the food group questions have not been shown to be predictive of health outcomes in rural older adults (13) and other community-dwelling older adults (13,14). One reason may be the low specificity of these items relative to more comprehensive dietary assessment (15). A variety of tools have been developed to assess risks of inadequate intakes but generally focus on 1 or 2 dietary components such as calcium (16), fruit and vegetables (17,18), or fat (19,20). These tools are designed to assess intakes of specific nutrients or foods but are not designed, nor are they intended, to determine overall dietary intake.

Recent evidence supports the utility of dietary pattern analysis for evaluating risk of chronic diseases such as obesity (21,22), some types of cancer (23–27), osteoporosis (28), metabolic syndrome and glucose intolerance (29–31), and risk of cardiovascular disease (32,33). Dietary patterns consistent with national guidelines also have been associated with lower risk of mortality (34,35). Based on the work of Ledikwe et al. (36), older rural adults in the Geisinger Rural Aging Study (GRAS) with unfavorable dietary patterns are at a much greater nutrition risk; in fact, individuals with a low nutrient-dense dietary pattern were twice as likely to be obese or to have low plasma vitamin B-12 levels and 3 to 17 times more likely to have low nutrient intake. Unlike the image of frail elderly suffering from malnutrition, the GRAS data indicates that overweight and obese older adults are at nutritional risk (37). Thus, dietary pattern analysis is important for identifying those who may be at nutritional risk in order to provide appropriate interventions.

A well-designed dietary screening instrument could be used in public health and medical settings to provide appropriate counseling and to guide interventions for older adults. Gans et al. (20) provided prerequisites for optimal use of a screening tool in the community and public health setting: brevity, ability to be administered to a diverse population, ability to provide feedback to

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[7] Abbreviations used: GRAS, Geisinger Rural Aging Study; HDL-C, HDL-cholesterol; LDL-C, LDL-cholesterol; NSI, Nutrition Screening Initiative; PCA, principle components analysis; TG, triacylglycerol.

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participants, food specificity, and minimal cost. Furthermore, the screening tool does not necessarily need to be quantitative (i.e. ability to capture exact measurement of intake) but should be able to classify the diets of individuals as relatively low or high in the dietary characteristics assessed by the instrument. The purpose of this study is to develop a dietary screening instrument that meets the above criteria for use with older adults.

## Subjects and Methods

This work is presented in 3 phases: questionnaire development, cognitive testing, and dietary pattern assessment (**Fig. 1**). Subjects for phases 1 and 3 were randomly selected from the GRAS. GRAS is a longitudinal study of >20,000 rural adults over the age of 65 and enrolled in a Medicare-managed health maintenance organization. The goals of GRAS are to implement a regional approach to screening for nutritional risk in a managed care setting, to characterize the relations between nutrition risk, functional status, and health outcomes, and to relate long-term nutrition risk, functional status, and health outcomes to baseline screening.

Participants in all 3 phases were required to pass both the Geriatric Depression Scale with a score ≤6 (38) and the Mini-mental State Examination with a score ≥23 (39). We used these tests to exclude individuals who exhibited depressive symptomology or cognitive impairment, respectively. All participants read and signed an informed consent document. All study procedures were approved by the human investigation review boards at Geisinger Health Systems and The Pennsylvania State University.

### Phase 1: Questionnaire development

*Subjects.* The questionnaire development came from secondary dietary data analysis of a 1994–1996 GRAS cohort, details of which have been published elsewhere (37). The sample for Phase 1 consisted of 81 men and 98 women, aged 66–87 y with a mean age of 73 (±5) y. Participants were primarily white (99%), married (73%), and with at least a high school education (80%). More descriptive data on the sample are published elsewhere (37).

