A Whole Grain Education Program for Older Adults: Its Effectiveness on Older Adults' Knowledge and Intake of Whole Grains and its Implications for Use with Younger Adults

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A WHOLE GRAIN EDUCATION PROGRAM FOR OLDER ADULTS: ITS EFFECTIVENESS ON OLDER ADULTS’ KNOWLEDGE AND INTAKE OF WHOLE GRAINS AND ITS IMPLICATIONS FOR USE WITH YOUNGER ADULTS

BY

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THESIS

Submitted to the University of New Hampshire in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Nutritional Sciences

December, 2014
This thesis has been examined and approved in partial fulfillment of the requirements for the degree of Master of Science in Nutritional Sciences.

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On September 12, 2014

Original approval signatures are on file with the University of New Hampshire Graduate School.
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ABSTRACT

A WHOLE GRAIN EDUCATION PROGRAM FOR OLDER ADULTS: ITS EFFECTIVENESS ON OLDER ADULTS’ KNOWLEDGE AND INTAKE OF WHOLE GRAINS AND ITS IMPLICATIONS FOR USE WITH YOUNGER ADULTS

by

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University of New Hampshire, December, 2014

The average adult in America eats less than one serving of the recommended three serving minimum of whole grains each day. Consumption of whole grains in older adults is particularly low; consumption in college students is even lower. This pilot study investigated the effectiveness of a three-session nutrition education program, entitled Is It Whole Grain? to improve older adults knowledge, identification and consumption of whole grains. Based on the analysis of pre- and post- intervention whole grain questionnaire responses from 157 older adults, aged 60 or older, residing in New Hampshire and Iowa, significant improvements in older adults’ knowledge and intake frequency of whole grains were shown. Participants’ mean pre- to post- whole grain knowledge scores increased significantly from 15.46 ± 0.38 to 21.96 ± 0.31 (p < 0.001). Participants’ median frequency of whole grains consumed increased significantly from eight to ten times a week (p=0.009). The whole grain knowledge and consumption of 256 undergraduate college students from the University of New Hampshire were assessed using a similar pre-intervention whole grain survey as that of the older adults. The
college students’ whole grain knowledge and consumption levels were statistically different to that of the pre-intervention older adults, yet effect sizes were small. College students’ median knowledge scores were slightly higher than that of the older adults, 18.0 versus 16.0 out of 31.0 respectively. Yet college students’ intake was lower, the median number of times whole grains were consumed in a week was 6.0 compared to 8.0 in that of the older adults. The overall low whole grain knowledge and intake of the younger population suggest that they would benefit from whole grain education similar in content to that for the older adults, with particular emphasis on the grain content of foods, taste testing and the practical application of concepts in the discernment of whole grain foods. Validation of a whole grain assessment tool appropriate for older adults is needed to further advance the findings generated from this pilot study. Input and feedback from college students, such as through focus group interviews, would guide the development of whole grain education tailored to their interests and needs.
CHAPTER 1

LITERATURE REVIEW

Whole Grain Intake Recommendations and Consumption

Whole grains are an important part of a healthy diet. The current Dietary Guidelines for Americans 2010 and Healthy People 2020 Nutrition and Weight Status Objectives emphasize the need for increased whole grain consumption in the diets of Americans and worldwide. The whole grain recommendation for adults aged 19 and older, set forth by the Dietary Guidelines for Americans 2010 and United States Department of Agriculture’s ChooseMyPlate.gov, is to eat half of all grains as whole grains and more specifically, consume a minimum of three ounce-equivalents a day; the exact recommendations are dependent on the individual’s age, sex and activity level. In addition, Americans are urged to replace their intake of refined grains with whole grains to stay within caloric intake limits.

