Assessment of dietary intakes, nutritional risk and whole grain behaviors of community-residing adults age 60+ years

by

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

NOMENCLATURE

ADL	Activities of Daily Living
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
CVD	Cardiovascular Disease
DIF	Dietary Intake Frequency
DST	Dietary Screening Tool
IA	Iowa
IADL	Instrumental Activities of Daily Living
MD	Mean Difference
NH	New Hampshire
OAA	Older Americans Act
QOL	Quality of Life
RI	Rhode Island
SMT	Social Marketing Theory
USDA	United States Department of Agriculture
WG	Whole Grain
$\bar{x}$	Mean

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ABSTRACT

Older adults (OA) are not meeting MyPlate recommendations. Tailored lifestyle intervention programs have the potential to improve nutrition-related knowledge and dietary behaviors. Study 1 assessed the nutritional risk and dietary intake frequencies (DIF) of community-residing OA electing to participate in lifestyle intervention programs and sociodemographic characteristics influencing these behaviors. It was a cross-sectional study consisting of participants from three states who completed the Dietary Screening Tool (DST). Study 2 evaluated to what extent a three-week whole grain (WG) education program is able to impact WG behaviors. The program incorporated discussion, hands-on activities and taste-testing among OA. Participants were assigned to PowerPoint classes (n=13 sites) or discussion-based classes (n=12 sites). The DST and a non-validated WG questionnaire were completed pre and post.

Study 1 participants (n=352) were mostly college-educated, white females, age 60-70 years classified as "at nutritional risk" or "at possible nutritional risk." Participants had "low" DIF of dairy, lean protein and processed meat. Participants also had "moderate" DIF of added fats, sugars and sweets, total and WG, vegetables and whole fruit and juice. Whole fruit and juice DIF were influenced by state ($p\leq.001$). Vegetable DIF were influenced by state (p=.021) and gender (p=.022). Processed meat DIF were influenced by gender (p=.033) and age (p=.001). Finally, nutritional risk was influenced by gender (p=.006). Study 2 participants (n=157) were mostly white, high-income females. Significant increases in WG knowledge were observed ($p\leq.001$). "DST total grain and WG DIF" increased ($p\leq.001$), with a positive correlation between post WG knowledge and "DST WG DIF" (p=.027). At post, more participants reported liking the taste of WG foods (p=0.019) and knew how to use a product's package to determine WG content ($p\leq.001$). About 59.2% had a "strong" intention to eat more WG foods at post. A positive association between post intention to eat more WG foods and "DST WG DIF" was observed ($p\leq.001$). Furthermore, WG knowledge was higher among those in the PowerPoint-based classes (p=0.002). These findings suggest community-residing OA are at nutritional risk. Additionally, a WG education program may be an effective strategy for increasing WG knowledge and encouraging improvements in WG intake among OA.

CHAPTER I: INTRODUCTION

Background

The Baby Boomer generation, those born from 1946 to 1964, has brought about an increase in the number of adults classified as "older adults," as they began turning 65 years old in 2011 (Ortman, Velkoff & Hogan, 2014). Today, one in every seven (13.7%) individuals is considered an older adult (Administration on Aging, Administration for Community Living & United States Department of Health and Human Services, 2013). In Iowa, New Hampshire and Rhode Island, older adults comprise 15.6%, 15.4% and 15.5% of the state's population respectively; these figures are above the national average of 14.1% (United States Census Bureau, 2013). With a rapid rise in the number of older adults over the past few years, the need for health care and other services that encourage adequate nutrition, improve physical functioning and quality of life (QOL) as well as promote independence among older adults increases.

As adults age, their risk for malnutrition increases due to a variety of factors such as decreased appetite, chewing and swallowing difficulties, physical limitations, limited income, reduced social interaction, medication use and chronic disease, among others. In fact, a majority (80%) of adults age 50+ years have one chronic illness, with 77% reporting two or more (National Council on Aging, 2014). Malnutrition, a term referring to both undernutrition and overnutrition, can lead to serious health consequences among older adults. It is estimated that more than one million older adults who are homebound, 65% in hospitals and between 35-50% of those living in long-term care facilities are malnourished (Florida International University's National Resource Center on Nutrition, Physical Activity & Aging, 2013). It is imperative that an older adult's nutritional risk be assessed early using easy-to-administer screening tools, as chronic malnutrition can lead to a reduced QOL, sarcopenia (i.e., the progressive loss of skeletal muscle mass and strength with aging) and an increased risk for both morbidity and mortality in addition to other negative outcomes (Chia-Hui, Schilling & Lyder, 2001).

Despite MyPlate recommendations suggesting that adults age 51+ years consume 1½ to 2 cups of fruits, 2 to 2½ cups of vegetables, 5 to 6 ounce-equivalents of grains (half of which should be whole grains), 5 to 5½ ounce-equivalents of protein and 3 cups of

dairy daily, older adults have low intakes of fruits, vegetables, dairy and whole grains (United States Department of Agriculture [USDA], 2015; USDA Agricultural Research Service, 2011-2012). Failing to consume an adequate amount of food from the aforementioned food groups places an older adult at risk for macronutrient (e.g., protein, fiber) as well as micronutrient deficiencies such as calcium, folate, iron and vitamin D.

It is therefore essential that lifestyle and nutrition education intervention programs target community-residing older adults and focus on improving knowledge and behaviors related to dietary practices that may be placing them at nutritional risk. Nutrition education programs have not only been shown to improve nutrient intake and health behaviors (Beebe et al., 2013; Cottell, Dorfman, Straight, Delmonico & Lofgren, 2011; Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014), but also increase nutrition-related knowledge (Wagner, 2013) in addition to self-efficacy (Francis, Taylor & Haldeman, 2009). Participation in such programs has the potential to improve nutritional risk, and thus, reduce the burden of chronic disease while prolonging independence and QOL among older adults.

Goals and Objectives

Study 1: Nutritional Risk and Dietary Intake Assessment of Community-Residing Older Adults

The overall objective of this multistate study was to determine the nutritional risk and dietary intake frequencies of community-residing adults age 60+ years who were electing to participate in community-based lifestyle interventions. Based on knowledge gained pertaining to the excess or lack of consumption of certain dietary components that are placing older adults at risk for malnutrition, nutrition educators can tailor future nutrition education intervention programs to meet specific needs and improve nutritional risk among the aging population. The central hypothesis was that the dietary practices of community-residing older adults are placing a majority “at possible nutritional risk” or “at nutritional risk” as well as at a greater risk for negative health outcomes. This hypothesis is based on existing literature and government-based data suggesting that older adults are not meeting key nutrient and food group recommendations that promote overall health.

Study 2: Evaluation of the "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" Program

The overall objective of this study was to pilot test the "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" program in Iowa and New Hampshire and determine the whole grain behaviors of community-residing adults age 60+ years following participation. Assessing whole grain behavior changes following this program will allow nutrition educators to evaluate the program's success and refine the curriculum to meet better meet the participant wants and/or needs and improve program implementation and outcomes. The central hypothesis was that following participation in the "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" program, older adults will have been able to define a whole grain, identify three health benefits to eating whole grain foods, list the three-step whole grain identification process and name one intended behavior change to increase whole grain consumption. The long-term goal is to create an evidence-based whole grain nutrition education program for older adults that can be implemented through Extension nationally.

In order to meet the aforementioned research goals and objectives, the following research questions are posed:

1. What is the nutritional risk and dietary intake frequencies of a cross-sectional sample of community-residing adults age 60+ years choosing to participate in lifestyle interventions in Iowa, New Hampshire and Rhode Island?
2. To what extent is the "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" program for community-residing adults age 60+ years capable of influencing whole grain dietary behaviors?

Thesis Organization

This research-based thesis will start with a review of literature pertaining to older adult demographics, malnutrition, current nutrition habits of the aging population, whole grains and nutrition education and intervention. Next, the detailed methodology for both studies is discussed followed by two manuscripts that will be submitted to the *Journal of Nutrition in Gerontology and Geriatrics*. Manuscript authors were either part of the multistate research team or was a graduate committee member. Dr. Sarah Francis is the

author of correspondence. Finally, conclusions, appendices and references will conclude the thesis.

CHAPTER II: REVIEW OF LITERATURE

Introduction

A growing older adult population afflicted with chronic disease, disability and malnutrition merits the need for programs and other resources that help older adults achieve and maintain good health. Living a healthy lifestyle can further lead to remaining independent and attaining an improved quality of life (QOL). Older adults with limited income and education are often at a greater nutritional risk, as they may be consuming energy-rich, nutrient-poor diets that can result in poor nutritional outcomes (Visvanathan, Newbury & Chapman, 2004). Conducting routine nutritional risk assessments among community-residing older adults will identify those at risk for malnutrition and allow practitioners to take the necessary steps toward improving dietary practices and overall health (Visvanathan, Newbury & Chapman, 2004). To improve dietary habits of community-residing older adults, it is imperative to understand their wants and needs in relation to educational programming in order to design effective nutrition education interventions that lead to both knowledge and behavior changes. The Academy of Nutrition and Dietetics recommends that nutrition screening and assessment be performed among older adults and nutrition/health education for older Americans be promoted in a community-based setting through partnerships with agencies and organizations that are willing to cater to older adults' needs and preferences (Bernstein & Munoz, 2012).

Demographics

National

Older adults are defined as individuals who are 65 years or older. The general older adult population can be further divided into age-specific subcategories. The "young-old" consist of adults ages 65 to 74 years, the "middle-old" includes adults age 75 to 84 years and the "old-old" is comprised of adults age 85+ years (Shores, West, Theriault & Davison, 2009). The older adult population is one of the fastest growing segments in the United States (Werner, 2011) with one in every seven individuals (13.7%) being classified as an older American (AOA, ACL & USDHHS, 2013).

Approximately 40.3 million adults age 65+ years are currently living in the United States and since 2000, the number of adults age 65+ years has grown by 15.1% (Werner, 2011). By 2040, it is projected that the older adult population will almost double (reaching 79.7 million) (AOA, ACL & USDHHS, 2013), with those age 65+ years comprising 21% of the total population, a 7.7% increase from today's figures (AOA, ACL & USDHHS, 2013). This substantial increase in the older adult population can be attributed to the Baby Boomer generation (those born from 1946 to 1964), a cohort who began turning 65 years old in 2011 (Ortman, Velkoff & Hogan, 2014).

The older adult population is diverse. Not only does the U.S. older adult population consist of more older adult women (23.4 million) than older adult men (18.8 million), but it also encompasses a wide variety of racial and ethnic minorities (AOA, ACL & USDHHS, 2013). Although females continue to outnumber males, the older adult population will continue to experience a faster increase in the number of males by 2030 (Werner, 2011). While the number of older adults who belong to minority groups is expected to increase to 28% of the elderly, Caucasian older adults remain as the most prevalent racial group (AOA, ACL & USDHHS, 2013).

Iowa

In the rural state of Iowa, it is estimated that 15.6% of the total population is age 65+ years, placing Iowa tied for the sixth state in the U.S. for having the most older adults as a percentage of the state's total population (AOA, ACL & USDHHS, 2013; United States Census Bureau, 2013). It is projected that by 2040, the Iowa older adult population will comprise 19.8% of Iowa's total population (State Data Center of Iowa & The Iowa Department on Aging, 2013). Similarly, 83 counties in Iowa will have 20% of their residents age 65 years or older by 2040, reflecting the number of Baby Boomers who will continue to age (State Data Center of Iowa & The Iowa Department on Aging, 2013).

New Hampshire

Adults age 65+ years account for 15.4% of New Hampshire's total population and over the next 20 years, the state's older adult population is expected to increase to 21%

(New Hampshire Department of Health and Human Services, 2011; United States Census Bureau, 2013). Based on the projected older adult population estimate, New Hampshire is expected to rank 17th in the nation for having the largest number of older adults by 2030 (New Hampshire Department of Health and Human Services, 2011).

Rhode Island

In Rhode Island, about 15.5% of the population is comprised of adults age 65+ years (United States Census Bureau, 2013). While the Rhode Island older adult population experienced negative growth from 2000 to 2010 due to a multitude of factors, adults age 60+ years are expected to increase to 25% of the total population by 2030 (Substance Abuse and Mental Health Service Administration and the United States AOA, 2012).

Iowa, New Hampshire and Rhode Island have an older adult population (15.6%, 15.4% and 15.5% respectively) that is above the national percentage of 14.1% (United States Census Bureau, 2013). As the older adult population continues to grow on both a statewide and national level, the need for health care services, caregiving, nutrition interventions and other social services that strive to improve QOL and positive health outcomes for older adults increases.

Socioeconomic Barriers

Poverty

Older adults with limited income, or those who are poor, are more likely to have physical disabilities, chronic diseases, cognitive limitations, require assistance with activities of daily living (ADLs) and report less than optimal health status (O'Brien, Wu & Baer, 2010). A lack of financial security and the prevalence of poverty are apparent in the older adult population, especially in the following subcategories: women, racial minorities, age 85+ years, those living alone and not married (i.e., never married, separated or divorced) (O'Brien, Wu & Baer, 2010). Older adults with lower educational attainment are also more likely to live in poverty (O'Brien, Wu & Baer, 2010). In 2011, 8.7% of adults age 65+ years fell below the national poverty line and in 2012, 9.1% were classified as living below poverty (DeNavas-Walt, Proctor & Smith, 2013). In addition to

those living in poverty, 5.5% of older adults were considered to be "near poor" in 2012, meaning that their income fell between the federal poverty level and 125% of the poverty level (AOA, ACL & USDHHS, 2013). Although the median income for adults age 65+ years rose slightly from 2011 to 2012, the modest increase still left many older adults worrying about paying for housing, food, medical care and other expenses (DeNavas-Walt, Proctor & Smith, 2013). Those who live in poverty are also less likely to be covered by health insurance (Wu, 2010), which may limit their access to preventative health services.

Food Insecurity

Due to limited income, a greater number of older adults rely on other major sources of income (aside from their salaries) including social security, income from assets, government employee pensions and private pensions, with social security serving as the largest source of income (AOA, ACL & USDHHS, 2013; O'Brien, Wu & Baer, 2010). Low income can contribute to food insecurity among older adult households, as they may be unable to afford food, spend less money on food purchases or consume a limited amount of food throughout the day in order to save money for other expenses. Food insecurity refers to limited access to or availability of a sufficient, continuous amount of food that is both nutrient-rich and safe (Holben, 2010). Food insecurity can have serious consequences and is related to both nutrition-related and non-nutrition-related outcomes (Holben, 2010). Of adults age 50+ years in 2009, 3.5 million were "low food insecure," 15.6 million were "marginally food insecure" and 8.8 million were "food insecure" (Ziliak & Gunderson, 2011). Since 2001, these figures have increased by 132%, 66% and 79% respectively (Ziliak & Gunderson, 2011).

In addition to low income, other factors associated with food insecurity include low education, participation in food assistance programs and ethnicity (Lee & Frongillo, 2001). Older adults who are food insecure are more likely to have low nutrient intakes, (Bhattacharya, Currie & Haider, 2004; Lee & Frongillo, 2001; Lee, Fischer & Johnston, 2010), report poor health status (Lee & Frongillo, 2001; Lee, Fischer & Johnson, 2010), consume fewer meals per day (Holben, 2010; Zizza, Duffy & Gerrior, 2008) have functional impairments (Lee & Frongillo, 2001), experience increased weight and

incidence of depression (Kim & Frongillo, 2007), have a decreased QOL (Lee, Fischer & Johnson, 2010) and encounter other health-related complications.

In order to lower the number of older adults who are at nutritional risk and improve health outcomes, federal food assistance and nutrition programs have been established. The purpose of the Older Americans Act (OAA) Nutrition Program is to "promote the health and well-being of older individuals by assisting such individuals to gain access to nutrition and other disease prevention and health promotion services to delay the onset of adverse health conditions resulting from poor nutritional health or sedentary behavior" (Kamp, Wellman & Russell, 2010). To achieve this purpose, meals provided to older adults must meet the current Dietary Guidelines for Americans in addition to providing one-third (or more) of the Dietary Reference Intakes for older adults (Kamp, Wellman & Russell, 2010). Under the OAA, the U.S. Administration on Aging (AOA) distributes funds to state Area Agencies on Aging to deliver nutrition and other supportive services to eligible older adults (Thomas, Almanza & Ghiselli, 2010). Federal food and nutrition assistance programs for adults ages 60+ years include both congregate meal sites and home-delivered meals. Approximately 236 million home-delivered and congregate meals are served to 2.6 million older adults annually (Kamp, Wellman & Russell, 2010). Participation in the congregate meal program has led to improved nutritional status and food intake, and less self-reported food insecurity (Duerr, 2006). Other food and nutrition assistance programs available to older adults include: the Supplemental Nutrition Assistance Program, the Commodity Supplemental Food Program, the Senior Farmers' Market Nutrition Program, the Emergency Food Assistance Program and The Child and Adult Care Food Program. Older adult participation in food assistance programs for the purpose of reducing or preventing negative outcomes related to food insecurity can improve QOL, assist in meeting nutritional needs and result in health care savings (Kim & Frongillo, 2007).

Health Care

Health care coverage currently costs $7,681 per person and America spends over $2 trillion on health care each year (American Medical Association, 2013). Due to rising costs associated with malnutrition, chronic disease and the prevalence of other health-

related complications, older adults may rely on health insurance to cover expenses that cannot be paid out-of-pocket. For older adults with limited income, rising health care costs can be financially burdensome (O'Brien, Wu & Baer, 2010). In 2012, older adults spent 12.7% of their total expenses on health (nearly double the proportion spent by all U.S. consumers) and their out-of-pocket health care costs averaged $5,118, a 43% increase from 2010 (AOA, ACL & USDHHS, 2013). Total health care expenditures for the average older American included 64% on insurance, 15% on medications, 16% for medical services and 4% for medical supplies (O'Brien, Wu & Baer, 2010). If older adults spend a significant portion of their earnings and/or savings on healthcare, they may cut back on necessities such as food, placing them at a higher nutritional risk.

A 2012 National Health Care Quality Report stated that as compared to a reference group, individuals categorized as "poor/low-income" received worse care and had less access to health care than those classified as "high income" (USDHHS, 2013). This may explain why adults with limited income are less likely to report "excellent" or "very good" health compared to their high-income counterparts (O'Brien, Wu & Baer, 2010; USDHHS, Centers for Disease Control and Prevention [CDC] & National Center for Health Statistics [NCHS], 2012). Regardless of income or age, high health care costs may also be a deterrent for obtaining health insurance and seeking preventative health services.

Chronic Disease

Older adults afflicted with chronic disease can potentially experience poor QOL, have difficulty performing ADLs such as bathing, eating and getting dressed, and have a shorter life expectancy. The majority of adults age 50+ years have a nutrition-related chronic illness, with four out of five adults (70 million Americans) afflicted with at least one chronic illness (American Association of Retired Persons, 2009) and 77% with two or more (National Council on Aging [NCOA], 2014). The top four chronic diseases resulting in nearly two-thirds of older adult deaths include heart disease, cancer, stroke and diabetes (NCOA, 2014). Most (80-86%) adults age 70+ years have nutrition-related chronic diseases like hypertension, high cholesterol or diabetes (Higgins & Barkley, 2004). In fact, about 15% have diabetes and over one in four older Americans has high

cholesterol (NCOA, 2014). Although uncontrolled high blood pressure has declined for men and women among all age groups from 2009-2012, nearly half of adults age 65-74 years and almost 60% of adults age 75+ years suffered from uncontrolled hypertension (USDHHS, CDC & NCHS, 2013). Furthermore, older adults with limited incomes have a higher prevalence of chronic diseases like diabetes, chronic obstructive pulmonary disease and mental illnesses than their high-income counterparts (NCOA, 2014).

The high prevalence of chronic disease has affected the number of older adults that currently take prescription medications daily. From 2007-2010, half of adults age 65+ years had used one to four prescription medications and 39.7% had taken five or more prescription medications within the past 30 days (USDHHS, CDC & NCHS, 2013). Chronic disease has also made an impression on health care spending, as older adults use four times the amount of health care services as compared to younger adults (Silver & Wellman, 2002).

Disability

One goal of Healthy People 2020 is to "promote the health and well-being of people with disabilities" in addition to accomplishing the following objectives for people with disabilities: "be included in public health activities, receive well-timed interventions and services, interact with their environment without barriers and participate in everyday life activities" (USDHHS, 2015). This goal and its respective objectives applies not only to the general population, but more specifically, the older population since older adults suffer from a variety of disabilities including those that hinder body function (e.g., memory, food digestion), basic functioning (e.g., walking, hearing/vision loss) and performing ADLs. In 2012, it was reported that 36% of adults age 65+ years had some type of disability (AOA, ACL & USDHHS, 2013). These disabilities may limit either ADLs, instrumental activities of daily living (IADLs; e.g., shopping, taking medication or preparing meals) or a combination of the two (AOA, ACL & USDHHS, 2013). In fact, 28% of community-residing adults age 65+ years receiving Medicare expressed difficulty performing one or more ADLs and 12% reported trouble performing one or more IADLs (AOA, ACL & USDHHS, 2013). Older adults living with one or more disabilities may be unable to function independently, have reduced self-efficacy and experience a poorer

quality of life. Inability to go shopping or prepare meals places an older adult at risk for malnutrition, since inadequate intake of nutrient-rich foods is likely.

Malnutrition

Malnutrition encompasses both ends of the health spectrum, undernutrition and overnutrition, with both having equally detrimental health consequences. The prevalence of malnutrition among older adults is problematic since a nutrient-poor diet is related to morbidity and mortality, physical impairments, functional disability and a greater frequency of admittance into hospitals and other long-term care facilities (Furman, 2006). Socioeconomic status, reduced savings and lower income place older adults at a higher risk for malnutrition (Visvanathan, Newbury & Chapman, 2004). Those who are malnourished experience longer hospital stays, an additional 2 to 20 times more complications and hospital costs that can range from $2,000 to $10,000 more per stay (Wellman, Weddle, Kranz & Brain, 1997). Malnutrition is more prevalent in older adults who earn less money, are physically impaired, have limited transportation and may consume nutrient-poor, energy-rich foods (Kamp, Wellman & Russell, 2010).

From 2007-2010, 35% of adults age 65+ years were classified as obese; 8 million were 65-74 years and 5 million were 75+ years (Fakhouri et al., 2012). As a result of aging, causes of high obesity prevalence among older adults includes an increase in total body fat and less fat free mass, increased energy intake, a decrease in total energy expenditure, a lower resting metabolic rate, low physical activity participation and hormonal changes (Villareal et al., 2005). Obesity complications for older adults include, but are not limited to: higher mortality rate, metabolic syndrome (e.g., high plasma glucose, hypertension, and dyslipidemia), arthritis, pulmonary abnormalities (e.g., obstructive sleep apnea), cancer, cataracts, urinary incontinence and a decrease in both physical function and QOL (Villareal et al., 2005). On the contrary, it is estimated that over one million older adults confined in their homes, 65% of older adults in hospitals and between 35-50% of older adults residing in long-term care facilities are malnourished (National Resource Center on Nutrition, Physical Activity & Aging, 2013). Malnutrition can result in sarcopenia (i.e., the progressive loss of skeletal muscle mass and strength with aging), an increase in both morbidity and mortality, poor organ function, a

compromised immune system, diminished QOL, decreased physical functioning, chronic disability and other complications (Chia-Hui, Schilling & Lyder, 2001).