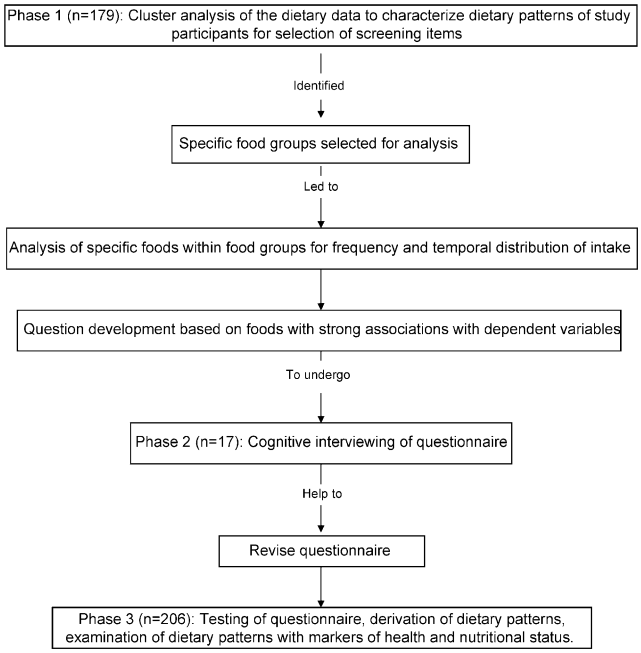


**Figure 1** Development of the screening questionnaire in 3 phases. In Phase 1, secondary data analysis was performed to identify dietary patterns. Foods from within these dietary patterns were used as targets for screening questions. All possible questions were completed by a new sample with cognitive interviewing techniques. The questions were revised and given to a new sample of older adults. Dietary pattern analysis was conducted with the questionnaire items.

*Methods.* Five 24-h dietary recalls were collected by telephone over a 10-mo time period by trained interviewers at the Pennsylvania State University Diet Assessment Center. The Nutrition Data System software, food database version 12A, nutrient database version 28 (Nutrition Coordinating Center) was used for data collection and analyses, using a multiple pass technique to facilitate recall. Diet recalls were conducted on unannounced, random, nonconsecutive days throughout the 10 mo. The average of the 5-d dietary intake data were used for analysis. Daily food intakes were categorized into food subgroups based on similarity of nutrient composition. Anthropometric and biochemical measures were collected at baseline and at 1-y follow up (37).

We used a 2-step process to develop items for inclusion on the questionnaire. First, we examined dietary patterns using a comparative cluster analysis strategy (40). A cluster represents a group of individuals consuming a similar dietary pattern. PROC FASTCLUS, SAS version 8 (SAS Institute) was used to create disjoint clusters based on least-squares estimation. To assess the robustness of the food patterns, we compared the results derived from 2 different treatments of the input variables (food subgroups): number of servings and percent energy contribution from subgroups (40). We also examined the effect of plausible reports of energy intake on the derivation of dietary patterns using the prediction algorithms derived by McCrory et al. (41). All analyses yielded 2 distinct dietary patterns: a "nutrient-dense" pattern characterized by fruit, vegetables, whole grains, dairy, and lean meats, and a "less healthy" pattern characterized by cakes, cookies, candies, ice cream, salty snacks, and processed meats.

Each food group that characterized a dietary pattern was intensively examined to determine specific foods to target for the questionnaire. First, each food group was deconstructed to assess which foods were consumed with the highest frequency. The most frequently consumed food items were then examined independently for associations with over-all nutrient profiles estimated from the 24-h recalls for temporal distribution of intake (i.e. eating occasions) and amounts of food consumed. The items on the questionnaire came from these analyses (Fig. 1).

After determining which foods to query, we determined the format of the questions. We examined the frequency of consumption of specific foods or food groups to determine the format of response options. Probing questions were also selected such as time of day a food is consumed, combinations of foods, or specific characteristics of a food (e.g. low fat dairy, whole grain breads). The time frame of the questionnaire was a 1-mo period of time.

### Phase 2: Cognitive interviewing

We used cognitive interviewing techniques following the procedures of Subar et al. (42) to identify problems in "comprehension, interpretation, or formulation of answers," including combination of concurrent and retrospective techniques (43). Concurrent interviewing involves a participant performing a think-aloud technique as the question is being completed. The retrospective interview is conducted after the participant has completed the question and involves probing for more information. All interviews were audio-taped and transcribed as needed. The sample for the cognitive interviewing phase of the study was a convenience sample of adults over the age of 65 ($n$ = 17) with similar gender distribution and educational attainment to participants in the GRAS.

The cognitive interviewing was an iterative process. After the first 5 interviews were completed, we summarized common themes and made changes to the questionnaire. This procedure was followed for all remaining interviews. Many questions posed as "Do you usually eat [food]?" with only dichotomous response options were difficult for subjects to complete. When asked what the word "usually" meant, participants' answers varied greatly, from "once a week" to "a few times per day." These questions were revised to frequency of consumption response options. However, questions based on behaviors, such as adding sugar to coffee and teas, adding butter to breads, and the use of gravy were retained with "yes" and "no" response options.