Despite the intake recommendations and health benefits associated with whole grain consumption, less than 2% of U.S. adults consume the recommended amount for their sex and age group. Based on dietary data from the 2007-10 National Health and Nutrition Examination Survey (NHANES), the estimated mean whole grain intake for males and females, 19 years and older, was 0.9 ounces and 0.8 ounces a day respectively.
An ounce-equivalent of whole grains, also referred to as one serving in the literature, contains sixteen grams of whole grain ingredients. Examples of one serving of a whole grain food include 1 slice of whole grain bread; ½ cup of cooked: whole grain cereal (such as oatmeal), whole wheat pasta or brown rice; 1 cup of ready-to-eat whole grain cereal flakes; 5 to 7 small whole wheat crackers; one 6-inch whole wheat tortilla or 3 cups popped popcorn. The majority of whole grains in the American diet, 56.9%, are consumed at breakfast. Seventeen percent are consumed as snacks; 12 to 14% are consumed at each of the remaining two meals, lunch and dinner. Cereals and breads, respectively, are the leading food sources of whole grains in the American diet and together account for approximately 70% of whole grain intake. Based on 2009-10 NHANES one day dietary intake data, the major whole grain food sources consumed by adults, 19 years and older, include yeast breads and rolls (27%), oatmeal (21%), ready-to-eat cereals (20%) and popcorn (9%). These findings are similar to the dietary intake data from the 2001-2 NHANES in which the leading whole grain food sources were ready-to-eat cereals (28.7%), yeast breads (25.3%), hot cereals (13.7%), popcorn (12.4%) and crackers (6.4%).

Grain Terminology

A plethora of vocabulary accompanies whole grains and can contribute to the inadequate intake and confusion that often accompanies a consumer’s ability to select whole grains and whole grain foods.
Structure of a Grain

A grain is the seed, or kernel, of a cereal grass from the Poaceae family, such as wheat, oats, corn, rice or barley. This grain kernel has three distinct parts: the bran, germ and endosperm. The hard outer covering that encases the kernel and protects the endosperm and germ from pestilence, disease and the environment is the bran.\textsuperscript{9,10} It is a rich source of fiber, minerals, B vitamins, small amounts of vitamin E and phytochemicals, particularly phenolic compounds.\textsuperscript{9-12} The endosperm is the large inner portion of the grain kernel which provides food for the germ and energy for the plant.\textsuperscript{9,10} It is comprised primarily of starchy digestible carbohydrates, protein and the B vitamins, riboflavin and pantothenic acid.\textsuperscript{9,10,13} The germ, or embryo, is the smallest fraction of the kernel that eventually grows into a new plant.\textsuperscript{9,10} It contains B vitamins, vitamin E, minerals, phytochemicals, some protein and fat.\textsuperscript{9,10,12} Minerals present in the bran and the germ include iron, magnesium, selenium and zinc.\textsuperscript{13}

![Grain Anatomy](image)

Figure 1. A whole grain.
(Permission for use granted by: Bob’s Red Mill Natural Foods)
Definition of a Whole Grain

A whole grain contains all three parts of the grain kernel: the bran, germ and endosperm. The American Association of Cereal Chemists International (AACCI) issued the following definition of a whole grain in 1999: "Whole grains shall consist of the intact, ground, cracked or flaked caryopsis, whose principal anatomical components—the starchy endosperm, germ, and bran—are present in the same relative proportions as they exist in the intact caryopsis."14 To assist the U.S. food industry and manufacturers in the labeling of whole grain products, the United States Food and Drug Administration (FDA) published a draft guidance on whole grain label statements in February of 2006.15 AACI added pseudocereals, seeds of plant species external to the Poaceae family, to their whole grain definition in 2006 as their macronutrient composition, function in the diet and preparation techniques are similar to that of cereal grains. Pseudocereals include amaranth, quinoa and buckwheat.16 These pseudocereals are considered whole grains by the FDA as well.15