Identifying nutritional risk often involves assessing dietary intake, looking at laboratory values and taking anthropometric measurements (Visvanathan, Newbury & Chapman, 2004). Malnutrition can be detected by using a variety of tools and questionnaires such as the Mini Nutritional Assessment and its accompanying six-item short form (Guigoz, 2006; Guigoz, Vellas & Garry, 1996; Rubenstein, Harker, Salva, Guigoz & Vellas, 2001), the Dietary Screening Tool (DST) (Bailey et al., 2007; Bailey et al. 2009) and the Malnutrition Universal Screening Tool (MUST) (Stratton et al., 2004; Stratton, King, Stroud, Jackson & Elia, 2006). Nutrition screening often looks at variables such as body mass index, unintentional weight loss, dietary habits and frequency of food intakes, bowel habits, appetite changes, neuropsychological problems, stress, nausea/vomiting, mobility and anthropometric measurements. Advantages to using the aforementioned tools include simplicity, quick administration, validity and easy interpretation. Limitations to nutrition screening tools may include a narrow scope of application and limited generalizability to specific populations of older adults. Conducting regular screenings may help identify behaviors placing older adults at increased risk and help guide the development of nutrition interventions. Nutrition interventions such as supplementation, clinical interventions, fortification of foods and nutrition education can improve patient outcomes and nutritional status. Providing nutrition information and empowering older adults to improve nutrient intakes may lead to the prevention of malnutrition (Visvanathan, Newbury & Chapman, 2004).

Dietary Intake Frequencies

Like most Americans, older adults are not consuming a health-promoting diet. A study conducted by Foote, Giuliano and Harris (2000) showed that among 1,740 healthy Southwestern adults ages 51-85 years, over 60% of the population had intakes of vitamins D and E, calcium and folate that fell below the estimated average requirements. Less than 10% of participants consumed the recommended amounts of both dairy and grains and nearly 50% met the daily requirements for fruits and vegetables (Foote, Giuliano & Harris, 2000). Other studies have yielded similar results, demonstrating that

older adults may be at nutritional risk due to dietary intakes that fall below national recommendations.

National

According to the United States Department of Agriculture's (USDA) MyPlate guidelines, adults ages 51+ years should be consuming 1½ to 2 cups of fruits, 2 to 2½ cups of vegetables, 5 to 6 ounce-equivalents of grains (half of which should be whole grains), 5 to 5½ ounce-equivalents of protein and 3 cups of dairy daily (USDA, 2015). On a national level, adults age 65+ years report eating whole grains 5.2 days weekly, at least five servings of fruits and vegetables 4.3 days weekly and drinking sugar-sweetened beverages two days weekly (USDHHS & Food and Drug Administration [FDA], 2008). While they do consume beans, peas and fish, they are eaten less often than other food groups (USDHHS & FDA, 2008). As compared to their younger adult counterparts, older adults are more likely to select lean meats, poultry without skin, choose reduced or low-sodium foods and not drink milk (USDHHS & FDA, 2008). Older adults are also more likely to report having tried to reduce saturated fat, trans fat and cholesterol intakes (USDHHS & FDA, 2008).

Based on the Healthy Eating Index, only 18% of adults age 60+ years are meeting grain recommendations, 32% meet recommendations for vegetables, 34% meet recommendations for total fat and 23-27% are consuming the recommended amount of meat, dairy and fruit (Ervin, 2008). These estimates are not surprising, as consumption data provided by an NHANES *What We Eat in America* report shows that both male and female adults age 60+ years have intakes of fruits (1.13 cups for males versus 1.04 cups for females), vegetables (1.70 cups for males versus 1.54 cups for females) and dairy (1.59 cups for males versus 1.33 cups for females) that fall below MyPlate recommendations (USDA Agricultural Research Service, 2011-2012) (Table 1). While older adults are meeting the recommendation for total grains (6.96 ounce equivalents for males versus 5.05 ounce equivalents for females), a majority of total grain intake is derived from refined grains (5.47 ounce equivalents for males versus 4.01 ounce equivalents for females) (Table 1). Finally, older adult males are meeting MyPlate recommendations for protein, but older adult females fall short of the recommendation by

about 0.5 ounce equivalents, even when adding legume consumption to total protein intake (Table 1).

State-Specific

Adults in Iowa have the highest median intake fruits (1 time per day) and vegetables (1.4 times per day) as compared to adults residing in New Hampshire and Rhode Island, with 39.8% reporting consuming fruits less than once daily and 26.9% consuming vegetables once daily (CDC, 2013). New Hampshire adults fare slightly worse, with a median fruit intake of 1.3 times daily and median vegetable intake of 1.8 times daily (CDC, 2013). The percentage of New Hampshire adults who report eating fruits and vegetables less than once daily is 30.3% and 17.6% respectively (CDC, 2013). Finally, Rhode Island adults report a median intake of fruits 1.2 times daily and vegetables 1.6 times daily (CDC, 2013). About 32.9% consume fruits less than once daily while 20.7% consume vegetables less than once daily (CDC, 2013). State-specific adult consumption data for other MyPlate food groups (i.e., grains, protein and dairy) is currently unavailable.

Older adults who are not meeting dietary recommendations are likely not consuming an adequate amount of food from each food group, thus, placing them at risk for malnutrition and vitamin and/or mineral deficiencies. Since national intake data suggests that vegetable, dairy and grain intakes are lower than recommended, adults may not be consuming sufficient fiber, folate, calcium, protein and other essential micronutrients that support overall health. As identified in the 2010 Dietary Guidelines for Americans, nutrients of concern for older adults include calcium, vitamin D, vitamin B12, fiber and potassium (USDA & USDHHS, 2010). Consuming a nutrient-poor diet, fewer than three meals per day and foods from only specific food groups may result in poor nutrient intakes among older adults.

Table 1. U.S. older adult food intakes[1] compared to MyPlate recommendations

Food Group	**Women**		**Men**	
	Actual (Age 60+ Years)	*Recommended* (Age 51+ Years)	*Actual* (Age 60+Years)	*Recommended* (Age 51+ Years)
Fruit	1.04 cups[2]	1.5 cups	1.13 cups[2]	2 cups
Vegetables	1.54 cups[3]	2 cups	1.70 cups[3]	2.5 cups
Total Grains	5.05 oz eq[4]	5 oz eq	6.96 oz eq[4]	6 oz eq
Whole Grains	1.04 oz eq	3 oz eq	1.47 oz eq	3 oz eq
Protein	4.55 oz eq[5]	5 oz eq	6.48 oz eq[5]	5.5 oz eq
Dairy	1.33 cups[6]	3 cups	1.59 cups[6]	3 cups

[1]Mean daily food patterns cup/ounce equivalents consumed per individual, by gender and age, in the United States, 2011-2012 from *What We Eat in America* (NHANES). [2]Total fruit includes citrus fruits, melons, berries, other fruit and fruit juice; [3]Total vegetables includes potatoes, other starchy vegetables, tomatoes, other red and orange vegetables, dark green vegetables, and other vegetables; [4]Total grains includes whole and refined grains; [5]Total protein includes total meat, poultry and seafood (finfish, shellfish and other seafood), eggs, nuts, seeds and soybean products; [6]Total dairy includes fluid milk, cheese and yogurt.

Current Intakes and Recommendations

In the United States, many grain-based options are available for consumption, but most grains that comprise an individual's daily total grain intake are refined grains instead of whole grains (USDA & USDHHS, 2010). U.S. adults eat an average of 1.09 ounce equivalents of whole grains daily while refined grain consumption totals 5.57 ounce equivalents daily (Lin & Yen, 2007). It is recommended that women ages 51+ consume 5 ounce equivalents of grains daily while men ages 51+ consume 6 ounce equivalents of grains daily (USDA, 2015). Additionally, the 2010 Dietary Guidelines for Americans and The USDA's MyPlate recommend that half of total grain intake come from whole grains (3 ounce equivalents daily) (USDA, 2015; USDA & USDHHS, 2010). One serving of whole grains is equivalent to 16 grams of whole grains (Whole Grains Council, 2013). Despite MyPlate recommendations suggesting that half of total grain intake come from whole grains, only 7% of Americans are meeting this recommendation; adults only consume 35% of recommended whole grains while refined grain consumption is 175.34% of the recommended amount (Lin & Yen, 2007).

Whole grain intake is influenced by income and education. Consumers earning the highest income (income-poverty ratio greater than 300%) eat 1.17 ounce equivalents of whole grains daily as compared to individuals with limited incomes (income-poverty ratio less than 130%) consuming 0.95 ounce equivalents daily (Lin & Yen, 2007). Individuals who have attended college or some college eat more whole grains per day than those who have a high school education or less (Lin & Yen, 2007). In 2009, 61.3% of Iowans reported using whole grains daily. Similar to national data, Iowans who consumed the highest amount of whole grains daily were those placed in the highest income bracket (66.9%), had previously graduated from college (65.6%) and were 75+ years old (67.6%) (Iowa Department of Public Health [IDPH], 2010). Iowans ages 55-64 years and 65-74 years had a lower whole grain consumption, with less than two-thirds (63.9% vs. 61.9%) reporting a daily use of one or more whole grain products (IDPH, 2010). Since 8.7% of adults age 65+ years fall below the national poverty line, 9.1% are classified as living below poverty (DeNavas-Walt, Proctor & Smith, 2013) and 5.5% of

older adults are considered to be "near poor" (AOA, ACL & USDHHS, 2013), it is reasonable to assume they are not consuming the recommended amount of whole grains daily. Although older adults consume more whole grains than younger adults, they continue to not meet current whole grain recommendations established by the USDA.

Health Benefits

The consumption of whole grains, rather than refined grains, provides numerous health benefits including lower risk of chronic diseases like cancer, cardiovascular disease (CVD) and type 2 diabetes as well as weight maintenance and gastrointestinal health. Making simple substitutions with grain foods in order to aim for three ounce equivalents of whole grains daily can help older adults receive these health benefits.

Weight Management and Metabolic Syndrome

Low intakes of whole grains are of particular concern for older adults given the numerous health benefits gained from whole grain consumption. One the many positive effects of eating whole grains is their ability to aid in weight management, which is advantageous given the increase in the number of older adults classified as overweight or obese. Abdominal adiposity in older adults is problematic because it is a risk factor for mortality and chronic diseases (Adams et al., 2006; Houston, Nicklas & Zizza, 2009). Research indicates that for older adults, whole grain intake is inversely associated with body mass index, percent body fat, waist circumference and a lower percentage of overweight or obese individuals (McKeown et al., 2009; O'Neil, Zanovec, Cho & Nicklas, 2010). Whole grain intake is also inversely associated with metabolic syndrome, which may be due to its effects on improving insulin sensitivity and reducing weight gain (Sahyoun et al., 2006). Conversely, high refined grain intake is associated with a greater chance of having metabolic risk factors such as hypertension, hypertriglyceridemia and hypercholesterolemia in addition to metabolic syndrome (Esmaillzadeh, Mirmiran & Azizi, 2005). Body weight regulation as a result of whole grain consumption may be attributed to high fiber content which, in turn, delays gastric emptying and enhances satiety (Slavin, 2004).

Cancer and Chronic Disease

Whole grains can also protect against chronic diseases and certain types of cancer. Since four out of five American adults age 50+ years suffer from one or more chronic diseases (AARP, 2009) and the risk of adults age 65+ years developing cancer is 10 times greater than individuals under age 65 years (Berger et al., 2006), it is imperative that older adults increase their whole grain consumption. Eating whole grains may protect against colorectal (Schatzkin et al., 2007), gastric (Terry, Lagergren, Ye, Wolk & Nyren, 2001), endometrial (Kasum, et al., 2001), pancreatic cancer (Chan, Wang & Holly, 2007) and intestinal cancer (Schatzkin, Park, Leitzman, Hollenbeck & Cross, 2008). Plausible mechanisms for cancer protection include: intakes of selenium (prevent oxidative tissue damage), vitamin E (antioxidant preventing carcinogen formation) and anti-nutrient compounds such as phytic acid (inhibit interaction between cells and carcinogens) found in whole grains in addition to improvements in bowel health, weight loss, changes in blood glucose levels and the effects of other biologically-active compounds available in whole grain foods (Slavin, 2004).

Along with lowering one's risk of various types of cancer, whole grain intake is also associated with a lower risk for chronic diseases such as CVD (Jonnalagadda et al., 2011; Steffen et al., 2003) and hypertension (Flint et al., 2009; Tighe et al., 2010; Wang et al., 2007). Potential mechanisms for CVD risk reduction include an increase in cholesterol and bile excretion in fecal matter due to soluble fiber, the presence of phytonutrients and polyphenolic compounds, and short chain fatty acid production that can reduce cholesterol synthesis (Jonnalagadda et al., 2011). Other risk-reducing properties of whole grains include presence of tocotrienols (i.e., vitamin E) and plant sterols which can also lower cholesterol (Slavin, 2004). Additionally, multiple studies have shown that fiber from whole grains as well as whole grain intake in general is associated with a lower mortality rate (Jacobs, Pereira, Meyer & Kushi, 2000; Sahyoun, Jacques, Zhang, Juan & McKeown, 2006). Sahyoun and colleagues (2006) discovered that among a cohort of healthy men and women ages 60-98 years, greater whole grain consumption was associated with an improvement in CVD risk factors and a lower incidence of CVD mortality.

Type 2 Diabetes

As shown in numerous epidemiological studies, an increase in whole grain consumption can also contribute to a lower risk of developing type 2 diabetes (de Munter, Hu, Spiegelman, Franz & van Dam, 2007; Fung et al., 2002; Liu et al., 2000; Meyer et al., 2000). Since digestion and absorption of whole grains is slowed due to the presence of dietary fiber, both insulin and the plasma glucose response are affected (Slavin, 2003). Because whole grain foods are considered low glycemic index foods, they slow the glycemic response and decrease insulin secretion, thus, reducing the risk for type 2 diabetes (Slavin, 2003).

van Dam et al. (2000) concluded that dietary patterns characteristic of a prudent diet (i.e., high intakes of fruits, vegetables, whole grains, seafood, nuts, etc.) as opposed to a Western diet (i.e., increased consumption of processed meat, refined grains, sweets and candy, etc.) were inversely associated with the risk of type 2 diabetes. While nearly 15% of older adults have diabetes (AARP, 2013), this percentage may be lowered by increasing whole grain consumption and adopting a dietary pattern that resembles a prudent diet.

Antioxidants, Fiber and Bioactive Compounds

Whole grains have a high antioxidant activity and contain known antioxidants such as vitamin E and phytic acid that quench free radicals and protect cells from oxidative damage (Slavin, 2004). Phytochemicals, the majority of which are present in both the bran and the germ of the whole grain kernel, are associated with lower risks of chronic diseases like CVD and cancer (Jonnalagadda et al., 2011). Other bioactive compounds, such as phenolic acids, carotenoids, tocotrienols and tocopherols, plant sterols and stanols and anti-nutrients (i.e., phytic acid and a variety of enzyme inhibitors) possess functions such as the ability to reduce cholesterol, act as antioxidants and protect against a multitude of chronic diseases (Jonnalagadda et al., 2011). Fiber, another main component of whole grain foods, may protect against CVD, cancer, diabetes and aid in both bowel health and weight management (Slavin, 2008). Because the average fiber intake for U.S. adults continues to remain low (15 grams daily versus 25 grams for adult

women and 38 grams for adult men), it is imperative that whole grain consumption increase, as grain foods are one of the major sources of dietary fiber (Slavin, 2008).

Whole Grain Interventions

To date, there has only been one study conducted that examined the effectiveness of community-based whole grain education programs for older adults and reported the outcomes of the intervention. Ellis, Fischer and Hargrove (2005) found that a theory-based, multi-lesson whole grain education intervention for adults age 59+ years resulted in an increase in total intakes of whole grain bread, whole wheat crackers and whole grain cereal and a greater percentage of participants who were able to correctly identify a whole grain food. Researchers determined that whole grain intake was associated with variables such as taste of whole grain foods, whole grain labeling knowledge and knowledge of whole grain recommendations (Ellis, Fischer & Hargrove, 2005).

Considering the wealth of scientific evidence revealing the connection between whole grain consumption and human health, it is imperative that nutrition education programs for older adults focus on the definition of a whole grain and the health benefits it has to offer, current intake recommendations, barriers to whole grain consumption, how to identify whole grain foods using a nutrition facts label and product package indicators, and how to incorporate whole grains into snacks and meals throughout the day. It is critical that health professionals understand the benefits of whole grain foods so that promoting whole grain foods through nutrition communication will result in greater consumption (Adams & Engstrom, 2000). Nutrition educators must also be able to aid individuals in identifying whole grain foods and suggesting simple strategies for incorporation into one's diet (Adams & Engstrom, 2000). It is suggested that when educating individuals about whole grain foods, components of the whole grain kernel, more specifically, the bran and germ, be discussed as well as the whole grain health claim (Jones et al., 2002).

Nutrition Education and Intervention

Nutrition education programming often uses a combination of multiple techniques including behavior change models, print materials and other resources to change older

adults' attitudes, beliefs, knowledge and behaviors related to nutrition and living a healthy lifestyle. While nutrition education and intervention research is growing, many studies and literature reviews discuss its effectiveness and favorable qualities.

Benefits

There is a growing need for nutrition intervention programs targeting the unique nutritional needs and preferences of older adults that lead to knowledge and/or behavior changes and promote the maintenance and/or improvement of health and independence. Among Baby Boomers and older adults, home- and community-based services have been mentioned as one of the top interests in which more information should be provided (Brossoie, Roberto, Willis-Walton & Reynolds, 2010). Nutrition education programs are beneficial for older adults because they are able to learn current nutrition information and acquire important knowledge that can be applied to their own lives (Sahyoun, 2002). Nutrition education programs may also improve QOL and reduce health care costs (Meck Higgins & Barkley, 2004), increase nutrition knowledge (Sahyoun, Pratt, & Anderson, 2004) and invoke both behavior change (Meck Higgins & Clarke, 2003) and changes in dietary intake. Older adults may need guidance with meeting nutrient recommendations, following MyPlate recommendations and discerning credible health information from mainstream media and other sources.

Barriers

Older adults are receptive to learning new information, yet barriers to responding to nutrition education include time constraints, limited money and resources, other priorities, belief that they are already consuming a nutrient-rich diet, skepticism about presented information and personal beliefs and attitudes (Meck Higgins & Barkley, 2004). Additionally, challenges with effectively teaching older adult nutrition education programs include perceptions that older adults are unresponsive, incapable of learning or set in their ways, limited funding and attention given to older adult programs and ineffective recruitment methods (Meck Higgins & Barkley, 2004). Understanding how to overcome barriers associated with nutrition education will allow program developers to

create a strong nutrition education framework whose foundation is set up for improving dietary practices and health outcomes.

Characteristics of Successful Programs

Although designing nutrition interventions for the older adult population requires time and careful planning to be successful, it is necessary to include a multitude of integral components that, once combined, will contribute toward achieving set goals and objectives in addition to positive outcomes. Nutrition interventions should be audience-specific, emphasize nutrition benefits, provide realistic suggestions for making healthy behavior changes and propose achievable personal goals to encourage participation in a given program (Thomas, Almanza & Ghiselli, 2010). Tailoring a nutrition education program to meet the identified needs of the audience has been shown to improve dietary intake and nutritional risk (Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014). Program tailoring involves conducting focus groups and talking with individuals or groups of people who will serve as the focus of the intervention in order to determine information of interest related to nutrition (Meck Higgins & Barkley, 2003). Nutrition interventions should also strive to modify behaviors based on theoretical models (Sahyoun, Pratt & Anderson, 2004). Facilitated group discussion should be included in order to encourage participants to actively engage in conversation with others, share their knowledge and foster a supportive environment (Abusabha, Peacock & Achterberg, 1999). Since discussions are based on learning from others while contributing one's own knowledge, active participation aids in facilitating behavior change (Abusabha, Peacock & Achterberg, 1999).

Additionally, the inclusion of nutrition education messages should be limited, as an overwhelming amount of information can affect an older adult's ability to change preexisting attitudes or behaviors toward nutrition concepts due to misinterpretation or choosing to ignore the presented information (Thomas, Almanza & Ghiselli, 2010). Nutrition messages should also be simple and easy to comprehend, practical, tailored and be reinforced through hands-on activities (Sahyoun, Pratt & Anderson, 2004; Meck Higgins & Barkley, 2004). Finally, nutrition education information should be presented in a mode preferred by most older adults. Brochures, pamphlets and community

presentations are among the top preferred information formats for Baby Boomers and older adults (Brossoie, Roberto, Willis-Walton & Reynolds, 2010). Other preferred methods include group discussion and other interactive education techniques (Meck Higgins & Barkley, 2003). Information should be presented by a knowledgeable educator who is respectful and understands the target audience (Meck Higgins & Barkley, 2003). The instructor should also be culturally sensitive, friendly, engaging, attentive to the participant's needs and abilities and open to constructive criticism.

Summary

The rising older adult population in the United States is not consuming the recommended amounts of key nutrients, especially whole grains, which are necessary for achieving good health, maintaining independence and reducing one's risk for chronic disease and malnutrition. The development of theory-based nutrition education intervention programs that aim to improve both nutrition knowledge and dietary habits of community-residing older adults is necessary. To date, limited research has been conducted that examines nutritional risk, dietary habits and both whole grain knowledge and behaviors of community-residing older adults. It is hypothesized that following a nutrition education intervention program for community-residing adults age 60+ years, participants will have improved whole grain knowledge and behaviors and reduced nutritional risk. Additionally, the following research questions will be addressed:

1. What is the nutritional risk and dietary intake frequencies of a cross-sectional sample of community-residing adults age 60+ years electing to participate in lifestyle intervention programs in Iowa, New Hampshire and Rhode Island?
2. To what extent does a whole grain nutrition education intervention program for community-residing adults age 60+ years influence whole grain behaviors?

CHAPTER III: METHODOLOGY

Study 1: Nutritional Risk and Dietary Intake Assessment of Community-Residing Older Adults

Study Design

This cross-sectional study examined the dietary intake frequencies (DIF) and nutritional risk of older adults participating in lifestyle intervention programs (i.e., nutrition education and physical activity programs) using the Dietary Screening Tool (DST; pre-study). Community-residing adults ages 60+ years were recruited for various lifestyle intervention programs in three states including Iowa (IA), New Hampshire (NH) and Rhode Island (RI), over a five-year period. These lifestyle intervention programs included nutrition and/or physical activity interventions (RI), nutrition education at congregate meal sites (IA) and Extension-delivered nutrition education programs (IA and NH).

Recruitment

A convenience sample of 392 older adults was recruited from community-based lifestyle intervention programs in IA (*n*=111), NH (*n*=85) and RI (*n*=196). To be eligible for the study, older adults had to be: "community-residing" (i.e., not residing in assisted living or nursing home facilities), age 60+ years and literate in English. Participants were recruited through flyers, in-person discussions and presentations, and word of mouth.

Study Evaluation

Dietary Screening Tool (DST)

The DST was developed to assess DIF as well as determine the nutritional risk of older adults. It can be completed in less than 10 minutes and scored in less than five minutes (Bailey et al., 2007; Bailey et al., 2009). It has a 79% accuracy level, 83% sensitivity, positive predictive values of 75% and 75% specificity when compared against the Dietary Reference Intakes for identifying nutritional risk (Bailey et al., 2009).

