DEVELOPMENT AND VALIDATION OF A DIET SCREENING TOOL FOR
OLDER ADULTS

A Thesis in
Nutrition
by
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ABSTRACT

The proportion of older adults in the United States is increasing dramatically. Unfortunately the aging process is associated with chronic diseases. Taken together, these trends will place significant demands on the healthcare system. Thus, it is important to identify modifiable factors that may help lessen the burden of chronic diseases of aging. Diet is a well-established modifiable factor that is directly related to risk and treatment of the major causes of death in adults over the age of 65: cardiovascular disease, cancer, and stroke. Identification of individuals that are at nutrition risk may be an effective intervention strategy to lessen the burden of morbidity.

A variety of tools have been developed to assess risk of inadequate dietary intakes for specific dietary components. However, no known total dietary screening tools exist for older adults. Therefore, the overall purpose of this study was to evaluate a newly developed population-specific diet screening tool (DST) to identify community-dwelling older adults that may be at nutritional risk.

The overall hypothesis of this study was that a diet screening tool could be used to identify individuals at nutrition risk. In this study, a population-specific diet screening tool was developed and the subsequently tested. Psychometric evaluation of the screening tool revealed strong test-retest reliability and adequate sensitivity, specificity, and positive predictive value. The screening tool had the ability to differentiate between individuals at varying degrees of nutrition risk, and DST scores were related to dietary intakes estimated from multiple 24-hour recalls and well as biomarkers of nutritional status.
The tool was developed on a cross-section of the Geisinger Rural Aging Study (n=179). Extensive secondary dietary pattern analysis revealed several food groups that were related to nutrition risk and thus would be ideal targets for the questionnaire. The first draft of the screening tool was subjected to cognitive interviewing in a new sample of older adults (n=17).

After cognitive interviewing feedback, the DST had 37 items: 28 food specific questions, 5 yes and no questions, and four behavior-related questions. The total point range was 0 -100. A new sample was recruited to test the DST (n=204 with a mean age of 78.5 ± 4 SD). All participants attended a local medical clinic where they completed a battery of questionnaires (including the DST), had height and weight measured, and provided a fasting blood sample.

Individuals were classified by DST scores as follows: scores <55 were at nutrition risk (the lowest 25\textsuperscript{th} percentile), scores in the range of 55-75 (the middle 50-75\textsuperscript{th} percentile) were at moderate nutrition risk, and scores > 75 (highest 25\textsuperscript{th} percentile) were not likely to be at nutrition risk. No energy differences were noted among the groups; however, percent of energy from fat and saturated fat, dietary fiber intake, and indicators of diet quality were significantly different among all groups. Biomarker differences were also observed among the groups in the expected directions; but, no differences in anthropometry were observed.

Nutrition plays an integral role in the management of multiple chronic diseases. However, dietary assessment in clinical treatment of older adults is not a routine practice. Older adults are vulnerable to nutrition risk. Any strategies to help combat age-related chronic disease and improve quality of life for older adults are
essential. The clinic setting provides an ideal place to screen older adults and the DST is a simple and practical diet screening tool that can help detect nutrition risk in older adults.
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Chapter 1

INTRODUCTION

Americans over the age of 65 are one of the fastest growing segments of the population (1). The number of Americans over the age of 65 is projected to double by 2030, reaching 19% of the population (2). The population shift will undoubtedly place significant demands on healthcare use and costs (3). A primary goal of Healthy People 2010 is to enhance health-related quality of life rather than simply extend years of life (4). Age-related diseases significantly influence the quality of life of older adults. Many of the diseases common to aging are influenced by diet (5-9), including obesity, diabetes, cancer, and heart disease. Nutrient-dense diets are related to indicators of obesity (10), functional status (11), and biomarkers of nutrient status, including Vitamin C, beta-cryptoxanthin, Vitamin B12, and alpha-tocopherol (10, 12, 13). These serotological indicators are markers for key nutrients that play significant roles in the prevention of cardiovascular disease as well as the maintenance of neurological and visual health (14-19). Therefore diet quality is a key component in maintaining the health of older adults (20).

The risk of nutritional deficiencies increases with aging (21). Physiological changes such as decreased muscle mass and lower energy expenditure generally lead to decreased caloric intakes (22). Concomitant decreases in micronutrients typically accompany lower dietary intakes. However, nutrient requirements remain the same for many nutrients and actually increase for some (23-26).
Understanding the role of diet in the etiology and management of chronic age-related diseases depends on accurately assessing dietary intake. However, current methods of comprehensive dietary assessment (i.e., 24-hour recalls and food frequency questionnaires) are not intended for broad-based screening, which is essential for determining older adults at nutrition risk. A well-designed screener could be used in public health and medical settings to provide appropriate counseling, and to guide interventions for older adults. Therefore the purpose of this study was to develop a diet screening instrument to assess overall diet of older adults.

The Dietary Screening Tool (DST) queries food and beverage intake as well as typical behaviors shown to be related to health outcomes from previous studies of older adults. The DST was developed on available data provided by a cross-sectional sample (n=179) from the Geisinger Rural Aging Study (GRAS). GRAS is a longitudinal nutritional risk-screening study of enrollees in a managed-risk Medicare insurance program administered through the Geisinger Health System. GRAS consists of approximately 21,000 rural older adults in Pennsylvania over the age of 65 (mean age of 71 years). A randomly selected sample of GRAS participants completed the DST. These individuals also completed a battery of questionnaires, anthropometric data and a fasting blood sample was also collected.
References

Chapter 2
REVIEW OF LITERATURE

Introduction

By the year 2030, one in five Americans will be over the age of 65 (1, 2). The population shift will increase the prevalence of age-related chronic diseases and place significant demands on the healthcare system (3-5). Chronic disease, common among older adults, contributes to disability and diminishes quality of life (6). Recent evidence suggests that individuals with poor dietary intakes are more likely to develop chronic disease later in life (7). Diet is a well-established and modifiable risk factor for many chronic diseases. Older adults are a high-risk population for nutritional deficiency; as such, a need exists to identify, prevent, or reduce factors that mitigate this effect.

Aging is characterized by a complex interplay of physiological, psycho-social, and functional changes, all of which may predispose older adults to have compromised nutritional status. Relevant physiological factors include decreased lean body mass (8, 9), decreased cardiac output (10), decreased lung and kidney function (11), and changes in the gastrointestinal (12), skeletal (11), and sensory systems (13). In fact, national data indicate that about 45% of adults over the age of 60 have some degree of sarcopenia (i.e., loss of muscle mass) (14). Declining gastric acid secretion with aging leads to bacterial overgrowth and altered absorption of many micronutrients, including iron, folate, vitamin K, and vitamin B12 - essential
nutrients for maintenance of normal red blood cell activity, bone health, muscle contraction, blood coagulation, and metabolism. A decreased ability to convert ultraviolet light from the sun into the active form of Vitamin D (25-OH Vitamin D3) is another factor complicating the nutritional health of older adults (15). In addition to biological mechanisms contributing to poor Vitamin D status in older adults, further limited reliable food sources exist, as well as low intakes of these Vitamin D-rich foods have been reported among older adults (16). While calcium absorption decreases with age, it may be a secondary consequence of low Vitamin D status (10). Taken together, all of these changes influence dietary intake, metabolism, and absorption. Thus, the risk of poor nutritional status increases with aging (17).

**Nutrition Risk**

Older adults are frequently described as being at nutrition risk. However, the term “nutrition risk” is widely used within the field of nutrition without an established definition (18). For the purposes of this investigation, the term “nutrition risk” is operationalized through the Institute of Medicine definition(19). Public Law 94-105 broadly defines nutrition risk as

"(a) detrimental or abnormal nutritional conditions detectable by biochemical or anthropometric measures, (b) other documented nutritionally related medical conditions, (c) dietary deficiencies that impair or endanger health, or (d) conditions that predispose persons to inadequate nutritional patterns or nutritionally related medical conditions(19)."
This definition provides a triangulation of factors to be considered within the framework of nutrition risk: anthropometry, biochemical biomarkers, and dietary intakes. Each of these factors will be presented within the context of aging.

Weight Status and Nutrition Risk

Weight status is an important component of overall health and nutrition risk among older adults. Traditionally, low weight and weight loss were the primary concern among older adults (20-22). However, data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) indicates that an estimated 66 percent of U.S. adults are either overweight or obese (23). Overweight and obesity are associated with increased risk for many diseases including hypertension, diabetes, sleep apnea, cancer, gallbladder disease, musculoskeletal disorders, and pancreatitis (24-27). Obesity directly relates to decreased functional capacity (28), increased healthcare utilization (29), economic strain (30, 31), and even earlier mortality (32).

Previous work with the Geisinger Rural Aging Study (GRAS) indicates that 44 percent of participants were overweight (BMI 25-29.9) and 35 percent were obese (BMI > 30). Evidence suggests that overweight and obesity may be accompanied by macro- and micronutrient deficiencies (16, 33, 34). Furthermore, being overweight or obese places individuals at greater risk for lower biomarkers of nutritional status with stronger relationships among women (34). In fact, BMI was significantly correlated to intakes of fat ($r = 0.26$), saturated fat ($r = 0.21$), and homocysteine
concentration \( r = 0.25 \) for females. Weight status was inversely related to intakes of carbohydrates \( r = -0.25 \), fiber \( r = -0.35 \), folate \( r = -0.24 \), magnesium \( r = -0.29 \), iron \( r = -0.22 \), and zinc \( r = -0.23 \) among females. The United States Department of Agriculture’s Healthy Eating Index scores were also inversely associated with BMI \( r = -0.22 \) (34).

Obesity is generally defined as body mass index (BMI) greater than 30 with BMI calculated as weight in kilograms divided by height in meters squared (35). However, classification of overweight and obesity among older adults using BMI criteria alone may be flawed as it does not account for body fat distribution - key determinant of disease risk (36). The aging process results in changes in body composition; in general, fat-free mass decreases, fat mass increases, and fat tends to be redistributed with accumulation in the intra-abdominal cavity (37). Thus, waist circumference may be a more useful clinical indicator for obesity in older adults (38).

Central adiposity, as assessed by waist circumference measurements, is associated with a greater risk of morbidity independent of BMI (39). The waist circumference associated with the most risk is greater than 102 cm for males and 88 cm for females; however, recently these guidelines have been challenged as they were derived from only one study in Scotland (38). Greater central adiposity increases the risk for diabetes (26) and impaired glucose tolerance in older adults (39). Central adiposity has also been related to functional limitation (40) and reduced ability to perform activities of daily living (41). Recent data highlights nutritional risk as a strong independent predictor of central obesity and metabolic syndrome in females (42).
Sarcopenia is a well-documented consequence of aging. As a result, decreases in basal metabolic rate and loss of muscle strength occur (43). Sarcopenia can exist even in weight-stable older adults (44); however, if a decrease in energy requirements is not accompanied by a decrease in energy intake, overweight and obesity can result (43, 45, 46). Sarcopenia has also been associated with physical disability (47) and inflammation (46).

Both under and overweight status predispose older adults to nutrition risk. The shifts in body composition seen in older adults complicate physical assessment by reference standards, generally developed on younger age groups. Furthermore, physical assessment of overweight and obese older adults may be difficult for clinicians to complete (48), which may partially explain low correlations that have been observed between anthropometric indicators and muscle mass and fat distribution (49). Therefore, the use of waist circumference in addition to BMI to assess overall weight status among older adults may be advantageous in clinical practice (49).

**Biomarkers and Nutrition Risk**

Biomarkers serve as a clinical measure of nutrition status. Most micronutrients can be assessed biologically, either directly or indirectly. In addition to nutrient indicators, various other markers of nutritional status exist including homocysteine, lipid panels (i.e., total cholesterol, high-density lipoproteins, low-
density lipoproteins, and triglycerides), albumin, C-reactive protein, and fasting blood glucose. Older adults have alterations in several hematological indicators of nutrition status (50); however, it is not known whether these alterations are the cause or the consequence of morbidity.

Serum carotenoids are used extensively to validate dietary assessment tools as they highly relate to fruit and vegetable intakes (51, 52). Higher serum carotenoids are characteristic of higher quality diets (53, 54). Carotenoids have been associated with reduced risk of eye disorders such as macular degeneration and cataract formation (55). Recent findings in community-dwelling older females show that low serum carotenoids are associated with lower skeletal muscle strength and the development of walking disability (56). High serum carotenoid levels are also related to a reduced risk of inflammation, hypertension, diabetes, cardiovascular disease, and mortality (57).

Vitamin B12 status can be evaluated using direct assessment in the plasma or indirectly through methylmalonic acid (MMA) levels. Vitamin B12 is an essential cofactor in the conversion of methylmalonyl coenzyme A to succinyl coenzyme A; thus, a deficiency of Vitamin B12 would lead to an accumulation of MMA. The choice of the appropriate Vitamin B12 assessment method relies on the sensitivity of information required from the test. Plasma levels are good general indicators of tissue status; however, MMA is more sensitive to determine deficiency states but has questionable validity when plasma B12 levels are within the normal range (58). Serum Vitamin B12 levels tend to decrease with aging (50). Low serum and plasma Vitamin B12 levels, in the absence of clinical deficiency, relate to impaired cognitive performance (59) as well vascular disease (59).
High homocysteine concentrations are associated with vascular disease (60, 61), cognition function (62-64), and mortality (61, 65). Several B vitamins regulate homocysteine concentrations in the body; higher homocysteine levels are observed in deficiency of Vitamin B12 or folate (58). Homocysteine can be lowered in the body by ensuring adequate dietary B-vitamin intake, predominantly folic acid deficiencies, but to a lesser extent Vitamins B12 and B6 (66-71). Jacques et al. found homocysteine concentrations to be 23 percent higher in individuals over the age 65 when compared to those less than 45 years of age, even after adjustment for factors known to alter circulating homocysteine concentration (Framingham Offspring Study, n=1960, aged 28-82) (72). Homocysteine concentrations in aging individuals are a complex interplay of B-vitamin intakes, presence of morbidity, and nutrient-gene interactions (73). Low B-vitamin status and high homocysteine concentrations have been linked to poor cognitive performance in older adults (59, 74-76) and dementia (77).

Dyslipidemia has negative health consequences for cardiovascular disease (71, 78-93) and increases risk for early mortality (94-96). Adverse serum lipid profiles are associated with the onset and sequelae of cardiovascular disease. A typical lipid profile consists of total cholesterol, LDL-C, HDL-C, and triglycerides. Total cholesterol, HDL-C, and triglycerides increase with advancing age (11, 50). However, lipid profiles are highly variable because all fractions of lipids can be manipulated by diet, exercise, and/or weight loss (78, 97-101). Interventions using dietary fat have been effective at lowering total cholesterol and/or certain fragments of cholesterol (86). Briefly, both high saturated fatty acid and trans fatty acid intakes have been implicated in increasing LDL-C (90, 102) (78, 88); however, saturated fat
increases HDL-C, and trans fat lowers HDL-C (90). High intakes of polyunsaturated and monounsaturated fatty acids are generally associated with an increase in HDL-C (85). Dietary intake of alpha-linolenic acid is inversely related to plasma triglyceride concentrations in both Caucasian males and females (80).

C-reactive protein (CRP) is a marker for generalized inflammation (103) and is related to insulin resistance (104, 105), depression (106, 107), and obesity (105, 108, 109). CRP is associated with risk for cardiovascular disease risk; however, few studies specific to older adults exist (110). CRP levels are elevated in overweight and obese individuals (111); however, weight loss decreases CRP (112, 113). Diet can modify CRP levels; specifically, glycemic load increases levels (114) whereas diets rich in alpha-linolenic acid decrease CRP (115). Zhao et al. have found diets rich in alpha-linolenic acid from walnuts, walnut oil and flaxseed oil were effective in lowering CRP levels (n=23; 20 males aged 36–60 years and 3 females 55–65 y) (115).

Fasting blood glucose is a diagnostic tool for impaired glucose tolerance (i.e., diabetes). A wide body of literature supports increases in fasting blood glucose with age (11). Fasting blood glucose is one of the criteria used to diagnose metabolic syndrome, a complex disorder involving disturbance in glucose homeostasis, cardiovascular disease risk factors, and obesity (116). The prevalence of metabolic syndrome is increasing among older adults (117). McKeown and Jacques found that whole-grain intake was inversely associated with fasting blood sugar levels found in a sample of older adults (n=535 aged 60-98 y) (118).
**Dietary Intakes and Nutrition Risk**

Compromised dietary intakes in older adults can result from a multitude of factors: inability to purchase or prepare food (7), functional limitations (119), financial inadequacy, poly-pharmacy (120), sensory changes (13), oral health problems (121-126), and morbidity (127). Body composition changes that accompany aging and lower energy expenditure generally lead to reduced energy requirements. Concomitant decreases in micronutrients are often associated with lower energy intakes. However, requirements remain the same for many nutrients and actually increase for some nutrients (128-131). Vitamin B12 deficiency is a common problem among the elderly with prevalence rates ranging from 10-40 percent of older adults (59). Holick et al. found a high percentage of community-dwelling Caucasian (30 percent), Hispanic (42 percent) and African-American adults (84 percent) to have Vitamin D deficiency (16).

Poor diet quality among older adults has been determined by both national and regional research (34, 132-134). Data from the 1999-2000 National Health and Nutrition Examination Survey (NHANES) has provided insight into dietary intakes of older adults from a nationally representative perspective. NHANES data reveals lower intakes of the majority of vitamins by adults 60 years and older than by younger adults (135, 136). More specifically, lower intakes were observed for thiamin, riboflavin, niacin, folic acid, Vitamin B12, and Vitamin E. Vitamin A was higher in the 60-plus age group. Mineral intakes were also notably lower for older adults than younger adults. The recommended calcium intake for adults over the age of 51 is 1200 mg (15); NHANES data indicates a mean intake for those 60+ was only
721 mg. Lower intakes of iron, magnesium, phosphorus, potassium, selenium, and zinc were also observed among the 60 and over age group.

Data from the Salisbury Eye Evaluation trial (SEE) also confirm low intakes of micronutrients among older adults (134). SEE is a cross-sectional study of older Caucasian and African-American individuals residing in Maryland (n=2,655, ages 65-85). The highest prevalence of inadequate intakes was observed for zinc, calcium, Vitamin E, and Vitamin B6. Nutritional inadequacies were more likely to occur in females compared to males as well as in African American compared to Caucasians (134). Notably, white adults had higher mean intakes of energy and most micronutrients than blacks.

Other regional studies indicate that older adults have lower nutrient intakes than national recommendations. Calcium intakes were very low (636mg) among community-dwelling older adults in New England (> 70, n= 1156)(137). As much as 60 percent of the sample failed to meet calcium recommendations and many failed to reach even 75 percent of the recommendations for Vitamin A, protein, Vitamin C, and thiamin. Individuals with lower educational attainment and dental problems were more likely to have low nutrient profiles. In this sample, mean intake of percent energy from fat was above recommendations (137).