Whole Grain Foods

Whole grains can be eaten as a single food (such as brown rice, quinoa, oatmeal and popcorn) or as an ingredient in a food. For example, whole wheat is a whole grain ingredient commonly used in pasta products and breads. Whole grain foods can contain the intact whole grain kernel or be reconstituted. In an intact whole grain food, the grain kernel is unchanged and it retains its original proportions of bran, germ and endosperm. In a reconstituted whole grain food product, the whole grains are milled (separating the kernel into its three parts: the bran, germ and endosperm) and then recombined so that the
proportions of bran, germ and endosperm are similar to that of the original grain kernel. The majority of whole grain foods on the market today are reconstituted.\textsuperscript{9,10}

Until December of 2012, a consistent definition of a whole grain food did not exist making it particularly difficult to determine which partial whole grain foods were actually considered whole grain foods. It is speculated that the lack of a standard definition prior to this time has hindered progress in the area of whole grains, impacting research, the food industry and the consumer. Based on a roundtable discussion of multidisciplinary experts representing United States and Europe, a definition of a whole grain food was established as a food containing at least 8 grams of whole grains per 30-gram serving.\textsuperscript{17} This definition is consistent with the 2010 Dietary Guidelines as well as the Whole Grain Working Group’s categorization of a whole grain product, approved by the AACC\textsuperscript{i} Board of Directors in late April, 2013.\textsuperscript{1,14} It is anticipated that the establishment of a standard whole grain food definition will encourage the food industry to formulate new whole grain products that meet this definition, further research efforts in whole grains, create consistency in product labeling and ultimately help consumers meet whole grain dietary recommendations.\textsuperscript{17}

A Refined Grain

A refined grain, in contrast, is milled. Milling partially or completely removes the bran and/or germ retaining the endosperm. While this process gives grains a longer shelf life and a finer texture, it reduces a grain’s nutrient density. For example, refined flour, compared to whole wheat flour, is lower in protein, phytochemicals, many vitamins and minerals, and approximately 80\% lower in fiber. Most refined grains are enriched, whereby some of the nutrients lost during the refinement process are replaced. Some
grain foods are also fortified, in which nutrients never present in the original food are added.\textsuperscript{18,19} Per FDA requirements, a food can bear a nutrient content claim of “enriched” or “fortified” if it contains 10% or more of the Daily Value of that nutrient compared to the same food that is not enriched. These claims may only be used if the added nutrients have established Daily Values, such as vitamins, minerals, protein and dietary fiber.\textsuperscript{19}

**Nutrient Content of Whole Grains versus Refined Grains**

While specific nutrients can be added through enrichment and fortification to improve a refined grain’s nutrient density, it does not match the nutrient density of a whole grain. For example, thiamin, riboflavin, niacin, folic acid and iron are added to enrich refined flour per FDA requirements, yet other minerals and vitamins present in whole wheat flour are not replaced.\textsuperscript{18,20} Refined flour contains only 7\% of the vitamin E, 13\% of the vitamin B-6 and 16\% of the magnesium of whole wheat flour.\textsuperscript{18}

Evidence is mounting that many of the health-protection and disease-prevention benefits associated with whole grain intake may be attributed to the phytochemical content of whole grains. Research regarding the exact roles and metabolism of whole grain phytochemicals in the human body is ongoing; discussed below are just some of the functions that these phytochemicals may play. Many whole grain phytochemicals, such as phenolic acids, lignans, phytic acid and carotenoids, exhibit antioxidative effects. They can minimize or prevent oxidative damage from free radicals and thus may decrease the risk of certain cancers and cardiovascular disease.\textsuperscript{10,13} Phytoestrogens, such as isoflavones and lignin, may yield anticarcinogenic effects through a variety of mechanisms including the inhibition of tumor formation and proliferation, regulation of sex hormone metabolism and its impact on enzyme activity.\textsuperscript{13,21} Plant sterols and stanols
exhibit cholesterol-lowering effects and thus may be cardio protective.\textsuperscript{9,22} Dietary fiber, resistant starch and oligosaccharides may help lower cholesterol, control blood glucose and insulin concentrations, improve digestive health and thereby may lower the risk of certain gastrointestinal cancers and cardiovascular disease.\textsuperscript{9,10}