The dietary patterns questionnaire, a component of the DST, was created after data analysis from 179 adults age 66-87 years who were a part of the 1994-1996 Geisinger Rural Aging Study (GRAS) cohort (Bailey et al., 2007). The analysis examined participant dietary patterns in order to identify specific food groups requiring further analysis (Bailey et al., 2007). After examining the consumption frequency of certain foods within foods groups, questions were developed based on the foods that had strong independent associations (Bailey et al., 2007). Cognitive interviewing using the questionnaire was then used to identify common themes and further revise the questionnaire (i.e., conveyed meaning, specificity of wording) (Bailey et al., 2007). Finally, the revised questionnaire was completed and validated with 206 adults age 73-94 years who were apart of the 2005-2006 GRAS cohort, examining both dietary patterns and items indicating health and nutritional status (Bailey et al., 2007). Validation of its ability to classify individuals into nutritional risk categories was shown in a study involving 204 participants age 73-94 years who were a part of the Pennsylvania Geisinger Health Care System. The DST classifications were related to both biochemical indicators in addition to intakes from food groups (Bailey et al., 2009).

The DST itself contains a total of 24 questions (five of which are “yes” or “no” questions related to the consumption of added fats, sugars and sweets) broken into seven diet component categories (Table 2).

Table 2. Diet component categories of the DST

Diet Component Category	**Total Points**
Dairy	10
Lean Protein	10
Processed Meat	10
Vegetables	15
Total and Whole Grains	15
Whole Fruit and Juice	15
Added Fats, Sugars, and Sweets	25

The diet component categories were divided into two overarching dietary patterns: "Western" (i.e., processed meats, sweets, candy) or "Prudent" (i.e., whole grains, dairy, fruits, vegetables, lean protein) (Bailey et al., 2007). A total point score of 100 was chosen to increase both score interpretation and applicability to clinical settings (Bailey et al., 2009). For questions indicating a "healthier" dietary pattern, more points were given to a higher reported frequency of consumption (i.e., higher consumption frequency of total and whole grains was rewarded with a greater number of points; Bailey et al., 2009). Conversely, more points were given to a lower reported frequency of consumption for questions related to "less healthy" eating (i.e., more points were given for a lower consumption of added fats, sugars and sweets; Bailey et al., 2009). Five additional bonus points are awarded if the individual takes a daily dietary supplement (not included in the 100 point total; Bailey et al., 2009). By using this scoring system, the DST allows for the identification of dietary components that may need further improvement in addition to developing tailored nutrition education messages aimed at the client (Bailey et al., 2009).

Based on the total point score, individuals are classified into one of three nutritional risk categories: "at nutritional risk" (total DST score less than 60 and are placed in the lowest 25^{th} percentile), at "possible nutritional risk" (total DST score ranging from 60 to 75 and are classified as being in the 25^{th} to 75^{th} percentile) and "not at nutritional risk" (total DST score greater than 75 points and are placed in the highest 25^{th} percentile; Bailey et al., 2009).

Data Analysis

Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS) for Windows, version 20.0. Participants who were less than 60 years old and/or had missing values for DST score, DST classification or each of the seven diet component categories were excluded (n=40). The final sample included 352 older adults (IA, n=111; NH, n=77 and RI, n=164). Sociodemographic information, DST score and classification, and mean DIF were analyzed using descriptive statistics.

For interpretation of the results, mean DIF for each food component category was classified based on DIF quantity. All statistics were run using actual DIF values. Whole

fruit and juice, vegetables and total and whole grain DIF were classified as “low” (0-5 points), “moderate” (6-10 points) and “high” (11-15 points). For dairy and lean protein, DIF were classified as “low” (0-5 points) or “high” (6-10 points). Processed meat was also grouped in a manner similar to the aforementioned categories, but a point score of 0-5 points was considered a “high” DIF while a point score of 6-10 points was considered a “low” DIF. Added fats, sugars and sweets were classified as “high” (0-10 points), “moderate” (11-15 points) or “low” (16-25 points) DIF. For both processed meat and added fats, sugars and sweets, a higher point score indicated a reduced DIF.

A multivariate main effects general linear model was used to determine which sociodemographic characteristics (e.g., state of residence, gender, age and education level) influenced total scores of the seven diet component categories in addition to the total DST score. Statistical significance was determined at $p<.05$. Lifestyle intervention program protocols were approved by the respective university’s Human Subjects Institutional Review Board.

Study 2: "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" Program Evaluation

Background

There is a need for creating a whole grain (WG) program tailored toward older adults since older Americans are not meeting the national recommendation for daily WG consumption. The "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" (henceforth to be referred to as "Is It Whole Grain?") program is a theory-based nutrition education program targeting community-residing adults age 60+ years. The curriculum was created by a multistate research team and entailed identifying how older adults use product packages to identify foods containing WG in addition to working with older adults to determine desired nutrition education characteristics and the type of information they preferred pertaining to WG. This study examined to what extent a WG nutrition education intervention program for adults age 60+ years influences WG behaviors.

Program Design

Theoretical Models

In order to develop lifestyle interventions that are effective in addressing the needs of older adults and result in behavior change, a theoretical base is needed (Sayhoun, Pratt & Anderson, 2004). The "Is It Whole Grain?" program was developed using Social Marketing Theory (SMT) principles. The SMT is comprised of three main components: both individuals and society can benefit, behavior change, not a change in either awareness or attitude, is the focus and the target audience plays a primary role in the development process (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008). Its six cyclical steps guide program developers in identifying both the needs and preferences of the target audience to produce measureable behavior change (Francis, 2012; Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014).

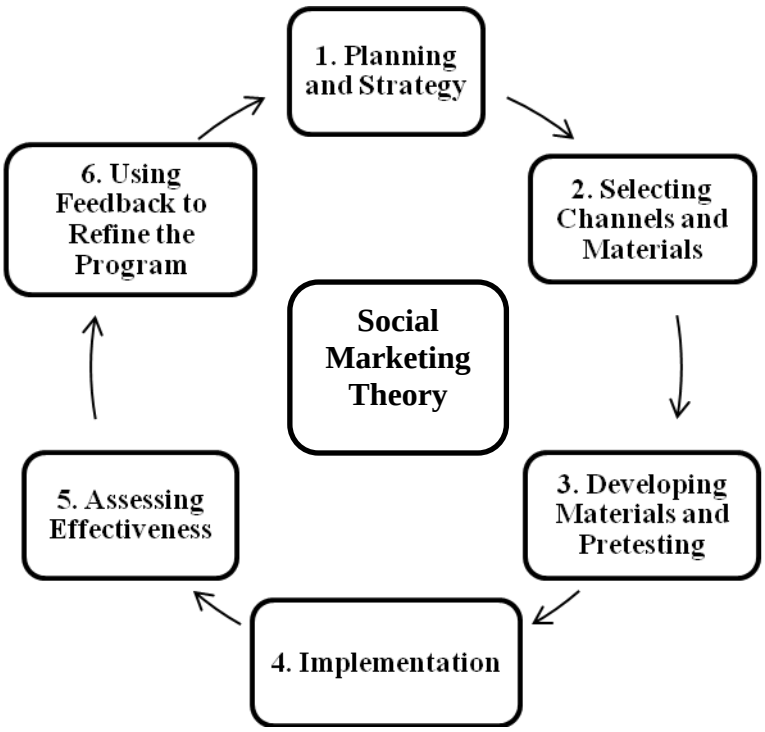

Figure 1. Six cyclical steps comprising Social Marketing Theory

Step One, planning and strategy, involves establishing goals and objectives, examining and selecting the target audience by identifying their attributes, attitudes and preferences, and finding available resources (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008). Step Two, selecting channels and materials, includes establishing the structure of the program, developing outcome measures and creating a plan of action (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008). Step Three, developing materials and pretesting, is comprised of executing the plan of action and testing the pilot program with the target audience to identify areas for improvement and refinement. This is a crucial step in the social marketing process (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008). Step Four, implementation, involves complete implementation of the program, making sure that specific variables are being measured and the program is proceeding as planned (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008). Step Five, assessing effectiveness, is useful for determining whether or not the program is meeting objectives by analyzing data at given time points. The analysis will provide program managers with the opportunity to make any necessary changes during the

implementation of the program or partake in any opportunities that may arise (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008). Step Six, using feedback to refine the program, involves complete evaluation of the program so that problems can be addressed, strengths can be emphasized and new strategies can be developed to improve the program's implementation and outcomes (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008).

The SMT has been used to develop a limited number of nutrition education and intervention programs for older adults, as evidenced by past and present literature. Among the few studies, Francis & Taylor (2009) found that a SMT-based cardiovascular disease diet education program led to improved nutritional risk scores, dietary changes, self-efficacy and morale among community-residing older adult women. Other SMT-based nutrition education programs found improvements in familiarity with heart healthy behaviors and positive self-reported dietary changes (i.e., sodium reduction, portion control, increased protein intake) among adults ages 23-74 years (Francis, 2012). Furthermore, a SMT-based older adult nutrition program resulted in reduced nutritional risk and a decrease in fat and sweet consumption (Francis, MacNab & Shelley, 2014).

Steps Three, Four and Five primarily guided development of the study framework. The curriculum was established prior to the start of the "Is It Whole Grain?" program (Step Three). The plan of action was also developed, which included conducting focus groups to determine the appropriate education strategy and topics (Step Three). Finally, "Is It Whole Grain?" program was implemented in community-based settings with adults age 60+ years in both IA and NH (Step Four). Program effectiveness was assessed with pre- and post-questionnaires. Participant feedback was also gathered via a post-evaluation (Steps Four and Five). Participant comments and suggestions were collected to assist with future program refinement (Step Six; not part of this study).

Curriculum

At each site, the program was led by a trained nutrition educator and lasted a span of three weeks. Each session was approximately one hour long and took place once weekly during the same time and at the same location. Each session focused on breakfast, lunch, dinner and snacks respectively and included instructor-participant interaction and

group discussion as well as hands-on activities and taste testing. Nutrition educators were provided an outline and script for each session of the "Is It Whole Grain?" program to ensure a consistent message was provided. Educators were encouraged to review these before each session. Each outline included overall program objectives, objectives specific to each lesson, a list of needed materials and a timeline breakdown of each session. The general timeline provided nutrition educators with an idea of how much time to allot for each discussion topic, taste testing opportunity or hands-on activity. The curriculum was designed to better enable participants to define a WG, name three health benefits of eating WG, use the three step process to identify WG and increase intention to choose WG foods. Each session entailed discussing the key message, reviewing the "3 steps to 3 servings of WG" and participation in both taste-testing and hands-on activities (Table 2).

Two educational approaches were used during the "Is It Whole Grain?" program including PowerPoint presentations (*n*=13 sites) and discussion-based without PowerPoint presentations (*n*=12 sites). All other program elements remained the same.

Program Description

Table 3 describes the sessions' activities in more detail. Session One focused on breakfast and morning snacks. Following this session, participants were able to identify foods that are made from 100% WG, those that are made from some WG and those that are made from refined grains. This session discussed the definition of a WG and health benefits associated with eating WG foods. Hands-on activities included viewing product packages and their nutrition facts labels to determine which food product in each pair contained more WG. Additionally, participants completed a worksheet which asked participants to determine whether or not the sample product contained WG after examining the nutrition facts label and ingredient list. Taste testing included sampling various types of English muffins that were used during the activity. The three step WG identification method was also introduced.

Session Two focused on lunch and afternoon snacks. This session entailed reviewing the definition of various grains, examples of grain and WG foods, health benefits of WG and the recommended amount of WG that should be consumed daily. The term "multigrain" was introduced and the three-step WG identification method was

reviewed. The hands-on activity involved bread tasting in which participants sampled various types of breads to determine whether or not they contained WG based solely on color, taste and texture. Following the bread tasting activity, pairs or small groups of participants were asked to determine whether or not a specific loaf of bread was made from 100% WG, some WG or refined grain using the product package, nutrition facts label and ingredients list. At the end of the activity, the nutrition educator revealed the correct answers and discussed how using the three-step WG identification method is preferred over sensory and visual characteristics alone. The bread tasting activity also demonstrated how the term "multigrain" does not ensure that the product contains WG. Finally, taste-testing included sampling of a quinoa black bean salad.

Session Three focused on dinner and evening snacks. This session reviewed the key points from sessions one and two followed by case study group discussions. The case studies replaced hands-on activities built into prior sessions. This approach encouraged participants to apply knowledge they had learned in previous sessions and apply it to practical, real-life situations. Taste testing included sampling of whole wheat pasta with tomato sauce and "wheat" versus "whole wheat" crackers and cheese.

Table 3. Structured activities and handouts utilized during sessions 1-3

	Objective 1	Objective 2	Objective 3	Objective 4
Session 1				
Activities				
❖ Compare pairs of food products (i.e. English muffins, ready-to-eat cereal, hot cereal) to determine the item containing more WG			X	
❖ Examine a bran muffin's ingredient list to determine whether or not it is a WG food			X	
❖ Identify WG breakfast foods	X			
Handouts				
❖ PowerPoint slides	X	X	X	
❖ "Your Guide to Buying and Eating More Whole Grains" ➢ Included grain/WG information, the three step WG identification process, a quiz, testimonies and goal setting	X	X	X	X
❖ "3 Steps to 3 Servings of Whole Grain"			X	
❖ "Whole Grain Basics" ➢ Defines types of grains, health benefits of WG, etc.	X	X		
❖ Breakfast Recipes (3 recipes)				X
Session 2				
Activities				
❖ Taste testing; determine whether or not the product is a WG based on visual and sensory characteristics as well as using the three step WG identification method, food package and nutrition facts label			X	
Handouts				
❖ PowerPoint slides	X	X	X	
❖ "Your Guide to Buying and Eating More Whole Grains"	X	X	X	X

Table 3 continued

❖ "3 Steps to 3 Servings of Whole Grain"			X	
❖ "Whole Grain Basics"	X	X		
❖ Lunch & Dinner Recipes (6 recipes)				X
Session 3				
Activities				
❖ Five case studies requiring suggestions for handling each situation	X		X	
Handouts				
❖ PowerPoint slides	X	X	X	
❖ "Your Guide to Buying and Eating More Whole Grains"	X	X	X	X
❖ "3 Steps to 3 Servings of Whole Grain"			X	
❖ "Whole Grain Basics"	X	X		
❖ Dessert Recipes (2 recipes)				X

Recruitment

Programming Locations

The "Is It Whole Grain?" program was pilot tested in both IA and NH. In IA, the program was implemented at seven locations including senior apartments for individuals classified as low-income (*n*=2), retirement communities (*n*=4) and a congregate meal site (*n*=1). In NH, the program took place at 18 locations including senior centers (*n*=5), senior apartments (*n*=5), assisted living facilities (*n*=1), recreation centers (*n*=2), public libraries (*n*=1) and health or care-based sites (e.g., hospitals, clinics; *n*=3). At each site, the program was taught by trained nutrition educators.

Participant Recruitment

In total, 174 older adults participated (NH, *n*=114; IA, *n*=60). To be eligible for study participation, participants had to be age 60+ years and literate in English. Recruitment strategies included in-person presentations, flyers, information cards and word of mouth.

Program Evaluation

Dietary intake frequencies and nutritional risk were assessed at pre (Session 1) and post (Session 3) with the DST. Participants filled out a general, non-validated, pre- and post-WG questionnaire inquiring about WG knowledge (i.e., identifying WGs, label reading), grain and WG intake frequencies, the number of program sessions attended, intent to eat more WG foods and the strength of the intention to consume more WG foods. The survey also asked about sociodemographics and current or previous chronic diseases or conditions. Finally, participants completed a program evaluation containing 13 questions, many of which were provided in a 5-point Likert scale format (1=strongly disagree, 5=strongly agree). These questions inquired after the reason for program participation, WG consumption post-program, using information provided on food packages and labels to determine if a food is WG, effectiveness of activities, PowerPoint slides, handouts and the WG packet used during the program, seeking additional WG information from outside sources, overall program experience and likelihood of

recommending the program to a friend. Other qualitative questions inquired about the "best-" and "least-" liked programming aspects as well as session length. Participants were also asked to provide other suggestions or comments about the "Is It Whole Grain?" program. While NH older adults did not receive an incentive for voluntary participation, IA participants received a cookbook for participating. All study protocols were approved by the respective university's Human Subjects Institutional Review Board.

Data Analysis

Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS) for Windows, versions 20.0 and 21.0. Of the initial sample (n=174), 157 participants (IA, n=53; NH, n=104) were included in the analysis. Those excluded were less than 60 years, did not complete both the pre- and post-questionnaires or did not attend all three sessions. Sociodemographic information, intention to eat WG and strength of intention to eat WG at post were analyzed using descriptive statistics. Statistical significance was determined at $p < .05$.

Pre- and post-questionnaire WG knowledge responses were recoded as "correct" or "incorrect," with opinion responses as "yes" or "no/don't know." Categorical knowledge variables were transformed into continuous data by calculating a "total WG knowledge score" based on each participant's correct responses. A maximum score of 31 was possible. For scoring purposes, responses were recoded as "correct response"=1 and "incorrect" or "omitted"=0. The "total WG knowledge score" was comprised of the "grain content identification score," "product package indicator score" and a "basic WG knowledge score." The "grain content identification score" comprised the identification of 11 foods, four of which were WG foods. The "product package indicator score" included identification of five WG product package indicators from ten indicators listed. Finally, the "basic WG knowledge score" included participants' knowledge about the definition of a WG, WG health benefits and WG intake recommendations. A paired samples t-test determined significant changes in pre and post mean "total WG knowledge scores."

The "DST total grain DIF" was determined by summing the three questions related to grain intake frequencies (i.e., WG breads, WG cereals and hot or cold

breakfast cereal). A maximum score of 15 was possible, with a higher score indicating a greater frequency of consumption. The same process was employed to determine the "DST WG DIF," as questions specific to whole grain intake frequencies (i.e., whole grain breads and WG cereals) were added together. A maximum score of 10 was possible, with a higher score indicating a greater frequency of intake. A paired samples *t*-test compared differences between "DST total grain and WG DIF" from pre to post.

A one-way analysis of variance (ANOVA) determined differences in mean "total WG knowledge scores" and "DST WG DIF" between PowerPoint-based classes and discussion-based without PowerPoint classes, with analysis of covariance (ANCOVA) controlling for pre "total WG knowledge scores." To assess significant changes in opinion/perception responses from pre- to post-intervention, a McNemar's test was performed. Finally, a Spearman's Rank Order Correlation investigated whether or not there was a relationship between post "total WG knowledge scores" and "DST WG DIF" as well as post strength of intention to eat WG foods and "DST total grain and WG DIF."

CHAPTER IV: IDENTIFYING FACTORS INFLUENCING DIETARY INTAKE FREQUENCIES AND NUTRITIONAL RISK AMONG COMMUNITY-RESIDING ADULTS AGE 60+ YEARS

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Abstract

Background. Malnutrition, a term encompassing both undernutrition and overnutrition, is highly prevalent among the older adult population. This cross-sectional study examined the nutritional risk and dietary intake frequencies (DIF) among community-residing adults age 60+ years who took part in lifestyle interventions. Additionally, this study assessed sociodemographic characteristics influencing nutritional risk and DIF.

Methods. Participants completed the Dietary Screening Tool (DST) at the start of an intervention. Sociodemographic information, nutritional risk score and classification, and mean DIF for each diet component category (n=7) were assessed with descriptive statistics. A multivariate main effects general linear model identified sociodemographic characteristics (i.e., state of residence, age, gender and education level) that influenced nutritional risk and DIF of each diet component category. Specific influences were further broken down by the aforementioned sociodemographic characteristics.

Results. Participants (n=352) were mostly college-educated (39.5%) females (83.5%) age 60-70 years (42.9%). Over three-quarters (80.1%) were classified as "at

nutritional risk" or "at possible nutritional risk" prior to voluntary participation in a lifestyle intervention program. Overall, participants had "low" DIF of lean protein ($\bar{x}$=5.7±2.42), dairy ($\bar{x}$=5.7±2.85) and processed meat ($\bar{x}$=8.3±2.27). Participants also had "moderate" DIF of whole fruit and juice ($\bar{x}$=10.6±3.15), total and whole grains ($\bar{x}$=10.4±4.14), vegetables ($\bar{x}$=9.7±3.67) and added fats, sugars and sweets ($\bar{x}$=13.2±4.09). Whole fruit and juice DIF were influenced by state ($p \leq .001$). Vegetable DIF were influenced by state (p=.021) and gender (p=.022). Processed meat DIF were influenced by gender (p=.033) and age (p=.001). Nutritional risk was influenced by gender (p=.006).

Conclusions. These results indicate that community-residing older adults electing to take part in lifestyle interventions are at nutritional risk. When developing future nutrition education programs, sociodemographic factors (i.e., state, age and gender) of the target audience must be considered given their influence on dietary intakes. Furthermore, dietary interventions should focus on increasing consumption of dairy and protein-rich foods.

Keywords: dietary intake, nutrition, nutrition screening, nutritional status, older adult, sociodemographics

Introduction

Consuming a nutrient-rich diet is essential for older adults to maintain quality of life and independence as well as protect against chronic disease. While almost three-quarters of older Americans (70%) report the increasing importance of nutrition, less than half are meeting the following dietary recommendations based on the Healthy Eating Index (HEI): grains (18%), vegetables (32%), and fruit, dairy and meat (23% to 27%) (Ervin, 2008; United States Department of Health and Human Services' [USDHHS] Office of Disease Prevention and Health Promotion & Food and Drug Administration, 2008). Additionally, a majority of older adults (68%) are consuming a diet that "needs improvement" based on HEI score (Ervin, 2008). According to NHANES, older adults are also consuming higher mean amounts of total sugar, saturated fat and total fat (United States Department of Agriculture [USDA] Agricultural Research Service, 2011-2012). Older adults who eat energy-rich, nutrient-poor foods and are not meeting the current

dietary recommendations may be at a higher nutritional risk and/or risk for malnutrition, a term encompassing both overnutrition and undernutrition.

It is estimated that over one million community-residing older adults, 35-50% of older adults residing in long-term care facilities and 65% of older adults in hospitals are malnourished (Florida International University's National Resource Center on Nutrition, Physical Activity and Aging, 2013). Adults at higher nutritional risk include those with limited resources, have limited access to transportation, are physically impaired and consume nutrient-poor foods (Kamp, Wellman & Russell, 2010). Malnutrition is associated with a higher mortality rate and complications (Correia & Waitzberg, 2003), longer hospital stays (Correia & Waitzberg, 2003), increased healthcare costs (Correia & Waitzberg, 2003), decreased quality of life (Vailas, Nitzke, Becker & Gast, 1998), impaired functional abilities (Vailas, Nitzke, Becker & Gast, 1998), reduced ability to fight infection (Scrimshaw & SanGiovanni, 1997) and other detrimental health outcomes. It is imperative that nutritional risk be detected early to guide the development of nutrition programs that improve diet quality and nutritional status.

Community-based food and nutrition programs, including nutrition education, should be made available to older adults in order to optimize nutritional status and promote healthy aging (Kamp, Wellman & Russell, 2010). Nutrition education improves dietary intake and health behaviors (Beebe et al.2013; Cottell, Dorfman, Straight, Delmonico & Lofgren, 2011; Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014), self-efficacy (Francis, Taylor & Haldeman, 2009) and nutrition-related knowledge (Wagner, 2013) among community-residing adults. The key to impactful nutrition education is to understand the nutritional needs and practices of the target audience. The purpose of this study was to determine the nutritional risk and DIF of community-residing adults age 60+ years in addition to sociodemographic factors influencing both nutritional risk and DIF.