Participants also encountered problems separating foods that were aggregated. For example, when asked "How often do you eat cookies, cakes, or pies?" participants considered cakes and pies to be dessert items, whereas cookies were considered a snack food. Subsequent versions of the questionnaire separated cookies from pies and cakes. We also separated whole grain breads and cereals, because some people ate whole grain breads and not cereal or vice-versa. Finally, some participants ($n$ = 4) were not reporting all fruit intake, because they did not think canned or frozen fruit qualified, assuming the question was asking only about fresh fruit. We altered the fruit intake questions to read "How often do you eat fruit (not including juice)? Please include fresh, canned or frozen fruit."

The draft of the questionnaire was revised and each item assessed for convergent validity with nutrient intakes estimated from the 24-h recalls in GRAS phase 1. $t$ Tests and analysis of covariance were used to assess relations between response options and nutrient intakes. Thirty-seven items were selected for the final version of the questionnaire: 28 food questions about frequency of intake of foods, 4 behavior-related questions (e.g. how many snacks do you consume each day?), and 5 yes or no questions (e.g. do you usually add sugar to coffee or tea?).

### Phase 3: Questionnaire testing and dietary pattern assessment

*Subjects.* The sample used for the questionnaire administration was a different subset of a continuing sequential cohort study of nutrition and health outcomes in GRAS participants recruited 2005–2006. Letters introducing the sequential cohort study were mailed to 1930 individuals, 1432 (74%) of whom met all eligibility criteria: free-living individuals residing within 120 kilometers of a Geisinger medical clinic participating in the study and free from major depressive disorders upon phone screening. Of those who met the criteria, 333 agreed to participate and were scheduled for a clinic visit; 49 withdrew before the clinic visit, 7 were excluded on GDS criteria, and 5 participants withdrew consent after the visit or did not complete all dietary recalls. The final 210 participants in the sequential cohort were recruited for the subset used in Phase 3, and 206 of those completed the questionnaire and all other study protocol. The Phase 3 sample consisted of 83 males (40%) and 123 females (60%). The age range was 73–94 y, with a mean of 78 (± 3.6 SD). Participants were primarily white (98%), married (65%), or widowed (27%), and with at least a high school education (82%).

*Methods.* The research coordinator scheduled visits for participants at the closest Geisinger medical clinic. Participants completed questionnaires, including the diet screening questionnaire, demographic, and health-related data. Data were collected on medication and dietary supplement use. Activity level was assessed via the Physical Activity Scale for the Elderly.

Height and weight measures were recorded by trained research dietitians using a portable digital scale (Tanita) and statiometer (Infant/Child/Adult Height Measuring Board, Shorr Productions). BMI was calculated as weight (kg)/height $(m)^2$. Waist circumference was measured using a flexible, nonelastic, measuring tape. Standardized procedures based on the National Health and Nutrition Examination Survey were followed (44).

A fasting venous blood draw (23 mL) was obtained during the clinic visit by a trained phlebotomist. Laboratory analyses were conducted by the accredited laboratories of the Geisinger Medical Center. The lipid panel included total cholesterol, HDL-cholesterol (HDL-C), LDL-cholesterol (LDL-C), and triacylglycerol (TG) and was determined by routine enzymatic methods on automated modular analyzers (Roche and Hitachi). Serum vitamin B-12 was determined by electrochemiluminescence (Roche Elecsys 2010). Homocysteine was measured by fluorescence polarization immunoassay using the Abbott AXSYM system (Abbott Laboratories). C-reactive protein was assessed using an immunoturbidometric method (Tina Quant, Roche Diagnostics). Unfavorable values were designated as follows: plasma vitamin cobalamin, $<$350 pmol/L (45); homocysteine, $>$14.0 $\mu$mol/L (46); and lipid profiles according to the National Cholesterol Education, Advanced Treatment Panel III guidelines, cholesterol, $<$200 mg/dL (5.19 mmol/L), HDL-C $>$ 40 mg/dL (1.04 mmol/L), TG $<$150 mg/dL (1.70 mmol/L) and LDL-C $<$100 mg/dL (2.60 mmol/L) (47).