The majority of whole grain phytochemicals are found in the bran and germ rather than the endosperm. A study examining the phytochemical and antioxidant activity of the endosperm to that of the bran/germ fractions of whole wheat flour revealed the bran/germ fractions to contribute 85 to 94\% of the antioxidant activity, 83\% of the total phenolic content, 79\% of the flavonoids, 51\% of the lutein, 78\% of the zeaxanthin and 42\% of the β-cryptoxanthin content (lutein, zeaxanthin and β-cryptoxanthin are common carotenoids).\textsuperscript{23}

These findings highlight that the nutrient and phytochemical density inherent in whole grains is greater than that of refined grains. The components in whole grains may work alone or synergistically to yield their many health benefits; the exact mechanisms are currently unclear and further research in this area continues.

**Health Benefits of Whole Grains**

Research indicates that the consumption of whole grains, as compared to refined grains, is associated with better gastrointestinal health, weight management, and the reduced risk of many diseases and health conditions including cardiovascular disease, type 2 diabetes and certain cancers, specifically cancers of the lower gastrointestinal tract. Whole grain intake and its association with reduced cardiovascular disease risk and lower body weight is supported by moderate evidence; limited evidence is available regarding type 2 diabetes incidence.\textsuperscript{1,24} Much of the evidence is based on large, population-based,
prospective, observational studies, which infer associations. The evidence from clinical trials, which can infer causality, is less and the results more variable.

**Cardiovascular Disease**

Cardiovascular disease (CVD) is the leading cause of mortality in the United States, accounting for 32.3% of all deaths in 2009. Whole grain consumption is repeatedly linked to the risk reduction of CVD in large epidemiologic studies. Results from the Atherosclerosis Risk in Communities Studies, Women’s Health Study, Health Professionals Follow-Up Study and the Iowa Women’s Health Study, reveal whole grain intake to be significantly associated with a 7 to 30% reduction in CVD risk over nine to thirteen years of follow up. A recent meta-analysis of ten longitudinal studies concluded that a daily whole grain intake of 48 to 80 grams, or 3-5 servings, was associated with a 21% lower CVD risk compared to those who rarely or never consumed whole grains.

Whole grain intake is shown to impact factors that influence CVD risk as well, particularly serum lipid concentrations and blood pressure. Whole grain consumption is associated with lower concentrations of total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-c). A 2012 meta-analysis of 21 randomized control trials estimated that increased whole grain intake for 4 to 16 weeks significantly reduced total and LDL-c concentrations by 0.83 mmol/L and 0.72 mmol/L respectively. Cross-sectional data from 1516 subjects in the Baltimore Longitudinal Study of Aging showed a significant decrease in both serum TC and LDL-c concentrations across quintiles of increasing whole grain intake. In the 2013 *American Heart Association/American College of Cardiology Guideline of Lifestyle Management to Reduce Cardiovascular Risk,*
consumption of a dietary pattern inclusive of whole grains is recommended to help lower LDL-c concentrations.\textsuperscript{33}

Whole grain foods higher in viscous or soluble fibers, such as oats and barley, significantly reduced TC and LDL-c concentrations compared to foods higher in nonviscous or insoluble fibers, such as wheat and brown rice in numerous studies.\textsuperscript{34-40} In a 12-week randomized controlled trial of 144 overweight and obese hypercholesterolemic adults, subjects consuming two daily portions of a whole grain ready-to-eat cereal, supplying three grams of the soluble fiber, β-glucan, were able to significantly reduce their TC and LDL-c concentrations compared to those subjects eating energy equivalent low fiber foods.\textsuperscript{36} The dose dependent effects of β-glucan were illustrated in a clinical trial of 25 hypercholesterolemic males and females in which subjects consumed whole grain foods containing 0, 3 or 6 grams of β-glucan from barley for 5 weeks each. Consumption of the medium and high β-glucan diets significantly lowered TC levels by 9\% and 10\%, respectively, and significantly lowered LDL-c by 13.8\% and 17.4\%, respectively.\textsuperscript{34} Every 10\% reduction in serum TC or LDL-c correlates with a reduced risk of coronary heart disease by 15\% to 10\% respectively.\textsuperscript{41} Sample populations in the studies reviewed included free living, healthy adults as well as those with hypercholesterolemia, suggesting the effects may be generalizable to a wide population of adults.