Methods

Study Design. This multistate, cross-sectional study examined the nutritional risk and DIF of 392 community-residing older adults (age 60+ years) who elected to take part in nutrition and/or physical activity intervention programs as part of a NE-1039 multistate

research program over a five-year period. These lifestyle intervention programs included community-based nutrition education (Iowa [IA], New Hampshire [NH]), and Rhode Island [RI]) and nutrition/physical activity interventions (RI). Nutritional risk and DIF were assessed prior to the start of each intervention using the DST.

Dietary Screening Tool. The DST is a validated screening instrument (79% accuracy, 83% sensitivity, 75% positive predictive values and specificity) used to determine nutritional risk and DIF of older adults (Bailey et al., 2007; Bailey et al., 2009). The DST contains 24 questions, with response options provided in Likert scale format, pertaining to intake frequencies of various foods and beverages. Of the 24 questions, five are "yes" or "no" questions related to consumption of added fats, sugars and sweets. Questions are grouped into seven diet component categories which add up to a total point score of 100; five bonus points are awarded to individuals who use a multivitamin or mineral preparation (Bailey et al., 2009; Table 1).

For questions pertaining to a "healthier" eating pattern, more points are allocated to a higher reported intake frequency (e.g., more points awarded to a greater consumption of lean protein). Conversely, for questions pertaining to a "less healthy" eating pattern, more points are allocated to a lower reported intake frequency (e.g., more points given to a lower consumption of added fats, sugars and sweets). The food and beverage items stem from two main dietary patterns: "Prudent" (i.e., "healthier" diet pattern including whole fruit and juice, vegetables, total and whole grains, lean protein and dairy) or "Western" (i.e., "less healthy" diet pattern including added fats, sugars and sweets and processed meat).

Table 1. DST diet component categories

Diet Component Category	**Point Total**
Added Fats, Sugars, and Sweets	25
Whole Fruit and Juice	15
Total and Whole Grains	15
Vegetables	15
Processed Meat	10
Lean Protein	10
Dairy	10

The total DST score indicates nutritional risk: “at risk” (less than 60 points), “at possible risk” (60-75 points) and “not at risk” (greater than 75 points). The DST is useful for determining which diet categories need further improvement among an older adult population in addition to developing tailored nutrition education messages for a specific audience (Bailey et al., 2009).

Recruitment. A convenience sample of older adults was recruited during lifestyle intervention programs that took place in IA (*n*=111), NH (*n*=85) and RI (*n*=196). In order to participate, participants had to be age 60+ years, literate in English and considered “community-residing” (e.g., living in own home, in a senior retirement community or senior apartments). Participants were recruited through in-person discussions and presentations, flyers and word of mouth. All participants provided informed consent. Lifestyle intervention program protocols were approved by each university’s Human Subjects Institutional Review Board.

Data Analysis. Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS) for Windows, version 20.0. Participants who were younger than 60 years old and had missing values for both DST score and classification and/or one or more of the seven diet component categories were excluded (*n*=40). The final sample was comprised of 352 participants (IA=111, NH=77 and RI=164).

Sociodemographic information, nutritional risk score and classification and mean DIF were analyzed using descriptive statistics. For interpretation of the results, mean DIF for each food component category was classified based on DIF quantity. All statistical analyses were conducted using actual DIF values. These classifications include the DIF of whole fruit and juice, total and whole grains, and vegetables classified as “low” (0-5 points), “moderate” (6-10 points) and “high” (11-15 points), the DIF of dairy and lean protein classified as “low” (0-5 points) or “high” (6-10 points), the DIF for processed meat classified as “high” (0-5 points) or “low” (6-10 points; a higher number indicates a lower DIF) and the DIF for added fats, sugars and sweets classified as “high” (0-10 points), “moderate” (11-15 points) or “low” (16-25 points; a lower DIF is desirable and is given a higher number).

A multivariate main effects general linear model was used to determine which sociodemographic characteristics (i.e., state of residence, age, gender and education

level) influenced nutritional risk and DIFs for each of the diet component categories. Statistical significance was determined at $p<.05$.

Results

Participants were mostly college-educated (39.5%) females (83.5%) age 60-70 years (42.9%) who were classified as "at nutritional risk" or "at possible nutritional risk" (80.1%; Table 2).

Table 2. Participant sociodemographic characteristics

Characteristic	**Overall** (*n*=352)	**IA** (*n*=111)	**NH** (*n*=77)	**RI** (*n*=164)
Age				
60-70 Years	151 (42.9%)	28 (25.2%)	33 (42.9%)	90 (54.9%)
71-80 Years	142 (40.3%)	39 (35.1%)	29 (37.7%)	74 (45.1%)
81+ Years	51 (14.5%)	40 (36.0%)	11 (14.3%)	-
Missing	8 (2.3%)	4 (3.6%)	4 (5.2%)	-
Gender				
Male	56 (15.9%)	32 (28.8%)	5 (6.5%)	19 (11.6%)
Female	294 (83.5%)	78 (70.3%)	71 (92.2%)	145 (88.4%)
Missing	2 (0.6%)	1 (0.9%)	1 (1.3%)	-
Education[a]				
High School or Less	68 (19.3%)	32 (28.8%)	24 (31.2%)	12 (7.3%)
Some College/Associate's/Technical	68 (19.3%)	34 (30.6%)	28 (36.4%)	6 (3.7%)
Bachelor's or Higher	71 (20.2%)	43 (38.7%)	24 (31.2%)	4 (2.4%)
Other	1 (0.3%)	-	-	1 (0.6%)
Missing	144 (40.9%)	2 (1.8%)	1 (1.3%)	141 (86.0%)[b]
DST Score ($\bar{x}$±SD)	65.36±11.9	65.04±12.3	66.40±12.1	65.09±11.7
DST Classification				
"At Nutritional Risk"	93 (26.4%)	31 (27.9%)	20 (26.0%)	42 (25.6%)
"At Possible Nutritional Risk"	189 (53.7%)	56 (50.5%)	39 (50.6%)	94 (57.3%)
"Not At Nutritional Risk"	70 (19.9%)	24 (21.6%)	18 (23.4%)	28 (17.1%)

[a] Education level includes no responses or not assessed.

Nutritional Risk. Over three-quarters (*n*=282, 80.1%) of all participants were classified as "at nutritional risk" or "at possible nutritional risk" (Figure 1). The greatest number of participants for each state was classified as "at possible nutritional risk" (Figure 1).

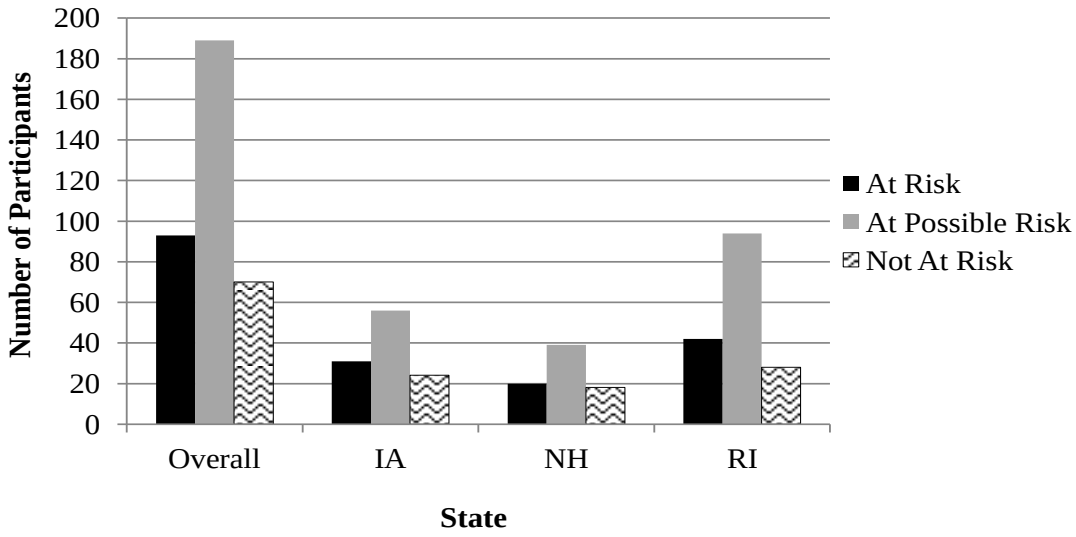

Figure 1. DST nutritional risk classification by state

Dietary Intake Frequencies

Overall. Participants had a "low" DIF of protein ($\bar{x}$=5.7±2.42) and dairy ($\bar{x}$=5.7±2.85; Table 3). The processed meat DIF ($\bar{x}$=8.3±2.27) also suggests a "lower" frequency of intake. There was a "moderate" DIF of whole fruit and juice ($\bar{x}$=10.6±3.15), total and whole grains ($\bar{x}$=10.4±4.14), vegetables ($\bar{x}$=9.7±3.67) and added fats, sugars and sweets ($\bar{x}$=13.2±4.09; Table 3).

Iowa. Iowa had a "low" DIF of processed meats ($\bar{x}$=8.1±2.26) and lean protein ($\bar{x}$=5.1±2.25). The DIF for dairy ($\bar{x}$=6.5±2.51) was classified as "high." Iowa also had a "moderate" DIF of added fats, sugars and sweets ($\bar{x}$=12.8±3.98), whole fruit and juice

($\bar{x}$=10.6±3.25), total and whole grains ($\bar{x}$=10.4±3.71) and vegetables ($\bar{x}$=8.9±3.58; Table 3).

New Hampshire. New Hampshire had a "low" DIF of processed meat ($\bar{x}$=8.4±2.36) and dairy ($\bar{x}$=5.7±2.81; Table 3). New Hampshire also had a "moderate" DIF of added fats, sugars and sweets ($\bar{x}$=12.7±4.16), total and whole grains ($\bar{x}$=10.0±4.60) and vegetables ($\bar{x}$=10.4±3.53; Table 3). Additionally, NH's DIF for whole fruit and juice ($\bar{x}$=12.2±2.81) and lean protein ($\bar{x}$=6.1±2.61) were classified as "high" (Table 3).

Rhode Island. Rhode Island had a "low" DIF of both processed meat ($\bar{x}$=8.4±2.24) and dairy ($\bar{x}$=5.0±2.94; Table 3). Rhode Island had a "moderate" DIF of added fats, sugars and sweets ($\bar{x}$=13.6±4.11), whole fruit and juice ($\bar{x}$=9.9±2.98), total and whole grains ($\bar{x}$=10.6±4.20) and vegetables ($\bar{x}$=9.8±3.70; Table 3). The DIF for lean protein ($\bar{x}$=6.0±2.38), was classified as "high" (Table 3).

Table 3. Mean dietary intake frequencies by state

Diet Component Categories (Max Score)	**Overall** ($\bar{x}$±SD)	**IA** ($\bar{x}$±SD)	**NH** ($\bar{x}$±SD)	**RI** ($\bar{x}$±SD)
Added Fats, Sugars and Sweets[a] (25)	13.2±4.09	12.8±3.98	12.7±4.16	13.6±4.11
Whole Fruit and Juice (15)	10.6±3.15	10.6±3.25	12.2±2.81	9.9±2.98
Total and Whole Grains (15)	10.4±4.14	10.4±3.71	10.0±4.60	10.6±4.20
Vegetables (15)	9.7±3.67	8.9±3.58	10.4±3.53	9.8±3.70
Processed Meat[a] (10)	8.3±2.27	8.1±2.26	8.4±2.36	8.4±2.24
Lean Protein (10)	5.7±2.42	5.1±2.25	6.1±2.61	6.0±2.38
Dairy (10)	5.7±2.85	6.5±2.51	5.7±2.81	5.0±2.94

[a] Higher score indicates reduced DIF, which is desirable.

General Influences. The DIF for whole fruit and juice was influenced by state ($p \leq .001$; Table 4). The DIF for vegetables was influenced by both state (p=.017) and gender (p=.025; Table 4). Additionally, the DIF for processed meat was influenced by age ($p \leq .001$) and gender (p=.033; Table 4). Furthermore, nutritional risk (i.e., DST score) was influenced by gender (p=.006; Table 4).

Table 4. Sociodemographic characteristics influencing nutritional risk and DIF[a]

	F	Partial Eta Squared	*p*-value
Whole Fruit and Juice			
State	10.00	0.093	≤.001
Vegetables			
State	4.15	0.041	.017
Gender	5.07	0.025	.025
Processed Meat			
Age	8.27	0.079	≤.001
Gender	4.63	0.024	.033
Nutritional Risk			
Gender	7.68	0.038	.006

[a]Tests of between-subjects effects from a multivariate general linear model

Specific Influences. New Hampshire had a higher DIF of whole fruit and juice in comparison to IA (MD=1.79, *p*=.001) and RI (MD=2.51, *p*=.025; Table 5). New Hampshire also had a higher DIF of vegetables than IA (MD=1.54, *p*=.025; Table 5). Additionally, female participants had a higher DIF of vegetables in comparison to male participants (MD=1.57, *p*=.025; Table 7). The DIF for processed meat was influenced by age, as participants ages 71-80 years (MD=1.47, *p*≤.001) and 81+ years (MD=1.28, *p*=.013) had a lower processed meat DIF than those age 60-70 years (Table 6). Processed meat DIF was also influenced by gender, with female participants having a lower processed meat DIF than the male participants (MD=1.03, *p*=.022; Table 7). Finally, male participants were classified at higher nutritional risk than female participants (MD=6.39, *p*=.006; Table 7).

Table 5. State pairwise comparisons[a]

	Mean Difference (MD)	Standard Error	*p*-value[b]	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
State					
Whole Fruit and Juice					
NH to IA	1.79	0.468	.001	0.616	2.962
NH to RI	2.51	0.727	.002	0.752	4.261
Vegetables					
NH to IA	1.54	0.576	.025	0.147	2.930

[a]Based on estimated marginal means; [b]Adjustment for multiple comparisons: Bonferroni

Table 6. Age pairwise comparisons[a]

	Mean Difference (MD)	Standard Error	*p*-value[b]	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
Age					
Processed Meat					
71-80 Years to 60-70 Years	1.47	0.375	≤.001	0.563	2.376
81+ Years to 60-70 Years	1.28	0.443	.013	0.207	2.345

[a]Based on estimated marginal means; [b]Adjustment for multiple comparisons: Bonferroni

Table 7. Gender pairwise comparisons[a]

	Mean Difference (MD)	Standard Error	*p*-value[b]	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
Gender					
Vegetables					
Females to Males	1.57	0.696	.025	0.195	2.941
Processed Meat					
Females to Males	1.03	0.449	.022	0.148	1.918
DST Score					
Females to Males	6.39	2.307	.006	1.845	10.944

[a]Based on estimated marginal means; [b]Adjustment for multiple comparisons: Bonferroni

Discussion

These findings indicate that a majority of this sample of community-residing adults who elected to take place in lifestyle intervention programs are "at possible nutritional risk" or "at nutritional risk" and have "lower" DIF of specific diet component categories that may be placing them at nutritional risk.

Nutritional Risk. A majority (80.1%) of participants was classified as "at nutritional risk" or "at possible nutritional risk." The total DST score was reflective of the DIFs, as participants were at 65-70% of the total point score for whole fruit and juice, total and whole grains, and vegetables, and 57% of the total point score for lean protein and dairy. Higher scores for these categories indicate a higher DIF. While participants are at 83% of the total point score for processed meat, the mean intake score for added fats, sugars and sweets was at 52% of the total score, indicating reduced DIF, which is desired. Although 2011-2012 NHANES data suggest older adult men have higher intakes of foods from all five food groups than women (USDA Agricultural Research Service, 2011-2012), it is likely that a lower nutritional risk classification detected among the females in this sample is attributable to a higher intake frequency of vegetables in addition to a lower intake frequency of processed meat. Commonly reported health behaviors of men, including being less likely than females to have visited the doctor in the past year (USDHHS Agency for Healthcare Research and Quality, 2012) and being less aware of current dietary recommendations and how dietary intake is related to chronic disease prevention (Hughes, Bennett & Hetherington, 2004; Baker & Wardle, 2003), may be placing them at a higher nutritional risk than their female counterparts. Other factors such as limited nutrition knowledge, poor cooking skills and lack of self-efficacy for healthy eating among older adult men may contribute to an increased nutritional risk score. These findings suggest that older men may benefit from future nutrition education interventions incorporating explanation about dietary intake recommendations and how they relate to chronic disease prevention as well as cooking practicums.

Lean Protein. Among the three states collectively, the mean lean protein intake frequency was "low." Low consumption of lean protein is concerning, as sarcopenia, the progressive loss of skeletal muscle mass and strength with aging (Walston, 2012), is common among older adults; it is estimated that nearly half of U.S. older adults are

affected by sarcopenia (Janssen, Shepard, Katzmaryk & Roubenhoff, 2004). Potential negative health effects of sarcopenia include weakening of bones, reduced muscle strength and ultimately the loss of physical capabilities and independence among older adults (Alliance for Aging Research, 2011). Additionally, older adults with sarcopenia have a 1.5 to 4.6 times higher rate of disability (Janssen, Shepard, Katzmaryk & Roubenhoff, 2004) and an increased risk of falls (McArdle & Jackson, 2011). Researchers involved in the Health, Aging and Body Composition (Health ABC) study found that among community-residing older adults, those with higher protein intakes lost significantly less lean body mass than those with the lowest protein intakes (Houston, 2008). Furthermore, Symons et al. (2007) reported that a simple, protein-rich meal may help preserve or increase muscle mass among aging adults. Older adults may benefit from the promotion of nutrition education messaging in intervention programming related to incorporating more protein-rich foods into meals and snacks.

Dairy. The mean intake frequency of dairy among all participants was considered to be "low." Since dairy foods are a source of calcium and vitamin D, reduced intakes of these nutrients is likely. Older adults who consume more dairy products have higher intakes of protein, calcium and vitamin D, among other nutrients (Barr et al., 2000). Inadequate dairy consumption among older adults is concerning, as lower intakes of calcium are associated with an increased risk of fractures and osteoporosis (Warensjö et al., 2011). Among those ages 50+ years, one in three women and one in five men will experience bone fractures due to osteoporosis (International Osteoporosis Foundation, 2015). It is possible that participants have self-diagnosed lactose intolerance, as perceived milk intolerance among older adults has been shown to result in lower intake frequencies of dairy products and a greater likelihood of not making an effort to consume sufficient calcium (Elbon, Johnson, Fischer & Searcy, 1999). Lactose intolerance/malabsorption increases with age (Stefano, Veneto, Malservisi, Strocchi & Corrazza, 2001), which may explain why a "low" dairy intake frequency was detected among this sample. Future nutrition education and lifestyle intervention programs targeting older adults should promote increasing dairy consumption and/or dairy alternatives, as nutrition education programs have been shown to improve dairy intake and nutritional risk among community-residing elders (Bernstein, et al., 2002; Francis, MacNab & Shelley, 2014).

Whole Fruit and Juice. These findings of "moderate" whole fruit and juice intake frequencies are similar to those reported in the Center for Disease Control and Prevention's (CDC) State Indicator Report on Fruits and Vegetables. This reports states that NH adults are consuming a higher median intake of fruits (1.3 times daily), in comparison to RI adults (1.2 times daily) and IA adults (1 time daily; CDC, 2013). Findings from this study also suggest gender may influence whole fruit and juice intake frequency. Similarly, Baker and Wardle (2003) found that among older adults attending cancer screenings, women were consuming more fruit servings than men (Baker & Wardle, 2003).

Vegetables. For this sample of older adults, a "moderate" vegetable intake frequency was detected. The vegetable intake frequency detected among IA older adults is consistent with national data stating that IA adults consume vegetables less than one time daily (median daily intake of 1.4 times per day; CDC, 2013). A smaller proportion (17.6%) of NH adults consumes vegetables less than once daily (median daily intake of 1.8 times per day; CDC, 2013). The increased vegetable intake frequency detected among this group of older females is similar to Baker and Wardle (2003) who report that women had a higher consumption of vegetables than men. Furthermore, the higher vegetable intake frequencies detected among NH participants, as opposed to IA participants, may also be attributed to a higher proportion of female participants.

Processed Meat. The reported processed meat intake frequency for this group of older adults was "low" among those ages 71+ years, but was higher among those ages 60-70 years. The higher processed meat intake frequency detected for those ages 60-70 years may be explained by a lower likelihood of participating in the congregate meal program and their living situation. Congregate meal program participants tend to be older, with an average age of 76 years (Wacker & Roberto, 2014). These "older" adults may be consuming more lean protein in the meal provided at the congregate meal site, as opposed to processed meats. The same may hold true for older adults living in a retirement community, as they too may be provided daily meals by individuals who are responsible for keeping the nutrient requirements of older adults in mind.

Our results differ from NHANES 2003-2004 data, in which processed meat consumption is nearly comparable among males and females (Daniel, Cross, Koebnick &

Sinha, 2011). However, the most recent NHANES report shows that cured meat consumption is lower among older adult females than older adult males (USDA Agricultural Research Service, 2011-2012). Additionally, females may refrain from eating processed meats more frequently due to the high sodium content of these foods. Females age 65+ years have a higher risk of developing hypertension (CDC, 2015), which may motivate them to limit processed meat intake due to increased exposure of nutrition education messages or advice encouraging lower sodium intakes.

Limitations. While this study was based in a community-setting, a convenience sampling method used to recruit older adults for lifestyle intervention programs may have resulted in including participants who were more motivated to make positive behavior changes. Generalizability may be limited, as participants in our study sample were not chosen at random. Additionally, a majority of participants was female, which may have impacted our findings. Finally, self-reported data on the DST may have been subject to over- or underestimation of DIF if participants desired to be perceived in a positive manner (i.e., social desirability bias). Future studies should aim to expand participant recruitment and include collection of objective measures such as three-day diet recalls for nutrient analysis and anthropometric measurements (e.g., height, weight, BMI and calf and/or arm circumference).

Summary. Our findings suggest that community-residing older adults have "low" intakes of lean protein and dairy and are "at possible nutritional risk" or "at nutritional risk." Sociodemographic characteristics (e.g., state of residence, gender and age) influence both nutritional risk and dietary intake frequencies and should therefore be taken into consideration when developing nutrition education and/or lifestyle intervention programs. Understanding and acknowledging both diet-related and non-diet-related factors influencing an older adult's nutritional risk prior to participation in lifestyle interventions will allow the educator to tailor the program curriculum to meet the participant's needs and produce favorable outcomes.

Take-Away Points

- Further assessment of the nutritional risk and dietary practices of community-residing older adults is needed.

- Future lifestyle interventions for older adults should focus on increasing consumption of both protein and dairy, as these diet component categories were considered “low” and are potential risk factors for sarcopenia and osteoporosis, which can lead to loss of independence and malnutrition.
- When developing and/or adapting nutrition education programming for older adults, sociodemographic factors such as state of residence, age and gender should be considered.
- Targeting foods characteristic of a prudent dietary pattern that are consumed less frequently (e.g. dairy, lean protein) during nutrition education classes provides the educator with the opportunity to promote increased consumption and highlight the importance of certain nutrient intakes in relation to chronic disease risk.

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References

Alliance for Aging Research. (2011). *Aging motion: the facts about sarcopenia.* Retrieved from http://www.aginginmotion.org/wp-content/uploads/2011/04/sarcopenia_fact_sheet.pdf

Bailey et al. (2007). A dietary screening questionnaire identifies dietary patterns in older adults. *Journal of Nutrition, 137(2),* 421-226.