Approximately one-third to one-half of participants in the Geisinger Rural Aging Study (GRAS) had “at-risk” nutrient intakes of Vitamin B12, Vitamin B6, and zinc as determined by the Estimated Average Intake requirements established by the Institutes of Medicine (129). Two-thirds or more had “at-risk” dietary intakes of folate and magnesium. Mean intakes of calcium and Vitamin D were approximately one-half the recommendation (34, 138). While the majority of GRAS participants
had adequate intakes of iron, selenium, Vitamin A, Vitamin E, and Vitamin C, those with oral health problems had significantly lower intakes of Vitamin A and a higher prevalence of inadequate intakes of Vitamin B-6 (139). Taken together, it is clear that improved measures to screen for nutrition risk in the GRAS population are warranted.

Dietary Patterns and Nutrition Risk

In addition to the assessment of key nutrients, dietary patterns must also be considered as they relate to nutrition risk in older adults. The term dietary pattern encompasses foods regularly consumed, the number of eating occasions, meal stability, snack patterns, and temporal distribution of intake. Poor dietary patterns have been associated with many chronic diseases such as certain cancers, obesity, osteoporosis, and heart disease (140-144). Favorable dietary patterns are also associated with high-nutrient quality diets (53, 145). Dietary patterns consistent with national guidelines have been associated with a lower risk of mortality in the National Health Interview Surveys, 1987 and 1992 (n = 10,084, ages > 45) (146, 147).

A recent dietary pattern study revealed an association between dietary patterns and risk for chronic disease among males in the Framingham Offspring-Spouse (n= 1,666)(148). Five dietary patterns were derived via cluster analysis: (1) Transition to Heart Health (highest intakes of vegetables, shellfish, whole grains, low fat foods choices, fish, soups, and organ meats); (2) Higher Starch (highest intakes of lean protein sources, diet soda, and firm vegetable fats); (3) Average Male (typical food intake of males, moderate in all food groups); (4) Lower Variety (habitual consumption of only a few food groups); and (5) Empty Calories (highest intakes of
refined grain, high-fat protein sources, sweets, and salty snacks) (148). Nutritional risk was calculated based on 19 selected nutrients. The Empty Calorie pattern had the highest nutritional risk score, whereas the Transition to Heart Healthy pattern had the lowest. Risk for chronic disease was compared at baseline and 16-year follow-up for all dietary patterns. At baseline, the Transition to Heart Health had the highest prevalence of diabetes and hypertension; at year 16, only the greater prevalence of diabetes persisted. At both time periods, highest prevalence of tobacco use was associated with the Empty Calorie pattern. The Average Male pattern also had the highest Framingham Risk Scores, an indicator of cardiovascular disease risk, at both time periods. The Average Male pattern was also associated with the highest prevalence of hypertension, high cholesterol, and obesity.

The Dietary Approaches to Stop Hypertension (DASH) has been a successful dietary pattern intervention to reduce high blood pressure, particularly for hypertensive and minority populations. The DASH diet reduced systolic and diastolic blood pressure by 11.4 and 5.5 mm Hg respectively (149, 150). The DASH dietary pattern includes the following number of servings per day: 7-8 grain; 4-5 vegetable; 4-5 fruits; 2-3 low-fat dairy products; <=2 servings of meat, fish or poultry; and 2-3 fats/oil. In addition to reducing blood pressure the DASH dietary pattern also lowers serum homocysteine, an established risk factor for cardiovascular disease. Appel et al. conducted a sub-study within the larger DASH study (n=118). Homocysteine was measured, with a mean change was +0.46 µmol/L for the control group compared to -0.34 µmol/L in the experimental group following the DASH diet (151). Taken together this dietary pattern helped to elicit favorable responses to two established risk factors for cardiovascular disease.
Similar research has supported the influence of dietary patterns on markers of cardiovascular disease. Factor analysis of the diets among the males enrolled in the Health Professionals Follow-up Study (n = 466) revealed two dietary patterns: Western and prudent (70). The prudent diet was comprised of higher intakes of fruit, vegetables, whole grains, and poultry. The Western dietary pattern consisted of higher intakes of red meats, dairy products, and refined grains. The Western dietary pattern was significantly associated with higher levels of insulin, CRP, leptin, homocysteine and lower levels of folate (70).

Fish consumption has been associated with healthier dietary patterns and decreased risk for cardiovascular disease due to a high level of omega-3 fatty acids. In the Nurse’s Health Study, a lower risk of CHD and CHD-related mortality was observed for individuals in the highest quintile of fish intake. Another large prospective study, The National Heart, Lung, and Blood Institute Family Heart Study, showed similar results with dietary linolenic acid, an omega-3 fatty acid. Djousse et al. showed a significant decrease in odd ratios for atherosclerosis, plasma triacylglycerols (an independent risk factor for heart disease), and coronary artery disease among those in the highest dietary intake quintiles of linolenic acid (80, 81, 152). Overall, the epidemiological data shows a consistent, dose-response relationship between intakes of higher intake of n-3 fatty acids and lower risk of coronary heart disease.

Dietary patterns have been related to obesity among participants of the Baltimore Longitudinal Study of Aging (n=459 men and women). Five dietary patterns were derived by cluster analysis (healthy, white bread, alcohol, sweets, and meat and potatoes) (144). In longitudinal analysis, the mean yearly change in BMI
was 0.30 kg/m² for those within the meat/potatoes group compared to only 0.05 kg/m² in the healthy pattern (p= < 0.01). Further, the differences in waist circumference were more pronounced; subjects in the white bread group experienced an annual increase of 1.32 +/- 0.29 cm compared to those in the healthy cluster (0.43 +/- 0.27 cm, p = 0.05). Diets rich in fruit, vegetables, whole grains, and low-fat dairy were associated with the smallest increases in obesity measured by BMI and waist circumference measurements.

The dietary patterns of Geisinger Rural Aging Study (GRAS) participants were originally presented by Ledikwe et. al (145). Two distinct dietary patterns were derived via cluster analysis of the GRAS data: one pattern was of higher nutrient density (n=72), and one of lower nutrient density (n=107). The higher nutrient-dense dietary pattern was represented by higher intakes of cereals, dark green/yellow vegetables, other vegetables, citrus/melons/berries, fruit juices, other fruits, milks, poultry, fish, and beans. The lower nutrient-dense dietary pattern included higher intakes of breads, sweet breads/desserts, dairy desserts, processed meats, eggs, and fats/oils. Lower mean energy intake was observed for the higher nutrient-dense dietary pattern. Higher energy-adjusted intakes fiber, iron, zinc, folate, Vitamins B6 and B12 were associated with the higher nutrient dense dietary pattern. The higher nutrient-dense dietary pattern was associated with higher Healthy Eating Index scores (a national index of dietary quality), lower waist circumference, and higher plasma vitamin B12 levels. Further, individuals in the lower nutrient dense dietary pattern were twice as likely to be obese and to have low plasma Vitamin B12 levels. A review of previous dietary pattern research among adults older than 60 years of age is presented in Table 2.1.
<table>
<thead>
<tr>
<th>Author</th>
<th># of Clusters</th>
<th>Results</th>
</tr>
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</table>
| Tucker et al. (142) | (1) Meat, dairy and bread  
(2) Meat & sweet baked foods  
(3) Sweet baked foods  
(4) Alcohol  
(5) Candy  
(6) Fruits, vegetables, and cereals | *Study was assessing bone mineral density (BMD)  
C5: Associated with lower BMD in both men and women.  
C6: Associated with highest BMD in males only |
| Pryer et al. (153) | (1) Mixed diet ("traditional")  
(2) Healthy  
(3) Alcohol | C2: Highest nutrient intake for 18 of nutrients whereas  
C3: Had lowest intakes of 16 of 20 nutrients. |
|---|---|---|
| **Haveman Nies et al.** | (1) Sugar and sugar products  
(2) Fish and grain  
(3) Meat, eggs and fat  
(4) Milk and fruit  
(5) Alcohol | C3 and C5: Lowest diet scores  
C2: Best diet scores**  
** Diet scores were combination of healthy diet indicator and Mediterranean diet score |
| Tuck er et al. | (155) | (1) Alcohol  
(2) Milk, cereal and fruit  
(3) Bread and poultry  
(4) Meat and potatoes | C1: Related to low serum B12 and riboflavin with highest HDL level. C2: Best overall hematological profiles C3: Lowest energy intake but highest BMI C4: Lowest plasma folate and B6 |
|----------------|-------|---------------------------------------------------------------|
| Huijbregs et al. | (156) | (1) Alcohol  
(2) Meats  
(3) Healthy  
(4) Refined sugars | * Study was addressing CVD risk factors C1: Highest total cholesterol, HDL, and prevalence of hypertension C2: Higher HDL than C4 |
Summary

Older adults are a particularly vulnerable group for nutrition risk. Low intakes of critical nutrients as well as unfavorable dietary patterns place older adults at risk for poor nutritional status. Furthermore, weight status and biomarkers are key components to nutrition risk, and older adults have been shown to have adverse alterations in these markers of nutritional status. Given the complexity of nutrition risk, the ramifications of impaired nutrition status for chronic diseases related to aging, and the increasing population older adults, never has the salience of nutrition screening been more apparent.

Nutrition Screening

Nutrition screening identifies characteristics known or suspected to be associated with nutrition risk. Nutrition screening is intended for early detection of risk factors by an easily applied tool where there is potential for effective intervention (157, 158). The prerequisites of effective screening programs are: 1) acceptable levels of sensitivity, specificity, and relatively high positive predictive value; 2) availability of proven interventions; 3) significant benefits from early intervention; and 4) selective identification is preferable to other strategies such as universal application of an intervention (157).

Various screening tools are available to assess multiple indicators of nutritional risk beyond the diet, with a few developed specifically for older adult populations. For example, the Subjective Global Assessment has been designed for
use specifically for older individuals with gastro-intestinal disease (159, 160). In general, screening tools tend to focus on three segments of older adults: community-dwelling, institutionalized or other formal care settings or acute-care settings (161). The scope of this section will focus on available tools for use with community-dwelling older adults.

The Nutrition Screening Initiative (NSI) is the most widely recognized and utilized instrument in use for older populations (162). The NSI developed and distributed three screening instruments: the DETERMINE checklist as well as the Level I and Level II (L-II) screening instruments. The DETERMINE is an acronym for common nutrition risk indicators among older adults: Disease, Eating poorly, Tooth loss/mouth pain, Economic hardship, Reduced social contact, Multiple medicines, Involuntary weight loss/gain, Needs assistance in Self Care, and Elder years above age 80. The Level I screening is to be completed by a clinician and queries weight status, eating habits, and living conditions such as isolation, depression and functional status. The L-II is more in-depth than the Level I and queries anthropometric data, laboratory data, medication use, oral health status, skin changes, eating habits, living environment, functional status, and cognitive status and is to be completed by a healthcare professional (162).

Specific Level-II items, including, the use of multiple medications, high Body Mass Index (BMI), elevated blood cholesterol, weight loss, eating alone, mouth pain and eating problems have been associated with functional limitations, healthcare charges, and hospitalization (29). However, the NSI has major limitations for assessing dietary intakes. The food group questions embedded in the Level-II (n=4) have not been shown to be predictive of health outcomes (29). One reason may be
the low specificity of these items relative to more comprehensive dietary assessment (163). The low sensitivity, specificity, and positive predictive value of these questions suggest misclassification of those not at nutrition risk. Specifically, the L-II food group questions were sensitive in identifying persons whose intakes were low but lacked specificity for most of the food groups (163).

The Mini Nutritional Assessment (MNA) is another screening tool for malnutrition. The MNA is composed of 18 questions grouped in four categories: anthropometric assessment (weight, height, and weight loss), general assessment (six questions related to lifestyle, medication, and mobility), dietary assessment (eight questions related to number of meals, food and fluid intake, and autonomy of feeding), and subjective assessment (self-perception of health and nutrition) (164). In community-dwelling elderly persons, MNA scores have been related to nutritional risk. In hospitalized patients, the MNA has shown to be predictive of cost of care (164). The MNA also has two levels of screening: a short form of eight questions and a long form. It is the only known malnutrition screening tool to query functional status, dementia, and depression(161).

A host of diet-specific screening instruments exists that focus on one or two dietary components such as calcium, fruits and vegetables, or fat (165-171). These tools serve a purpose to study or assess the specific nutrient or food group in question. However, these instruments are not designed to determine those at overall dietary inadequacy. The malnutrition screening tools presented within this section have questionable efficacy for the emerging population of overweight and obese older adults (48). Furthermore, none are designed to assess diet quality specifically in older adults (172). Strong evidence from multiple studies associates overall diet
quality and dietary patterns as strong predictors of morbidity and mortality among older adults. However, understanding the role of diet in the etiology and management of chronic diseases depends on accurately assessing dietary intake.

**Dietary Assessment Methods**

Current methods of dietary assessment include food records, food frequency questionnaires (FFQ), and 24-hour recalls. Diet records will not be used in this study and will not be described in detail. Briefly, a food record is a detailed list of all foods and beverages consumed within a specified period of time. Usually three-four days of intake are recorded as participant burden generally causes a decline in the quality of information beyond this time frame. Ideally, dietary intakes are either weighed, measured, or estimated by participants both before and after eating occasions (173). Choice of assessment strategy is dependant upon the research question, and sample characteristics and size (174). The FFQ and 24-hour recall will be discussed in more detail in the following sections.

**24-hour dietary recalls**

A 24-hour recall is a means to assess an individual's intake over the previous 24 hours, generally with multiple days of intake recorded. The telephone provides an easily accessible and methodologically valid means to collect the data (175). Subjects are asked to recall all food and beverages consumed during the previous 24 hours. The use of probing questions aids the ease of responses and has been
shown to enhance data accuracy (176). Probes include questions regarding food preparation methods, additions made after preparation (i.e., condiments, butter, spices), and time of the eating occasion (173).

Multiple 24-hour recalls are recommended to compensate for day-to-day variability in intake, both for individual (intra-individual variation) and groups (inter-individual variability). Day of the week can induce variability in the diet, as dietary intake on week days may differ than on weekend days (177). Intake of macronutrients, which are consumed in large amounts everyday, are usually more stable than micronutrient intake(178). Some foods are consumed in large quantities by some individuals but, rarely or never by others (178). Large day-to-day variability has been reported for cholesterol, Vitamin C, and Vitamin A (177, 179). For these reasons, some foods and nutrients can be accurately quantified by a few days of 24-hour recalls, whereas some nutrients require upwards of weeks. Thus, the number of recalls may be a factor in the nutrients of interest. Participant motivation decreases with longer periods of assessment, leading to reduce data quality (180).

Multiple benefits of the 24-hour recall over other dietary assessment strategies exist. First, literacy of the subject is not required. Additionally, the 24-hour recall allows for data collection of individuals with a physical disability (e.g., blindness, lack of ability to write due to injury, or arthritis). A typical recall lasts approximately 30 to 45 minutes, and participant burden is low. The recall is collected in real time and thus interpretation problems are minimized because subjects can clarify directly to the interviewer, which may help eliminate errors in response and missing data. The recall has the potential to capture a wider variety of foods and nutritional supplements that may be limited by specific dietary questionnaires. For
research purposes, the 24-hour recall is administered on random days; the retrospective nature of this technique may reduce response bias or change in food intake due to an observation effect. Participants can be provided with various aides (e.g., two-dimensional food portion visual posters) to increase accuracy or portion size estimates. Finally, direct entry of the recall minimizes time spent coding and entering data.

Weaknesses of the 24-hour recall also exist. This assessment tool relies on memory. Seasonal variability can introduce a bias estimate of habitual food and nutrient intake. Substantial inter-individual variability in day-to-day dietary intake requires multiple days of dietary data collection. Extensive training of the interviewer, combined with the necessary software to collect 24-hour recall, makes it an expensive technique. The expense precludes the availability of this method for large sample sizes, such as those participants in large epidemiological studies.

Food Frequency Questionnaires

Food frequency questionnaires (FFQ) assess usual dietary intake over a specified period of time and queries how frequently a person consumes multiple food items. Questions are generally presented in food aggregates; for example, how often do you eat carrots, broccoli, sweet potatoes, or spinach? Qualitative FFQs do not assess the amount of food that is eaten, only the frequency. Qualitative FFQs are based on data that indicates a correlation between the frequency and weight of food data from diet records (181). Semi-quantitative FFQs query portion sizes of foods consumed, in addition to frequency (179). FFQS can be created or adapted to measure a variety of dietary components. For example, FFQs can be nutrient-
specific or food(s)-specific (170, 182, 183). They can be modified to assess overall dietary intake or change in intake over time (142, 154, 184).

FFQs offer a more cost-effective alternative to the 24-hour recall because the subject usually completes the tool by himself or herself. FFQs are generally intended for large samples. As such, the absolute intakes of nutrients are not as important as the ranking of individuals. FFQs are used to classify individuals into groups based on intakes in order to explore epidemiological relationships. Willet lists the lack of episodic memory as one major benefit to the FFQ (179). This is supported by others that indicate typical behaviors (i.e., food intake patterns) are easier to recall than specific foods or portion sizes (185). Data collected by FFQ techniques can also be entered electronically by optical scanners to reduce data-entry errors.

The FFQ limits the scope of foods that can be queried. The FFQ may create participant burden, and it may be difficult or confusing to complete. This technique requires literacy and physical ability to complete. Most importantly, the accuracy of nutrient profiles determined by FFQs has been questioned. FFQs are criticized for lack of precision in measuring absolute intake of energy and nutrients.

Krall and Dwyer found an FFQ to significantly underestimate all nutrients under investigation (186). Subar et al. determined much under-reporting of energy intakes assessed by FFQ compared to 24-hour recalls in the Observing Protein and Energy Study (187). Doubly labeled water and urinary nitrogen were used to derive energy and protein needs. In men, energy intake determined by FFQ were 31 to 36 percent lower and for 24-hour recalls were 12 to 14 percent lower than physiologically determined energy intakes, respectively. Protein intake was also under-reported by the two methods ranging from 34 to 38 percent on the FFQs and
16-20 percent on 24-hour recalls. For women, energy determined by FFQ were 31 to 36 percent and 12 to 14 percent for 24-hour recalls for energy, respectively; protein intake was also under-reported by the two methods ranging from 27 to 32 percent on FFQs and 11 to 15 percent on 24-hour recalls (187).

All dietary assessment methods are subject to error. The type of errors vary with the method used; error is broadly classified as random or systematic. Random errors tend to decrease precision of an instrument (174). Random errors, but not systematic errors, can be minimized by increasing the number of observations (174). Random errors occur for all subjects, whereas systematic errors may occur in certain respondents. For example, overweight individuals tend to under-report energy intakes.

Several common errors exist in dietary assessment: respondent bias, interviewer bias, memory problems, and errors in estimating portion size. Errors also can occur in collecting or entering the dietary data (174). Likewise, an interviewer may be the source of bias. Interviewers may ask subjects the same question in different ways, may inconsistently probe for more information when necessary, and may introduce errors when coding or entering the data. Respondent bias may arise because of social desirability to over-report foods that are healthy and under-report less healthy foods (188).