Four 24-h dietary recalls were collected by telephone during the 4- to 6-wk time period following the visit by trained interviewers at the Pennsylvania State University Diet Assessment Center using the same procedures as Phase 1. Diet recalls were conducted on unannounced, random, nonconsecutive days. The average of the 4 d of dietary intake data was used for analysis. A nutrient adequacy ratio (NAR) for 10 vitamins and minerals was calculated based on the work of Guthrie and Scheer (48). The 10 micronutrients included vitamin C, vitamin B-6, vitamin D, vitamin A, vitamin E, vitamin K, and folate, magnesium, zinc, and calcium. All NAR were truncated at 1.0 and a mean adequacy ratio (MAR) was calculated by summing the NAR and dividing by 10.

We analyzed data using SAS version 9.1 (SAS Institute). Categorical variables were summarized using frequencies and percents. Means and SD were calculated for all variables. Normality was assessed for all variables and those not normally distributed were transformed to conform to normality prior to analysis. We assessed dietary patterns using principle components analysis (PCA) of 28 food-specific questions, PROC FACTOR, using a varimax rotation. Five dichotomous response options items and 4 behavior-related questions were not entered into the PCA. The behavior-related questions (e.g. "How many meals do you eat each day?") and "yes or no" questions (e.g. "Do you usually add butter to bread, rolls, or biscuits?") were on a different scale of measurement than the food questions (i.e. frequency of consumption) and thus were not entered into the analysis. Significance level was set at $P < 0.05$.

The number of factors to retain was arrived at by considering the eigen values, the scree test, and the interpretability of the factors. Partial Pearson correlations were used to determine the association between factor scores and anthropometric, biomarker, and dietary variables. These correlations were adjusted for age, BMI, vitamin, and mineral supplement use and energy intakes.

## Results

Two dietary patterns were derived via PCA, which explained 23% of the variance (**Table 1**). Positive factor loadings indicate a positive association with a dietary pattern, negative loadings are indicative of an inverse association with a dietary pattern. Dietary pattern 1 is consistent with a "prudent" dietary pattern, whereas dietary pattern 2 could be considered "Western" or low nutrient dense. dietary pattern 1 was characterized by fruits, vegetables, lean white meat, dairy, and whole grain products (particularly cereals) and was negatively associated with fried fish. Dietary pattern 2 contained foods that would be considered lower in nutrient density, such as sweets and candy, processed meats, and salty snacks and negatively associated with orange juice and juices consumed at breakfast. Some questions were not strongly associated with either pattern: whole grain breads, nut intake, alcohol, 100% juices, eggs, and total amount of bread servings.

Dietary pattern 1 was significantly related to a higher MAR, indicating diets consistent with national guidelines (49–52) (**Table 2**). The MAR was comprised of 10 micronutrients; dietary pattern 1 was associated with most of the nutrients used to calculate the MAR. In addition to the MAR, dietary pattern 1 was also associated with higher intakes of niacin, $\beta$-carotene, and potassium and lower sodium intakes (data not shown). Dietary pattern 1 was also related to lower dietary fat intake and higher intakes of n-3 fatty acids, fiber, and protein. Dietary pattern 2 was associated with lower intakes of many micronutrients, fiber, and protein as well as a higher intake of added sugars.

Dietary pattern 1 was significantly correlated to higher HDL-C and lower triglycerides, indicative of a more favorable lipid profile (**Table 3**). Dietary pattern 2 was correlated with lower serum vitamin B-12 concentrations. Dietary pattern 1 was also associated with a lower waist circumference, an emerging risk factor for many chronic diseases of aging. Dietary pattern 1 was related to higher level of physical activity (MAR).

## Discussion

In this study, we developed a dietary screening questionnaire to assess overall dietary intake. Subar et al. (53) propose that

**TABLE 1** Dietary patterns and factor loadings derived from a dietary screening instrument among rural older adults[1]

| | Pattern 1 | Pattern 2 |
|---|---|---|
| Carrots, sweet potatoes, broccoli, or spinach | 0.66 | — |
| All fruit | 0.57 | — |
| Chicken and turkey | 0.53 | — |
| Fruit as a snack | 0.50 | — |
| Whole grain cereals | 0.44 | — |
| Vegetables with main meal | 0.43 | — |
| Milk, cheese, and yogurt | 0.38 | −0.23 |
| Vegetables as a snack | 0.37 | — |
| Hot and cold breakfast cereals | 0.35 | — |
| Fried fish | −0.40 | — |
| Whole grain breads | 0.28 | |
| Nuts and seeds | 0.25 | |
| 100% Fruit juices (excluding orange juice) | 0.22 | |
| Cakes and pies | — | 0.69 |
| Cookies | — | 0.56 |
| Candy and chocolate | — | 0.55 |
| Cold cuts, hot dogs, and deli meats | — | 0.42 |
| Crackers, pretzels, chips, or popcorn | — | 0.37 |
| Ice cream | — | 0.36 |
| Bacon or sausage | — | 0.33 |
| Orange juice | — | −0.33 |
| Juice consumed at breakfast | | −0.33 |
| Potatoes | — | −0.29 |
| Eggs | — | −0.26 |
| All breads | — | −0.25 |
| Milk | — | — |
| Alcoholic beverages | — | — |
| Fish (Not fried) | — | — |