Bailey et al. (2009). Dietary screening tool identifies nutritional risk in older adults. *American Journal of Clinical Nutrition, 90(1),* 177-183.

Baker, A. H. & Wardle, J. (2003). Sex differences in fruit and vegetable intake in older adults. *Journal of Appetite, 40(3),* 269-275.

Barr, et al. (2000). Effects of increased consumption of fluid milk on energy and nutrient intake, body weight, and cardiovascular risk factors in healthy older adults. *Journal of the American Dietetic Association, 100(7),* 810-817.

Beebe, et al. (2013). Effects of the addition of t'ai chi to a dietary weight loss program on lipoprotein atherogenicity in obese older women. *Journal of Alternative Complementary Medicine, 19(9),* 756-766.

Bernstein, et al. (2002). A home-based nutrition intervention to increase consumption of fruits, vegetables, and calcium-rich foods in community dwelling elders. *Journal of the American Dietetic Association, 102(10),* 1421-1427.

Centers for Disease Control and Prevention. (2013). *State indicator report on fruits and vegetables 2013.* Retrieved from http://www.cdc.gov/nutrition/downloads/State-Indicator-Report-Fruits-Vegetables-2013.pdf

Centers for Disease Control and Prevention. (2015). *High blood pressure facts.* Retrieved from http://www.cdc.gov/bloodpressure/facts.htm

Correia, M. I. & Waitzberg, D. L. (2003). The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Journal of Clinical Nutrition, 22(3),* 235-239.

Cottell, K. E., Dorfman, L. R., Straight, C. R., Delmonico, M. J. & Lofgren, I. E. (2011). The effects of diet education plus light resistance training on coronary heart disease risk factors in community-dwelling older adults. *Journal of Nutrition, Health and Aging, 15(9),* 762-770.

Daniel, C. R., Cross, A. J., Koebnick, C. & Sinha, R. (2011). Trends in meat consumption in the United States. *Journal of Public Health and Nutrition, 14(4),* 575-583.

Elbon, S. M., Johnson, M. A., Fischer, J. G. & Searcy, C. A. (2000). The influence of perceived milk intolerance on dairy product consumption in older American adults. *Journal of Nutrition for the Elderly, 19(1),* 25-39.

Ervin, B. R. (2008). *Healthy eating index scores among adults, 60 years of age and over, by sociodemographic and health characteristics: United States, 1999-2002.* Retrieved from http://www.cdc.gov/nchs/data/ad/ad395.pdf

Florida International University's National Resource Center on Nutrition, Physical Activity & Aging. (2013). *Malnutrition and Older Americans.* Retrieved from http://nutritionandaging.fiu.edu/aging_network/malfact2.asp

Francis, S. L., MacNab, L. & Shelley, M. (2014). A theory-based newsletter nutrition education program reduces nutritional risk and improves dietary intake for congregate meal participants. *Journal of Nutrition in Gerontology and Geriatrics, 33(2),* 91-107.

Francis, S. L. & Taylor, M. L. (2009). A social marketing theory-based diet-education program for women ages 54 to 83 years improved dietary status. *Journal of the American Dietetic Association, 109(12),* 2052-2056.

Francis, S. L., Taylor, M. L. & Haldeman, L. M. (2009). Nutrition education improves morale and self-efficacy for middle-aged and older women. *Journal of Nutrition for the Elderly, 28(3),* 272-286.

Genkinger, J. M., Platz, E. A., Hoffman, S. C., Comstock, G. W. & Helzlsouer, K. J. (2004). Fruit, vegetable, and antioxidant intake and all-cause, cancer, and cardiovascular disease mortality in a community-dwelling population in Washington County, Maryland. *American Journal of Epidemiology, 160(12),* 1223-1233.

Houston, et al. (2008). Dietary protein intake is associated with lean mass change in older, community-dwelling adults: the Health, Aging and Body Composition (Health ABC) Study. *American Journal of Clinical Nutrition, 87(1),* 150-155.

Hughes, G., Bennett, K. M. & Hetherington, M. M. (2004). Old and alone: barriers to healthy eating in older men living on their own. *Journal of Appetite, 43(3),* 269-276.

International Osteoporosis Foundation. (2015). *Facts and Statistics.* Retrieved from http://www.iofbonehealth.org/facts-statistics

Janssen I., Shepard D. S., Katzmarzyk P. T. & Roubenoff R. (2004). The healthcare costs of sarcopenia in the United States. *Journal of the American Geriatric Society, 52(1),* 80–85.

Kamp, B. J., Wellman, N. S. & Russell, C. (2010). Position of the American Dietetic Association, American Society for Nutrition and Society for Nutrition Education: food and nutrition programs for community-residing older adults. *Journal of Nutrition Education and Behavior, 42(2),* 72-82.

McArdle, A. & Jackson, M. J. (2011). *Sarcopenia – age-related muscle wasting and* weakness. p. 318. Gordon S. Lynch (ed.). Springer Science.

Scrimshaw, N. S. & SanGiovanni, J. P. (1997). Synergism of nutrition, infection, and immunity: an overview. *American Journal of Clinical Nutrition, 66(2),* 464S-477S.

Södergren, M., McNaughton, S. A., Salmon, J., Ball, K. & Crawford, D. A. (2012). Associations between fruit and vegetable intake, leisure-time physical activity, sitting time and self-rated health among older adults: cross-sectional data from the WELL study. *BMC Public Health, 12,* 1-9.

Stefano, D., Veneto, G., Malservisi, S., Strocchi, A. & Corazza, G. R. (2001). Lactose malabsorption and intolerance in the elderly. *Scandinavian Journal of Gastroenterology, 36(12),* 1274-1278.

Symons, et al. (2007). Aging does not impair the anabolic response to a protein-rich meal. *American Journal of Clinical Nutrition, 86(2), 451-456.*

United States Department of Agriculture Agriculture Research Service, *What We Eat in America,* NHANES. (2011-2012). *Mean daily food patterns cups/ounce equivalents consumed per individual, by gender and age, in the United States, 2011-2012.* Retrieved from http://www.ars.usda.gov/Services/docs.htm?docid= 23868

United States Department of Agriculture Agriculture Research Service, *What We Eat in America,* NHANES. (2011-2012). *Nutrient intakes from food and beverages: mean amounts consumed per individual, by gender and age, in the United States, 2011-2012.* Retrieved from http://www.ars.usda.gov/Services/docs. htm?docid=18349

United States Department of Health and Human Services Agency for Healthcare Research and Quality. (2012). *Healthy Men.* Retrieved from http://www.ahrq.gov/patients-consumers/patient-involvement/healthy-men/

United States Department of Health & Human Services Office of Disease Prevention and Health Promotion & Food and Drug Administration. (2008). *Health and diet survey: dietary guidelines supplement—report of findings (2004 & 2005).* Retrieved from http://www.fda.gov/Food/FoodScienceResearch/ ConsumerBehaviorResearch/ucm080331.htm

Vailas, L. I., Nitzke, S. A., Becker, M. & Gast, J. (1998). Risk indicators for malnutrition are associated inversely with quality of life for participants in meal programs for older adults. *Journal of the American Dietetic Association, 98(5),* 548-553.

Wacker, R. R. & Roberto, K. A. (2013). Community resources for older adults: Programs and services in an era of change. Thousand Oaks: SAGE Publications, Inc.

Wagner, M. (2013). Community-based nutrition education improves knowledge, attitudes, and behaviors related to fruit and vegetable consumption. *Journal of Nutrition Education and Behavior, 45(4),* S39.

Walston, J. D. (2012). Sarcopenia in older adults. *Current Opinion in Rheumatology, 24(6),* 623-627.

Wang, L., Manson, J. E., Gaziano, J. M., Buring, J. E. & Sesso, H. D. (2012). Fruit and vegetable intake and the risk of hypertension in middle-aged and older women. *American Journal of Hypertension, 25(2),* 180-189.

Warensjö, et al. (2011). Dietary calcium intake and risk of fracture and osteoporosis: prospective longitudinal cohort study. *BMJ*, 1-9.

CHAPTER V: MULTISTATE WHOLE GRAIN NUTRITION EDUCATION PROGRAM IMPROVES WHOLE GRAIN KNOWLEDGE AND BEHAVIORS AMONG COMMUNITY-RESIDING ADULTS AGES 60+ YEARS

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Abstract

Background. U.S. older adults are not meeting the daily three ounce equivalent recommendation for whole grains (WG), as refined grains comprise a majority of total grain intake. The purpose of this study was to determine the extent to which a WG nutrition education intervention program for community-residing adults age 60+ years influences knowledge and WG behaviors.

Methods. "Is It Whole Grain?" is a weekly, three consecutive session program (one hour per session) including WG education and discussion, participation in hands-on activities and taste-testing of WG foods. At the start of Session 1 (pre) and Session 3 (post), participants completed a WG questionnaire and the Dietary Screening Tool (DST). Descriptive statistics assessed sociodemographic characteristics as well as post intention and strength of intention to eat WG foods. Paired samples *t*-tests assessed changes in knowledge and "DST total grain and WG dietary intake frequencies" (DIF). Differences in knowledge and "DST total grain and WG DIF" by education style was determined using one-way analysis of variance (ANOVA), with analysis of covariance (ANCOVA) controlling for pre WG knowledge. A McNemar's test measured changes in WG opinions and perceptions from pre to post while Spearman's Rank Order Correlations investigated the relationship between post WG knowledge and "DST total grain and WG DIF" in addition to post strength of intention to eat WG foods and "DST WG DIF."

Results. Participants were mostly white (*n*=151, 96.2%), high-income (*n*=108, 68.8%) females (*n*=140, 89.2%). Whole grain knowledge increased from pre ($\bar{x}$=15.1±4.9) to post ($\bar{x}$=21.6±4.0, $p \leq .001$). "DST total grain and WG DIF" increased from pre to post ($p \leq .001$), with a small, positive correlation between post WG knowledge and "DST WG DIF" (*r*=.203, *p*=.027). Participants in the PowerPoint-based classes had a higher WG knowledge score ($\bar{x}$=22.2±0.4) at post than participants in the discussion-based, non-PowerPoint classes ($\bar{x}$=20.3±0.5, *p*=.002). Nearly all (*n*=139, 88.5%) participants intended to eat more WG foods at post, with almost two-thirds (*n*=93, 59.3%) reporting a "strong" intention to do so. A moderate, positive association (*r*=.435, $p \leq .001$) was found between post strength of intention to eat more WG foods and "DST WG DIF."

Conclusions. These results suggest that the "Is It Whole Grain?" program is an effective strategy for educating older adults about WGs, as participants improved WG knowledge, increased consumption of WG foods and had a moderate to strong intention to eat more WGs.

Keywords: behavior change, knowledge change, nutrition, nutrition education, older adult, theory-based intervention, whole grain

Introduction

Given the numerous health benefits associated with consuming WGs, older adults should strive to incorporate more WGs into their daily eating plan. However, few are meeting the current MyPlate recommendation of three ounce equivalents daily. Adults are consuming 35% of the recommended number of WG servings while refined grain consumption is at 175% of the recommendation (Lin & Yen, 2007). While adults age 60+ years are meeting the recommendation for total grains (6.96 ounce equivalents for males versus 5.05 ounce equivalents for females), a majority of total grain intake is derived from refined grains (5.47 ounce equivalents for males versus 4.01 ounce equivalents for females) (United States Department of Agriculture Agricultural Research Service, 2011-2012). Since four out of five adults age 50+ years have at least one chronic illness, with

77% reporting two or more (National Council on Aging, 2014), adding WGs to an older adult's meal plan would be beneficial.

Despite advantages associated with eating WG-rich foods, barriers to WG intake such as perceived higher cost, undesirable taste or texture, limited or lack of knowledge pertaining to WG health benefits and methods for preparing WG foods, and limited availability of WG options when dining out may prevent older adults from purchasing and consuming WGs (Ferruzzi, et al., 2014; Kunzesof, Brownlee, Moore, Richardson, Jebb & Seal, 2012; McKeown et al., 2013; McMackin, Dean, Woodside & McKinley, 2013). Nutrition educators can play a pivotal role in determining solutions to overcoming the aforementioned barriers through nutrition education programming. Nutrition education for older adults has been shown not only to improve dietary intake (Beebe et al.2013; Cottell, Dorfman, Straight, Delmonico & Lofgren, 2011; Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014), but increase nutrition-related knowledge (Wagner, 2013) as well as self-efficacy (Francis, Taylor & Haldeman, 2009). Participation in a WG nutrition education program may be beneficial for community-residing older adults who are not currently meeting the recommended intakes for WG and lack or have limited knowledge related to selecting and preparing WG foods. Therefore, the purpose of this study was to determine the extent to which a WG nutrition education intervention program for community-residing adults age 60+ years influences WG knowledge and behaviors.

Methods

Program Development. The "Is It Whole Grain?" nutrition education intervention program for community-residing adults age 60+ years was developed using Social Marketing Theory (SMT; Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008) principles. SMT-based nutrition education programs have been shown to produce measurable behavior changes among participants (Francis, 2012; Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014). The SMT is comprised of six steps: (1) planning and strategy, (2) selecting channels and materials, (3) developing materials and pretesting, (4) implementation, (5) assessing effectiveness and (6) using feedback to refine the program (Lefebvre & Rochlin, 1997; Storey, Saffitz & Rimón, 2008).

Development of the "Is it Whole Grain?" program curriculum utilized Steps 1 through 3. Needs assessments determined how older adults identify WG foods using product packages as well as motivators and barriers to WG consumption. Step 2 included receiving suggestions and preferences related to content and design of a WG education program; the result was the development of the "Is It Whole Grain?" program. This study concentrated on Step 3 and examined the impact that the "Is it Whole Grain?" program had on WG knowledge and behaviors.

Curriculum. The "Is it Whole Grain?" program is comprised of three, one-hour sessions focused on breakfast, lunch and dinner and snacks using one of two educational approaches: PowerPoint presentations (*n*=13 sites) and discussion-based without PowerPoint presentations (*n*=12 sites). In addition to nutrition education via participant-instructor interaction, participants were involved in small group discussion, hands-on activities and taste-testing. The goal of the program was to increase WG knowledge, (i.e., define a WG, name three health benefits associated with eating WG foods and use the three step process to identify WG products) and promote positive behavior change related to WG consumption.

Program Description. All participants received a folder containing PowerPoint slides, worksheets, informational handouts and recipes. All three sessions involved discussion, a hands-on activity, completion of a worksheet(s) and taste testing of a WG food(s). Each session is outlined in Table 1.

Table 1. Overview of "Is It Whole Grain?" sessions 1-3

	Session 1	**Session 2**	**Session 3**
Meal	Breakfast and morning snacks	Lunch and afternoon snacks	Dinner and evening snacks
Main Topic(s)	• WG definition • WG health benefits • 3 step WG identification process	• Review session 1 information • Discuss the term "multigrain"	• Review information from sessions 1 and 2
Main Activity	• Compare two cereal products for WG content	• Identify WG breads based on taste, texture and color • Identify WG breads using the product package	• WG case scenarios to apply learned knowledge to real-life situations

Recruitment. The "Is it Whole Grain?" program was pilot tested in Iowa (IA) and New Hampshire (NH) with 174 community-residing older adults (IA: *n*=60, NH: *n*=114). These two states were selected, as they are part of the NE-1039 multistate research project. Participants had to be literate in English and at least 60 years and were recruited via flyers, word of mouth, in-person presentations and information cards. Examples of program sites include, but are not limited to, senior apartments, retirement communities and senior centers.

Program Evaluation. Participants completed the validated Dietary Screening Tool (DST) and a non-validated WG questionnaire at both pre- and post-program. The DST assessed both DIF and nutritional risk; it has 79% accuracy, 83% sensitivity, 75% specificity levels and 75% positive predictive values when compared against the Dietary Reference Intakes for determining nutritional risk (Bailey et al., 2007; Bailey et al., 2009). The DST poses 24 questions related to DIF of various foods and beverages, five of which are "yes" or "no" questions related to consumption of added fats, sugars and sweets. It further groups the questions into 7 diet component categories, adding up to a total point score of 100 (Bailey et al., 2009; Table 2). Individuals who use a multivitamin or nutritional supplement are given an additional five points.

The DST food and beverage items are derived from two dietary patterns (Table 2). Foods characteristic of a "Prudent" dietary pattern (i.e., "healthier" diet pattern including whole fruit and juice, vegetables, total and whole grains, lean protein and dairy) are allotted more points to a higher reported consumption frequency (e.g., more points awarded to a greater consumption of dairy). For a "Western" dietary pattern (i.e., "less healthy" diet pattern including added fats, sugars and sweets and processed meat), more points are allocated to a lower reported consumption frequency (e.g., more points given to a lower consumption of processed meats).

Table 2. Diet component categories comprising the DST

Diet Component Category	Point Total
Prudent Dietary Pattern	
Dairy	10
Lean Protein	10
Vegetables	15
Total and Whole Grains	15
Whole Fruit and Juice	15
Western Dietary Pattern[a]	
Processed Meat	10
Added Fats, Sugars, and Sweets	25

[a] A higher score reflects a lower intake frequency, which is desirable.

Based on a participant's total DST point score, he/she is classified into one of the following nutritional risk categories: "at risk" (less than 60 points), "at possible risk" (60-75 points) and "not at risk" (greater than 75 points). The DST is beneficial for tailoring nutrition education messages to older adults and identifying diet component categories that require a higher or lower frequency of intakes (Bailey et al., 2009).

The WG questionnaire inquired about WG knowledge (e.g., recommended daily WG servings, definition of a WG), WG behaviors (e.g., consumption frequency of WG and multigrain foods), opinions related to WG (e.g. taste preferences, perceived cost, perceived ability to use food packages to select WG foods) and lifestyle habits (e.g., grocery shopping, planning/cooking meals). The pre-questionnaire also contained general sociodemographic questions (e.g., gender, age, education level). The post-questionnaire omitted the sociodemographic questions, but included questions related to intention to eat WG foods and the strength of intention. Additionally, participants completed a post-program evaluation assessing reasons for program participation, "best-" and "least–liked" programming aspects, effectiveness of supplemental materials and satisfaction with program length. Iowa participants received an incentive ($5 value) for participation. All study protocols were approved by the respective Human Subjects Institutional Review Boards.

Data Analysis. Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS) for Windows, versions 20.0 and 21.0. Sociodemographic information, intention to eat WG and strength of intention to eat

WG at post were analyzed using descriptive statistics. Significance was determined at $p<.05$. Only participants who were 60+ years, completed the pre- and post-questionnaires and attended all three sessions were included in data analysis ($n=157$).

Pre- and post-questionnaire responses pertaining to WG knowledge were recoded for scoring purposes as "correct"=1 or "incorrect" or "omitted"=0. A "total WG knowledge score" for each participant was calculated based on the total number of correct responses. The "total WG knowledge score" was comprised of: (1) "basic WG knowledge" (i.e., the definition of a WG, knowledge about WG health benefits and WG intake recommendations), (2) "grain content identification" (i.e., correctly classifying 11 grain foods, four of which were WG foods) and (3) "product package indicators" (i.e., correctly identifying five WG product package indicators from ten indicators listed). A paired samples *t*-test determined significant differences between pre and post mean "total WG knowledge scores," with a maximum possible score of 31.

The "DST total grain DIF" was calculated by summing three questions pertaining to grain intake frequencies (i.e., WG breads, WG cereals and hot or cold breakfast cereal); a maximum score of 15 was possible, with a higher score indicating a greater frequency of consumption. Similarly, the "DST WG DIF" was determined by summing questions addressing WG DIF (i.e., WG breads and WG cereals); a maximum score of 10 was possible, with a higher score indicating a greater frequency of intake. A paired samples *t*-test compared differences from pre to post intervention for "DST total grain and WG DIF."

One-way analysis of variance (ANOVA) assessed differences in mean "total WG knowledge scores" and "DST WG DIF" between the PowerPoint-based versus discussion-based without PowerPoint sessions. Analysis of covariance (ANCOVA) was used to control for pre "total WG knowledge scores" for both education styles. Responses to opinion/perception questions were recoded as "yes"=1 and "no"=2. A McNemar's test assessed significant changes in responses to opinion and perception questions from pre- to post-intervention. Finally, a Spearman's Rank Order Correlation investigated the relationship between post "total WG knowledge scores" and "DST WG DIF" as well as post strength of intention to eat WG foods and "DST WG DIF."

Results

Participants were mostly white (*n*=151, 96.2%), high-income (*n*=108, 68.8%) females (*n*=140, 89.2%; Table 3). Over one-half of participants reported history of hypercholesterolemia (*n*=81, 51.6%) and hypertension (*n*=82, 52.2%), which are both risk factors for cardiovascular disease. Nearly one-quarter (*n*=35, 22.3%) reported history of cancer and over one-quarter (*n*=44, 28.0%) reported intestinal health issues (e.g., constipation, diverticulosis, diverticulitis; Table 3). The majority of participants were responsible for their own grocery shopping (*n*=134, 85.4%), cooking (*n*=130, 82.8%) and meal planning (*n*=118, 75.2%; Table 3).

Table 3. Sociodemographic characteristics of older adult participants

Sociodemographic Characteristics (*n*=157)	**Number (*n*)**	**Percent (%)**
State of Residence		
IA	53	33.8%
NH	104	66.2%
Age		
60-70 Years	45	28.7%
71-80 Years	56	35.7%
81+ Years	56	35.7%
Sex		
Female	140	89.2%
Male	17	10.8%
Ethnicity		
White	151	96.2%
Non-White	6	3.8%
Education		
High School, GED or Less	50	31.8%
Some College/Technical School/Associate's Degree	51	32.5%
Bachelor's Degree or Higher	55	35.0%
Socioeconomic Site Location[1]		
Low-Income	49	31.2%
High-Income	108	68.8%
Education Style		
PowerPoint	89	56.7%
No PowerPoint	68	43.3%
History of Select Chronic Diseases/Conditions		
Hypertension	82	52.2%
Hypercholesterolemia	81	51.6%
Intestinal Health Issues[2]	44	28.0%
Cancer	35	22.3%

Table 3 continued

Diabetes	30	19.1%
Heart Disease or Heart Attack	25	15.9%
Celiac Disease or Grain Allergy	7	4.5%
Meal Preparation		
Grocery Shops	134	85.4%
Cooks Own Meals	130	82.8%
Plans Own Meals	118	75.2%

[1]Low-income defined as those residing in senior apartments with income restrictions or congregate meal site participants; high-income defined as sites other than those previously defined as low-income.
[2]Intestinal health issues defined as constipation and/or diverticulosis or diverticulitis.

WG Knowledge and DST Total Grain and WG DIF. Mean WG knowledge scores significantly increased from pre ($\bar{x}$=15.1±4.9) to post ($\bar{x}$=21.6±4.0, $p \leq .001$). Both "DST total grain and WG DIF" increased from pre to post (Table 2). A small, yet positive correlation was discovered between participants' post "total WG knowledge score" and post "DST WG DIF" (r=.203, p=.027). As post "total WG knowledge score" increased, post "DST WG DIF" increased as well.