Each method has benefits and drawbacks; however, the 24-hour recall is the most accurate means to assess food and nutrient intake at present. The body of literature concurs that FFQs are useful tools to rank food intake of large groups; however, the 24-hour is a more precise and reliable measure of dietary intake. For this reason, the 24-hour recall is considered the “gold standard” dietary assessment
tool (189) and is frequently used as a reference method for validating FFQs (190). However, neither of these techniques is routinely performed outside of a research environment. Many of the health clinics where older adults are seen are not capable of collecting and analyzing these types of data. Thus, a screening tool that builds on the strengths of these methods would be of utility in a clinical setting.

**Summary of Review of Literature**

The number of older adults in America is on the rise. Strategies that help mitigate chronic diseases of aging and improve quality of life for older adults are essential. Diet is a modifiable factor that is related to the most common causes of death in older adults, including cardiovascular disease, some types of cancer, stroke, and diabetes. Current diet screening tools have merit for specific foods or nutrients but are not sufficient to determine overall dietary intakes. Traditional dietary assessment methods, such as the 24-hour recall and FFQ, are not practical clinic assessment strategies. Therefore, a screening tool that can be used as a proxy for comprehensive dietary assessment methods will be beneficial in determining those individuals for whom more follow-up is warranted. Given the body of evidence surrounding diet and health in older adults and the challenges surrounding broad based application of comprehensive dietary assessment methods, a diet screening protocol is warranted.
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Objectives and Hypothesis

The overall alternative hypothesis of this study was that a diet screening tool (DST) could serve to identify individuals at nutrition risk within the Geisinger Rural Aging Study (GRAS). The aims occurred in three phases: characterization of dietary patterns, development of a screening tool, and testing the screening tool (Figure 3.1). The characterization of dietary patterns was determined through secondary data analysis of a 1994-1996 GRAS cohort. These data were used to determine specific questions to include on the DST. To test the DST a new cross-section of GRAS participants was selected. The objectives and hypothesis for each phase will be presented within the upcoming sections.
Phase 1 (n=179): Cluster analysis of the dietary data to characterize dietary patterns of study participants for selection of screening items

Identified

Specific food groups selected for analysis

Led to

Phase 2: Question development based on foods with strong associations with dependent variables

Analysis of specific foods within food groups for frequency and temporal distribution of intake

To undergo

Cognitive interviewing of questionnaire

Help to

Revise questionnaire

Phase 3 (n=204): Testing of questionnaire, derivation of dietary patterns, examination of dietary patterns with markers of health and nutritional status.

Figure 3.1: Overall flow of study procedures
Phase I. Characterization of dietary patterns

The first step in determining appropriate foods to include on the DST was to characterize dietary patterns among previous GRAS participants using a comparative cluster strategy. The relevance of a dietary patterns approach was provided in Chapter 2.

Phase I Objectives

- To explore the stability of dietary patterns, specifically, to determine how
  1. methodology effects dietary pattern derivation
  Ho: Dietary patterns will not be changed by statistical methodology
  2. plausible and implausible reporters of energy intake effects dietary pattern derivation
  Ho: Dietary patterns will not be different when only plausible reporters of energy intake are used.

Dietary Pattern Assessment

No gold standard analytic method exists for dietary pattern assessment. Common methodology for assessing dietary patterns is through data reduction techniques, such as factor or cluster analysis (1). The dietary patterns of GRAS participants were originally presented by Ledikwe et. al (2). The goal of the initial analysis was to characterize dietary patterns of GRAS participants and relate patterns to weight status and nutritional status (2). Two distinct dietary patterns were derived via cluster analysis of the GRAS data. The clustering variable was the number of servings from 24 food groups. The clusters were described based upon
the amount of nutrients per calorie (i.e. nutrient density). One pattern was of higher nutrient density (n=72), and one of lower nutrient density (n=107).

The number of servings from food subgroups was the technique used to derive the initial dietary patterns because national dietary guidance is generally provided within a servings framework (e.g. 8-10 servings of fruits and vegetables per day). However, the percent energy contribution from food subgroups is a common method to derive dietary patterns. Recently, Kant suggested comparative evaluations of dietary patterns derived from different methods in the same cohort with similar confounders to examine reproducibility dietary patterns(3). For this reason, the stability of the dietary patterns was explored using different cluster analysis techniques. Specifically, the methodological differences were explored of using two cluster analysis techniques number of servings from food subgroups and percent energy contribution from food subgroups using the same sample of older adults. The results of this Phase I study published in the Journal of the American Dietetic Association as a manuscript entitled “Comparative strategies to conduct cluster analysis to assess dietary patterns” that is contained within Chapter IV.

Energy intake should approximate energy expenditure in a weight-stable individual. However, under-reporting of energy consumption ranges from 10- 50% lower than estimated caloric needs assessed by doubly labeled water (DLW) and other validation studies (4-7). DLW techniques are not feasible for large sample sizes and are very expensive. McCrory et al. developed a procedure for screening inaccurate dietary reporters that serves as a proxy for DLW studies (8). Errors in accurately reporting energy intake are pervasive (6, 9-13). However, very little is known about the stability of dietary patterns across plausible and implausible reporters of energy intakes. The primary goal of this part of Phase I was to apply
McCrory’s prediction algorithm to assess the impact of reporting errors dietary patterns among GRAS participants. This technique would ensure the dietary patterns were not an artifact of implausible reporting.

The results of this Phase I study were published in the Journal of the American Dietetic Association as a manuscript entitled “Assessing the impact of under-reporting energy intake on dietary patterns and weight status”, which is contained within Chapter V.

**Phase II: Diet Quality Screener (DST) Development**

Many factors must be considered when developing questionnaire items; however, the fundamental issues include the selections of items (i.e. questions) and structural aspects of questions (i.e. wording of questions and response options).

One must first decide the goal of the questionnaire. Is it intended to rank individuals in a group or to provide a measure of absolute intake of selected nutrients(14)? Further, generation of foods to include on an instrument is another consideration. Population-specific approaches are recommended to determine questionnaire items for inclusion an instrument (15). Foods can be chosen because of high consumption among the given population (15) or foods can be selected based on the ability to differentiate intake of a given nutrient (14). Furthermore, items can be created by performing multiple regression of food items onto the target of interest such as the USDA’s Healthy Eating Index, measure of diet quality, to see which food contribute the most to explaining the variance (16).
Phase II objective

- To develop a diet quality screening instrument (DST)

The following steps were employed in the development of the DST: item selection, question format, cognitive interviewing, and revision of instrument. The details of the development of the screening tool items are contained within Chapter VI, in a manuscript entitled “A Dietary Screening Tool identifies dietary patterns in older adults”, published in the Journal of Nutrition. A more detailed account of the questionnaire development and cognitive interviewing procedures can be found within Appendix A.

Phase III: Testing of the Dietary Screening Tool (DST)

Phase III objective

- To test the DST in a new cross-section of the Geisinger Rural Aging study
- To relate DST scores to meaningful clinical outcomes and to multiple 24-hour recall data

Ho: DST scores will not be related to indicators of nutritional risk: dietary intakes, biomarkers, and anthropometry
Phase III Study Protocol and Procedures

The study design is depicted in Figure 3.2. This new cohort is identified as the Senior Health In Pennsylvania Study (SHIP).

Week

<table>
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<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td><strong>Four 24-hour dietary recalls</strong></td>
</tr>
</tbody>
</table>

**Clinic Visit**
- Clinic Report Form (Appendix B)
- Anthropometric Data: Height, weight, and waist circumference.
- DST
- Fasted blood draw

Figure 3.2 Phase III Outline

**Sampling and recruitment**

Study entry/exclusion criteria are shown in Table 3.1. Recruitment for the study was conducted at Geisinger Medical Center by the longitudinal research coordinator of the study.
Table 3.1 Participant selection criteria

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>Member of GRAS cohort &gt;65 years of age.</td>
<td>Not in GRAS cohort.</td>
</tr>
<tr>
<td>Must reside in community setting at enrollment.</td>
<td>Cannot reside in acute, sub-acute, or chronic care setting at enrollment.</td>
</tr>
<tr>
<td>Must have telephone.</td>
<td>Does not have telephone.</td>
</tr>
<tr>
<td>Must consent to completion of clinic visits and telephone recalls.</td>
<td>Does not give consent.</td>
</tr>
<tr>
<td>Must be capable of performing study tasks. Proxy assistance can be provided.</td>
<td>Major psychiatric illness, severe dementia/cognitive limitation (MMSE &lt;24), or severe depression (GDS &gt;5), that preclude completion of study tasks.</td>
</tr>
</tbody>
</table>

Potential subjects were sampled with a computer-based random number generator from the GRAS cohort with selection of only one person per household. Previous GRAS studies have been based on a sample of 200 people(17). In this study, 225 people were identified for participation. The previous GRAS study was conducted over a one-year time period. In the prior study, 7 of 200 people recruited were excluded from baseline data collection and 14 did not complete all study measures including blood draws (17). Thus, recruiting 225 people should enable us to obtain an adequate number of people (n=200) to conduct the study.

Eligible candidates were mailed an introductory letter that briefly explaining the purpose of the study. This letter alerted potential participants that they will be telephoned by research personnel. Approximately 10 days later potential participants were contacted by telephone to query interest in participation and eligibility. The research coordinator scheduled visits at a primary care clinic for
those who agreed to participate. A reminder telephone call will be made the day before the scheduled visit.

**Procedures for Clinic Visit**

The entire set of visit tasks was usually completed in 45-60 minutes. Written informed consent was first obtained at the clinic visit and participants received a photocopy of the informed consent. A battery of questionnaires was completed by participants to obtain demographic and health-related data, functional status and physical activity. Clinic Report Forms (CRF) containing all the questionnaires to be used are contained within Appendix B.

All information obtained for this study can be found in the Clinic Report Form. The interviewer first asked the participants to complete the Geriatric Depression Scale (GDS) (18) and Mini-Mental Status Examination (MMSE)(19). Both are administered and scored by the researcher before the participant progresses MMSE scores of <24 and/or GDS scores >6 will be used to exclude participants because of impaired cognitive function or severe depression, respectively.

All eligible participants were asked by the interviewer to complete a medical history, an eye health questionnaire and the oral health questionnaire. Next, the participant is weighed and measured. Finally, the participant completed the Physical Activity Scale for the Elderly (labeled “Leisure time activity” in the CRF), Food and Health Questionnaire, Modified Mini Nutritional Assessment and finally, the DST.

Height and weight was measured by trained research personnel using a portable digital scale (UC300; A&D Engineering, Milpitas, CA) and a stadiometer (Infant/Child/Adult Height Measuring Board; Shorr Productions, Olney, MD). Body
Mass Index (BMI) was calculated as weight (kg)/height (m)$^2$. Waist circumference was measured with a flexible, non-elastic measuring tape. Standardized procedures developed on the basis of the National Health and Nutrition Examination Survey was followed.

A fasting venous blood draw (23 mL) was obtained during the clinic visit by a trained phlebotomist. The lipid panel included total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (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). Carotenoids were extracted and analyzed with a normal-phase, gradient HPLC system.

After the clinic visit, the participant received four random 24-hour dietary recalls by telephone at approximately 1-week intervals. Interviews are obtained using a multi-pass methodology and are entered into the Nutrition Data System for Research by trained interviewers at the Pennsylvania State University Diet Assessment Center (7). Data will be collected on three weekdays and one weekend day. The Nutrition Data System for Research software’s most current version (NDS-R Version 4.05_33, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN) was used for data collection. Two-dimensional visuals of cups, spoons, bowls, and various shapes was provided to participants at the clinic visit and used to assist participants with portion-size estimations. Food group analyses were
based on established procedures. Food and nutrient intakes were estimated from
the four-day averages.
References


Chapter 4

COMPARATIVE STRATEGIES FOR USING CLUSTER ANALYSIS TO ASSESS DIETARY PATTERNS

A reprint of this manuscript can be accessed as a PDF file on this website

Abstract
Introduction
Subjects and Methods
Results
Discussion
Conclusions
References
Chapter 5

ASSESSING THE IMPACT OF UNDER-REPORTING ENERGY INTAKE ON DIETARY PATTERNS AND WEIGHT STATUS

A reprint of this manuscript can be accessed as a PDF file on this website

Abstract

Introduction

Subjects and Methods

Results

Discussion

Conclusions

References
Chapter 6

A DIETARY SCREENING QUESTIONNAIRE IDENTIFIES FOOD PATTERNS IN OLDER ADULTS

A reprint of this manuscript can be accessed as a PDF file on this website

Abstract

Introduction

Subjects and Methods

Results

Discussion

Conclusions
Chapter 7

EVALUATION OF A DIET SCREENING TOOL FOR OLDER ADULTS

Introduction

A dramatic increase in the percentage of Americans over the age of 65 (1, 2) will place tremendous strain on the healthcare system, the economy (3), and formal and informal caregivers (4). This trend is accompanied by a higher projected life expectancy than previous generations. However, living longer does not necessarily translate into living better; many older adults are afflicted with age-related chronic disease, economic strain, and other social factors that reduce quality of life (5, 6). Thus, this demographic transition must be met with preventative approaches to mitigate or reduce the incidence of chronic diseases in order to enhance quality of life and reduce medical expenditures.

Diet is a modifiable factor that is directly related to risk and treatment of the three major causes of death in adults over the age of 65: cardiovascular disease, cancer, and stroke (7). Furthermore, as obesity prevalence increases within the aging population, risk for obesity-related diseases and functional decline are likely (8). The Dietary Guidelines for Americans recognize adults over the age of 50 as a population with unique dietary recommendations (9). Older adults are a vulnerable population for compromised nutritional status due to a complex interplay of physiological, social and psychological factors (10).

Early detection of those with compromised dietary intakes may be an effective strategy to prevent nutrition risk and help to ease some of the burden of chronic disease within this age segment. Some screening tools are currently
available to detect malnutrition in older adults (11-14). While some of these tools are designed for use in a clinical setting (i.e. acute and long-term care), others are appropriate for use in the community. However, frank malnutrition may not necessarily be the end point of interest when screening community-dwelling older adults for nutrition risk. Poor dietary intakes may predispose individuals to nutrition risk and sub-clinical malnutrition. Therefore, proactive screening of older adults in the community may help target individuals who could make dietary improvements for primary or secondary prevention of disease (15).

A variety of tools have been developed to assess risk of inadequate dietary intakes for specific dietary components such as calcium (16, 17), fruit and vegetables (18, 19), or fat (20-22). However, no screening tools are available to assess total dietary intakes of older adults. Therefore, the overall purpose of this study was to evaluate a newly developed diet screening tool (DST) to identify nutritional risk among community-dwelling older adults.

**Methods**

**Subjects**

A sample was selected from participants in the Geisinger Rural Aging Study, a longitudinal study of more than 20,000 older rural adults enrolled in a Medicare managed health maintenance organization. Letters introducing the study were mailed to 1930 individuals who had completed a recent wave of longitudinal data collection; 1432 of those individuals (74%) met the study eligibility criteria upon initial phone screening: community dwelling, residing within 120 kilometers of one of 13 selected Geisinger medical clinics, and free from major depressive disorders upon phone screening. Of those meeting eligibility criteria, 333 agreed to participate and
were scheduled for a clinic visit; 49 withdrew before the clinic visit, seven were excluded by the Geriatric Depression Scale criteria and five 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 this study, and 206 of those completed the questionnaire and all other study protocol.

Data Collection

A research coordinator scheduled visits for participants at the closest Geisinger medical clinic. Participants completed a battery of questionnaires on demographics, medical history, and functional status. Activity level was assessed via the Physical Activity Scale for the Elderly (23). Data were collected on the use of medications and dietary supplements and at this time participants also self-completed the DST, which generally takes less than ten minutes.

Measures

Diet Screening Tool: Development, Item Selection, and Scoring

The details of DST development have been published elsewhere (24). Briefly, secondary data analysis was performed on a previous Geisinger Rural Aging Study cohort (n=179) (24). Dietary pattern analysis revealed several food groups that were related to diet quality and nutrient density. These foods and food groups were used as targets for questionnaire items. Thirty-seven items were selected for the final version of the DST: 28 questions about frequency of intake of specific foods; five yes or no questions; two questions on meal frequency; one on the type of milk consumed; one on alcohol intake; and one on vitamin and mineral supplement use. This section describes the identification of items for scoring, and how the individual
response options were scored. Psychometric properties of the DST are presented in the following sections.

All 37 questionnaire items were simultaneously regressed onto a latent construct of diet quality using M Plus Version 4 (Muthen and Muthen, Los Angeles, CA, 2006). The absolute values of the beta weights from each question were summed, and the percent contribution to diet quality was determined by dividing the individual beta weights by the sum of all the beta weights. Any questions explaining 0% of the variance were excluded from analysis (Table 7.1).

Table 7.1 Beta weights of each DST item (n=37) and the percent contribution

<table>
<thead>
<tr>
<th>DST Question</th>
<th>Beta Weight</th>
<th>% Contribution</th>
<th>Rounded</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often do you usually drink wine, beer or other alcoholic beverages?</td>
<td>0.053</td>
<td>0.165734</td>
<td>0</td>
</tr>
<tr>
<td>How often do you eat bacon?</td>
<td>0.088</td>
<td>0.275181</td>
<td>0</td>
</tr>
<tr>
<td>How many pieces of bread, bagels, rolls, or English muffins do you usually eat each DAY?</td>
<td>0.113</td>
<td>0.353357</td>
<td>0</td>
</tr>
<tr>
<td>Do you usually add sugar or honey to sweeten your coffee or tea?</td>
<td>0.114</td>
<td>0.356484</td>
<td>0</td>
</tr>
<tr>
<td>Do you usually add fat (butter, margarine or oil) to potatoes and other vegetables?</td>
<td>0.128</td>
<td>0.400263</td>
<td>0</td>
</tr>
<tr>
<td>How many times a week do you usually eat at restaurants or other places where food is prepared?</td>
<td>0.133</td>
<td>0.415898</td>
<td>0</td>
</tr>
<tr>
<td>How often do you eat fish or seafood that IS fried?</td>
<td>0.143</td>
<td>0.447168</td>
<td>0</td>
</tr>
<tr>
<td>Do you usually add jelly, jam or honey to foods like bread, rolls, or biscuits?</td>
<td>0.16</td>
<td>0.500328</td>
<td>1</td>
</tr>
<tr>
<td>How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?</td>
<td>0.262</td>
<td>0.819288</td>
<td>1</td>
</tr>
<tr>
<td>How often do you eat crackers, pretzels, chips, or popcorn?</td>
<td>0.393</td>
<td>1.228931</td>
<td>1</td>
</tr>
<tr>
<td>Do you use gravy (when available) at meals?</td>
<td>0.439</td>
<td>1.372776</td>
<td>1</td>
</tr>
<tr>
<td>How often do you eat potatoes?</td>
<td>0.486</td>
<td>1.519747</td>
<td>2</td>
</tr>
<tr>
<td>How often do you eat eggs?</td>
<td>0.568</td>
<td>1.776166</td>
<td>2</td>
</tr>
<tr>
<td>How often do you eat nuts?</td>
<td>0.634</td>
<td>1.982551</td>
<td>2</td>
</tr>
<tr>
<td>How often do you drink a glass of milk?</td>
<td>0.641</td>
<td>2.00444</td>
<td>2</td>
</tr>
<tr>
<td>How often do you usually eat vegetables as a snack?</td>
<td>0.646</td>
<td>2.020076</td>
<td>2</td>
</tr>
<tr>
<td>How many times each DAY do you eat between meals, including an evening snack?</td>
<td>0.691</td>
<td>2.160793</td>
<td>2</td>
</tr>
<tr>
<td>Do you usually add butter or margarine to foods like bread, rolls, or biscuits?</td>
<td>0.765</td>
<td>2.392195</td>
<td>2</td>
</tr>
<tr>
<td>What kind of milk do you drink or serve with cereal?</td>
<td>0.812</td>
<td>2.539166</td>
<td>3</td>
</tr>
</tbody>
</table>
Seven questions were eliminated as they did not contribute to the variance explained. Excluded items included alcohol use, bacon intake, bread intake, adding sugar to coffee and tea, adding fat to vegetables, eating away from the home and fried fish intake. A new M Plus model was employed with the remaining 30 questions (Table 7.2).