[1] The 28 food questions listed above were entered into the factor analysis. For simplicity, loadings from food groups with absolute values <0.20 are represented by a dashed line.

the first rule in creating dietary assessment tools for a specific population subgroup is to identify recent population-specific data to determine the appropriate foods to include. We accomplished this in developing the questionnaire, using data from the population of interest: older rural adults participating in an on-going screening study. The instrument derived from such a data-based analysis approach generated 2 dietary patterns: 1 considered more healthy and characterized by fruit and vegetables, lean meats, fish, dairy, and whole grains and another characterized by baked goods, processed meats, ice cream, and white potatoes. It could be argued that identifying these 2 patterns is not surprising given that the questions were derived from previous dietary pattern analysis. However, the original dietary pattern analysis was based on multiple 24-h dietary recalls, whereas our analysis was based on an abbreviated screening questionnaire.

**TABLE 2** Correlations between dietary patterns and MAR and nutrient intakes assessed by 24-h dietary recall among older rural adults[1]

| | Pattern 1 | Pattern 2 |
|---|---|---|
| MAR[2] | 0.37* | −0.13 |
| Protein, *g* | 0.25** | −0.26** |
| Carbohydrate, *g* | 0.19* | 0.13 |
| Added sugars, *g* | −0.11 | 0.20** |
| Fiber, *g* | 0.45* | −0.20** |
| Total fat, *g* | −0.20* | −0.04 |
| Saturated fat, *g* | −0.25** | 0.04 |
| n-3 Fatty acids, *g* | 0.16** | −0.03 |

[1] Correlations are controlled for age, BMI, vitamin and mineral supplement use, and energy. *P = ≤ 0.0001; **P = ≤ 0.05.
[2] The 10 micronutrients included in calculation of the MAR are vitamin C, vitamin B-6, vitamin D, vitamin A, vitamin E, vitamin K, and folate, magnesium, zinc, and calcium.

**TABLE 3** Pearson partial correlations of dietary patterns and selected biomarkers, anthropometry, and physical activity among rural older adults[1]

| | Pattern 1 | Pattern 2 |
|---|---|---|
| Serum total cholesterol, *mmol/L* | 0.14 | −0.05 |
| Serum HDL-C, *mmol/L* | 0.17* | −0.07 |
| Serum LDL-C, *mmol/L* | 0.12 | −0.05 |
| Serum TG, *mmol/L* | −0.15* | 0.02 |
| Plasma homocysteine, *μmol/L* | −0.13 | −0.02 |
| Serum vitamin B-12, *pmol/L* | 0.15 | −0.19** |
| Waist circumference, *cm* | −0.18* | 0.02 |
| Physical activity score[2] | 0.16* | 0.11 |

[1] Correlations are controlled for age, BMI, vitamin and mineral supplement use, and energy. *P = < 0.05; **P = < 0.0001.
[2] Physical activity was assessed using the Physical Activity Scale for the Elderly.

The questionnaire meets the key criteria for the administration of screening tools proposed by Gans (20). The questionnaire was easily administrable; it was completed in ~10 min and used simple food- and behavior-specific questions. Although the questionnaire met the criteria proposed for instrument administration, such an instrument must also be validated. In our report, criterion-related validity was assessed by the relations of the dietary patterns to dietary data derived from multiple 24-h recalls. We observed associations between the dietary patterns and intakes of micro- and macro-nutrients in the expected directions. We also considered validity of the dietary patterns relative to biomarkers of nutritional status.