Table 2. Mean "DST total grain and WG DIF"

	PRE ($\bar{x}$±SD)	**POST ($\bar{x}$±SD)**	***p*-value**
Total grain	10.4±4.5	11.3±3.9	≤.001
WG	7.0±3.3	7.7±2.6	≤.001

Whole Grain Opinions/Perceptions and Intent to Consume Whole Grains. More participants reported liking the taste of WG foods at post (n=140) than at pre (n=129; p=.019) and reported knowing how to use the food package to select WG foods at post (n=147) than at pre (n=80; $p \leq .001$). Additionally, 139 (88.5%) participants reported they intended to eat more WG at post, with almost two-thirds (n=93, 59.2%) rating their strength of intention as "strong" and approximately one-third (n=52, 33.1%) as "moderate." A moderate, positive association (r=.435, $p \leq .001$) was observed between post strength of intention to eat more WG foods and "DST WG DIF." As strength of intention to eat more WG foods increased, so, too, did post "DST WG DIF."

Class Format Differences. Effectiveness of education format (PowerPoint-based classes versus the discussion-based classes without PowerPoint) on "total WG knowledge scores" and "DST WG DIF" for each group was compared. Participants in the

PowerPoint-based classes had a significantly higher mean "total WG knowledge score" ($\bar{x}$=22.2±0.4) at post than participants in the discussion-based classes without PowerPoint ($\bar{x}$=20.3±0.5, p=.002). No significant differences existed between education styles in relation to "DST WG DIF" at post-intervention (p=.442).

Discussion

These data indicate the "Is It Whole Grain?" program is effective at improving both WG knowledge and consumption of WG foods among this group of older adults. These findings support those of Ellis and others (2005) who also found an increase in WG identification and WG dietary changes among older adult congregate mealsite participants following participation in a WG education program. Increases in both knowledge and behavior change following the conclusion of the program may be attributed to its theory-based design, which led to the development of a program that was tailored to the needs of community-residing older adults. These finding are similar to Francis (2012) who reported that following a SMT-based, community-based heart health nutrition education program, participants' familiarity of 14 heart-healthy lifestyle practices significantly increased. Similarly, other SMT-based education programs for older adults suggest that this theory-based approach to program design is effective at improving dietary intake (Francis & Taylor, 2009; Francis, MacNab & Shelley, 2014).

The literature suggests that low WG consumption may be attributed to limited familiarity with WG foods, lack of connection between WG and potential health benefits, undesirable taste and limited time/knowledge to prepare WG foods (Adams & Engstrom, 2000; Arvola et al., 2007; Kantor, Jayachandra, Allshouse, Putnam & Lin, 2001). The "Is It Whole Grain?" program addressed these barriers, with the WG education highlighting how WG intake plays a role in chronic disease risk, taste-testing and hands-on activities exposing older adults to WG foods and their sensory characteristics, and the distribution of recipes containing WG ingredients to facilitate WG preparation/cooking skills. Participants who perceived themselves at risk for or currently have a given chronic disease/condition in which WG intake has been shown to play a role, may have been more likely to consume more WG foods. The leading self-reported chronic diseases/conditions for this group of older adults included hypercholesterolemia, intestinal health issues,

cancer and diabetes. Since the curriculum addressed how WG may help regulate the digestive system, reduce the risk for certain cancers, aid in blood sugar control and promote the removal of LDL (i.e., "bad") cholesterol, participants who had or have had the aforementioned chronic diseases/conditions may have been more motivated to make WG behavior changes.

Since questions related to the "DST WG DIF" specifically addressed the consumption of WG bread, WG cold cereal and hot and cold breakfast cereal, higher intake frequencies of these foods likely contributed to the higher "DST WG DIF" at post-intervention. Whole grain cereal and oatmeal are common breakfast foods. Increased self-reported intake frequencies of these foods may have occurred at breakfast, as the literature indicates that the majority (64%) of WG intake among older adults takes place at breakfast (Whole Grains Council, 2009). Smith, Kuznesof, Richardson & Seal (2003) suggest targeting breakfast foods in order to increase WG consumption. Improvements in "DST WG DIF" may be a result of familiarization of the WG content of certain WG breads and cereals during the hands-on activities. In Sessions 1 and 2, participants received a pair of similar cereal and bread products respectively and were asked to identify which product was composed of WG or which one contained more WG. Discovery of those products that contain WG and/or have a higher WG content may have led to greater likelihood of purchasing and consuming WG products, thus, increasing the aforementioned "DST WG DIF." Other self-reported benefits to eating more WG such as higher satiety and energy levels, perceived naturalness/wholesomeness and exceptional taste reported by Kuznesof et al. (2012) may also explain higher intake frequencies.

Furthermore, improvements in "DST WG DIF" may have resulted from taste-testing WG foods during the program sessions. Taste-testing allows older adults to try unfamiliar foods and determine whether or not they like them before spending their money on those that they don't particularly care for (Lyons, 2014). The Evergreen Action Nutrition program study, an older adult nutrition education program consisting of activities such as food demonstrations or workshops, taste-testing, educational handouts, recipes, and more, resulted in participants reporting that taste-testing, in combination with the food demonstrations, led to changes in eating behaviors (Keller, Hedley, Hadley, Wong & Vanderkooy, 2005). Keller and colleagues (2005) found that there was a

significant increase in the proportion of participants indicating an interest in trying new foods, with the majority reporting purchasing of new foods. Taste-testing WG foods during the "Is It Whole Grain?" program sessions may have contributed to the majority (89.2%) of participants reporting liking the taste of WG foods. A study conducted by Burgess-Champoux, Marquart, Vickers and Reicks (2006) found that the incorporation of a WG taste-testing activity led to more adults reporting "moderately liking" to "very much liking" a WG cereal and WG bread. Among the older adult population, exposure to new WG foods may increase their acceptability and desirability.

The "Is It Whole Grain?" program incorporated successful characteristics of older adult nutrition education programs. It was short (one hour weekly for three weeks), designed to meet the needs and preferences of older adults, incorporated active participation and hands-on activities, used simple, specific, reinforced messages and provided participants with nutrition education resources (i.e., print materials) that were culturally appropriate, contained practical information, and included high contrast colors, a large, easy-to-read font and concrete graphics (Meck Higgins & Barkley, 2003; Meck Higgins & Barkley, 2004, Sayhoun, Pratt & Anderson, 2004). Taking time to review key concepts (i.e., repetitive messages) covered in previous sessions may have also led to participants increased comprehension and retention of the curriculum. Consistent reinforcement of the three step WG identification method may have played a key role in most participants (93.6%) reporting knowing how to use a product package to select those that contain WG.

At post, a majority of participants reported a "moderate" to "strong" intention to eat more WG foods. Since intention alone does not necessarily equate to facilitation of behavior change, action planning or coping planning (i.e., anticipating barriers and adopting strategies to overcome those barriers in order to maintain or acquire a new behavior) in addition to self-efficacy is necessary (Schwarzer, 2008). A meta-analysis by Webb and Sheeran (2006) showed that medium-to-large changes in intentions related behavior adoption leads to small-to-medium changes in carrying out a particular behavior. This concept is supported by the moderate positive association found between post strength of intention to eat more WG foods and "DST WG DIF," as the "DST WG DIF" increased, even with nearly two-thirds of participants indicating a "strong" intention.

Finally, a significantly higher "total WG knowledge score" was observed for those who attended the PowerPoint sessions versus those who were in the non-PowerPoint, discussion-based sessions. The difference may be attributed to encouragement of participants to follow along with the printed PowerPoint slides provided in paper format, as active engagement may have improved knowledge retention. While it is unknown whether a PowerPoint presentation format was desired over a discussion-based education style, Hoerr and others (submitted for publication) report that PowerPoint was a "least-liked" programming attribute reported by older adults following participation in a nutrition education program. However, these findings support those of Meck Higgins and Barkley (2004), who suggest that information be presented in an interactive format; distribution of printed slides in conjunction with a PowerPoint presentation may meet this characteristic of effective resources.

Limitations. Generalizability may be limited, as a majority of participants were white and female. A convenience sampling technique may have led to recruitment of participants that were more motivated to make lifestyle behavior changes. Additionally, the WG questionnaire was not validated prior to program implementation. Self-reported responses on both the DST and the WG questionnaire are subject to under- or overestimation, as the participant may desire to be portrayed in a more favorable manner (i.e., social desirability bias); responses are also limited by one's memory and recollection (i.e., recall bias). Furthermore, both the DST and pre- and post-questionnaires did not inquire about serving sizes, which may impact true estimations of grain intake. Finally, while post-program outcomes are both desirable and positive, program duration (i.e., three weeks, one session per week) may have limited long-term changes in WG knowledge and behaviors. Future studies should consider expanding participant recruitment, distributing validated questionnaires, providing quantitative and visual portion size references for grain-based foods and collecting three-day diet recalls to examine total and WG intakes as well as analyze specific nutrient profiles.

Take-Away Points

- Nutrition educators should consider incorporating theory-based models such as Social Marketing Theory when developing future nutrition education programming

and/or interventions, as the likelihood of observing behavior change increases.

- Targeted, repeated, theory-based nutrition education messages may result in greater improvements in both knowledge and dietary behavior changes.
- Incorporation of relevant hands-on activities in addition to taste-testing may lead to increases in selection and intake of foods featured during nutrition education sessions.

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References

Adams, J. F. & Engstrom, A. (2000). Helping consumers achieve recommended intakes of whole grain foods. *Journal of the American College of Nutrition, 19(3),* 339S-344S.

Arvola et al. (2007). Consumers' beliefs about whole and refined grain products in the US, Italy and Finland. *Journal of Cereal Science, 46(3),* 197-206.

Bailey et al. (2007). A dietary screening questionnaire identifies dietary patterns in older adults. *Journal of Nutrition, 137(2),* 421-226.

Bailey et al. (2009). Dietary screening tool identifies nutritional risk in older adults. *American Journal of Clinical Nutrition, 90(1),* 177-183.

Beebe et al. (2013). Effects of the addition of t'ai chi to a dietary weight loss program on lipoprotein atherogenicity in obese older women. *The Journal of Alternative and Complementary Medicine, 19(9),* 759-766.

Burgess-Champoux, T., Marquart, L., Vickers, Z. & Reicks, M. (2006). Perceptions of children, parents, and teachers regarding whole-grain foods, and implications for a school-based intervention. *Journal of Nutrition Education and Behavior, 38,* 230-237.

Cottell, K. E., Dorfman, L. R., Straight, C. R., Delmonico, M. J. & Lofgren, I. E. The effects of diet education plus light resistance training on coronary heart disease risk factors in community-dwelling older adults. *The Journal of Nutrition, Health & Aging, 15(9),* 762-767.

Ellis, J., Johnson, M. A., Fischer, J. G. & Hargrove, J. L. (2005). Nutrition and health education intervention for whole grain foods in the Georgia older Americans nutrition programs. *Journal of Nutrition for the Elderly,* 24(3), 67-83.

Ferruzzi et al. (2014). Developing a standard definition of whole-grain foods for dietary recommendations: Summary report of a multidisciplinary expert roundtable discussion. *Advances in Nutrition, 5(2),* 164-176.

Francis, S. L. (2012). Heart disease nutrition education program increases familiarity with heart-healthy lifestyle recommendations. *Journal of Nutrition Education and Behavior, 44(6),* 658-660.

Francis, S. L., MacNab, L. & Shelley, M. (2014). A theory-based newsletter nutrition education program reduces nutritional risk and improves dietary intake for congregate meal participants. *Journal of Nutrition in Gerontology and Geriatrics, 33(2),* 91-107.

Francis, S. L. & Taylor, M. L. (2009). A social marketing theory-based diet-education program for women ages 54 to 83 years improved dietary status. *Journal of the American Dietetic Association, 109(12),* 2052-2056.

Francis, S. L., Taylor, M. L. & Haldeman, L. M. (2009). Nutrition education improves morale and self-efficacy for middle-aged and older women. *Journal of Nutrition for the Elderly, 28(3),* 272-286.

Kantor, L. S., Variyam, J. N., Allshouse, J. E., Putnam, J. J. & Lin, B. H. (2001). Choose a variety of grains daily, especially whole grains: a challenge for consumers. *Journal of Nutrition, 131(2S-1),* 473S-86S.

Keller, H. H., Hedley, M., Hadley, T., Wong, S. & Vanderkooy, P. (2005). Food workshops, nutrition education, and older adults: a process evaluation. *Journal of Nutrition for the Elderly, 24(3),* 5-23.

Kuznesof et al. (2012). WHOLEheart study participant acceptance of wholegrain foods. *Appetite, 59(1),* 187-193.

Lefebvre, R.C., & Rochlin, L. Social Marketing. In K. Glanz, F. M. Lewis, & B. K. Rimer (Eds), *Health behavior and health education* (Second ed. 1997; pp. 384-402), San Francisco, CA: Jossey-Bass Publishers.

Lin, B. H. & Yen, S. T. (2007). *The U.S. Grain Consumption Landscape: Who Eats Grain, in What Form, Where and How Much?* Retrieved from http://www.ers.usda.gov/media/216648/err50_1_.pdf

Lyons, B. P. (2014). Nutrition education intervention with community-dwelling older adults: research challenges and opportunities. *Journal of Community Health, 39(4),* 810-818.

McKeown et al. (2013). Whole grains and health: From theory to practice—highlights of the grains for health foundation's whole grains summit. *Journal of Nutrition, 143(5),* 744S-758S.

McMackin E., Dean M., Woodside J. V. & McKinley M. C. (2013). Whole grains and health: Attitudes to whole grains against a prevailing background of increased marketing and promotion. *Public Health Nutrition, 16(4),* 743-751.

Meck Higgins M. & Barkley, M. C. (2003). Tailoring nutrition education intervention programs to meet needs and interests of older adults. *Journal of Nutrition for the Elderly, 23(1),* 59-79.

Meck Higgins, M. & Barkley, M. C. (2004). Improving effectiveness of nutrition education resources for older adults. *Journal of Nutrition for the Elderly, 23(3),* 19-53.

National Council on Aging. (2014). *Healthy Aging fact sheet.* Retrieved from http://www.ncoa.org/press-room/fact-sheets/healthy-aging-fact-sheet.html

Sayhoun, N. R., Pratt, C. A. & Anderson, A. (2004). Evaluation of nutrition education interventions for older adults: A proposed framework. *Journal of the American Dietetic Association, 104,* 58-69.

Schwarzer, R. (2008). Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. *Journal of Applied Psychology, 57(1),* 1-29.

Smith, A. T., Kuznesof, S., Richardson, D. P. & Seal, C. J. (2003). Behavioural, attitudinal, and dietary responses to the consumption of wholegrain foods. *Proceedings of the Nutrition Society, 62,* 455-467.

Storey, J. D., Saffitz, G .B., & Rimón, J. G. (2008). Social marketing. In K. Glanz, B. K. Rimer, & Viswanath, K. (Eds), *Health behavior and health education* (Fourth ed., pp. 435-464), San Francisco, CA: Jossey-Bass Publishers.

Wagner, M. (2013). Community-based nutrition education improves knowledge, attitudes, and behaviors related to fruit and vegetable consumption. *Journal of Nutrition Education and Behavior, 45(4),* S39.

Webb, T. L. & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132(2),* 249-268.

Whole Grains Council. (2009). Make half of your grains whole conference. Retrieved from http://wholegrainscouncil.org/files/3.AreWeThereYet.pdf

CHAPTER VI: CONCLUSIONS

Study 1 was conducted in order to determine the nutritional risk and dietary intake frequencies (DIF) of community-residing adults age 60+ years electing to take part in lifestyle intervention programs, in addition to sociodemographic characteristics that influence both nutritional risk and DIF. The aim of Study 2 was to determine the extent to which a whole grain (WG) nutrition education intervention program improves WG behaviors of community residing adults age 60+ years. Both studies utilized the Dietary Screening Tool (DST), with Study 2 focusing solely on the questions related to "DST total grain and WG DIF."

Study 1 suggests that older adults voluntarily participating in nutrition education and/or physical activity intervention programs are "at nutritional risk" or "at possible nutritional risk." Given the prevalence of sarcopenia and osteoporosis among the aging population, future nutrition intervention programs should promote increasing consumption of dairy and protein-rich foods. Among our study participants, DIF of both dairy and protein were considered "low." Additionally, given that state of residence, gender and age had an influence on nutritional risk and DIF for three of seven diet component categories, sociodemographic characteristics of participants should be taken into consideration when developing future lifestyle intervention programming. Other sociodemographic factors such as income level, chronic disease and medication use may also influence outcomes, although these factors were not assessed during Study 1.

The findings from the "Is It Whole Grain? 3 Steps to 3 Servings of Whole Grains" evaluation study denote that it was successful at improving WG knowledge and WG dietary behaviors among community-residing older adults. An increase in "DST WG DIF" may be attributed to the inclusion of hands-on activities and taste-testing of WG foods. Incorporation of SMT-based constructs may also account for the improvements observed. Including theory-based models, targeted, repeated nutrition messages and a PowerPoint education style in future nutrition education intervention programs may increase the likelihood of observing positive changes in knowledge and dietary consumption post-program.

REFERENCES

Abusabha, R., Peacock, J. & Achterberg, C. (1999). How to make nutrition education more meaningful through facilitated group discussions. *Journal of the American Dietetic Association, 99(1),* 72-76.

Adams, et al. (2006). Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *The New England Journal of Medicine, 355,* 763-778.

Adams, J. F. & Engstrom, A. (2000). Helping consumers achieve recommended intakes of whole grain foods. *Journal of the American College of Nutrition, 19(3 Suppl),* 339S-344S.

Administration on Aging, Administration for Community Living & United States Department of Health and Human Services. (2013). *A profile of older Americans: 2013.* Retrieved from http://www.aoa.acl.gov/Aging_ Statistics/Profile/index.aspx

Alliance for Aging Research. (2011). *Aging motion: the facts about sarcopenia.* Retrieved from http://www.aginginmotion.org/wpcontent/uploads/ 2011/04/sarcopenia_fact_sheet.pdf

American Association of Retired Persons. (2009). *Chronic conditions among older Americans.* Retrieved from http://assets.aarp.org/rgcenter/health/ beyond_50_hcr_conditions.pdf

American Medical Association. (2013). *Getting the most for our health care dollars: strategies to address rising health care costs.* Retrieved from http://www.ama-assn.org/ama/pub/advocacy/topics/health-care-costs.page

Arvola et al. (2007). Consumers' beliefs about whole and refined grain products in the US, Italy and Finland. *Journal of Cereal Science, 46(3),* 197-206.

Bailey et al. (2007). A dietary screening questionnaire identifies dietary patterns in older adults. *Journal of Nutrition, 137(2),* 421-226.

Bailey et al. (2009). Dietary screening tool identifies nutritional risk in older adults. *American Journal of Clinical Nutrition, 90(1),* 177-183.

Baker, A. H. & Wardle, J. (2003). Sex differences in fruit and vegetable intake in older adults. *Journal of Appetite, 40(3),* 269-275.

Barr, et al. (2000). Effects of increased consumption of fluid milk on energy and nutrient intake, body weight, and cardiovascular risk factors in healthy older adults. *Journal of the American Dietetic Association, 100(7),* 810-817.

Beebe et al. (2013). Effects of the addition of t'ai chi to a dietary weight loss program on lipoprotein atherogenicity in obese older women. *The Journal of Alternative and Complementary Medicine, 19(9),* 759-766.

Berger, et al. (2006). Cancer in the elderly. *Transactions of the American Clinical and Climatological Association, 117,* 147-156.

Bernstein, et al. (2002). A home-based nutrition intervention to increase consumption of fruits, vegetables, and calcium-rich foods in community dwelling elders. *Journal of the American Dietetic Association, 102(10),* 1421-1427.

Bernstein, M. & Munoz, N. (2012). Position of the Academy of Nutrition and Dietetics: food and nutrition for older adults: promoting health and wellness. *Journal of the Academy of Nutrition and Dietetics, 112,* 1255-1277.

Bhattacharya, J., Currie, J. & Haider, S. (2004). Poverty, food insecurity, and nutritional outcomes in children and adults. *Journal of Health Economics, 23,* 839-862.

Brossoie, N., Roberto, K. A., Willis-Walton, S. & Reynolds, S. (2010). *Report on baby boomers and older adults: information and service needs.* Retrieved from https://vtechworks.lib.vt.edu/handle/10919/46989

Burgess-Champoux, T., Marquart, L., Vickers, Z. & Reicks, M. (2006). Perceptions of children, parents, and teachers regarding whole-grain foods, and implications for a school-based intervention. *Journal of Nutrition Education and Behavior, 38,* 230-237.

Centers for Disease Control and Prevention. (2013). *State indicator report on fruits and vegetables 2013.* Retrieved from http://www.cdc.gov/nutrition/downloads/State-Indicator-Report-Fruits-Vegetables-2013.pdf

Centers for Disease Control and Prevention. (2015). *High blood pressure facts.* Retrieved from http://www.cdc.gov/bloodpressure/facts.htm

Chan, J. M., Wang, F. & Holly, E. A. (2007). Whole grains and risk of pancreatic cancer in a large population-based case-control study in the San Francisco Bay Area, California. *American Journal of Epidemiology, 166(10),* 1174-1785.

Chia-Hui Chen, C., Schilling, L. S. & Lyder, C. H. (2001). A concept analysis of malnutrition in the elderly. *Journal of Advanced Nursing, 36(1),* 131-142.

Correia, M. I. & Waitzberg, D. L. (2003). The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Journal of Clinical Nutrition, 22(3),* 235-239.

Cottell, K. E., Dorfman, L. R., Straight, C. R., Delmonico, M. J. & Lofgren, I. E. The effects of diet education plus light resistance training on coronary heart disease risk factors in community-dwelling older adults. *The Journal of Nutrition, Health & Aging, 15(9),* 762-767.

Daniel, C. R., Cross, A. J., Koebnick, C. & Sinha, R. (2011). Trends in meat consumption in the United States. *Journal of Public Health and Nutrition, 14(4),* 575-583.

de Munter, J. S., Hu, F. B., Spiegelman, D., Franz, M. & van Dam, R. M. (2007). Whole grain, bran, and germ intake and risk of type 2 diabetes: a prospective cohort study and systematic review. *PLoS Medicine, 4(8),* e261.

DeNavas-Walt, C., Proctor, B. D. & Smith, J. C. (2013). *Income, poverty and health insurance coverage in the United States: 2012.* Retrieved from http://www.census.gov/prod/2013pubs/p60-245.pdf

Duerr, L. (2006). Prevalence of food insecurity and comprehensiveness of its measurement for older adult congregate meals program participants. *Journal of Nutrition for the Elderly, 25(3-4),* 121-146.

Elbon, S. M., Johnson, M. A., Fischer, J. G. & Searcy, C. A. (2000). The influence of perceived milk intolerance on dairy product consumption in older American adults. *Journal of Nutrition for the Elderly, 19(1),* 25-39.

Ellis, J., Johnson, M. A., Fischer, J. G. & Hargrove, J. L. (2005). Nutrition and health education intervention for whole grain foods in the Georgia older Americans nutrition programs. *Journal of Nutrition for the Elderly, 24(3),* 67-83.

Ervin, B. R. (2008). *Healthy eating index scores among adults, 60 years of age and over, by sociodemographic and health characteristics: United States, 1999-2002.* Retrieved from http://www.cdc.gov/nchs/data/ad/ad395.pdf

Esmaillzadeh, A., Mirmiran, P. & Azizi F. (2005). Whole-grain consumption and the metabolic syndrome: a favorable association in Tehranian adults. *European Journal of Clinical Nutrition, 59(3),* 353-362.