Table 7.2 Beta weights of each DST item (n=30) and the percent contribution

<table>
<thead>
<tr>
<th>DST Question</th>
<th>Beta Weight</th>
<th>% Contribution</th>
<th>% Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you usually add jelly, jam or honey to foods like bread, rolls, or biscuits?</td>
<td>0.143</td>
<td>0.48596479</td>
<td>0</td>
</tr>
<tr>
<td>How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?</td>
<td>0.201</td>
<td>0.68306939</td>
<td>1</td>
</tr>
<tr>
<td>How often do you eat crackers, pretzels, chips, or popcorn?</td>
<td>0.332</td>
<td>1.12825393</td>
<td>1</td>
</tr>
<tr>
<td>How often do you eat potatoes?</td>
<td>0.43</td>
<td>1.46129273</td>
<td>1</td>
</tr>
<tr>
<td>How often do you eat eggs?</td>
<td>0.464</td>
<td>1.57683681</td>
<td>2</td>
</tr>
<tr>
<td>How often do you eat GRAVY?</td>
<td>0.517</td>
<td>1.75694964</td>
<td>2</td>
</tr>
<tr>
<td>How often do you drink a glass of milk?</td>
<td>0.592</td>
<td>2.01182628</td>
<td>2</td>
</tr>
</tbody>
</table>
Using the model presented in Table 7.2, jelly was eliminated from further consideration from scoring as it contributed 0% explanation of variance. Next, each question was awarded a total point score based on the percent of variance explained. For example, the question “How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?” was awarded a total score of one point, whereas the

<table>
<thead>
<tr>
<th>Question</th>
<th>Weight</th>
<th>Score</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often do you eat nuts?</td>
<td>0.598</td>
<td>2.03221641</td>
<td>2</td>
</tr>
<tr>
<td>How often do you usually eat vegetables as a snack?</td>
<td>0.631</td>
<td>2.14436213</td>
<td>2</td>
</tr>
<tr>
<td>How many times each DAY do you eat between meals, including an evening snack?</td>
<td>0.646</td>
<td>2.19533746</td>
<td>2</td>
</tr>
<tr>
<td>Do you usually add butter or margarine to foods like bread, rolls, or biscuits?</td>
<td>0.76</td>
<td>2.58274995</td>
<td>3</td>
</tr>
<tr>
<td>How often do you eat ice cream?</td>
<td>0.762</td>
<td>2.58954666</td>
<td>3</td>
</tr>
<tr>
<td>What kind of milk do you drink or serve with cereal?</td>
<td>0.779</td>
<td>2.6473187</td>
<td>3</td>
</tr>
<tr>
<td>How often do you usually drink 100% fruit juices (other than orange juice)?</td>
<td>0.802</td>
<td>2.72548087</td>
<td>3</td>
</tr>
<tr>
<td>How often do you usually eat whole grain breads?</td>
<td>0.828</td>
<td>2.8138381</td>
<td>3</td>
</tr>
<tr>
<td>How many times each DAY do you eat cookies?</td>
<td>0.831</td>
<td>2.82403317</td>
<td>3</td>
</tr>
<tr>
<td>How often do you eat fish or seafood that IS NOT fried?</td>
<td>0.937</td>
<td>3.18425882</td>
<td>3</td>
</tr>
<tr>
<td>How often do you usually eat candy or chocolate?</td>
<td>0.942</td>
<td>3.20125059</td>
<td>3</td>
</tr>
<tr>
<td>How many different vegetable servings do you usually have at your main meal of the day?</td>
<td>1.179</td>
<td>4.00666078</td>
<td>4</td>
</tr>
<tr>
<td>How often do you eat cakes or pies?</td>
<td>1.193</td>
<td>4.05423775</td>
<td>4</td>
</tr>
<tr>
<td>How often do you eat chicken or turkey?</td>
<td>1.292</td>
<td>4.39067491</td>
<td>4</td>
</tr>
<tr>
<td>How often do you usually drink orange juice?</td>
<td>1.332</td>
<td>4.52660912</td>
<td>5</td>
</tr>
<tr>
<td>How often do you usually eat fruit as a snack?</td>
<td>1.458</td>
<td>4.95480188</td>
<td>5</td>
</tr>
<tr>
<td>How many servings of milk, cheese, or yogurt do you usually have each DAY?</td>
<td>1.459</td>
<td>4.95820023</td>
<td>5</td>
</tr>
<tr>
<td>How often do you eat fruit (not including juice)?</td>
<td>1.508</td>
<td>5.12471964</td>
<td>5</td>
</tr>
<tr>
<td>How often do you drink some kind of juice at breakfast?</td>
<td>1.549</td>
<td>5.2640522</td>
<td>5</td>
</tr>
<tr>
<td>How often do you eat carrots, sweet potatoes, broccoli, or spinach?</td>
<td>1.629</td>
<td>5.53592061</td>
<td>6</td>
</tr>
<tr>
<td>How often do you eat hot or cold breakfast cereal?</td>
<td>2.235</td>
<td>7.59532386</td>
<td>8</td>
</tr>
<tr>
<td>How often do you usually eat whole grain cereals?</td>
<td>2.541</td>
<td>8.63522055</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29.426</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
question “How often do you usually eat whole grain cereals?” was awarded a total point score of 9. Thus, the total score could range from 0 – 100.

Total points per questions, determined from the beta weights, were divided among the response options (See Appendix C). The maximum score for a response option was subjectively awarded to the option that would have the highest association with diet quality measures. For example, the highest reported intakes of fruits and vegetables would receive the highest points, and lowest intakes of undesirable foods like cookies and cake would receive the highest points. All questions with the same total point score were standardized; for example, all questions worth four points with 4 response options would receive either 0, 1, 2, or 4 points (Table 7.3). A total score for the DST was derived by adding all of the items together. Five bonus points were awarded to the use of vitamin and mineral supplements.

Anthropometry

Height and weight measures were recorded by trained research dietitians using a portable digital scale (Tanita, Arlington Heights, Illinois) and stadiometer (Infant/Child/Adult Height Measuring Board, Shorr Productions, Olney, MD). Body Mass Index (BMI) was calculated as weight (kg)/ height (m)$^2$ and was classified using the World Health Organization criteria. Waist circumference was measured using a flexible, non-elastic, measuring tape. Standardized procedures based on the National Health and Nutrition Examination Survey were followed (25). A horizontal mark is drawn above upper margin of the great trochanters, the line is next crossed
Table 7.3 Examples of Point Classification $^{1,2,3}$

<table>
<thead>
<tr>
<th>Number of Response Points</th>
<th>1 $^3$</th>
<th>2</th>
<th>3</th>
<th>3 $^3$</th>
<th>4 $^3$</th>
<th>5</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Response Options</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Never</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Never or less than once a week</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Less than once a week</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>More than once a week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 or 2 times a week</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3 or more times a week</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>3 to 5 times a week</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Every day or almost every day</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1$ Some questions were not posed as frequency of intake and are scored differently than those that are.

$^2$ The yes and no questions were awarded full points for no and zero points for yes.

$^3$ Reverse coded, the same points were awarded but in the opposite magnitude.
with a vertical mark on the midaxillary line. After normal expiration the tape was
aligned with the markings and the measurement was taken in duplicate (25). Waist
circumference risk was calculated using National Institutes of Health Guidelines: >
88 cm for females and > 102 cm for males.

Biochemical Biomarkers

A fasting venous blood draw (23 mL) was obtained during the clinic visit by a
trained phlebotomist at each clinic and placed on ice for transport to the Geisinger
Medical Center (Danville, Pennsylvania). The serum was separated by centrifugation
(3000 x g for 12 min at 2–8 °C) and stored at -70 °C. The carotenoid analysis was
conducted at the University of New Hampshire under the direction of Dr. Joanne
Celentano. Carotenoids were extracted and analyzed with a normal-phase, high-
performance liquid chromatography system with a gradient reversed-phase system
(Hewlett Packard, Burlington, MA).

All other laboratory analysis were conducted at Geisinger Medical Center.
The lipid panel included total cholesterol, high-density lipoprotein cholesterol (HDL-
C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (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 < 258 pmol/L (26); homocysteine > 12.0 μmol/L (27); CRP > 5.0 mg/dL,
and fasting blood glucose > 120 mg/dL. Lipid profiles were classified according to
the National Cholesterol Education, Advanced Treatment Panel III guidelines total cholesterol > 5.19 µmol/L, HDL-C < 1.04 µmol/L, TG > 1.7 µmol/L and LDL-C > 2.6 µmol/L (28). Unfavorable values were designated as follows: cholesterol > 200 mg/dL, HDL < 40 mg/dL, TG > 150 mg/dL and LDL > 100 mg/dL (28), homocysteine > 14.0 µmol/L (27), CRP > 5 mg/dL, and fasting blood glucose > 120 mg/dL.

Dietary Assessment

During the four to six week time period following the clinic visit, four 24-hour dietary recalls were collected via telephone by trained interviewers at the Pennsylvania State University Diet Assessment Center (29). Diet recalls were conducted on unannounced, random non-consecutive days with at least one weekend day of data. Nutrient averages of the four days of dietary intake data were used for analysis. Daily food intakes then were categorized into food subgroups based on similarity of nutrient composition.

Two indices of diet quality were calculated from the 24-hour recall data, the Mean Adequacy Ratio (MAR) and Healthy Eating Index (HEI). To calculate the MAR, a nutrient adequacy ratio (NAR) was calculated for twelve vitamins and minerals (30). All NARs were truncated at 1.0, and then mean adequacy ratio (MAR) was calculated by summing the NARs and dividing by twelve. The twelve micronutrients included Vitamin C, Vitamin B-6, Vitamin D, Vitamin A, Vitamin E, Vitamin K, folate, magnesium, zinc, potassium, pantothenic acid and calcium. Nutrients were selected based on a high prevalence of inadequate intakes (>25% of the sample) observed as determined by the Estimated Average Requirement (EAR) when available or Adequate Intakes when no EAR is established (31-33). The Healthy Eating Index 2005 (HEI) scores were calculated (34).
The HEI is a measured score of 12 dietary components corresponding to the Food Guide Pyramid (35) and Dietary Guidelines for Americans. The components include total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fat, sodium and calories from solid fat, alcohol and added sugar. HEI scores range from 0-100 with a higher score indicating higher dietary quality.

Nutrition Risk

Currently, no universally accepted definition of nutrition risk exists within the nutrition field (36). For the purposes of the study, nutrition risk is classified as having two of three adverse assessments of dietary intake from the 24-hour recall data, weight status, or biochemical indices. Adverse dietary intakes were determined using the EAR method. Twelve of the nutrients used in the MAR calculation were considered for dietary nutrition risk. Only eight of these nutrients had established EAR criteria, which is necessary to classify individuals as “at risk”(32). If an individual did not meet the EAR for four of eight nutrients then he or she would be determined at dietary nutrition risk. Adverse weight status was operationalized using waist circumference risk, or having a BMI less than 18.5, the World Health Organization’s classification of under weight. If an individual was overweight or underweight he or should would be considered at weight status risk. Six biochemical biomarkers were considered for classification of risk: lipid panel (Total Cholesterol, LDL-C, or HDL-C), fasting blood glucose, serum Vitamin B 12, C-reactive protein, homocysteine, and triglycerides. If an individual had one or more biomarkers not within established parameters then he or she was classified at biomarker risk.
**Statistical Analysis**

Data were analyzed using SAS version 9.1 (SAS Institute Inc., Cary, NC, 1999) and M Plus Version 4 (Muthen and Muthen, Los Angeles, CA, 2006). Normality was assessed for all continuous variables and those not normally distributed were transformed to conform to normality prior to analysis. Descriptive statistics were obtained for all variables. Categorical variables were summarized using frequencies and percents.

Individuals were classified into one of three risk groups determined using percentiles from the frequency outputs of total DST scores. Individuals were classified into one of three groups: at nutrition risk (lowest twenty-fifth percentile), may be at nutrition risk (middle 25-75th percentile), and likely not at nutrition risk (highest 25th percentile). ANOVA was used to evaluate group differences with a Duncan’s post-hoc test.

Contingency tables are necessary for calculation of sensitivity, specificity and positive predictive values. Thus, individuals in the mid 25-75th percentiles were treated using four different strategies. Method 1 excluded these individuals from analysis; while method 2 categorized the group along with the “at risk” group. Method 3 split the group at DST median with those scoring higher than the median were considered “at risk” and compared to those below the median, which were “not at risk”. Finally, in method 4 individuals in the DST score range were grouped the “not at risk” group.
Results

Sample characteristics

The final sample consisted of 206 individuals; however, two participants were excluded based on low reported energy intakes: less than 800 kilocalories for males and less than 500 calories for females (37). Of the 204 remaining, 82 were male (40%) and 122 were female (60%). The age range was 73 to 94 years, with a mean of 78.5 (± 4 SD). Participants were primarily white (98%), married (65%) or widowed (27%), and with at least a high school education (82%).

Dietary intakes for the sample and by gender are located within Table 7.4. Notably, no participants met the Adequate Intakes for Vitamin D. Almost two-thirds of the sample exceeded recommendations for percent energy intake from saturated fat and almost all exceeded for trans-fat. The majority were not meeting recommendations for Vitamin A, Vitamin E, calcium or magnesium. Very few participants were at risk for low dietary intakes of iron and vitamin B12.

Many participants were not at recommended levels for triglycerides or C-reactive protein (Table 7.5). Females had higher total cholesterol and LDL-C. More females were at risk for high total cholesterol levels whereas males were more likely to have suboptimal homocysteine levels. More males than females were overweight however more females than males were obese.

More than half (62%) reported using vitamin and mineral supplements. Users of supplements had higher MAR values, HEI scores, and higher serum Vitamin B12,
beta carotene, and beta cryptoxanthin (data not shown). Users of supplements did not differ from non-users with regard to age, gender, or prescription medication use.
Table 7.4 Dietary intake of male and female study participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Recommended dietary intakes</th>
<th>Mean ± Std. Deviation</th>
<th>% not meeting recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Males (n=82)</td>
<td>Females (n=122)</td>
</tr>
<tr>
<td>Dietary Intakes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy (kcal)</td>
<td>NA</td>
<td>1654±393</td>
<td>1362±356**</td>
</tr>
<tr>
<td>Protein (g)²</td>
<td>46 m, 38 f</td>
<td>67±17</td>
<td>55±15*</td>
</tr>
<tr>
<td>Carbohydrate (g)²</td>
<td>100 g/day</td>
<td>216±60</td>
<td>177±51</td>
</tr>
<tr>
<td>Total Fat (g)</td>
<td>NA</td>
<td>59±20</td>
<td>51±18**</td>
</tr>
<tr>
<td>% Energy 20-35%³</td>
<td></td>
<td>32 ± 6</td>
<td>33 ± 6</td>
</tr>
<tr>
<td>Saturated Fat (g)³</td>
<td>NA</td>
<td>20±8</td>
<td>17±7</td>
</tr>
<tr>
<td>% Energy &lt; 10%</td>
<td></td>
<td>11±3</td>
<td>11 ± 3</td>
</tr>
<tr>
<td>Trans fat (g)</td>
<td>NA</td>
<td>3.9±1.7</td>
<td>3.2±1.7</td>
</tr>
<tr>
<td>% Energy &lt; 1%</td>
<td></td>
<td>2±1</td>
<td>2±1</td>
</tr>
<tr>
<td>Fiber (g)⁵</td>
<td>30 m, 21 f</td>
<td>16.2±6.0</td>
<td>14.3±5.1</td>
</tr>
<tr>
<td>Vitamin D (µg)⁵</td>
<td>10 or 15</td>
<td>4.4±1.9</td>
<td>3.7±2.2</td>
</tr>
<tr>
<td>Vitamin A (µg)²</td>
<td>&lt; 500</td>
<td>703±362</td>
<td>695±425*</td>
</tr>
<tr>
<td>Vitamin E (mg)²</td>
<td>&lt; 12</td>
<td>9.2±8.3</td>
<td>8.5±6.9</td>
</tr>
<tr>
<td>Calcium (mg)⁵</td>
<td>1200</td>
<td>763.7±339.0</td>
<td>659.2±267.6</td>
</tr>
<tr>
<td>Vitamin C (mg)²</td>
<td>60</td>
<td>91±53</td>
<td>79±44</td>
</tr>
<tr>
<td>Vitamin B6 (mg)²</td>
<td>1.3</td>
<td>1.9±0.8</td>
<td>1.5±0.6*</td>
</tr>
<tr>
<td>Vitamin B12 (µg)²</td>
<td>2.0</td>
<td>5.3±3.1</td>
<td>4.4±3.9</td>
</tr>
<tr>
<td>Folate (µg)⁴</td>
<td>320</td>
<td>574±305</td>
<td>424±180**</td>
</tr>
<tr>
<td>Iron (mg)²</td>
<td>5</td>
<td>15.7±7.1</td>
<td>11.9±4.7**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>6.8</td>
<td>11.2±5.2</td>
<td>8.6±4.2*</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>265</td>
<td>255.1±79.8</td>
<td>219.0±67.7</td>
</tr>
<tr>
<td>Healthy Eating Index</td>
<td>&lt;80</td>
<td>69±10</td>
<td>71±8*</td>
</tr>
<tr>
<td>Mean Adequacy Ratio</td>
<td>&lt; 0.80</td>
<td>0.68±0.13</td>
<td>0.66±0.15</td>
</tr>
</tbody>
</table>

1 The significance for energy intake was adjusted for age, tobacco use, alcohol use and vitamin and mineral supplementation. All of significance tests were adjusted for these potential confounders and energy intakes.
2 Recommendations were determined using the Dietary Reference Intakes, Estimated Average Requirement.
3 Dietary Guidelines for Americans
4 American Heart Association Guidelines
5 Percent not meeting the Dietary Reference Intakes, Adequate Intakes. Individuals can not be classified to have at risk intakes using this method.
* p < 0.05, ** p < 0.001
Table 7.5 Biomarker, physical activity, and anthropometric data of study participants