Based on the strength of the evidence regarding the effectiveness of viscous fiber to reduce cholesterol concentrations, viscous fiber intake is recommended in the treatment of high cholesterol. The Therapeutic Lifestyle Changes diet, recommended by the National Institute of Health’s National Cholesterol Education Program, recommends
increasing daily viscous fiber intake to 10 to 25 grams as part of their cholesterol lowering diet. This report also cites that daily consumption of 5 to 10 grams of viscous fiber can reduce LDL-c levels by ~5%. In addition, the FDA approved health claims for β-glucan in whole oats and barley, citing that a daily minimum of three grams can lower TC, LDL-c and coronary heart disease risk. A thorough review of 22 studies from 1997 to 2010 regarding the soluble fiber β-glucan found in oats, provides recent data to substantiate the above recommendations. The authors concluded that a daily minimum of three grams of oat β-glucan may reduce TC and LDL-c concentrations by 5% to 10% in people with normal and high blood cholesterol levels.

The exact mechanisms by which viscous fibers act to lower serum cholesterol concentrations are largely unknown. The most widely accepted mechanism, and one that provides the most evidence scientifically, involves the effects of viscous fibers on lipid and bile acid metabolism. It is thought that viscous fiber binds bile acids, inhibiting their absorption in the small intestine and increasing their excretion. Viscous fibers, due to their gel forming capacity, also create a thick unstirred water layer which physically inhibits lipid absorption (including bile acids and cholesterol) and increases excretion as well. As bile acids are precursors of endogenous cholesterol, both of these processes force bile acid synthesis from cholesterol pools in the liver and from circulating cholesterol. The net effect is lower serum cholesterol levels.

Whole grain intake is significantly associated with a lower risk of hypertension in prospective cohort studies involving both older and younger adults as well. Consumption of three daily servings of whole grains, the average whole grain intake recommendation for an adult, was associated with a reduced risk of incident hypertension
by 11% in a cohort study of ~ 30,000 middle to older aged female health professionals from the Women’s Health Study and by 19% in a similar sized cohort study of men from the Health Professionals Follow-Up Study, also middle to older aged. A 4% reduction in hypertension risk was shown with each additional whole grain serving per day consumed in the Women’s Health Study, demonstrating a dose response relationship. Also in this study, hypertension risk remained statistically significant after adjusting for fiber, suggesting that other components of whole grains, in addition to fiber, may contribute to this decreased risk.

Reduced risk of incident hypertension was also shown in the Coronary Artery Risk Development in Young Adults (CARDIA) study, involving ~4300 adults, and aged 18 to 30 years at baseline, followed over 15 years. Daily whole grain consumption of 1.9 servings was associated with a 17% reduced risk of incident hypertension compared to those who consumed less than 0.4 servings a day. In both the CARDIA study and the Women’s Health Study, refined grain intakes were not associated with reduce blood pressure.