The dietary patterns were correlated with a lower waist circumference even when controlled for the effects of BMI. Central adiposity, as assessed by waist circumference measurements, is associated with greater risk of many diseases independent of BMI (54). Among elderly subjects, central adiposity is directly related to a higher risk for diabetes (55) and impaired glucose tolerance (54). Central adiposity has also been associated with several markers for cardiovascular risk, including blood pressure, serum lipoproteins, endothelial dysfunction, and C-reactive protein (56–59).

Several methodological issues strengthen our confidence in the questionnaire. The screening tool queries food intake in the previous month and is not quantitative, thereby minimizing errors in memory and computation, respectively. Notable correlations with biomarkers of nutritional status provide support for the questionnaire, because measurement error in the questionnaire is not likely correlated to measurement error in the assessment of biomarkers. The cognitive interviewing procedures have ensured that the target audience understands and correctly identifies the concepts as we have intended. Review of the questionnaires after self-administration revealed almost no missing data.

No known published reports assess dietary patterns via a screening tool. However, our patterns are consistent with the literature on dietary patterns among older adults. Bamia et al. (60) also found 2 dietary patterns, using similar techniques, with the European Prospective Investigation into Cancer and Nutrition Elderly cohort ($n = 99,744$ participants 60 y or older). The older adults in this study primarily consumed either a diet pattern rich in vegetables and fruit or one characterized by a preference for sweet foods and added fats. Other studies found similar patterns and called them "Western" and "Prudent." Tucker et al. (61) indicated favorable intakes of micronutrients and biomarkers among older adults who consumed foods rich in milk, fruit, and cereals. Although there are likely to be pattern differences across groups, the argument for generalizability is that the patterns we detected with the questionnaire were similar to those found in more diverse samples, with much more comprehensive dietary assessment methods.

No rapid methods for overall dietary screening for older adults in clinical settings exist. Several limitations exist for comprehensive dietary assessment methods (e.g. 24-h recalls, FFQ) in the clinic setting, including cost, feasibility, time constraints, and access to computer technology needed to complete the assessment. The questionnaire is an overall diet screening tool that asks food- and behavior-specific questions that provide a means to assess where a diet may be lacking or in excess of specific foods. The self-administration format decreases the burden of clinicians to assess all patients, freeing up resources for intervention for only those considered to be at nutrition risk. Determination of those at nutrition risk is not only beneficial from a public health perspective but has been shown to be cost effective.

The process of developing a data-based screening tool within specific populations is broadly generalizable and this work provides a detailed guide for researchers who seek to identify nutritional risk within specific population groups. This instrument is not intended at present for more diverse populations. This sample is comprised almost exclusively of white, community-dwelling rural older adults. We developed this instrument specifically for this population; as such, validation with other age and ethnic groups would be necessary. It is important to note, however, that the subjects in Phase 1 did not differ significantly from the large GRAS cohort ($n > 20,000$) regarding sex, age, demographics, anthropometric measures, and serum cholesterol and albumin. Individuals in the Phase 1 were less likely than were those in the large GRAS cohort to report having a poor appetite and needing assistance with some activities of daily living; however, these differences were quite small and were most likely a result of the tendency for individuals with more limitations to be less interested in research studies.

To our knowledge, the results of dietary patterns derived from a screening tool and estimates of nutrient intakes from 24-h recalls or FFQ have not been previously reported. Unlike correlations in the literature between nutrient intakes and dietary patterns derived from the same data, we compared patterns established from a brief questionnaire to nutrient intakes derived from comprehensive dietary assessment and were therefore not comparable. However, correlations in the expected direction illustrate the potential of this screening tool. More rigorous dietary assessment or clinical evaluation would be warranted for individuals that screen at risk.

The expanding older adult population is very susceptible to nutrition risk. Age-related chronic disease has the potential to be prevented, delayed, or ameliorated by nutrition intervention. As such, screening tools to target nutritional inadequacy are invaluable. However, the efficacy of screening tools lies within their ability to accurately determine those at risk in order to benefit in some way from the screening (i.e. by providing an effective intervention). In this study, we discerned from the questionnaire food patterns that related to weight status, biomarkers of nutritional status, and macro- and micronutrient profiles. The questionnaire is not intended to be used in a clinic setting with the factor analysis procedures we employed in this analysis. Further research will incorporate the weightings for each questionnaire item on the factors to develop a meaningful scoring algorithm. This research demonstrates that a simple screening tool can be used to identify dietary patterns in older adults. Our results indicate the questionnaire has the potential to be used as an effective screening tool to determine dietary patterns of older individuals.

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