<table>
<thead>
<tr>
<th>Biomarker</th>
<th>Recommended laboratory and anthropometric thresholds</th>
<th>Mean ± Std. Deviation</th>
<th>Percent not meeting recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Males (n=82)</td>
<td>Females (n=122)</td>
</tr>
<tr>
<td>Vitamin B12 (pmol/L)</td>
<td>&lt;258</td>
<td>556±306</td>
<td>595±308</td>
</tr>
<tr>
<td>Albumin (mg/dL)</td>
<td>3.5</td>
<td>4.3±0.3</td>
<td>4.3±0.3</td>
</tr>
<tr>
<td>C-Reactive Protein ^1</td>
<td>&gt;5</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Homocysteine (µmol/L)</td>
<td>12</td>
<td>10.5±2.9</td>
<td>9.8±4.3</td>
</tr>
<tr>
<td>Triglycerides (mg/dL) ^2</td>
<td>&gt;150</td>
<td>138±92</td>
<td>146±69</td>
</tr>
<tr>
<td>Total Cholesterol (mg/dL) ^2</td>
<td>&gt;200</td>
<td>176±33</td>
<td>209±42*</td>
</tr>
<tr>
<td>High density cholesterol (mg/dL) ^2</td>
<td>&lt;40</td>
<td>54±13</td>
<td>65±19*</td>
</tr>
<tr>
<td>Low density cholesterol (mg/dL) ^2</td>
<td>&gt;130</td>
<td>95±30</td>
<td>114±36*</td>
</tr>
<tr>
<td>Beta-cryptoxanthin (µmol/L)</td>
<td>NA</td>
<td>0.11±0.08</td>
<td>0.11±0.08</td>
</tr>
<tr>
<td>Beta-carotene (µmol/L)</td>
<td>NA</td>
<td>0.33±0.29</td>
<td>0.55±0.60*</td>
</tr>
<tr>
<td>Lutein &amp; Zeaxanthin (µmol/L)</td>
<td>NA</td>
<td>0.24±0.18</td>
<td>0.24±0.19</td>
</tr>
<tr>
<td>Physical Activity Score</td>
<td>NA</td>
<td>155±65</td>
<td>121±56*</td>
</tr>
<tr>
<td>Body Mass Index ^3</td>
<td></td>
<td>28±5</td>
<td>30±6</td>
</tr>
<tr>
<td>Overweight</td>
<td>&gt; 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>&gt; 29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist Circumference (cm) ^4</td>
<td></td>
<td>101±12</td>
<td>92±16</td>
</tr>
<tr>
<td>At risk</td>
<td>&gt; 102 cm, &gt; 88 in</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^1 Low sensitivity C-reactive protein
^2 ATP III guidelines were used to determine risk cut-offs
^3 Overweight and obese classified based on World Health Organization cut-offs
^4 Waist circumference risk determined by National Institutes of Health guidelines
* p < 0.05, ** p < 0.001
Using the scoring cut-offs, several significant associations with dietary intakes and biomarkers of nutritional status were observed (Table 7.6). No energy differences were noted; however, the “at risk” group had the highest intakes of energy from total and saturated fat. Fiber intake was significantly higher in the not at risk group. Indicators of diet quality (i.e. HEI and MAR) were different across all groups, with those at risk with the lowest values for both HEI and MAR. Similarly intake of fruits and vegetables differed for each group, with those at risk with the lowest reported intakes.

The DST classifications also were related to biochemical indicators of nutritional status. Individuals classified as not at risk had higher serum Vitamin B12 and beta-cryptoxanthin, and lower homocysteine than the other two groups. Similarly the not at risk had higher HDL-C and beta-carotene than the at risk group. No differences were noted among groups for triglycerides, total cholesterol, or LDL-C. No significant differences in BMI or waist circumference were observed.

Nutrition risk from the DST was compared to operationally defined nutrition risk variable comprised of inadequate dietary intakes from multiple 24-hour recalls, adverse weight status, and biochemical indices not within normal parameters. Four methods were examined for the risk levels. Method 1 excluded individuals that may be at nutrition risk and yielded a 56% sensitivity, 78% specificity, and 88% positive predictive value (Table 7.7). Method 2, where individuals at possible risk were classified with those at risk, yielded a higher sensitivity, but specificity and positive predictive value decreased when compared to Method 1.
Table 7.6. Mean values (± standard deviation) for dietary intakes, biomarkers, and anthropometry by DST classification of nutrition risk

<table>
<thead>
<tr>
<th>Dietary Screening Tool Scores</th>
<th>At risk (n = 64)</th>
<th>Possible risk (n=83)</th>
<th>Not at risk (n=56)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dietary Intakes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>1498±418</td>
<td>1436±398</td>
<td>1529±368</td>
</tr>
<tr>
<td>% Energy from Fat</td>
<td>36±6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>32±6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31±6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>% Energy from Sat. Fat</td>
<td>12.0±3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.8±3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.1±2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>12±4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15±5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18±6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mean Adequacy Ratio</td>
<td>0.61±0.13&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.65±0.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.75±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Healthy Eating Index</td>
<td>58±11&lt;sup&gt;c&lt;/sup&gt;</td>
<td>66±10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>71±9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Number of Fruits and Vegetables</td>
<td>3.3±1.6&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>4.4±1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.5±2.34&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Biomarkers</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B12 (pmol/L)</td>
<td>478±242&lt;sup&gt;b&lt;/sup&gt;</td>
<td>535±241&lt;sup&gt;b&lt;/sup&gt;</td>
<td>707±342&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Homocysteine (µmol/L)</td>
<td>10.8±4.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.4±4.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.0±2.4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>149±93</td>
<td>147±77</td>
<td>131±63</td>
</tr>
<tr>
<td>Total Cholesterol (mg/dL)</td>
<td>192±43</td>
<td>198±45</td>
<td>198±36</td>
</tr>
<tr>
<td>High density cholesterol (mg/dL)</td>
<td>58±18&lt;sup&gt;b&lt;/sup&gt;</td>
<td>61±20&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>64±14&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Low density cholesterol (mg/dL)</td>
<td>104±33</td>
<td>108±38</td>
<td>108±33</td>
</tr>
<tr>
<td>Beta-cryptoxanthin (µmol/L)</td>
<td>0.08±0.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.10±0.07&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.15±0.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Beta-carotene (µmol/L)</td>
<td>0.36±0.37&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.48±0.58&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>0.56±0.41&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Anthropometry</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>98.2±16</td>
<td>95.4±13</td>
<td>93.6±18</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>28.0±6</td>
<td>27.7±5</td>
<td>28.2±5</td>
</tr>
</tbody>
</table>

<sup>1</sup>The letter designation show significant difference between the groups. The a denotes the highest values.

When the possible risk group was split at the mean of score of 65, sensitivity was the same and specificity and positive predictive value were slightly lower than Method 1. Finally, Method 4, the at risk group was grouped with those not a risk revealed a large decrease in sensitivity and a increase in specificity, without change in positive predictive value when compared to Method 1.
Table 7.7 Sensitivity, specificity, and positive predictive values for the first scoring system

<table>
<thead>
<tr>
<th>Scoring Cut-Off</th>
<th>Sensitivity(^1)</th>
<th>Specificity(^2)</th>
<th>Positive Predictive Value(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method 1: Possible risk not used in analysis</td>
<td>56</td>
<td>78</td>
<td>88</td>
</tr>
<tr>
<td>Method 2: Possible risk included with at risk</td>
<td>74</td>
<td>49</td>
<td>81</td>
</tr>
<tr>
<td>Method 3: Possible Risk group split at 65</td>
<td>56</td>
<td>71</td>
<td>85</td>
</tr>
<tr>
<td>Method 4: Possible risk group included with not at risk</td>
<td>33</td>
<td>86</td>
<td>88</td>
</tr>
</tbody>
</table>

\(^1\) Sensitivity = true positives / (true positives + false negatives)
\(^2\) Specificity = true negatives / (true negatives + false positives)
\(^3\) Positive predictive value = true positives / (true positives + false positives)
\(^4\) Possible risk group, DST scores 60-75.

**Discussion**

A population-specific screening tool was able to classify individuals at varying degrees of nutrition risk. DST scores were related to nutrient intakes and biological biomarkers of nutrition status. The DST helps minimize some of the errors of traditional dietary assessment methods given that it is not quantitative and thus reduces errors associated with portion size estimation, computation, and memory. Previous research suggests it is easier for people to recall typical behavior and typical intakes rather than each specific detail of intake (37, 38).

Elimination of the “may be at nutrition risk” group provided reasonable sensitivity (56%), specificity (78%), and positive predictive values (88%) when compared to nutrition risk based on weight status, biomarker status, and dietary intake guidelines. Block et al. found similar ranges with a fruit and vegetable screener (sensitivity 52%, specificity 86%, and positive predictive value 66%) and two fat screeners, one screening for percent energy from fat (sensitivity 52%, specificity 93%, and positive predictive values 57%) and another screening for
saturated fat intakes (60% sensitivity, specificity 87%, and positive predictive value 63%)(39). However, Block et. al compared the screening tools to food frequency questionnaires, whereas we compared our screening tool to more rigorous criteria based on dietary intakes from multiple 24-hour recalls, anthropometry, and biomarkers on nutritional status.

In a separate study, community dwelling older adults completed the DST on two occasions with at least a two week time period elapsed between admissions. The sample consisted of 18 individuals (15 females, 3 males) with a means age of 77 ± 8 years, range 68-94. The test-retest coefficient was 0.83 (p < 0.001). The reliability coefficient (0.83) of the instrument is considered to be good (40) because anything above 0.70 is acceptable (41). The reliability, specificity, and positive predictive values add confidence to the use of the DST in a community screening.

Primary care clinics provide an excellent setting for nutrition education and interventions for chronic-disease prevention(42). Previous research demonstrates that physicians can help to affect dietary change (43, 44); however, barriers have been reported to physician involvement in nutrition-related behaviors including lack of time, perceived lack of counseling ability, inadequate tools to provide an education framework, and reimbursement issues (45-47). Lack of reliable information on the patients’ diet is another reported barrier to clinicians providing dietary counseling (48).

The DST is different than malnutrition screening tools like the Mini Nutritional Assessment (MNA). The MNA has been shown to have merit for malnutrition screening though its complexity prohibits widespread use (49). In a clinical setting the components on the MNA are generally monitored or can be easily determined
(e.g. weight status, number of prescription medications, presence of pressure ulcers), whereas information on dietary intakes are not as easily accessible.

Our results confirm that a population-specific approach to dietary screening has the potential to identify individuals that may be at nutrition risk and advances the body of literature recommending these types of tools (49-51). Categorization of individuals into 3 risk categories provides a format for which clinicians can determine who may require follow-up or assessment.

Limitations of the DST exist; The Geisinger Rural Aging Study is comprised of almost exclusively of Caucasian older rural adults. We recognize the DST is targeted to this population; but, many of the foods represented on the questionnaire are similar to national dietary guidelines (e.g. fruits, vegetables, whole grains). Nevertheless, the DST should be tested in other samples. However, the process of developing a population-specific tool is broadly applicable.

The decision to award five bonus point for supplementation was several fold. Older adults represent a unique population of individuals for whom nutrient requirements may be difficult to achieve. For a variety of reasons, such as compromised absorption and decreased energy intakes, multivitamin/mineral preparations may add key nutrients to the diet and thus may lower the proportion of older adults not meeting dietary recommendations. The Food Guide Pyramid for older adults recommends supplementation. Finally, we had a high prevalence of individuals who were not meeting the EAR for several nutrients; for these people dietary supplementation may be warranted. Furthermore, none of the participants met the AI (15 µg) for Vitamin D, recently the Dietary Guidelines for Americans
recommended older adults consume 25µg. Without supplements recommendations like these are difficult for this population to achieve.

Nutrition plays an integral role in the management of multiple chronic diseases. However, dietary assessment in clinical treatment of older adults is not a routine practice. Older adults are vulnerable to nutrition risk. Any strategies to help combat age-related chronic disease and improve quality of life for older adults are essential. The clinic setting provides an ideal place to screen the diets of older adults (52) and the DST is a simple and practical diet screening tool that can help detect nutrition risk in older adults.
References

2. Census Bureau US. International database. Table 094. Midyear population, by age and sex.


48. Rifas-Shiman SL, Willett WC, Lobb R, Kotch J, Dart C, Gillman MW. PrimeScreen, a brief dietary screening tool: reproducibility and
comparability with both a longer food frequency questionnaire and biomarkers. Public Health Nutr 2001;4:249-54.


Chapter 8

CONCLUSIONS

Summary of Research Findings

The purpose of this research was to develop and evaluate a population-specific diet screening tool for use among older rural adults. The overall hypothesis of this study was that a diet screening tool (DST) could serve to identify individuals at nutrition risk participating in the Geisinger Rural Aging Study. The study occurred in three phases: characterization of dietary patterns, development of a screening tool, and testing the screening tool.

Previous work within the GRAS showed that adverse dietary patterns were an important determinant of nutrition risk based on higher likelihoods for adverse dietary intakes, overweight and obesity, and sub-optimal biomarkers of nutrition status (1). The phase one analysis of this study aimed to explore the stability of those dietary patterns through two different methodological strategies. Ultimately the results of Phase 1 were used to guide item selection for the diet screening tool (DST).

The first strategy compared the input variables used to derive dietary patterns. In the previous dietary pattern study the number of servings from food subgroups was employed to derive the dietary patterns. However, the percent energy contribution from food subgroups is a much more common method in the nutrition field. Thus, we compared the dietary patterns derived using both methods.
Regardless of the cluster strategy, there was a cluster with a significantly lower Healthy Eating Index score (HEI, USDA’s measure of diet quality) and a cluster with a higher HEI. The methods differed in the food subgroups that “clustered” together. The clusters with higher HEI scores contained significantly higher amounts of most micronutrients. Both methods consistently clustered subgroups with high energy contribution (e.g., fats and oils, dairy desserts) with a lower HEI. Dietary patterns characterized by the number of servings method of analysis provided stronger association with weight status, and was more sensitive to fruit and vegetable intake with regard to a “healthier” dietary pattern. For this reason, the number of servings strategy was selected as a base for second part of phase 1, the plausible reporters analysis.

Energy intake should approximate energy expenditure in a weight-stable individual. Previous research in dietary assessment has indicated pervasive errors in self-reported energy intake (2-7). Under-reporting of energy consumption ranges from 10-50% lower than estimated caloric needs assessed by doubly labeled water techniques (6, 8-10). The objective of this Phase 1 study was to identify under-reporters of energy intakes using a prediction algorithm and to compare dietary patterns of plausible reporters to all reporters.

As expected, under-reporters consumed fewer servings across the majority of food groups. Two dietary patterns were determined for all reporters and for plausible-reporters, in both cases one of higher and one of lower nutrient density. Using only plausible reporters to determine dietary patterns was very similar to using all reporters.
Each food group that helped to characterize a dietary pattern was intensively examined to determine specific foods to target for the questionnaire. The following steps were employed in the development of the DST (Phase 2): item selection, question formatting, cognitive interviewing, and revision of instrument. 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-hour recalls. After determining which foods to query, we determined the format of the questions. We examined how often and at what times specific foods or food groups were consumed to determine format of response options.

Once a draft was developed we subjected it to cognitive interviewing techniques in a convenience sample of older adults (n=17) not affiliated with the GRAS. Modifications were made based on participant feedback and the DST was revised to include thirty-seven items: 28 questions about frequency of intake of specific foods; five yes or no questions; two questions on meal frequency; one on the type of milk consumed; one on alcohol intake; and one on vitamin and mineral supplement use. The sample used for the DST administration was a different subset of a continuing sequential cohort study of nutrition and health outcomes in the GRAS recruited in 2005 through 2006. The Phase 3 sample consisted of 83 males (40%) and 123 females (60%). The age range was 73 to 94 years, 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%). All participants attended a local medical clinic where they completed a battery of
questionnaires (including the DST), had height and weight measured, and provided a fasting blood sample.

Individuals were classified into one of three risk groups based on the DST score: at nutrition risk, may be at nutrition risk, and likely not at nutrition risk. Individuals in the at risk groups had higher intakes of total and saturated fat, lowest intakes of fiber, and the lowest Healthy Eating Index scores as well as lowest Mean Adequacy Ratio scores. Using the scoring cut-offs, several significant associations with dietary intakes and biomarkers of nutritional status were observed (Table 7.6). No energy differences were noted; however, the “at risk” group had the highest intakes of energy from total and saturated fat. Fiber intake was significantly higher in the not at risk group. Indicators of diet quality (i.e. HEI and MAR) were different across all groups, with those at risk with the lowest values for both HEI and MAR. Similarly intake of fruits and vegetables differed for each group, with those at risk with the lowest reported intakes.

The DST classifications also were related to biochemical indicators of nutritional status. Individuals classified as not at risk had higher serum Vitamin B12 and beta-cryptoxanthin, and lower homocysteine than the other two groups. Similarly the not at risk had higher HDL-C and beta-carotene than the at risk group. No differences were noted among groups for triglycerides, total cholesterol, or LDL-C. No significant differences in BMI or waist circumference were observed. Finally, the DST was shown to have reasonable sensitivity (56%), specificity (78%), and positive predictive values (88%) when compared to an nutrition risk based on weight status, biomarker status, and dietary intake guidelines.
Americans over the age of 65 are one of the fastest growing segments of the population (11), and are projected to double by 2030 reaching 19% of the population (12). Age-related diseases significantly influence the quality of life of older adults. Many of the diseases common to aging are influenced by diet (13-17) including obesity, diabetes, cancer and heart disease. However, dietary assessment in clinical treatment of older adults is not a routine practice. The DST is a practical and effective tool to help screen for individuals at nutrition risk.

**Study Limitations and Future Directions**

The Geisinger Rural Aging Study is comprised of almost exclusively of Caucasian older rural adults. Various environmental, social and physical factors place rural older adults at nutrition risk. Older adults residing in rural areas face special issues that preclude optimal healthcare. An inability to travel long distances prevents older rural adults from obtaining goods and services and also contributes to social isolation (18). Thus, research on rural older adults may not be broadly application to other populations of aging adults. However, the goal of the study was to design a population specific instrument, the developmental process is broadly applicable to any population.

The aging population is very diverse. The age range was 73 to 94 years, with a mean of 78.5 (± 4 SD). Future analysis should include age group analysis to separate the younger old from the older old age groups. Furthermore, participants were primarily white (98%); the DST should be tested in more racially and ethnically diverse groups.
The DST should be tested in other samples of the Geisinger Rural Aging Study. The scoring system was developed on the sample in which the data was collected, thus it is imperative to test the scoring system in other samples to ensure that the sensitivity, specificity, and positive predictive value remain unchanged with other groups. The DST has the potential to be included in routine care of older adults within the Geisinger Healthcare System, as such pilot testing should first be used to determine the efficacy and practicality of the DST in a clinical setting. Finally, the DST could be incorporated into the larger screening protocol (n > 20,000) in order to assess screening with long-term health and nutrition outcomes.
References


Appendix A

Diet Quality Screening Tool Development Methods

Subjects: The Geisinger Rural Aging Study (GRAS) is a nutritional-risk screening study involving > 20,000 rural Pennsylvanians ≥ 65. The GRAS subset includes 81 men and 98 women, aged 66–87. Virtually the entire sample (> 99%) was non-Hispanic white, consistent with the demographic composition of central Pennsylvania.