The evidence from randomized controlled trials is less consistent. Modest but significant reductions in systolic blood pressure were shown in the majority of studies reviewed. However a recent meta-analysis of 21 randomized controlled trials, in which blood pressure was examined in seven, found lower but not statistically significant, reductions in systolic or diastolic blood pressure after whole grain interventions compared with controls. The existing evidence is strong enough, however, that whole grain intake is recommended in the treatment of hypertension by the Dietary Approaches to Stop Hypertension (DASH) Diet. The Eighth Joint National Committee in their 2014
Evidence-Based Guideline for the Management of High Blood Pressure in Adults

does not directly address body weight management in the provided text. However, it does endorse the lifestyle recommendations of the 2013 American College of Cardiology/American Heart Association Lifestyle Work Group which also recommends a dietary pattern inclusive of whole grains to lower blood pressure.56

Body Weight Management

Obesity is a public health concern that affects Americans of all ages. Over two-thirds (69%) of U.S. adults, aged 20 and older, are overweight or obese; more than one-third (35.1%) are obese.57 Body mass index (BMI), a ratio comparing a person’s weight to height, is used to assess weight status and is also an estimate of the relative risk of morbidity and mortality. A BMI of 25.0 to 29.9 kg/m2 is considered overweight and increases the risks of morbidity and mortality. Being obese, with a BMI of 30.0 kg/m2 or greater, further increases morbidity and mortality risks. Health risks associated with excess body weight include cardiovascular disease, diabetes, cancer and arthritis.58

Based on 2009-12 NHANES data, approximately 71% of older adults, aged 65+, are overweight or obese; ~ 36 % in each of these weight classifications.59 These statistics are comparable to those obtained from the 2012 Behavioral Risk Surveillance System in which 76% of the older adults, 65+ years, surveyed were overweight or obese; 40% overweight and 26% obese. The prevalence of obesity is lower in the younger adult population, but also a health concern. Self-reported 2012 BRFSS data revealed that 40% of younger adults, aged 18 to 24, were overweight or obese; 25.3%, overweight and 14.7%, obese.60

Self-reported data obtained from college students in the spring 2008 American College Health Association-National College Health Assessment (ACHS/NCHA)
revealed that 22% of the approximate 80,000 college students surveyed were overweight, 10% were obese. The data in which self-reported heights and weights were used to determine BMI, that of the BRFSS and the ACHS/NCHA, may actually underestimate the prevalence of overweight and obesity as individuals tend to underreport these measurements. During the college years, young adults are also particularly vulnerable to weight gain. Many college students gain an average of 3.86 pounds during the freshman year of college, according to a meta-analysis of 24 studies. Over four years of college, studies report significant gains in weight and BMI; many gain an average of 5.5 to 6.7 pounds; BMI increases range from 0.7 to 1.0 kg/m$^2$. Seventy percent gained weight over the four years in Gropper’s study of 131 students. These students had significant increases in waist circumference and weight, 5.3 kg (11.7 pounds) on average, and those classified as overweight or obese escalated from 18% to 31%. These results highlight the need for dietary strategies that promote weight regulation and prevent weight gain on college campuses.

Eating whole grains is one dietary strategy that can aid in body weight management. Cross sectional studies show higher intakes of whole grains to be associated with lower BMI and lower abdominal adiposity, as measured by waist circumference and waist: hip ratio. A meta-analysis of 15 cross sectional studies involving ~120,000 adults, aged 13 and older, documented consumption of ~3 servings of whole grains a day to be significantly associated with lower BMI and central adiposity, although the findings were modest. Of the 120,000 subjects, a 0.6 kg/m$^2$ lower BMI was calculated in those with high whole grain intake compared to those with low or no whole grain intake. (p<0.0001) Mean differences in waist circumference and waist: hip ratio of
the lowest and highest whole grain intake groups were compared in subgroup analyses to assess central adiposity. A 2.7 cm lower waist circumference (p=0.03, n=4200) and 0.023 cm reduced waist: hip ratio (P<0.0001, n=20,150) was reported amongst the highest whole grain consumers. A thorough review article of 12 cross-sectional studies also support these findings, citing differences in BMI ranging from 1.0 to 2.5 kg/m² between those with highest whole grain intakes compared to those with lowest whole grain intakes.