Fakhouri, et al. (2012). *Prevalence of obesity among older adults in the United States, 2007-2010.* Retrieved from http://www.cdc.gov/nchs/data/databriefs/db106.htm

Flint, et al. (2009). Whole grains and incident hypertension in men. *American Journal of Clinical Nutrition, 90(30),* 493-498.

Florida International University's National Resource Center on Nutrition, Physical Activity & Aging. (2013). *Malnutrition and Older Americans.* Retrieved from http://nutritionandaging.fiu.edu/aging_network/malfact2.asp

Foote, J. A., Giuliano, A. R. & Harris, R. B. (2000). Older adults need guidance to meet nutritional requirements. *Journal of the American College of Nutrition, 19(5),* 628-640.

Francis, S. L. (2012). Heart disease nutrition education program increases familiarity with heart-healthy lifestyle recommendations. *Journal of Nutrition Education and Behavior, 44(6),* 658-660.

Francis, S. L., MacNab, L. & Shelley, M. (2014). A theory-based newsletter nutrition education program reduces nutritional risk and improves dietary intake for congregate meal participants. *Journal of Nutrition in Gerontology and Geriatrics, 33(2),* 91-107.

Francis, S. L. & Taylor, M. L. (2009). A social marketing theory-based diet-education program for women ages 54 to 83 years improved dietary status. *Journal of the American Dietetic Association, 109(12),* 2052-2056.

Francis, S. L., Taylor, M. L. & Haldeman, L. M. (2009). Nutrition education improves morale and self-efficacy for middle-aged and older women. *Journal of Nutrition for the Elderly, 28(3),* 272-286.

Fung et al. (2002). Whole-grain intake and the risk of type 2 diabetes: a prospective study in men. *American Journal of Clinical Nutrition, 76(3),* 535-540.

Furman, E. F. (2006). Undernutrition in older adults across the continuum of care: nutritional assessment, barriers, and interventions. *Journal of Gerontological Nursing, 32(1),* 22-27.

Genkinger, J. M., Platz, E. A., Hoffman, S. C., Comstock, G. W. & Helzlsouer, K. J. (2004). Fruit, vegetable, and antioxidant intake and all-cause, cancer, and cardiovascular disease mortality in a community-dwelling population in Washington County, Maryland. *American Journal of Epidemiology, 160(12),* 1223-1233.

Guigoz, Y. (2006). The Mini Nutritional Assessment (MNA) review of literature—what does it tell us? *Journal of Nutrition, Health & Aging, 10(6),* 466-485.

Guigoz, Y., Vellas, B. & Garry P. J. (1996). Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. *Journal of Nutrition Reviews, 54(1 Pt 2),* S59-S65.

Holben D. H. (2010). Position of the American Dietetic Association: food insecurity in the United States. *Journal of the American Dietetic Association, 110,* 1368-1377.

Houston, D. K., Nicklas, B. J. & Zizza C. A. (2009). Weighty concerns: the growing prevalence of obesity among older adults. *Journal of the American Dietetic Association, 109(11),* 1886-1895.

Houston, et al. (2008). Dietary protein intake is associated with lean mass change in older, community-dwelling adults: the Health, Aging and Body Composition (Health ABC) Study. *American Journal of Clinical Nutrition, 87(1),* 150-155.

Hughes, G., Bennett, K. M. & Hetherington, M. M. (2004). Old and alone: barriers to healthy eating in older men living on their own. *Journal of Appetite, 43(3),* 269-276.

International Osteoporosis Foundation. (2015). *Facts and Statistics.* Retrieved from http://www.iofbonehealth.org/facts-statistics

Iowa Department of Public Health. (2010). *The health of Iowa: impact of overweight and obesity.* Retrieved from https://www.idph.state.ia.us/iowansfitforlife/common/pdf/impact_obesity.pdf

Jacobs, D. R., Pereira, M. A., Meyer, K. A. & Kushi, L. H. (2000). Fiber from whole grains, but not refined grains, is inversely associated with all-cause mortality in older women: the Iowa women's health study. *Journal of the American College of Nutrition, 19(3 Suppl),* 326S-330S.

Janssen I., Shepard D. S., Katzmarzyk P. T. & Roubenoff R. (2004). The healthcare costs of sarcopenia in the United States. *Journal of the American Geriatric Society, 52(1),* 80–85.

Jones, et al. (2002). The importance of promoting a whole grain foods message. *Journal of the American College of Nutrition, 21(4),* 293-297.

Jonnalagadda, et al. (2011). Putting the whole grain puzzle together: health benefits associated with whole grains—summary of American Society for Nutrition 2010 Satellite Symposium. *Journal of Nutrition, 141(5),* 1011S-1022S.

Kamp, B. J., Wellman, N. S. & Russell, C. (2010). Position of the American Dietetic Association, American Society for Nutrition and Society for Nutrition Education: food and nutrition programs for community-residing older adults. *Journal of Nutrition Education and Behavior, 42(2),* 72-82.

Kantor, L. S., Variyam, J. N., Allshouse, J. E., Putnam, J. J. & Lin, B. H. (2001). Choose a variety of grains daily, especially whole grains: a challenge for consumers. *Journal of Nutrition, 131(2S-1),* 473S-86S.

Kasum, et al. (2001). Whole grain intake and incident endometrial cancer: the Iowa women's health study. *Journal of Nutrition and Cancer, 39(2),* 180-186.

Keller, H. H., Hedley, M., Hadley, T., Wong, S. & Vanderkooy, P. (2005). Food workshops, nutrition education, and older adults: a process evaluation. *Journal of Nutrition for the Elderly, 24(3),* 5-23.

Kim, K. & Frongillo, F. A. (2007). Participation in food assistance programs modifies the relation of food insecurity with weight and depression in elders. *Journal of Nutrition, 137(4),* 1005-1010.

Kuznesof et al. (2012). WHOLEheart study participant acceptance of wholegrain foods. *Appetite, 59(1),* 187-193.

Lee, J. S., Fischer, J. G. & Johnson, M. A. (2010). Food insecurity, food and nutrition programs, and aging: experiences from Georgia. *Journal of Nutrition for the Elderly, 29(2),* 116-149.

Lee, J. S. & Frongillo E. A. (2001). Factors associate with food insecurity among U.S. elderly persons: importance of functional impairments. *Journal of Gerontology: SOCIAL SCIENCES, 56B(2),* S94-S99.

Lee, J. S. & Frongillo, E. A. (2001). Nutritional and health consequences are associated with food insecurity among U.S. elderly persons. *Journal of Nutrition, 131,* 1503-1509.

Lefebvre, R. C., & Rochlin, L. (1997). *Social Marketing*. In K. Glanz, F. M. Lewis & B. K. Rimer (Eds.), *Health behavior and health education* (pp. 384-402). San Francisco, CA: Jossey-Bass Publishers.

Lin, B. H. & Yen, S. T. (2007). *The U.S. Grain Consumption Landscape: Who Eats Grain, in What Form, Where and How Much?* Retrieved from http://www. ers.usda. gov/media/216648/err50_1_.pdf

Liu et al. (2000). A prospective study of whole-grain intake and risk of type 2 diabetes mellitus in US women. *American Journal of Public Health, 90(9),* 1409-1415.

Lyons, B. P. (2014). Nutrition education intervention with community-dwelling older adults: research challenges and opportunities. *Journal of Community Health, 39(4),* 810-818.

McArdle, A. & Jackson, M. J. (2011). *Sarcopenia – age-related muscle wasting and* weakness. p. 318. Gordon S. Lynch (ed.). Springer Science.

McKeown, et al. (2009). Whole-grain intake and cereal fiber are associated with lower abdominal adiposity in older adults. *Journal of Nutrition, 139(10),* 1950-1955.

McKeown et al. (2013). Whole grains and health: From theory to practice—highlights of the grains for health foundation's whole grains summit. *Journal of Nutrition, 143(5),* 744S-758S.

McMackin E., Dean M., Woodside J. V. & McKinley M. C. (2013). Whole grains and health: Attitudes to whole grains against a prevailing background of increased marketing and promotion. *Public Health Nutrition, 16(4),* 743-751.

Meck Higgins, M. & Barkley, M. C. (2003). Tailoring nutrition education intervention programs to meet needs and interests of older adults. *Journal of Nutrition for the Elderly, 23(1),* 59-79.

Meck Higgins, M. & Barkley, M. C. (2004). Barriers to nutrition education for older adults, and nutrition and aging training opportunities for educators, healthcare providers, volunteers and caregivers. *Journal of Nutrition for the Elderly, 23(4),* 99-121.

Meck Higgins, M. & Barkley, M. C. (2004). Improving effectiveness of nutrition education resources for older adults. *Journal of Nutrition for the Elderly, 23(3),* 19-54.

Meck Higgins, M. & Clarke, M. (2003). Evaluating outcomes and impact of nutrition education programs designed for older adults. *Journal of Nutrition for the Elderly, 22(4),* 69-81.

Meyer et al. (2000). Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. *American Journal of Clinical Nutrition, 71(4),* 921-930.

National Council on Aging. (2014). *Healthy Aging fact sheet.* Retrieved from http://www.ncoa.org/press-room/fact-sheets/healthy-aging-fact-sheet.html

New Hampshire Department of Health and Human Services. (2011). *2011 New Hampshire state health profile.* Retrieved from www.dhhs.nh.gov/dphs/

O'Brien, Wu & Baer. (2010). *Older Americans in poverty: a snapshot.* Retrieved from http://www.aarp.org/work/retirement-planning/info-04-2010/2010-03-poverty-new.html

O'Neil, C. E., Zanovec, M., Cho, S. S. & Nicklas, T.A. (2010). Whole grain and fiber consumption are associated with lower body weight measures in US adults: national health and nutrition examination survey 1999-2004. *Journal of Nutrition Research, 30(12),* 815-822.

Ortman, J. M., Velkoff, V. A. & Hogan, H. (2014). *An aging nation: the older population in the United States.* Retrieved from http://www.census.gov/prod/2014pubs/p25-1140.pdf

Rubenstein, L. Z., Harker, J. O., Salva, A., Guigoz, Y. & Vellas, B. (2001). Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56(6),* M366-M372.

Sahyoun, N. R. (2002). Nutrition education for the healthy elderly population: isn't it time? *Journal of Nutrition Education and Behavior, 34(1 Suppl),* S42-S47.

Sahyoun, N.R., Jacques, P.F., Zhang, X. L., Juan, W. & McKeown, N. M. (2006). Whole-grain intake is inversely associated with metabolic syndrome and mortality in older adults. *American Journal of Clinical Nutrition, 83(1),* 124-131.

Sahyoun, N. R., Pratt, C. A. & Anderson, A. (2004). Evaluation of nutrition education interventions for older adults: a proposed framework. *Journal of the American Dietetic Association, 104(1),* 58-69.

Schatzkin, A., Park, Y., Leitzman, M. F., Hollenbeck, A.R. & Cross, A. J. (2008). Prospective study of dietary fiber, whole grain foods, and small intestinal cancer. *Journal of Gastroenterology, 135(4),* 1163-1170.

Schatzkin, et al. (2007). Dietary fiber and whole-grain consumption in relation to colorectal cancer in the NIH-AARP diet and health study. *American Journal of Clinical Nutrition, 85(5),* 1353-1360.

Schwarzer, R. (2008). Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. *Journal of Applied Psychology, 57(1),* 1-29.

Scrimshaw, N. S. & SanGiovanni, J. P. (1997). Synergism of nutrition, infection, and immunity: an overview. *American Journal of Clinical Nutrition, 66(2),* 464S-477S.

Shores, K. A., West, S. T., Theriault, D. S. & Davison, E. A. (2009). Extra-individual correlates of physical activity attainment in rural older adults. *The Journal of Rural Health, 25(2),* 211-218.

Silver, H. J. & Wellman, N. S. (2002). Nutrition education may reduce burden in family caregivers of older adults. *Journal of Nutrition Education and Behavior, 34(1),* S53-S58.

Slavin, J. (2003). Why whole grains are protective: biological mechanisms. *The Proceeding of the Nutrition Society, 62(1),* 129-134.

Slavin, J. (2004). Whole grains and human health. *Nutrition Research Reviews, 17,* 99-110.

Slavin, J. L. (2008). Position of the American Dietetic Association: health implications of dietary fiber. *Journal of the American Dietetic Association, 108(10),* 1716-1731.

Smith, A. T., Kuznesof, S., Richardson, D. P. & Seal, C. J. (2003). Behavioural, attitudinal, and dietary responses to the consumption of wholegrain foods. *Proceedings of the Nutrition Society, 62,* 455-467.

Södergren, M., McNaughton, S. A., Salmon, J., Ball, K. & Crawford, D. A. (2012). Associations between fruit and vegetable intake, leisure-time physical activity, sitting time and self-rated health among older adults: cross-sectional data from the WELL study. *BMC Public Health, 12,* 1-9.

Stefano, D., Veneto, G., Malservisi, S., Strocchi, A. & Corazza, G. R. (2001). Lactose malabsorption and intolerance in the elderly. *Scandinavian Journal of Gastroenterology, 36(12),* 1274-1278.

Steffen, et al. (2003). Associations of whole-grain, refined-grain, and fruit and vegetable consumption with risks of all-cause mortality and incident coronary artery disease and ischemic stroke: the Atherosclerosis Risk in Communities (ARIC) Study. *American Journal of Clinical Nutrition, 78(3),* 383-390.

Storey, J. D., Saffitz, G. B., & Rimón, J. G. (2008). *Social Marketing*. In K. Glanz, B. K. Rimer & Viswanath, K. (Eds.), *Health behavior and health education* (pp. 435-464). San Francisco, CA: Jossey-Bass Publishers.

Stratton, et al. (2004). Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. *British Journal of Nutrition, 92(5),* 799-808.

Stratton, R. J., King, C. L., Stroud, M. A., Jackson, A. A. & Elia, M. (2006). 'Malnutrition Universal Screening Tool' predicts mortality and length of hospital stay in acutely ill elderly. *British Journal of Nutrition, 95(2),* 325-330.

Substance Abuse and Mental Health Service Administration and the United States Administration on Aging. (2012). *Rhode Island policy academy state profile.* Retrieved from http://www.aoa.acl.gov/AoA_Programs/HPW/Behavioral/docs2/Rhode%20Island%20Epi%20Profile%20Final.pdf

Symons, et al. (2007). Aging does not impair the anabolic response to a protein-rich meal. *American Journal of Clinical Nutrition, 86(2), 451-456.*

Terry, P., Lagergren, J., Ye, W., Wolk, A. & Nyren, O. (2001). Inverse association between intake of cereal fiber and risk of gastric cardia cancer. *Gastroenterology, 120(2),* 387-391.

Thomas, L. Jr., Almanza, B. & Ghiselli, R. (2010). Nutrition knowledge of rural older populations: can congregate meal site participants manage their own diets? *Journal of Nutrition for the Elderly, 29(3),* 325-344.

Tighe, et al. (2010). Effect of increased consumption of whole-grain foods on blood pressure and other cardiovascular risk markers in healthy middle-aged persons: a randomized control trial. *American Journal of Clinical Nutrition, 92(4),* 733-740.

United States Census Bureau. (2013). *State & county quick facts: Iowa.* Retrieved from quickfacts.census.gov/qfd/states/19000.html

United States Census Bureau. (2013). *State & county quick facts: New Hampshire.* Retrieved from quickfacts.census.gov/qfd/states/33000.html

United States Census Bureau. (2013). *State & county quick facts: Rhode Island.* Retrieved from quickfacts.census.gov/qfd/states/44000.html

United States Department of Agriculture. (2015). *MyPlate food groups.* Retrieved from http://www.choosemyplate.gov/food-groups/

United States Department of Agriculture Agriculture Research Service, *What We Eat in America,* NHANES. (2011-2012). *Mean daily food patterns cups/ounce equivalents consumed per individual, by gender and age, in the United States, 2011-2012.* Retrieved from http://www.ars.usda.gov/Services/docs.htm?docid=23868

United States Department of Agriculture Agriculture Research Service, *What We Eat in America,* NHANES. (2011-2012). *Nutrient intakes from food and beverages: mean amounts consumed per individual, by gender and age, in the United States, 2011-2012.* Retrieved from http://www.ars.usda.gov/Services/docs.htm?docid=18349

United States Department of Agriculture & United States Department of Health and Human Services. (2010). *Dietary guidelines for Americans 2010.* Retrieved from *www.health.gov/dietaryguidelines/dga2010/dietaryguidelines2010.pdf*

United States Department of Health and Human Services. (2013). *2013 National healthcare quality report.* Retrieved from http://www.ahrq.gov/research/findings/nhqrdr/nhqr13/2013nhqr.pdf

United States Department of Health and Human Services. (2015). *Disability and health.* Retrieved from http://www.healthypeople.gov/2020/topics-objectives/ topic/disability-and-health

United States Department of Health and Human Services Agency for Healthcare Research and Quality. (2012). *Healthy Men.* Retrieved from http://www.ahrq.gov/patients-consumers/patient-involvement/healthy-men/

United States Department of Health and Human Services, Centers for Disease Control and Prevention & National Center for Health Statistics. (2012). *Summary health statistics for U.S. adults: national health interview survey, 2012.* Retrieved from http://www.cdc.gov/nchs/data/series/sr_10/sr10_260.pdf

United States Department of Health and Human Services, Centers for Disease Control and Prevention & National Center for Health Statistics. (2013). *Health, United States, 2013 with special feature on prescription drugs.* Retrieved from http://www.cdc.gov/nchs/data/hus/hus13.pdf

United States Department of Health & Human Services Office of Disease Prevention and Health Promotion & Food and Drug Administration. (2008). *Health and diet survey: dietary guidelines supplement—report of findings (2004 & 2005).* Retrieved from http://www.fda.gov/Food/FoodScienceResearch/ConsumerBehaviorResearch/ucm080331.htm

Vailas, L. I., Nitzke, S. A., Becker, M. & Gast, J. (1998). Risk indicators for malnutrition are associated inversely with quality of life for participants in meal programs for older adults. *Journal of the American Dietetic Association, 98(5),* 548-553.

van Dam, R. M., Rimm, E. B., Willett, W. C., Stampfer, M. J. & Hu, F. B. (2002). Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. *Annals of Internal Medicine, 136(3),* 201-209.

Villareal, et al. (2005). Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. *Journal of Obesity Research, 13(11),* 1849-1863.

Visvanathan, R., Newbury, J. W. & Chapman, I. (2004). Malnutrition in older people—screening and management strategies. *Australian Family Physician, 33(10),* 799-805.

Wacker, R. R. & Roberto, K. A. (2013). Community resources for older adults: Programs and services in an era of change. Thousand Oaks: SAGE Publications, Inc.

Wagner, M. (2013). Community-based nutrition education improves knowledge, attitudes, and behaviors related to fruit and vegetable consumption. *Journal of Nutrition Education and Behavior, 45(4),* S39.

Walston, J. D. (2012). Sarcopenia in older adults. *Current Opinion in Rheumatology, 24(6),* 623-627.

Wang, et al. (2007). Whole-and refined-grain intakes and the risk of hypertension in women. *American Journal of Clinical Nutrition, 86(2),* 472-479.

Wang, L., Manson, J. E., Gaziano, J. M., Buring, J. E. & Sesso, H. D. (2012). Fruit and vegetable intake and the risk of hypertension in middle-aged and older women. *American Journal of Hypertension, 25(2),* 180-189.

Warensjö, et al. (2011). Dietary calcium intake and risk of fracture and osteoporosis: prospective longitudinal cohort study. *BMJ,* 1-9.

Webb, T. L. & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132(2),* 249-268.

Wellman N. S., Weddle D. O., Kranz S. & Brain C. T. (1997). Elder insecurities: poverty, hunger, and malnutrition. *Journal of the American Dietetic Association, 97(10 Suppl 2),* S120-S122.

Werner, C. A. (2011). *The older population: 2010.* Retrieved from http://www.census.gov/newsroom/releases/archives/2010_census/cb11-cn192.html

Whole Grains Council. (2009). Make half of your grains whole conference. Retrieved from http://wholegrainscouncil.org/files/3.AreWeThereYet.pdf

Whole Grains Council. (2013). *What counts as a serving?* Retrieved from http://wholegrainscouncil.org/whole-grains-101/what-counts-as-a-serving

Wu, K. B. (2010). *Income, poverty and health insurance coverage of older Americans, 2010.* Retrieved from http://www.aarp.org/content/dam/aarp/research/public_policy_institute/econ_sec/2011/fs232.pdf

Ziliak, J. P. & Gunderson, C. (2011). *Food insecurity among older adults.* Retrieved from http://www.aarp.org/content/dam/aarp/aarp_foundation/pdf_2011/AARPFoundation_HungerReport_2011.pdf

Zizza, C. A., Duffy, P. A. & Gerrior, S. A. (2008). Food insecurity is not associated with lower energy intakes. *Journal of Obesity, 16(8),* 1908-1913.

APPENDIX A

CHEF CHARLES EVALUATION STUDY SOCIODEMOGRAPHIC QUESTIONS

Mealsite (circle one): Ankeny Northwest Pioneer/Columbus Central

Previous Chef Charles Program participation

- Yes
- No
- Don't Know

If yes, how long?

- < 1 year
- 2-5 years
- 6 or more years

What was your age on your last birthday? _____ years

Sex:

- Male
- Female

Ethnicity:

- White
- Black or African American
- Hispanic or Latino
- Asian
- Native Hawaiian or other Pacific Islander
- American Indian
- Other (specify) _____

Education:

- Eighth Grade
- High school and/or GED
- Some college
- Associates degree
- Technical school
- Bachelor's degree
- Graduate degree

Marital Status:

- Never Married
- Married
- Divorced
- Widow/Widower

APPENDIX B

INFORMED CONSENT DOCUMENT: CHEF CHARLES EVALUATION STUDY

Title of Study: Chef Charles Nutrition Education Program Project

Investigators:
Dr. Sarah L. Francis, Dept. of Food Science & Human Nutrition
Carlene Russell, MS RD LD, Iowa Department on Aging
Doris Montgomery, MS RD LD, Iowa Department of Public Health
Marilyn Jones, Administrative Assistant, Iowa Department of Public Health
Ms. Rebecca Brotzman, Graduate Student

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION
The purpose of this study is to pilot test a community-based, nutrition education program called Chef Charles. The study will take place at four Polk County congregate mealsites.

Chef Charles Revision Project Description:
The Chef Charles program is a monthly 30 minute nutrition education program provided at congregate meal sites and led on-site by a nutrition educator or volunteer. Participants receive a full color, monthly newsletter focusing on current nutrition and health topics, activities and exercises that improve flexibility, strength and balance, and sampling a recipe. The purpose of this proposed project is to revise the Chef Charles nutrition education program for Iowans age 60+ years and determine if changes in nutritional status and dietary intake result. There will be two "test" sites and two "control" sites. Each site will receive the same information; the difference between "test" sites and "control" sites will be the way in which the information is presented.

You are being invited to participate in this study because you meet the following qualifications to enroll as a participant: 1) age 60+, 2) currently participating in the congregate meal program, 3) able to read a newspaper without difficulty, and 4) willing to complete questionnaires.

DESCRIPTION OF PROCEDURES
If you agree to participate, you will be asked to participate in the Chef Charles program for six months. You will also be asked to complete a comprehensive questionnaire at two different times during the study. This questionnaire may take up to 20 minutes to complete. The questionnaire will ask information about nutritional status, health behaviors, and food purchasing. For the first questionnaire, you will also be asked to provide general descriptive information. Additionally, following the six month study period you will complete a program evaluation (about 10 minutes to complete). The

program evaluation asks about what you liked and did not like about the Chef Charles Program and any changes (positive or negative) you may have made as a result.