Dietary Assessment: Dietary information was collected via five, 24-hour dietary recalls on random days by telephone at two-month intervals for one-year. All interviews were performed by trained staff at the Pennsylvania State University Diet Assessment Center. The Nutrition Data System (NDS) software, food database version 12A, nutrient database version 28 was used for data collection and analyses using a multiple pass technique to facilitate recall (1).

DST Development

Item selection: Each food group that helped to characterize dietary patterns from Phase I (Table 1) was intensively examined in order to determine specific foods to target for DST questions (Figure 2). First, each food group was explored to assess which foods within the groups were consumed with the highest frequency.
The most frequently consumed food items were then examined independently for associations with over-all nutrient profiles, temporal distribution of intake (i.e. eating occasions), frequency of intakes, and amounts of food consumed. For example, in Phase I the citrus/melons/berries food subgroup was associated with a healthier dietary pattern. This subgroup contains multiple fruits (e.g. blueberries, oranges, orange juice, and watermelon, etc.). Within this group, orange juice was the most frequently consumed item. Orange juice was consumed by 138 people, 110 of those people drank orange juice exclusively at breakfast.
Citrus, Melons, and Berries Food Group

Examined for

- Number of mentions from five 24-hour recalls
- Most frequently used foods
- Number of users
- Temporal distribution

Orange Juice was used most frequently and by most people

Examined for relationships with

- Over-all nutrient profiles
- Indexes of diet quality

Orange juice at breakfast was associated with better nutrient profiles and will be an item for inclusion on the DST

Figure 2: Process of item selection for the DST
Participants who had orange juice at breakfast had significantly better nutrient profiles (Table 1). For example, individuals that consumed orange juice at breakfast had higher intakes of folate, Vitamin C, Vitamin K, magnesium and zinc. This does not necessarily mean that orange juice is a “good source” of all of these nutrients; but, orange juice at breakfast can be associated with higher nutrient intake. Orange juice at breakfast contributed to the association of the citrus/melons/berries subgroup with indicators of diet quality. This type of exploration was carried out with all the subgroups that were employed in Phase I.

Several food groups/items were added based on input from a project consultant, Dr. Katherine Tucker from Tufts University. Dr. Tucker’s work in the field of nutritional epidemiology provided insight on the addition of questions that were not originally included. For example, Dr. Tucker’s research indicates that individuals who consume gravy have a much higher likelihood of developing esophageal cancer.

Also added to the DST were a few questions based on significant research findings in other studies. For example, previous research has associated lower-fat dairy products to be beneficial in weight maintenance and management of blood pressure (3). For this reason, we want to assess type of dairy in relation to health outcomes. Whole grain breads and cereals are beneficial in the lowering risk for heart disease and certain types of cancers (4-8). The original GRAS
Table 2: Example of nutrient intakes by users and non-users of orange juice at breakfast

<table>
<thead>
<tr>
<th>Do you drink Orange Juice at breakfast?</th>
<th>Vitamin C (mg)</th>
<th>Folate (mcg)</th>
<th>Fiber (g)</th>
<th>Calcium (mg)</th>
<th>HEI</th>
<th>ED</th>
<th>MAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (n=110)</td>
<td>104</td>
<td>263</td>
<td>17.2</td>
<td>703</td>
<td>69</td>
<td>0.83</td>
<td>0.83</td>
</tr>
<tr>
<td>No (n=69)</td>
<td>94</td>
<td>229</td>
<td>15</td>
<td>635</td>
<td>69</td>
<td>0.79</td>
<td>0.79</td>
</tr>
<tr>
<td>P-value</td>
<td>0.16</td>
<td>0.02</td>
<td>0.01</td>
<td>0.11</td>
<td>0.25</td>
<td>0.04</td>
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<tr>
<td>Do you drink Orange Juice at breakfast?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fat (g)</td>
<td>Protein (g)</td>
<td>Carbohydrates (g)</td>
<td>Riboflavin (mg)</td>
<td>Niacin (mg)</td>
<td>P. Acid (mg)</td>
<td>Vit K (mg)</td>
</tr>
<tr>
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<td>58.2</td>
<td>63.1</td>
<td>220.8</td>
<td>1.7</td>
<td>19.6</td>
<td>4.2</td>
<td>2586</td>
</tr>
<tr>
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<td>58.04</td>
<td>204.2</td>
<td>1.5</td>
<td>18</td>
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<tr>
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<td>0.08</td>
<td>0.11</td>
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<td>0.11</td>
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<td>0.02</td>
</tr>
<tr>
<td>Do you drink Orange Juice at breakfast?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B6 (mg)</td>
<td>B12 (mcg)</td>
<td>Vitamin D (mcg)</td>
<td>Iron (mg)</td>
<td>Magnesium (mg)</td>
<td>Phos. (mg)</td>
<td>Vit E (mg)</td>
</tr>
<tr>
<td>Yes (n=110)</td>
<td>1.7</td>
<td>3.9</td>
<td>4.6</td>
<td>14</td>
<td>260.7</td>
<td>1045.8</td>
<td>6.4</td>
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<tr>
<td>No (n=69)</td>
<td>1.5</td>
<td>4.2</td>
<td>4.3</td>
<td>12.4</td>
<td>233.2</td>
<td>944.8</td>
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<td>0.02</td>
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</tr>
</tbody>
</table>
dietary patterns research did not assess whole grains versus other grains (9). However, because of the importance of whole grains to health we added questions about these types of foods to the DST.

**Format Choices:** After determining which foods to query, the next step is to determine the format of the question. Format refers to the way(s) that questions are asked about food intake (10). Questions may be asked with dichotomous response options (e.g., Do you ever eat a particular food (yes or no)?). Alternatively, questions may be posed about frequency of consumption with or without portion sizes (11, 12). Frequency of consumption responses may take alternative forms (e.g. often, sometimes, rarely, never). Questions may be posed as number of servings consumed in designated period (e.g. daily, weekly, monthly). Probing questions are another option, such as time of the day a food is consumed, combinations of foods, or specific characteristics of a food (e.g. high or low fat milk). After format choices were determined, we tested each question against the existing GRAS data set.

**Response Options:** To determine format of response options we examined frequency of consumption of specific foods or food groups, using the GRAS data. Five complete days of 24-hour dietary recalls were analyzed. For example, how many times did participants report having orange juice in the 5 days of dietary assessment. The distribution was used to determine where cut-offs should be made in order to choose response options. Judgments also were made on how to best translate 5 days intake data to questions that would ask about frequency of intake per day or week.
Initial DST: The first draft of the DST began with a series of yes/no questions. The majority of these questions were posed in this format because a clear bimodal response distribution occurred for many food items among the GRAS study. For example, those who snack on fruits and vegetables either did so frequently or not at all. The draft version ends with dietary supplement questions.

Cognitive interviewing (CI) is a systematic method to improve the quality of survey questions through probing the thought processes of individuals that represent the target audience(13). Cognitive interviews aid researchers discover if questions are appropriate and specifically where and why they are failing. Furthermore, CI helps researchers determine what can be done to solve problems of question design. CI elicits additional information from participants about their thinking and about how they react to questionnaire items.

Cognitive Interviewing Methods: A convenience sample of older adults within central Pennsylvania was recruited through local senior centers and word of mouth. We attempted to select a sample similar to the GRAS, adults over the age of 65 with attention to gender distribution and educational attainment. All subjects signed an Informed Consent and were paid ten dollars for participation. The Geriatric Depression Scale and the Mini-mental State Examination were used to exclude individuals who exhibited depression or cognitive impairment, respectively. Study procedures were approved by the Institutional Review Board at The Pennsylvania State University. Coding sheets were used to summarize each interview. A copy of the cognitive interviewing script is located at the end of this Appendix.
Demographic characteristics of the cognitive interviewing sample are presented in Table 2. Participants had one-on-one audio recorded interviews, each approximately 45 minutes in length. 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.

Cognitive Interviewing Results: The cognitive interviewing was an iterative process. After the first five interviews common themes were summarized and changes made to the DST. This iterative procedure was followed for all remaining interviews.

Table 3 Demographic characteristics of cognitive interview participants

<table>
<thead>
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<th>Characteristic</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
</tr>
<tr>
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<td>7</td>
<td>41</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than High-school</td>
<td>5</td>
<td>29.5</td>
</tr>
<tr>
<td>High-school graduate</td>
<td>7</td>
<td>41</td>
</tr>
<tr>
<td>Some or more college</td>
<td>5</td>
<td>29.5</td>
</tr>
</tbody>
</table>

Revisions to DST: The participant’s initial response to the yes and no questions was not favorable. Subjects found it difficult to answer these questions. The question, “Do you usually drink orange juice?” confused all of the first five participants. When asked what the word “usually” meant participant’s answers varied greatly, from “once a week” to “a few times per day”. This led us to believe yes and no questions would not capture actual intake adequately. However, these questions were not
problematic for several behavior-related questions, such as “Do you usually put butter or margarine on foods like bread, rolls, or muffins?”.

Participants encountered problems separating foods that were aggregated. For example, “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 DST separated cookies from pies and cakes. Two distinct questions arose from the original question, “How often do you eat fish?”. Based on the epidemiological data, fatty fish (e.g. salmon, mackerel) but not fried fish (e.g. beer battered fish), are related to lower risk of CVD events. Thus, we separated fried and non-fried fish into two questions on the subsequent versions of the DST. Participants were familiar with whole grain breads, but not with whole grain cereals. The original question asked about whole grain breads and cereals together. Confusion arose on the part of the participant about how to best answer the question, provided they were uncertain. We chose to break the question “How often do you eat whole grain breads and cereals?” into two separate questions.

The concept of number of meals and number of snacks was difficult for participants to calculate. The questions previously read “How many meals and snacks do you have each day?”. Previous research warns against mathematical computation as well. For these reasons, we asked how many meals and how many snacks per day in separate questions.

We were concerned about asking portion specific questions along with frequency intake, again related to errors with mathematical computation. However, all of the first ten participants correctly identified a serving of milk. The only problem that could potentially be problematic is servings of cheese.
Participants correctly identified one cup of milk or yogurt as a serving. Some participants said “a small piece of cheese” but nearly all also included a slice of cheese as a serving.

Candy and chocolate were food items the participants reported eating, but were not on the DST. We added a frequency of consumption of these items to the subsequent version. Participants also needed more response options for how often they eat at restaurants or other places where food is prepared. The original questions and responses were as follows.

**How many times a week do you usually eat at restaurants or other places where food is prepared?**

- Never or hardly ever
- One or two times a week
- Three or more times a week

Some participants did not seem to “eat out” on a weekly basis. Some participants said “one time a month” and “once in a great while”. We added the option of less than once a week. Note the time frame for this questionnaire is during the last month so response options were targeted at this time frame.

**How many times a week do you usually eat at restaurants or other places where food is prepared?**

- Never
- Less than once a week
- One or twice a week
- Three or more times a week

Two participants were frustrated that more descriptive details were not available. One participant complained that diabetic food alternatives were not included. She said, “I eat candy, but it’s not bad candy, its diabetic candy”. Similarly, one participant wanted to see ice-cream separated into low-fat;
however, all other participants indicated they used the regular or full-fat ice cream.

Finally, some participants (n=4) were not reporting all fruit intake because they did not think to consider canned or frozen fruit, 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.”

Diet Screening Tool Cognitive Interviewing Script

Hello. My name is Regan Bailey. Thank you for taking time to meet with me today. We are developing a questionnaire about foods that people eat. This questionnaire about food intake would be used in a medical office or another clinical setting. We want to know whether the questions are clear and easy to answer. We also want to know if you understand what we mean by certain questions and words. We are not going to collect data on you but we are asking your interpretation of items on the questionnaire. I will ask you each question on the questionnaire by showing it to you on a card. After some questions I will ask you how you interpreted certain words in the question. You may also want to answer the questions out loud as you are thinking about you answer. This is called a “think aloud” method. For example, if I asked you how many windows you had in your house. You may think about each room mentally and count each window out loud to explain your answer. For example you might say as I walk into my house, I am in the kitchen and there are two windows. Then when I love to the living room there is one window facing the backyard.

Some questions may be very easy and others you may find more difficult.

When you answer the questions think about foods that you have eaten in the past month. Please feel free to contribute information that we may not ask you. Your participation is voluntary and you may stop this interview any time you wish.

1.) Do you usually drink orange juice?
____ Yes
____ No
Q1. What does the word “usually” mean to you when you think about the foods you eat?

Q2. How many times a week would be usually intake for you?

Q2. What if we had used the word regularly (Do you regularly drink orange juice?). Does that mean something different to you than the word usually? Would you have answered the question differently?

2.) Do you usually drink 100% fruit juices?
   ____ Yes
   ____ No

Q1. Do you drink any juice?

Q2. What is 100% fruit juice?

Q3. How does someone determine if a juice is 100% fruit juice?

3.) Do you usually eat fruit as a snack?
   ____ Yes
   ____ No

Q1. If yes, what kind of fruit do you eat as a snack?

Q2. When do you usually snack?

4.) Do you usually eat vegetables as a snack?
   ____ Yes
   ____ No

Q1. If yes, what kind of vegetables do you eat as a snack?

5.) Do you usually eat whole grain breads and cereals?
   ____ Yes
   ____ No

Q1. Was this question easy for you to answer?

Q2. What does whole-grain mean to you?

Q3. How would you know if a food is whole grain?

6.) Do you usually eat ice cream as a snack?
Q1. When you answered the question, were you thinking about ice cream you eat at meals as well as snacks?

Q2. When do you usually eat ice cream for dessert after a meal or at a snack.

7.) Do you usually add butter or margarine to foods like bread, rolls, or biscuits?
   ____ Yes
   ____ No

Q1. Are there foods other than bread, rolls and biscuits that we should add to this list?

8.) Do you usually add fat (butter, margarine or oil) to potatoes and other vegetables?
   ____ Yes
   ____ No

Q1. When you answered did you think about fats adding while the foods is being cooked or just fat that you add?

Q2. Would you answer yes if you didn’t know how your foods are usually prepared?

9.) Do you use gravy (when available) at meals?
   ____ Yes
   ____ No

Q1. What do you put gravy on when you use it?

Q2. Would it have been easier to answer the question : (Ask alternative question) “Do you usually use gravy on meat and potatoes?”

10.) Do you usually add sugar or honey to sweeten your coffee or tea?
    ____ I don’t drink coffee or tea
    ____ I don’t sweeten my coffee or tea
    ____ Yes
    ____ No

11.) What kind of milk do you drink or serve with cereal?
    ____ I don’t drink milk or use it on cereal
    ____ Regular/Whole milk
Q1. What if you use more than one type of milk, how would you answer this question?

The next sets of questions ask how often or how many times you eat or drink certain foods.

12.) How often each DAY do you drink a glass of milk

- None
- One to two times
- Three or more times per day

13.) How often do you eat cookies, cakes, or pies?

- Never or hardly ever
- A few times a week
- Everyday or almost everyday

Q1. Was this question easy for you to answer?

Q2. When you answered this question, was it difficult to think about all of the types of items we asked in this question?

14.) How often do you eat fruit (not including juice)?

- Never or hardly ever
- A few times a week
- Everyday or almost everyday
- More than once everyday

Q1. How do you interpret “few” times a week?

Q2. If you hardly eat something, how much is that to you?

15.) How often do you eat hot or cold breakfast cereal?

- Never or hardly ever
- Once a week
- A few times a week
- Everyday or almost everyday

Q1. What kind of cereal do you think of when we say cold cereal?
Q2. What kind of cereal do you think of when we say hot cereal?

16.) How often do you eat ice cream?
   ____ Never or hardly ever
   ____ Once a week
   ____ A few times a week
   ____ Everyday or almost everyday

Q1. If you eat ice cream, do you usually eat regular ice cream or low fat ice cream?

17.) How often do you drink some kind of juice at breakfast?
   ____ Never or hardly ever
   ____ Once a week
   ____ A few times a week
   ____ Everyday or almost everyday

Q1. What kinds of juice do you drink?

18.) How often do you eat potatoes?
   ____ Never or hardly ever
   ____ Once a week
   ____ A few times a week
   ____ Everyday or almost everyday

19.) How often do you eat fish?
   ____ Never or hardly ever
   ____ Once a week
   ____ A few times a week
   ____ Everyday or almost everyday

Q1. Do you ever eat fish?

Q2. What kind of fish do you usually eat?

20.) How many times a WEEK do you eat cold cuts, hot dogs, lunchmeats or deli meats?
   ____ Never or hardly ever
   ____ Once a week
   ____ Two or more times a week
Q1. What is the best word to describe these foods? Cold cuts? Lunchmeats? Or deli meats?

21.) How many times a WEEK do you eat chicken or turkey?
   ____ Never or hardly ever
   ____ Once a week
   ____ Two or more times a week

22.) How many times a week do you eat nuts (this includes peanuts, walnuts, almonds, pistachios and other nuts)?
   ____ Never or hardly ever
   ____ One or two
   ____ Three or more

Q1. Are there any other types of nuts that you frequently eat?

Q2. When you eat nuts, how much do you have?

23.) How many times a week do you eat eggs with bacon or sausage?
   ____ Never or hardly ever
   ____ One or two times a week
   ____ Three or more times a week

Q1. Did you understand that we meant bacon and eggs together?

24.) How many times a week do you usually eat at restaurants or other places where food is prepared?
   ____ Never or hardly ever
   ____ One or two times a week
   ____ Three or more times a week

Q1. Do you eat different foods when you go out that you normally wouldn’t eat at home?

25.) How many times each DAY do you eat meals and snacks?
   ____ 1 or 2
   ____ 3
   ____ 4 – 5
   ____ 6 or more

Q1. Does this number seem to change depending on what day it is or is it almost always the same?

26.) How many pieces of bread, bagels, rolls, or English muffins do you usually eat each DAY?
Q1. How did you count up all of these items?

27.) How many servings of milk, cheese, or yogurt do you usually have per DAY?
_____ None
_____ One
_____ One to two
_____ Two
_____ Three or more

Q1. Do you know what is meant by serving?

Q2. Was it hard to count a total number of serving for all of these foods?

28.) How many different vegetables do you usually have at your main meal of the day? Please include salads when you answer the question.
_____ None
_____ One
_____ One to two
_____ Two
_____ Three or more

Q1. Do you know what I mean by main meal?

Q2. When do you eat this meal?

Q3. What vegetables do you eat most often?

29.) Which of the following best describes your nutritional supplement use (Check all that apply).
_____ I don’t use supplements
_____ I use a multivitamin/mineral preparation (e.g. Centrum)
_____ I take specific supplement, please check all that apply.
_____ Calcium
_____ Vitamin D
_____ Vitamin C
_____ Vitamin E
_____ Zinc
_____ Folate
_____ B12
_____ B Vitamins
Other_________________________________________________
Q1. Do you take your supplements every day?