In cross sectional studies involving older adults, individuals eating the most whole grains, approximately 3 servings a day, had significantly lower BMI's, 0.7 kg/m² to 1.2 kg/m² lower, compared to those eating the least whole grains, 0.6 servings or less. Greater whole grain intake was also significantly associated with smaller waist circumference, lower total percent body fat and lower percent trunk fat mass in older adults. McKeown et al. observed reduced percentages of body fat and trunk fat mass in the absence of significant changes in BMI, suggesting that higher whole grain consumption may lower central adiposity independent of body weight. Similarly, in a 12-week randomized control trial of 79 overweight or obese postmenopausal women, significant reductions in fat mass percentage, a trend toward lower central fat mass percentage yet insignificant differences in weight loss were observed in those consuming a diet with whole grain foods compared to those consuming the equivalent amount of refined grain foods.

Few studies have examined whole grain intake and college students. A cross sectional study of 159 college students, however, did find a relationship between whole grain intake and BMI. Students with healthy BMI’s had significantly higher whole grain
intakes, 0.8 servings per day, compared to students with overweight and obese BMI’s, 0.6 and 0.3 servings per day respectively. These students also ate a significantly greater proportion of their total grains as whole grains, 14.8%, compared to that of overweight and obese students who consumed respectively 9.1% and 5.9% of their total grains as whole grains.\textsuperscript{71}

Longer term effects of whole grain intake, both less weight gain and reduced risk of obesity over time, are shown in large, prospective studies. Studies involving cohorts from the Nurses’ Health Study, Health Professional Follow-up Study and the Physicians’ Health Study, found that subjects with higher whole grain intakes gained 0.39 kg to 0.49 kg less weight over 8 to 13 years of follow up.\textsuperscript{72-74} Although these findings are modest, yet statistically significant, it shows that whole grains can contribute towards reduced weight gain over time and suggest it is best incorporated in combination with additional weight management measures. Among the \textasciitilde{}74,000 female nurses in the Nurses’ Health Study, women in the highest quintile of whole grain intake (2.7 servings/day) had a 23% less risk of major weight gain (\(\geq 25\) kg) over 12 years compared to women in the lowest whole grain intake quintile, demonstrating the reduced risk of obesity over time.\textsuperscript{74} A 2012 meta-analysis calculated that consumers of 3 to 5 servings (48 to 60 g) of whole grains a day gained 1.27 kg (2.8 pounds) whereas never or rare consumers of whole grains a day gained 1.64 kg (3.6 pounds) over 8 to 13 years (p=0.001).\textsuperscript{31}

In contrast, clinical trials yield inconsistent findings regarding whole grain’s impact on body weight, in part due to inadequate sample sizes and the short duration of many clinical trials. A recent meta-analysis of randomized controlled trials, involving 2060 subjects, concluded that whole grain consumption, compared with refined grain
consumption, does not reduce body weight or waist circumference but may reduce body fat percentages slightly.\textsuperscript{75} It is also difficult to completely control dietary intake in studies using free living subjects. For example, in the WHOLEheart study, a randomized dietary intervention study of 316 free-living healthy, overweight British individuals, no significant changes in body weight, waist circumference or body fat were observed upon the substitution of 60 g or 120 g of whole grains for refined grains. Yet the authors noted that the subjects did not do as instructed and tended to add rather than substitute whole grains for refined grains, resulting in increased total energy intakes with whole grain intake affecting study results.\textsuperscript{76} The presence of residual confounding from other lifestyle and dietary factors in observational studies may account for some of the inconsistencies between clinical trials and observational studies as well. Higher whole grain intakes are associated with better diet quality, higher nutrient intakes and healthier lifestyles. For example, people who eat more whole grains often smoke less and exercise more. Their diets, overall, tend to be higher in fruits and vegetables and lower in saturated fat, meat and alcohol.\textsuperscript{66,68,77}