RISKS
While participating in this study the risk to you is minimal. You may also find answering pre- and post-questionnaires inconvenient.

BENEFITS
If you decide to participate in this study there may be direct benefit to you including improved nutritional status, improved dietary intake and more confidence in following healthful dietary practices. It is hoped that the information gained in this study will benefit society in that we will have created a nutrition education program that improves nutritional status and dietary practices.

COSTS AND COMPENSATION
You will need to pay for travel from your house to the on-site program and back home.

Midway (Month 3) and at the close (Month 6) of the program, you will receive a $25 check (total $50). You will need to complete a form in order to receive this item via mail within two weeks. This form will require your address as the checks will be mailed directly to you. This information allows the University to fulfill government reporting requirements. Confidentiality measures are in place to keep this information secure. You may forego receipt of the item and continue in the focus group discussion if you do not wish to complete this form. Information regarding documentation required for participant compensation may be obtained from the Controller's Department; 294-2555 or http://www.controller.iastate.edu.

PARTICIPANT RIGHTS
Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. When completing the questionnaires, you can skip any questions that you do not wish to answer.

CONFIDENTIALITY
Records identifying all Chef Charles program members will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies including the Wellmark Foundation (the funding agency), auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: each participant will be identified with a code number to which only the research team members have access. Identifying documents (e.g. registration forms) will be kept

separate from the coded documents in the PI's office. The collected data will be kept for five years following the close of the study or until the results are published, whichever occurs first. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study. For further information about the study contact Dr. Sarah L. Francis, 515-294-1456. If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

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PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in "Chef Charles Nutrition Education Program Project" study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant's Name (printed) _____

_____ _____

(Participant's Signature) (Date)

APPENDIX C

INFORMED CONSENT DOCUMENT: "IS IT WHOLE GRAIN?" PROGRAM EVALUATION

Title of Study: "Is it Whole Grain?" Program Evaluation

Investigators:
Dr. Sarah L. Francis, Dept. of Food Science & Human Nutrition

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION
The purpose of this study is to pilot test a community-based, whole grain nutrition education program called "Is it Whole Grain?" The study will take place at various community locations within a 35 mile radius of Iowa State University.

"Is It Whole Grain?" Program Description:
The "Is it Whole Grain" program is a three-week (1 hour)whole grain focused nutrition education program provided at various community locations and led on-site by an Iowa State University Extension and Outreach state nutrition specialist. Participants will receive the three sequential one hour sessions targeting breakfast, lunch, dinner and snacks. These sessions include several interactive activities including taste testing. Prior to Session 1 and after Session 3 participants will be asked to complete a pre- and post-questionnaire to assess if changes occur. The purpose of this evaluation study is to assess the effectiveness and acceptability of the "Is it Whole Grain?" program.

You are being invited to participate in this study because you meet the following qualifications to enroll as a participant: 1) age 60+, 2) willing to attend three weekly education sessions, 3) able to read a newspaper without difficulty, and 4) willing to complete questionnaires.

DESCRIPTION OF PROCEDURES
If you agree to participate, you will be asked to participate in the "Is it Whole Grain?" program (3 weeks). You will also be asked to complete a comprehensive questionnaire at two different times during the study. This questionnaire may take up to 20 minutes to complete. The questionnaire will ask information about whole grain selection behaviors and consumption. For the first questionnaire, you will also be asked to provide general descriptive information. Additionally, following the three week study period you will complete a program evaluation (about 10 minutes to complete). The program evaluation asks about what you liked and did not like about the "Is it Whole Grain?" Program and any changes (positive or negative) you may have made as a result.

RISKS
While participating in this study the risk to you is minimal. You may also find answering pre- and post-questionnaires inconvenient.

BENEFITS
If you decide to participate in this study there may be direct benefit to you including improved nutritional status, improved dietary intake and more confidence in following healthful dietary practices. It is hoped that the information gained in this study will benefit society in that we will have created a nutrition education program that improves nutritional status and dietary practices.

COSTS AND COMPENSATION
You will need to pay for travel from your house to the on-site program and back home.

After the third session you will receive the "Healthy Homemade" cookbook (ISU Extension and Outreach). You will need to complete a form verifying receipt of this item. This information allows the University to fulfill government reporting requirements. Confidentiality measures are in place to keep this information secure. You may forego receipt of the item and continue in the focus group discussion if you do not wish to complete this form. Information regarding documentation required for participant compensation may be obtained from the Controller's Department; 294-2555 or http://www.controller.iastate.edu.

PARTICIPANT RIGHTS
Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. When completing the questionnaires, you can skip any questions that you do not wish to answer.

CONFIDENTIALITY
Records identifying all "Is it Whole Grain?" program members will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies including ISU Extension and Outreach (the funding agency), auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: each participant will be identified with a code number to which only the research team members have access. Identifying documents (e.g. registration forms) will be kept separate from the coded documents in the PI's office. The collected data will be kept for five years following the close of the study or until the results are published, whichever occurs first. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study. For further information about the study contact Dr. Sarah L. Francis, 515-294-1456. If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

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PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in "Is it Whole Grain?" program evaluation study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant's Name (printed) _____

_____ _____

(Participant's Signature) (Date)

APPENDIX D

DIETARY SCREENING TOOL

Please answer the following questions about your dietary intake.	***Office Use Only***
1. How often do you usually eat fruit as a snack? □ Never (0) □ Less than once a week (2) □ 1 or 2 times a week (4) □ 3 or more times a week (5)	**DST 1**
2. How often do you usually eat whole grain <u>breads</u>? □ Never **or** less than once a week (0) □ 1 or 2 times a week (3) □ 3 or more times a week (5)	**DST2**
3. How often do you usually eat whole grain <u>cereals</u>? □ Never **or** less than once a week (0) □ 1 or 2 times a week (3) □ 3 or more times a week (5)	**DST3**
4. How often do you usually eat candy or chocolate? □ Never (4) □ Less than once a week (3) □ 1 or 2 times a week (2) □ 3 or more times a week (0)	**DST4**
5. How often do you eat crackers, pretzels, chips, or popcorn? □ Never (4) □ Less than once a week (3) □ 1 or 2 times a week (2) □ 3 or more times a week (0)	**DST5**
6. How often do you eat cakes or pies? □ Never (4) □ Less than once a week (3) □ 1 or 2 times a week (2) □ 3 or more times a week (0)	**DST6**
7. How often do you eat cookies? □ Never (4) □ Less than once a week (3) □ 1 or 2 times a week (2) □ 3 or more times a week (0)	**DST7**
8. How often do you eat ice cream? □ Never (4) □ Less than once a week (3) □ 1 or 2 times a week (2) □ 3 or more times a week (0)	**DST8**

	Office Use Only
9. How often do you eat cold cuts, hot dogs, lunchmeats or deli meats? □ Never **or** less than once a week (0) □ 1 or 2 times a week (3) □ 3 or more times a week (5)	**DST 9**
10. How often do you eat bacon or sausage? □ Never **or** less than once a week (0) □ 1 or 2 times a week (3) □ 3 or more times a week (5)	**DST10**
11. How often do you eat carrots, sweet potatoes, broccoli, or spinach? □ Never (0) □ Less than once a week (2) □ 1 or 2 times a week (6) □ 3 or more times a week (8)	**DST11**
12. How often do you eat fruit (not including juice)? Please include fresh, canned or frozen fruit. □ Never **or** Less than once a week (0) □ 1 or 2 times a week (2) □ 3 to 5 times a week (4) □ Every day or almost every day (5)	**DST12**
13. How often do you eat hot or cold breakfast cereal? □ Never (0) □ Less than once a week (1) □ 1 or 2 times a week (3) □ 3 to 5 times a week (4) □ Every day or almost every day (5)	**DST13**
14. How often do you drink some kind of juice at breakfast? □ Never **or** Less than once a week (0) □ 1 or 2 times a week (2) □ 3 to 5 times a week (4) □ Every day or almost every day (5)	**DST14**
15. How often do you eat chicken or turkey? □ Never **or** less than once a week (0) □ 1 or 2 times a week (3) □ 3 or more times a week (5)	**DST15**
16. How often do you drink a glass of milk? □ Never **or** Less than once a week (0) □ 1 or 2 times a week (1) □ 3 to 5 times a week (3) □ Every day or almost every day (4) □ More than once every day (5)	**DST16**
	Office Use Only

17. Do you usually add butter or margarine to foods like bread, rolls, or biscuits? □ Yes (0) □ No (1)	**DST17**
18. Do you usually add fat (butter, margarine or oil) to potatoes and other vegetables? □ Yes (0) □ No (1)	**DST18**
19. Do you use gravy (when available) at meals? □ Yes (0) □ No (1)	**DST19**
20. Do you usually add sugar or honey to sweeten your coffee or tea? □ Yes (0) □ No (1)	**DST20**
21. Do you usually drink wine, beer or other alcoholic beverages? □ Yes (0) □ No (1)	**DST21**
22. How often do you eat fish or seafood that <u>IS NOT</u> fried? □ Never (0) □ Less than once a week (1) □ Once a week (3) □ More than once a week (5)	**DST22**
23. How many servings of milk, cheese, or yogurt do you usually have each DAY? □ None (0) □ One (3) □ Two or more (5)	**DST23**
24. How many different vegetable servings do you usually have at your main meal of the day? □ None (0) □ One (1) □ Two (5) □ Three or more (7)	**DST24**
25. Which of the following best describes your nutritional supplement use? □ I don't use supplements (0) □ I use supplements other than vitamins and mineral (0) □ I use a multivitamin/mineral preparation (e.g. Centrum) (5)	**DST25**

APPENDIX E

"IS IT WHOLE GRAIN?" PROGRAM EVALUATION PRE QUESTIONNAIRE

ID # _____

PRE-Survey: "Is It Whole Grain?"

We need your help! Please answer the following questions. Your answers to these questions will help us to evaluate the "Is It Whole Grain?" program. Thank you!

1. Do you think eating more whole grains will help you to reduce your risk of the following diseases and conditions? *Please put a check mark (√) in the column that best answers the question - "yes," "no," or "don't know."*

Disease/Condition	Yes	No	Don't Know
Memory loss			
Cancer			
Heart disease			
Colds and respiratory infections			
Bowel conditions (constipation, diverticulosis)			
Type 2 diabetes			

2. How many servings of whole grain are recommended for adults each day? *Please check (√) only one answer.*

_____ 0 serving
_____ 1 serving
_____ 2 servings
_____ 3 servings
_____ 4 servings
_____ 5 or more servings

3. Whole grain foods are defined as: *[Please check (√) only one answer]*

_____ Any grain that is brown and has a course texture.
_____ A grain that has all the parts of the grain kernel (bran, germ, endosperm) in the same amounts found in the natural grain kernel.
_____ A grain that has the bran and germ removed during processing.
_____ Foods made from white flour with bran added to it.

4. Please indicate with a check mark (√) if the food listed below is made from 100% whole grain, some whole grain and some refined grain (white enriched flour), refined grain only, or is not a grain food. If you don't know, check that column.

Food	100% Whole Grain	Some Whole Grain	Refined Grains	Not a Grain Food	Don't Know/Not Sure
Oatmeal					
Brown rice					
Beans					
Whole wheat bread					
White bread					
Wheat bread					
Multigrain bread					
Pumpernickel bread					
Popcorn					
Flax seed					
Bran muffin					

5. What are 3 steps you can take to quickly and accurately determine if a food is whole grain? *Check (√) only one response.*

_____ 1. Look for brown color and course texture of the food;
2. Look at the grams of fiber on the Nutrition Facts Label;
3. Check for "wheat" in the name of the food.

__ ___ 1. Look for "100% whole wheat or whole grain" on the front of the package;
2. Check the first 3 ingredients on the ingredient list for terms like whole wheat, whole oats;
3. Look for the whole grain health claim or whole grain stamp or symbols.

_____ 1. Look for "multi-grain" in the name of the food;
2. Read the information on the package to see if it says "made with whole grain;"
3. Rely on advertisements on television and magazines to help you select whole grain foods.

6. What information on a food product package would tell you if a food is whole grain? *Please check (√) the "Yes" column if the information tells you it is whole grain, "No" if it doesn't, or if you don't know.*

Information	Yes	No	Don't Know
Whole Grain Logo by the WholeGrainsCouncil.org			
Nutrition Facts label (calories, fat, sodium, etc.)			

Ingredient list			
Picture or color of the food			
Whole grain health claim			
100% whole wheat or whole grain in the name of the food or on the front of the package			
"Wheat" in the name			
"Multigrain" in the name			
"Stoneground" in the name			
Whole Grain Heart Check Mark by the American Heart Association			

7. Below is the ingredient list for Barney's Double Fiber Multigrain Bread. Is this bread whole grain? _____ No _____ Yes _____ Don't Know

Barney's Double Fiber Multigrain Bread
Ingredients: Unbleached enriched wheat flour [flour, malted barley, niacin, reduced iron, thiamin mononitrate (vitamin B1), riboflavin (vitamin B2), folic acid], water, sugar, yeast, wheat bran. Contains 2% or less of: soybean oil, salt, 100% whole wheat flour, ground millet, barley, oats, calcium propionate, monoglycerides, calcium sulfate, grain vinegar, citric acid, soy lecithin, calcium carbonate, whey, rice bran.

8. How often do you eat these foods? *Place a check mark (√) in the column that best answers the question for you.*

Food	Less than 1/week	Once a week	2-3 times a week	4-6 times a week	1 or more times a day
Oatmeal					
Brown rice					
Whole grain cereal (cold)					
Whole grain pasta or noodles					
Brown or "wheat" bread					
White bread					
Multi-grain bread					
Whole grain bread					
Whole wheat crackers					
Popcorn					

9. Please answer the following questions by placing a check mark (√) in the column that best fits your answer.

	Yes	No	Don't know
Do you like the taste of whole grain foods?			

Do you prefer the taste of white bread to whole wheat bread?			
Whole wheat bread is more expensive than white bread.			
I know how to use the food package to select whole grain foods.			
Do you grocery shop?			
Do you plan the meals you eat?			
Do you cook the meals you eat?			

The following questions will help us describe the "Is It Whole Grain?" program participants when we report the results of this study in peer-reviewed journals.

Are you?

_____ Female _____ Male

What is your race?

_____ White
_____ Black
_____ Hispanic
_____ American Indian or Alaska Native
_____ Asian
_____ Other, please describe:

What is your age?

_____ 60 to 70 years
_____ 71 to 80 years
_____ 81 to 90 years
_____ 91 to 100 years
_____ 101 years or older

What is the highest level of education completed?

_____ Eighth grade
_____ High school and/or GED
_____ Some college
_____ Associates degree
_____ Technical school
_____ Bachelor's degree
_____ Graduate degree

Do you or have you ever had any of the following *(Mark [√] all that apply)*?

_____ Diabetes
_____ Cancer
_____ Heart disease or heart attack
_____ High blood cholesterol

_____ High blood pressure or hypertension
_____ Bowel disorder (constipation, diverticulosis, diverticulitis)
_____ Celiac disease (treated by a gluten-free diet)
_____ Food allergy to any grain

APPENDIX F

"IS IT WHOLE GRAIN?" PROGRAM EVALUATION POST QUESTIONNAIRE

ID # _____

POST-Survey: "Is It Whole Grain?"

We need your help! Please answer the following questions. Your answers to these questions will help us to evaluate the "Is It Whole Grain?" program. Thank you!

1. Do you think eating more whole grains will help you to reduce your risk of the following diseases and conditions? *Please put a check mark (√) in the column that best answers the question - "yes," "no," or "don't know."*

Disease/Condition	Yes	No	Don't Know
Memory loss			
Cancer			
Heart disease			
Colds and respiratory infections			
Bowel conditions (constipation, diverticulosis)			
Type 2 diabetes			

2. How many servings of whole grain are recommended for adults each day? *Please check (√) only one answer.*

_____ 0 serving
_____ 1 serving
_____ 2 servings
_____ 3 servings
_____ 4 servings
_____ 5 or more servings

3. Whole grain foods are defined as: *[Please check (√) only one answer]*

_____ Any grain that is brown and has a course texture.
_____ A grain that has all the parts of the grain kernel (bran, germ, endosperm) in the same amounts found in the natural grain kernel.
_____ A grain that has the bran and germ removed during processing.
_____ Foods made from white flour with bran added to it.

4. Please indicate with a check mark (√) if the food listed below is made from 100% whole grain, some whole grain and some refined grain (white enriched flour), refined grain only, or is not a grain food. If you don't know, check that column.

Food	100% Whole Grain	Some Whole Grain	Refined Grain	Not a Grain Food	Don't Know/Not Sure
Oatmeal					
Brown rice					
Beans					
Whole wheat bread					
White bread					
Wheat bread					
Multigrain bread					
Pumpernickel bread					
Popcorn					
Flax seed					
Bran muffin					

5. What are 3 steps you can take to quickly and accurately determine if a food is whole grain? *Check (√) only one response.*

_____ 1. Look for brown color and course texture of the food;
2. Look at the grams of fiber on the Nutrition Facts Label;
3. Check for "wheat" in the name of the food.

_____ 1. Look for "100% whole wheat or whole grain" on the front of the package;
2. Check the first 3 ingredients on the ingredient list for terms like whole wheat, whole oats;
3. Look for the whole grain health claim or whole grain stamp or symbols.

_____ 1. Look for "multi-grain" in the name of the food;
2. Read the information on the package to see if it says "made with whole grain;"
3. Rely on advertisements on television and magazines to help you select whole grain foods.

6. What information on a food product package would tell you if a food is whole grain? *Please check (√) the Yes if the information tells you it is whole grain, No if it doesn't, or if you don't know.*

Information	Yes	No	Don't Know
Whole Grain Logo by the WholeGrainsCouncil.org			
Nutrition Facts label (calories, fat, sodium, etc.)			

Ingredient list			
Picture or color of the food			
Whole grain health claim			
100% whole wheat or whole grain in the name of the food or on the front of the package			
"Wheat" in the name			
"Multigrain" in the name			
"Stoneground" in the name			
Whole Grain Heart Check Mark by the American Heart Association			

7. Below is the ingredient list for Barney's Double Fiber Multigrain Bread. Is this bread whole grain? _____ No _____ Yes _____ Don't Know

Barney's Double Fiber Multigrain Bread
Ingredients: Unbleached enriched wheat flour [flour, malted barley, niacin, reduced iron, thiamin mononitrate (vitamin B1), riboflavin (vitamin B2), folic acid], water, sugar yeast, wheat bran. Contains 2% or less of: soybean oil, salt, 100% whole wheat flour, ground millet, barley, oats, calcium propionate, monoglycerides, calcium sulfate, grain vinegar, citric acid, soy lecithin, calcium carbonate, whey, rice bran.

8. How often do you eat these foods? *Place a check mark (√) in the column that best answers the question for you.*

Food	Less than 1/week	Once a week	2-3 times a week	4-6 times a week	1 or more times a day
Oatmeal					
Brown rice					
Whole grain cereal (cold)					
Whole grain pasta or noodles					
Brown or "wheat" bread					
White bread					
Multi-grain bread					
Whole grain bread					
Whole wheat crackers					
Popcorn					

9. Please answer the following questions by placing a check mark (√) in the column that best fits your answer.

	Yes	No	Don't know
Do you like the taste of whole grain foods?			
Do you prefer the taste of white bread to			

whole wheat bread?			
Whole wheat bread is more expensive than white bread.			
I know how to use the food package to select whole grain foods.			
Do you grocery shop?			
Do you plan the meals you eat?			
Do you cook the meals you eat?			

10. How many sessions of the "Is It Whole Grain?" program did you attend?

_____ 1 session
_____ 2 sessions
_____ 3 sessions

11. As a result of attending the "Is It Whole Grain?" program, do you intend to eat more whole grain foods?

_____ No
_____ Yes
_____ Not sure

If you answered "yes," briefly describe the change you intend to make to eat more whole grain foods:

If you answered "yes" above, how strong is your intention to eat more whole grain foods? *Please circle the number that best represents the strength of your intention.*

1 2 3 4 5 6 7

Do not intend to eat more whole grain | Moderately intend to eat more whole grain | Strongly intend to eat more whole grain

APPENDIX G

"IS IT WHOLE GRAIN?" PROGRAM EVALUATION

ID:_____

"Is It Whole Grain?" Program Evaluation

These evaluation questions will help us determine which aspects of the "Is It Whole Grain?" program you enjoyed and those you did not. Please answer these questions honestly, as your comments will help us improve the program. Thank you again for participating!

Please **circle** the choice that best answers the question.	**Office Use Only**
1. I decided to participate in the "Is It Whole Grain?" program because *(check all that apply):* a. I have a health condition my health care provider said would be helped by diet (e.g. diabetes, heart disease, diverticulosis) (1) b. It seemed like it would be a fun way to socialize (2) c. It was provided at a convenient location and time (3) d. All of the above (4) e. None of the above (5)	Eval1a-e
2. After attending the "Is It Whole Grain?" program, I am eating more whole grain foods: a. Strongly agree (1) b. Agree (2) c. Undecided (3) d. Disagree (4) e. Strongly disagree (5)	Eval2
3. I feel confident that I can accurately determine if a food is whole grain by reading the information on the package: a. Strongly agree (1) b. Agree (2) c. Undecided (3) d. Disagree (4) e. Strongly disagree (5)	Eval3
4. The aspect I liked ***best*** about the "Is It Whole Grain?" program was:	Eval4
5. The aspect I liked ***least*** about the "Is It Whole Grain?" program was:	Eval5

6. The "Is It Whole Grain?" program **activities** helped me to better use and apply the information about whole grains: a. Strongly agree (1) b. Agree (2) c. Undecided (3) d. Disagree (4) e. Strongly disagree (5)	Eval6
7. The "Is It Whole Grain?" **slides** helped me to better use and apply the information about whole grains: a. Strongly agree (1) b. Agree (2) c. Undecided (3) d. Disagree (4) e. Strongly disagree (5) f. Not applicable (6)	Eval7
8. The "Is It Whole Grain?" handouts and booklet helped me to better use and apply the information about whole grains: a. Strongly agree (1) b. Agree (2) c. Undecided (3) d. Disagree (4) e. Strongly disagree (5)	Eval8
9. In addition to the program materials, I also looked for information about whole grains from *(check all that apply)*: a. I did not seek additional information about whole grains (1) b. Television (2) c. Magazines (3) d. Health professionals (e.g. doctor, nurse, dietitian) (4) e. Other _____	Eval9
10. Overall, I thought the "Is It Whole Grain?" program was: a. Excellent (1) b. Good (2) c. Okay (3) d. Can be improved (4)	Eval10
11. I would recommend the "Is It Whole Grain?" program to a friend. a. Strongly agree (1) b. Agree (2) c. Undecided (3) d. Disagree (4) e. Strongly disagree (5)	Eval11
12. The length of the "Is It Whole Grain?" sessions were: a. Too long; **please answer 5a** (1)	Eval12

b. Too short; **please answer 5b** (2) c. The right length (3)	
12a. If you said the "Is It Whole Grain?" sessions were too long, how long do you think they should last? _____ hours _____ minutes	Eval12a
12b. If you said the "Is It Whole Grain?" sessions were too short, how long do you think they should last? _____ hours _____ minutes	Eval12b
13. Please add any other suggestions or comments you have about the "Is It Whole Grain?" program:	Eval13