30.) How would you rate the overall quality of your diet?
   _______ Excellent
   _______ Good
   _______ Fair
   _______ Poor

Q1. How did you make this decision about your diet quality?
Q2. What do you think “quality of the diet” means?

Final Question: Are there some things that you eat that we did not ask you?
References


Appendix B

Clinic Report Forms

“Today I’m going to ask you a series of questions. It should take approximately 30 minutes. I would like to start out by asking a few questions about your background.” (Complete demographics form)

DEMOGRAPHICS

<p>| | |</p>
<table>
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<tbody>
<tr>
<td><strong>D1.</strong> Gender (circle one)</td>
<td>M=Male F=Female</td>
</tr>
<tr>
<td><strong>D2.</strong> Birth date</td>
<td>Mo/Day/Year: / /</td>
</tr>
<tr>
<td><strong>D3.</strong> Race (check one)</td>
<td>W=White □ B=Black □ A=Asian/Pacific Islander □ N=Native American □ H=Hispanic</td>
</tr>
<tr>
<td><strong>D4.</strong> Marital Status (check one)</td>
<td>M=Married □ W=Widowed □ S=Separated □ D=Divorced □ N=Never married</td>
</tr>
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</table>
| D5. Education: (Check highest year completed) | □E=Elementary School (Grades 1-8) or less  
□S=Some High School (Grades 9-12)  
□G=Graduate High School or GED  
□C=Some College or more |
<table>
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<tbody>
<tr>
<td>Employment:</td>
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</tr>
<tr>
<td>D6. Work for pay?</td>
<td>YES</td>
</tr>
<tr>
<td>D7. Number of hours per week</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>_________ Hr/wk</td>
</tr>
<tr>
<td>D8. Work as a volunteer?</td>
<td>YES</td>
</tr>
<tr>
<td>D9. Number of hours per month</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>_________ Hr/mo</td>
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</table>
MINI-MENTAL STATE EXAMINATION

“I would like to ask you a few questions to check your memory and concentration. Some questions are easy while others are hard. Try to answer each question, even if you have to guess.” (Interviewer may use prompts such as ‘try’ and ‘guess’. If more than one response is given, ask subject to choose only one answer). Correct answers – circle 1, incorrect answers – circle 0, no answer – circle 9.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>ERROR</th>
<th>CORRECT</th>
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<tr>
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<td></td>
</tr>
<tr>
<td>WHAT IS THE:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1. YEAR?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M2. SEASON OF THE YEAR?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M3. DATE?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M4. DAY OF THE WEEK?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M5. MONTH?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td><strong>WHERE ARE WE:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6. STATE?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M7. COUNTY?</td>
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<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M8. TOWN?</td>
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<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M9. STREET ADDRESS?</td>
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<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M10. ZIP CODE?</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td><strong>REGISTRATION:</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>“I am going to name three objects” (Take one second between each object). “After I have said them, I want you to repeat them” (Ask subject to repeat items below. Score one (1) point for each correct item)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M11. Ball</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M12. Flag</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M13. Tree</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>“Remember what the items are, I will ask you to name them again in a few minutes.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATTENTION:</strong></td>
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<tr>
<td>“Now I am going to ask you to spell a word forwards and backwards. The word is WORLD.” (Spell the word for the subject to avoid miscommunication. Give one (1) point for each letter given in proper sequence and circle number).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M14. Count # of letters given in correct order</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RECALL:</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ask for the names of the three (3) items learned in question #3. Give one (1) point for each correct item named. “What were the 3 objects I asked you to remember?”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M15. Ball</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>M16. Flag</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M17. Tree</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

**LANGUAGE:**

Point to a watch and then to a pencil. Ask the subject to identify each object in sequence. “What is this called?”

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>M18. Watch</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M19. Pencil</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Have the subject repeat a phrase. “I would like you to repeat the following phrase: **No Ifs Ands Or Buts**”. Only one trial.

<p>| | | | |</p>
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<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M20. Score one (1) point if said correctly.</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Have the subject follow a three-stage command: “I'm going to give you a piece of paper, when I do take the paper in your right hand, fold it in half and place it in your lap”.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M21. Right hand</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M22. Fold in half</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>M23. Place in lap</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

(Score one (1) point for each correctly completed stage.)

Have the subject read and obey a command.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M24. “Read the words on this page and do what it says”.</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

M25. Have the subject write a sentence of his/her own choice. (The sentence should contain a subject and an object and should make sense. Ignore spelling errors.) **Please write a sentence on this piece of paper**. If necessary, add the words, ‘about the weather’.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M25. “Please write a sentence on this piece of paper”</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

M26. Have subject copy the drawing. (Score correct if the two five-sided figures intersect to form a four-sided figure and if all angles in the five-sided figure are preserved.)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M26. Have subject copy the drawing.</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

**TOTAL SCORE =**

(Sum of all questions, excluding any missing ones. If all questions are answered, maximum score = 30 points. If questions are excluded, use Adjusted Score: 30 x total/30 - # of 9’s.)

If score ≤23, note in CRF.
MINI-MENTAL STATE EXAMINATION

SCORING INSTRUCTIONS

Scoring WORLD backwards

Correct sequence=5 points

Count 1 error for each omission, letter transposition (switching adjacent letters), insertion (inserting a new letter) or misplacement (moving WHORL or D by more than one space)

Correct=DLROW (5)

<table>
<thead>
<tr>
<th></th>
<th>Omission</th>
<th>Transposition</th>
<th>Insertion</th>
<th>Misplacement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Omission</strong></td>
<td>DLOW (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Transposition</strong></td>
<td>DOLW (3)</td>
<td>DLROW (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>DLTOW (3)</td>
<td>LRWWD (3)</td>
<td>DLRROW (4)</td>
<td></td>
</tr>
<tr>
<td><strong>Misplacement</strong></td>
<td>LOWD (3)</td>
<td>LRWO D (3)</td>
<td>LRWOWD (3)</td>
<td>LROWD (4)</td>
</tr>
</tbody>
</table>
GERIATRIC DEPRESSION SCALE

“Now I would like to ask you a few questions about your feelings.” Proceed with GDS. Matching answers are underlined.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1. Are you basically satisfied with your life?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G2. Have you dropped many of your activities and interests?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G3. Do you feel that your life is empty?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G4. Do you often get bored?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G5. Are you in good spirits most of the time?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G6. Are you afraid that something bad is going to happen to you?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G7. Do you feel happy most of the time?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G8. Do you often feel helpless?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G9. Do you prefer to stay at home, rather than going out and doing new things?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G10. Do you feel you have more problems with your memory than most?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G11. Do you think it is wonderful to be alive now?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G12. Do you feel pretty worthless the way you are now?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G13. Do you feel full of energy?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G14. Do you feel that your situation is hopeless?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G15. Do you feel most people are better off than you are?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

G SCORE =
(Each matching answer = 1 pt.)
If score >6, note in CRF.
MEDICAL HISTORY – PREMORBID CONDITIONS

“Now I would like to ask a few questions about your health and medical conditions. Has a physician ever told you that you have…”? Read through all conditions listed. Define all acronyms, e.g. say congestive heart failure not CHF. Explain any condition as needed, e.g. elevated cholesterol = serum cholesterol > 200 mg/dl. Please circle YES, NO, OR DK (don’t know) for each condition.

(As reported by subject)

<table>
<thead>
<tr>
<th>Condition</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiratory Disease:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1. COPD</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H2. Sleep APNEA</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H3. Other:</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td><strong>Cardiovascular:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H4. Angina/Chest Pain</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H5. Arrhythmia</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H6. CHF</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H7. CAD</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H8. Heart Attack/M.I.</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H9. Other:</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>HyperLipidemia:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H10. Elevated Cholesterol</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H11. Elevated Triglyceride</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
<tr>
<td>H12. Hypertension:</td>
<td>Yes</td>
<td>No</td>
<td>DK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood Disorders:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H13. Anemia</td>
<td>Yes</td>
</tr>
<tr>
<td>H14. Other</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appetite:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H15. Current Appetite</td>
<td>Good</td>
</tr>
<tr>
<td>H16. Nausea (&gt;3x/wk)</td>
<td>Yes</td>
</tr>
<tr>
<td>H17. Vomiting (&gt;3x/mo)</td>
<td>Yes</td>
</tr>
<tr>
<td>H18. Diarrhea (&gt;3x/wk)</td>
<td>Yes</td>
</tr>
<tr>
<td>H19. Special Diet (if yes, specify)</td>
<td>Yes</td>
</tr>
<tr>
<td>Gastrointestinal:</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>H20. Ulcer, Gastritis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H21. Crohn’s Disease</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H22. Diverticulosis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H23. IBD</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>Other (specify):</td>
<td>Yes No DK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diabetes:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H24. IDDM</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H25. NIDDM</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H26. Do you take insulin?</td>
<td>Yes No DK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kidney Disease:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H27. (specify)</td>
<td>Yes No DK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hepatobiliary Disease:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H28. Gallbladder Disease</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H29. Cirrhosis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H30. Hepatitis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>(specify)</td>
<td></td>
</tr>
<tr>
<td>Musculo-Skeletal:</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>--------</td>
</tr>
<tr>
<td>H31. DJD</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H32. Arthritis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H33. Fractures (in last 10 years)</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H34. Osteoporosis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H35. Rheumatoid Arthritis</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>Other: ___________</td>
<td>Yes No DK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cancer: (history of or currently)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H36. Breast</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H37. Colon</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H38. Lung</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H39. Ovarian</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H40. Prostate</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H41. Other: ___________</td>
<td>Yes No DK</td>
</tr>
</tbody>
</table>
### Tobacco Use:

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H42. Have you ever used tobacco on a daily basis?</strong></td>
<td>Yes No DK</td>
</tr>
<tr>
<td><strong>If yes, please indicate all forms:</strong></td>
<td></td>
</tr>
<tr>
<td>H43. Cigarette</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H44. Cigar</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H45. Chewing Tobacco</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H46. Pipe</td>
<td>Yes No DK</td>
</tr>
<tr>
<td>H47. Other</td>
<td>Yes No DK</td>
</tr>
<tr>
<td><strong>H48. Do you currently use tobacco?</strong></td>
<td>Yes No DK</td>
</tr>
<tr>
<td><strong>If yes, please indicate all forms:</strong></td>
<td></td>
</tr>
<tr>
<td>H49. Cigarette</td>
<td></td>
</tr>
<tr>
<td>H50. Cigar</td>
<td></td>
</tr>
<tr>
<td>H51. Chewing Tobacco</td>
<td></td>
</tr>
<tr>
<td>H52. Pipe</td>
<td></td>
</tr>
<tr>
<td>H53. Other</td>
<td></td>
</tr>
</tbody>
</table>

### Alcohol Consumption:

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H54. Do you drink &gt;2 alcoholic beverages/day (men) or &gt;1 alcoholic beverages/day (women)? (See Note!!)</strong></td>
<td>Yes No DK</td>
</tr>
<tr>
<td><strong>H55. Would you say you drink</strong></td>
<td></td>
</tr>
<tr>
<td><strong>H56. When you drink how many drinks do you typically have?</strong></td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>
Eye Health Questionnaire

1.) Have you ever been told by an eye doctor or any physician that you have glaucoma?

YES          NO          DON’T KNOW

2.) Have you ever been told by an eye doctor or any physician that you have cataracts?

YES          NO          DON’T KNOW

3.) Have you ever been told by an eye doctor or any physician that you have macular degeneration?

YES          NO          DON’T KNOW

4.) Have you ever been told by an eye doctor or any physician that you have any other eye problems?

YES          NO          DON’T KNOW

If yes, what problems?

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

____________________________________________________________________________________
MEDICATION SHEET

“I would like to review your medications. If it’s convenient, I can take the information directly from the medication bottles.”

Begin with prescription medications, followed by O-T-C and vitamin/mineral supplements. Write Yes or No under ‘Viewed containers’ and ‘RX by Doctor’.

Ask subject: “Did you take any over the counter medications in the past 24 hours?” If yes, ask if, it was prescribed by physician. Repeat questions using vit/min supplement.

Researcher will convert all trade names to generic names. Generic medications DO NOT require conversion.

<table>
<thead>
<tr>
<th>TRADE NAME</th>
<th>GENERIC NAME</th>
<th>Viewed container (YES/NO)</th>
<th>RX by Doctor (YES/NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5.</td>
<td></td>
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<td></td>
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<tr>
<td>D6.</td>
<td></td>
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<tr>
<td>D7.</td>
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<td></td>
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<tr>
<td>D8.</td>
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<td></td>
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<tr>
<td>D9.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>D10.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>OVER-THE-COUNTER</td>
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<td></td>
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</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin/Mineral/Other</td>
<td>Amount</td>
<td>Units</td>
<td>%DV</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
<td>-------</td>
<td>-----</td>
</tr>
<tr>
<td>Beta Carotene</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biotin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choline</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Chromium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobalt</td>
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<td></td>
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<tr>
<td>Copper</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fluoride</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Folic Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inositol</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Iodine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niacin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pantothenic Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Para-Aminobenzoic Acid (PABA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riboflavin (B2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiamin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin/Mineral/Other</td>
<td>Amount</td>
<td>Units</td>
<td>%DV</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------</td>
<td>-------</td>
<td>-----</td>
</tr>
<tr>
<td>Vitamin E</td>
<td></td>
<td></td>
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<tr>
<td>Vitamin K</td>
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<tr>
<td>Zinc</td>
<td></td>
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<tr>
<td><strong>OTHER: (to include any other vitamins/minerals/herbs or botannicals, enzymes, amino acids, fatty acids, or any other food components within this same supplement)</strong></td>
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<tr>
<td>10</td>
<td></td>
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</tbody>
</table>
Researcher may complete this sheet in the office. Please place the sum of the medications in the appropriate spaces.

**MEDICATION TOTALS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Number =</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total number of all prescription medications.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Total number prescription medications ordered by physician.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Total number of OTC medications.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Total number of OTC medications ordered by physician.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Total number of vitamins/mineral supplements.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Total number of vitamin/mineral supplements ordered by physician.</td>
<td></td>
</tr>
</tbody>
</table>
Oral Status Survey

“Now I’d like to ask you a few questions about your mouth and teeth.” Fill out survey as instructed.

01. Do you have difficulty chewing? (circle one)
    YES   NO

02. Do you have difficulty swallowing? (circle one)
    YES   NO

03. Do you have any missing teeth? (circle one)
    YES   NO

04. Do you wear dentures? (circle one)
    YES   NO
    (If yes)

05. Do they fit? YES   NO

06. Do you have mouth or tongue pain?
    YES   NO

07. Do you have diminished taste?
    YES   NO

08. Do you have diminished sense of smell?
    YES   NO
“There are two parts left to this visit, I will first take some body measurements and then ask you to complete some questionnaires. You will need to only stop by the lab for have blood drawn before you go today.” If patient has not fasted for labs they can come in another time in the next few days—up to a week from visit.

**ANTHROPOMETRICS**

<table>
<thead>
<tr>
<th>MEASURES TO BE COMPLETED</th>
<th>U=unable to perform</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. WEIGHT (LB.) 1.</td>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>5. HEIGHT (INS.) 1.</td>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>8. Waist circumference (cm)</td>
<td>2.</td>
<td></td>
</tr>
</tbody>
</table>
LEISURE TIME ACTIVITY

L1. Over the past 7 days, how often did you participate in sitting activities such as reading, watching TV or handcrafts?

- [0.] NEVER
- [1.] SELDOM (1-2 DAYS)
- [2.] SOMETIMES (3-4 DAYS)
- [3.] OFTEN (5-7 DAYS)

GO TO Q. #2

1a. What were these activities?
_________________

1b. On average, how many hours per day did you engage in these sitting activities?

- [1.] LESS THAN 1 HOUR
- [2.] 1 BUT LESS THAN 2 HOURS
- [3.] 2-4 HOURS
- [4.] MORE THAN 4 HOURS

GO TO Q. #3

L2. Over the past 7 days, how often did you take a walk outside your home or yard for any reason? For example, for fun or exercise, walking to work, walking to work, walking the dog, etc?

- [0.] NEVER
- [1.] SELDOM (1-2 DAYS)
- [2.] SOMETIMES (3-4 DAYS)
- [3.] OFTEN (5-7 DAYS)

GO TO Q. #3

2. On average, how many hours per day did you spend walking?

- [1.] LESS THAN 1 HOUR
- [2.] 1 BUT LESS THAN 2 HOURS
- [3.] 2-4 HOURS
- [4.] MORE THAN 4 HOURS
L3. Over the past 7 days, how often did you engage in light sport or recreational activities such as bowling, golf with a cart, shuffleboard, fishing from a boat or pier or other similar activities?

[0.] NEVER [1.] SELDOM [2.] SOMETIMES [3.] OFTEN

(1-2 DAYS) (3-4 DAYS) (5-7 DAYS)

GO TO Q. #4

3a. What were these activities?

_______________________________

3b. On average, how many hours per day did you engage in these activities?

[1.] LESS THAN 1 HOUR [2.] 1 BUT LESS THAN 2 HOURS

[3.] 2-4 HOURS [4.] MORE THAN 4 HOURS

L4. Over the past 7 days, how often did you engage in moderate sport and recreational activities such as doubles tennis, ballroom dancing, hunting, ice skating, golf without a cart, softball or other similar activities?

[0.] NEVER [1.] SELDOM [2.] SOMETIMES [3.] OFTEN

(1-2 DAYS) (3-4 DAYS) (5-7 DAYS)

GO TO Q. #L5

4a. What were these activities?

_______________________________

4b. On average, how many hours per day did you engage in these activities?

[1.] LESS THAN 1 HOUR [2.] 1 BUT LESS THAN 2 HOURS

[3.] 2-4 HOURS [4.] MORE THAN 4 HOURS
L5. Over the past 7 days, how often did you engage in strenuous sport and recreational activities such as jogging, swimming, cycling, singles tennis, aerobic dance, skiing (downhill or cross-country) or other similar activities?

<table>
<thead>
<tr>
<th>0. never</th>
<th>1. seldom</th>
<th>2. sometimes</th>
<th>3. often</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1-2 days)</td>
<td>(3-4 days)</td>
<td>(5-7 days)</td>
<td></td>
</tr>
</tbody>
</table>

GO TO Q. #L6

5a. What were these activities?

5b. On average, how many hours per day did you engage in these activities?

| 1. less than 1 hour | 2. 1 but less than 2 hours | 3. 2-4 hours | 4. more than 4 hours |

L6. Over the past 7 days, how often did you do any exercises specifically to increase muscle strength and endurance, such as lifting weights or pushups, etc?

<table>
<thead>
<tr>
<th>0. never</th>
<th>1. seldom</th>
<th>2. sometimes</th>
<th>3. often</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1-2 days)</td>
<td>(3-4 days)</td>
<td>(5-7 days)</td>
<td></td>
</tr>
</tbody>
</table>

GO TO Q. #L7

6a. What were these activities?

6b. On average, how many hours per day did you engage in these activities?

| 1. less than 1 hour | 2. 1 but less than 2 hours | 3. 2-4 hours | 4. more than 4 hours |
**HOUSEHOLD ACTIVITY**

L7. During the past 7 days, have you done any light housework, such as dusting or washing dishes?

[1.] NO  
[2.] YES

L8. During the past 7 days, have you done any heavy housework or chores, such as vacuuming, scrubbing floors, washing windows, or carrying wood?

[1.] NO  
[2.] YES

L9. During the past 7 days, did you engage in any of the following activities?

Please answer YES or NO for each item.

<table>
<thead>
<tr>
<th>Activity</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home repairs like painting, wallpapering, electrical work, ect.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Lawn work or yard care, including snow or leaf removal, wood chopping, etc.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Outdoor gardening</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Caring for an other person, such as children, dependent spouse, or an other adult.</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**WORK-RELATED ACTIVITY**

L10. During the past 7 days, did you work for pay or as a volunteer?

[1.] NO  
[2.] YES
L10a. How many hours per week did you work for pay and/or as a volunteer?  
__________________HOURS

L10b. Which of the following categories best describes the amount of physical activity required on your job and/or volunteer work?

[1.] Mainly sitting with slight arm movements.  
[Examples: office worker, watchmaker, sated assembly line worker, bus driver, etc.]

[2.] Sitting or standing with some walking.  
[Examples: cashier, general office worker, light tool and machinery worker.]

[3.] Walking, with some handling of materials generally weighing less than 50 pounds.  
[Examples: mailman, waiter/waitress, construction worker, heavy tool and machinery worker.]

[4.] Walking and heavy manual work often requiring handling of materials weighing over 50 pounds.  
[Examples: lumberjack, stone mason, farm or general laborer.]
**Food and Health Questionnaire**

1. Would you be interested in receiving more information about any of the following areas regarding food and nutrition? Please check all that apply.

- [ ] I am not interested in receiving any food and nutrition information (please skip to question 3).
- [ ] Choosing foods for healthy eating
- [ ] Nutrition and blood pressure control
- [ ] Nutrition and heart health
- [ ] Nutrition and diabetes management
- [ ] Nutrition and weight control
- [ ] Other, please describe

2. How would you prefer to receive information about nutrition and your health? Please check all that apply.

- [ ] Receive written material through regular mail
- [ ] Receive written material through electronic mail (e-mail)
- [ ] Talk to a doctor over the telephone
- [ ] Talk to another health care professional over the telephone
- [ ] Talk to a doctor during a clinic visit
- [ ] Talk to another health care professional during a clinic visit
- [ ] Talk to other people like me in a group setting

3. Has a doctor ever talked to you about healthy food choices?

- [ ] Yes
- [ ] No
- [ ] Not sure

4. Besides a doctor, has any other health care professional (such as a nurse or dietitian) talked to you about healthy food choices?

- [ ] Yes
- [ ] No
- [ ] Not sure

5. Has your doctor ever told you to make changes in the way you eat? If yes, what?

- [ ] No
- [ ] Not sure
- [ ] Yes, please explain

________________________________________________________
6. In recent years have you changed the **AMOUNT** of foods that you eat?

- [ ] No
- [ ] Not sure
- [ ] Yes
- [ ] I eat more than I used to eat.
- [ ] I eat less than I used to eat.

7. In recent years have you changed the **TYPE** of foods that you eat?

- [ ] No
- [ ] Not sure
- [ ] Yes, please

Explain_______________________________________________________

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

________________________
8. How often do you weigh yourself?

____ more that once per day
____ once per day
____ once per week
____ once per month
____ once per year or less

9. How would you describe your current weight?

____ Extremely thin
____ Somewhat thin
____ Just about right
____ Somewhat heavy
____ Extremely heavy

10. How often are you dieting to lose weight?

____ Never
____ Sometimes
____ Usually
____ Always

11. Have you ever received counseling to control or lose weight?

____ Yes
____ No
Modified Mini Nutritional Assessment

Form filled out by:  ☐ Self  ☐ Caregiver, Friend, or Relative

Please enter responses for the person to whom the survey was addressed.

**ITEM #1**
Enter your age/birth date, and check race/ethnic group and gender.

Age (years) _____
Birth date (month/day/year) _____ _____ _____
☐ Non-Hispanic White  ☐ Non-Hispanic Black  ☐ Mexican-American  ☐ Other
☐ Female  ☐ Male

---

**ITEM #2**
Please fill in your height and weight.

Height: ___________ (in feet and inches)  ☐ I do not know my height.
Weight: ___________ (in pounds)  ☐ I do not know my weight.

---

**ITEM #3**
Check each that apply to you:

☐ Have lost 10 or more pounds in the past six months.
☐ Have gained 10 or more pounds in the past six months.

---

**ITEM #4**
Have you been told by a doctor that you have or are being treated for the following conditions (check each that apply):

☐ Fluid (edema) in your legs, ankles, or feet?
☐ Take a diuretic (water pill) prescribed by a doctor.
**ITEM #5**
You follow a weight reduction diet. If yes, check all those items that apply:
- Self-prescribed weight loss diet.
- Doctor-prescribed weight loss diet.
- Received dietitian counseling.
- Focus is on cutting calories.
- Focus is on eating less fat.
- Focus is on eating less carbohydrates (example Atkins diet).
- Approach includes weight loss supplements or medications.
- Approach includes increased physical activity / exercise.
- Other weight reduction diet (please specify): _______________

You follow a special diet for another medical problem (not for weight loss). If yes, check all those items that apply:
- Low cholesterol or low fat diet.
- Diabetic diet.
- Low salt diet.
- Another special diet (please specify): _______________

**ITEM #6**
Check each that apply to you:
- Frequently skip breakfast altogether.
- Often worry whether there will be enough food to eat.
- Have difficulty chewing or swallowing.
- Have pain in mouth, teeth, or gums.

**ITEM #7**
Check each that apply to you:
- Use 3 or more prescription drugs per day.
- Take daily multivitamin supplements.
- Use herbal or other dietary supplements.
ITEM #8

Have you ever had (check each that apply):
- ☐ Coronary heart disease?
- ☐ Congestive heart failure (CHF)?
- ☐ Angina?
- ☐ A myocardial infarction (MI)?
- ☐ Any other heart attack?

Have you been told by a doctor that you have or are being treated for the following conditions (check each that apply):
- ☐ High blood pressure (hypertension)?
- ☐ Diabetes or borderline diabetes?
- ☐ Lung disease or breathing problems (for example: emphysema, chronic bronchitis, sleep apnea, or asthma)?
- ☐ High blood cholesterol or fats?
- ☐ Arthritis of the knee(s) or knee replacement surgery?

ITEM #9

In the previous 12 months, how many times did you visit a physician, emergency room, or clinic? (check one answer)
- ☐ Not at all
- ☐ One time
- ☐ Two or three times
- ☐ Four to six times
- ☐ More than six times

In the previous 12 months, have you stayed overnight as a patient in a hospital? (check one answer)
- ☐ Not at all
- ☐ One time
- ☐ Two or three times
- ☐ More than three times
ITEM #10

Usually or always need assistance with: (check each that apply to you)
- Bathing
- Dressing
- Grooming
- Toileting
- Eating
- Walking or moving about
- Getting out of bed or chair
- Traveling (outside the home)
- Preparing food
- Shopping for food or other necessities

ITEM #11

Do you live: (check one answer)
- Alone? □ With a son or daughter?
- With spouse? □ With other family member?
- Other? Explain: __________

Check each that apply:
- You are housebound (unable to leave home without assistance).
- Use an assistance device in daily activities (cane, walker or wheel chair).
- Have no one to provide assistance or care at home if needed.
- Must go up / down a flight of stairs in daily activities.
- Have a television available.
  If yes, you watch television:
    - Less than 4 hours daily.
    - 4 or more hours daily.
    - While eating snacks each day.
    - While eating at least one meal each day.
ITEM #12

Check each that apply to you:
- Feel depressed, sad, downhearted, “in the dumps”, or blue.
- Feel tired, worn out, and lacking in energy.
- Take anti-depressant medication prescribed by a doctor.

ITEM #13

In general would you say your health is:
(check one answer)
- Excellent
- Very Good
- Good
- Fair
- Poor

ITEM #14

Eat the following item(s) almost every day:
(check each that apply)
- Breakfast cereal
- Potatoes (including fried potatoes and French fries)
- Two or more servings of vegetables other than potatoes
- Three or more servings of fruit
- Two or more servings of low-fat or non-fat dairy products
- Sweets (such as pies, cookies, cakes or donuts)
Food Screening Questionnaire

1.) How often do you usually drink orange juice?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

2.) How often do you usually drink 100% fruit juices (other than orange juice)?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

3.) How often do you usually eat fruit as a snack?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

4.) How often do you usually eat vegetables as a snack?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

5.) How often do you usually eat whole grain breads?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

6.) How often do you usually eat whole grain cereals?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

7.) How often do you usually eat candy or chocolate?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week
8.) How often do you eat crackers, pretzels, chips, or popcorn?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

9.) How often do you eat cakes or pies?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

10.) How often do you eat cookies?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

11.) How often do you eat ice cream?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

12.) How often do you eat potatoes?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

13.) How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week

14.) How often do you eat nuts (this includes mixed nuts, peanuts, walnuts, almonds, pistachios and other nuts)?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 or more times a week
15.) How often do you eat eggs?
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 or more times a week

16.) How often do you eat bacon or sausage?
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 or more times a week

17.) How often do you eat carrots, sweet potatoes, broccoli, or spinach?
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 or more times a week

18.) How often do you eat fruit (not including juice)? Please include fresh, canned or frozen fruit.
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 to 5 times a week
   ___ Every day or almost every day

19.) How often do you eat hot or cold breakfast cereal?
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 to 5 times a week
   ___ Every day or almost every day

20.) How often do you drink some kind of juice at breakfast?
   ___ Never
   ___ Never
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 to 5 times a week
   ___ Every day or almost every day

21.) How often do you eat chicken or turkey?
   ___ Never
   ___ Less than once a week
   ___ 1 or 2 times a week
   ___ 3 to 5 times a week
   ___ Every day or almost every day
22.) How often do you drink a glass of milk?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 to 5 times a week
   ____ Every day or almost every day
   ____ More than once every day

23.) Do you usually add butter or margarine to foods like bread, rolls, or biscuits?
   ____ Yes
   ____ No

24.) Do you usually add jelly, jam or honey to foods like bread, rolls, or biscuits?
   ____ Yes
   ____ No

25.) Do you usually add fat (butter, margarine or oil) to potatoes and other vegetables?
   ____ Yes
   ____ No

26.) Do you use gravy (when available) at meals?
   ____ Yes
   ____ No

27.) Do you usually add sugar or honey to sweeten your coffee or tea?
   ____ Yes
   ____ No

28.) What kind of milk do you drink or serve with cereal?
   ____ I don’t drink milk or use it on cereal
   ____ Regular/Whole milk
   ____ Reduced Fat (1%, 2%) milk
   ____ Skim, Non-fat milk
   ____ Lactaid/Soy Milk/ or another type of milk not listed

29.) How often do you eat fish or seafood that IS NOT fried?
   ____ Never
   ____ Less than once a week
   ____ Once a week
   ____ More than once a week
30.) How often do you eat fish or seafood that IS fried?
   ____ Never
   ____ Less than once a week
   ____ Once a week
   ____ More than once a week

31.) How many times a week do you usually eat at restaurants or other places where food is prepared?
   ____ Never
   ____ Less than once a week
   ____ One or twice a week
   ____ Three or more times a week

32.) How many pieces of bread, bagels, rolls, or English muffins do you usually eat each DAY?
   ____ None
   ____ One to two
   ____ Three or more

33.) How many servings of milk, cheese, or yogurt do you usually have each DAY?
   ____ None
   ____ One
   ____ Two or more

34.) How many different vegetable servings do you usually have at your main meal of the day? Please include salads and potatoes when you answer the question.
   ____ None
   ____ One
   ____ Two
   ____ Three or more

35.) How often do you usually drink wine, beer or other alcoholic beverages?
   ____ Never
   ____ Less than once a week
   ____ 1 or 2 times a week
   ____ 3 to 5 times a week
   ____ Every day or almost every day

36.) How would you rate the overall quality of your diet?
   ____ Excellent
   ____ Good
   ____ Fair
   ____ Poor
37.) Which of the following best describes your nutritional supplement use (Check all that apply).

___ I don’t use supplements
___ I use a multivitamin/mineral preparation (e.g. Centrum)
___ I take specific supplement, please check all that apply.
   ___ Calcium
   ___ Vitamin D
   ___ Vitamin C
   ___ Vitamin E
   ___ Zinc
   ___ Folate
   ___ B12
   ___ B Vitamins
Other ________________________________
STUDY COMPLETION and SUMMARY

PATIENT STATUS:

C1. Did participant complete the study?       YES       NO

C2. Date of completion (month/day/year):     __________

C3. Did participant discontinue the study prematurely?       YES       NO

If yes, reason:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

C4. Date of study withdrawal (month/day/year): __________

C5. Are there any Investigator Comments: YES       NO

If yes, list comments:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Principle Investigator: __________________________

Signature/Title: __________________________ Date: __________
Appendix C

Final Diet Screening Tool

1.) How often do you usually drink orange juice?
   __0__ Never
   __1__ Less than once a week
   __3__ 1 or 2 times a week
   __5__ 3 or more times a week

2.) How often do you usually drink 100% fruit juices (other than orange juice)?
   __0__ Never
   __1__ Less than once a week
   __2__ 1 or 2 times a week
   __3__ 3 or more times a week

3.) How often do you usually eat fruit as a snack?
   __0__ Never or less than once a week
   __3__ 1 or 2 times a week
   __5__ 3 or more times a week

4.) How often do you usually eat vegetables as a snack?
   __0__ Never or Less than once a week
   __1__ 1 or 2 times a week
   __2__ 3 or more times a week

5.) How often do you usually eat whole grain breads?
   __0__ Never
   __1__ Less than once a week
   __2__ 1 or 2 times a week
   __3__ 3 or more times a week

6.) How often do you usually eat whole grain cereals?
   __0__ Never
   __3__ Less than once a week
   __6__ 1 or 2 times a week
   __9__ 3 or more times a week
7.) How often do you usually eat candy or chocolate?
- 3__ Never
- 2__ Less than once a week
- 1__ 1 or 2 times a week
- 0__ 3 or more times a week

8.) How often do you eat crackers, pretzels, chips, or popcorn?
- 1__ Never
- 1__ Less than once a week
- 0__ 1 or 2 times a week
- 0__ 3 or more times a week

9.) How often do you eat cakes or pies?
- 4__ Never
- 3__ Less than once a week
- 1__ 1 or 2 times a week
- 0__ 3 or more times a week

10.) How often do you eat cookies?
- 3__ Never
- 2__ Less than once a week
- 1__ 1 or 2 times a week
- 0__ 3 or more times a week

11.) How often do you eat ice cream?
- 3__ Never
- 2__ Less than once a week
- 1__ 1 or 2 times a week
- 0__ 3 or more times a week

12.) How often do you eat potatoes?
- 0__ Never
- 1__ Less than once a week
- 1__ 1 or 2 times a week
- 1__ 3 or more times a week

13.) How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?
- 1__ Never
- 1__ Less than once a week
- 0__ 1 or 2 times a week
- 0__ 3 or more times a week
14.) How often do you eat nuts (this includes mixed nuts, peanuts, walnuts, almonds, pistachios and other nuts)?
   __0__ Never
   __1__ Less than once a week
   __2__ 1 or 2 times a week
   __2__ 3 or more times a week

15.) How often do you eat eggs?
   __0__ Never
   __1__ Less than once a week
   __2__ 1 or 2 times a week
   __2__ 3 or more times a week

16.) How often do you eat carrots, sweet potatoes, broccoli, or spinach?
   __0__ Never   or less than once a week
   __3__ 1 or 2 times a week
   __6__ 3 or more times a week

17.) How often do you eat fruit (not including juice)? Please include fresh, canned or frozen fruit.
   __0__ Less than 2 times a week
   __3__ 3 to 5 times a week
   __5__ Every day or almost every day

18.) How often do you eat hot or cold breakfast cereal?
   __0__ Never or less than once a week
   __2__ 1 or 2 times a week
       __5__ 3 to 5 times a week
   __8__ Every day or almost every day

19.) How often do you drink some kind of juice at breakfast?
   __0__ Never   or less than once a week
   __3__ 2 to 5 times a week
   __5__ Every day or almost every day

20.) How often do you eat chicken or turkey?
   __0__ Never   or less than once a week
   __2__ 1 or 2 times a week
   __4__ More than 3 times a week
21.) How often do you drink a glass of milk?
   __0__ Never
   __1__ 1 or 2 times a week or less
   __2__ 3 to 5 times a week
   __2__ Every day or more than once every day

22.) Do you usually add butter or margarine to foods like bread, rolls, 
or biscuits?
   __0__ Yes
   __3__ No

23.) Do you use gravy (when available) at meals?
   __0__ Yes
   __2__ No

24.) Do you usually add sugar or honey to sweeten your coffee or 
tea?
   __0__ Yes
   __2__ No

25.) What kind of milk do you drink or serve with cereal?
   __0__ I don’t drink milk or use it on cereal
   __1__ Regular/Whole milk
   __2__ Reduced Fat (1%, 2%) milk
   __3__ Skim, Non-fat milk
   __3__ Lactaid/Soy Milk/ or another type of milk not listed

26.) How often do you eat fish or seafood that IS NOT fried?
   __0__ Never
   __1__ Less than once a week
   __2__ Once a week
   __3__ More than once a week

27.) How many servings of milk, cheese, or yogurt do you usually 
have each DAY?
   __0__ None
   __3__ One
   __5__ Two or more

28.) How many different vegetable servings do you usually have at 
your main meal of the day? Please include salads and potatoes when 
you answer the question.
   __0__ None
   __1__ One
   __3__ Two
   __4__ Three or more
29.) How many times each DAY do you eat MEALS?
   __0__ 1 or 2
   __3__ 3 or more

30.) How many times each DAY do you eat between meals, including an evening snack?
   __0__ 0
   __2__ 1 or more

Which of the following best describes your nutritional supplement use (Check all that apply).
   __0__ I don’t use supplements
   __5__ I use a multivitamin/mineral preparation (e.g. Centrum)
VITA

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Education
The Pennsylvania State University,
Ph.D. in Nutritional Science, Minor in Gerontology. 2007

Indiana University of Pennsylvania
Master of Science in Food and Nutrition, 2001

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Publications


Honors and Awards
Pre-doctoral Fellowship: National Institutes of Aging, 2005
Scholastic Award:, 2006 Graduate Expo Third Place Winner, 2006
Scholastic Award: Grace M. Henderson (College of Health and Human Development), 2004
Travel Award: Nutrition and Dietetics Alumni Society, 2006
Travel Award: Student Competitive Research, Department of Nutrition, 2004
Travel Award: National Institutes of Health, Dietary Supplement Use in Older Adults, 2003
President, Nutrition Graduate Student Association, Pennsylvania State University, 2003
Award, Internal Faculty Cooperative Grant, Indiana University of Pennsylvania, 2001