Whole grains are thought to play a role in body weight regulation through a variety of mechanisms. Whole grain foods often require increased eating effort and take longer to chew which can slow the rate of eating. They help promote satiation or feelings of fullness at the end of a meal due to their greater food volume, lower energy density (less calories per unit weight) compared to refined grains, lower glycemic index and slower gastric emptying. Whole grain foods can also enhance satiety or feelings of fullness for several hours after a meal. The fiber in whole grains, especially viscous (or soluble) fibers due to their gel forming capacity, help decrease insulin secretion, slow
intestinal transit times and slow nutrient digestion and absorption in the small intestine. Decreased insulin secretion also increases fat oxidation and decreases fat storage. Lastly, whole grains may alter the levels and types of bacteria in the gut. For example, whole grain intake can influence the production of short chain fatty acids that stimulate the secretion of the gut hormones, peptide YY and GLP-1. These hormones help suppress appetite, slow intestinal transit times and impact glucose metabolism. Whole grain intake may modulate gut microbiota as well. Research is ongoing in this area; evidence is emerging that the composition of gut bacteria may be linked to obesity and may be sensitive to dietary factors such as whole grain intake.9,66,78-80

Type 2 Diabetes

While the body of evidence linking whole grain intake to diabetes is not as strong as that of CVD or body weight management, it is substantial enough to warrant the FDA’s approval of its most recent health claim regarding whole grains and type 2 diabetes: “Whole grains may reduce the risk of type 2 diabetes, although the FDA has concluded that there is very limited scientific evidence for this claim.”81

The bulk of the evidence is based on prospective cohort studies in which researchers compared the incidence of type 2 diabetes and whole grain intake, estimated from food frequency questionnaires.82-86 In over 150,000 female nurses from the Nurses Health Studies I and II, the highest quintiles of whole grain intake, 2 and 2.5 servings per day respectively, had a 14% and 25% reduced risk of type 2 diabetes respectively after adjusting for potential confounders including BMI.82 An even greater reduction in type 2 diabetes incidence, 30%, was observed with greater consumption of whole grains, 3.5 servings a day, after adjusting for BMI in approximately 43,000 male health
professionals. In this study, only whole grains, and not refined grains, were associated with reduced type 2 diabetes risk.\textsuperscript{83}

The health benefits associated with the substitution of refined grains with whole grains was demonstrated in a more recent study that examined the consumption of brown rice versus white rice using these same three cohorts. Eating at least two weekly servings of brown rice was significantly associated with a lower risk of type 2 diabetes, whereas high intakes of white rice were associated with a higher risk of type 2 diabetes. Sun et al. estimated that replacing 50 grams (1/3 cup) of cooked white rice/day with an equivalent amount of brown rice or whole grain foods was associated with a 16\% or 36\% lower risk of type 2 diabetes respectively.\textsuperscript{84}

A recent study specific to older adults highlighted the dose-response relationship between whole grain intake and incident type 2 diabetes in ~ 72,000 postmenopausal women followed for a median 7.9 years. While a 25\% reduced risk of incident type 2 diabetes, after adjusting for confounders including BMI, was observed in women who ate at least 2 servings of whole grains a day, a lower risk of type 2 diabetes was also shown in those who ate lower intakes of whole grains, such as 1 serving a day.\textsuperscript{85}

Two recent meta-analyses support these findings. Eating 3 to 5 servings of whole grains a day was associated with a ~26\% lower risk type 2 diabetes; 3 servings was associated with a 32\% lower type 2 diabetes risk in meta-analyses conducted by Ye et al and Aune et al. respectively.\textsuperscript{31,87} Refined grains were not found to be associated with reduced type 2 diabetes risk by Aune et al., further supporting the replacement of refined grains with whole grains.\textsuperscript{87} Priebe et al. in their systematic Cochrane review concur with the above findings, estimating a 27 to 30\% reduced risk of type 2 diabetes. Priebe
furthermore concluded, that although the findings from prospective studies linking whole grain intake and type 2 diabetes are consistent, well designed randomized controlled trials are needed to establish a causal relationship.\textsuperscript{88}

Magnesium and fiber within whole grains appear to play key roles in lowering the risk of type 2 diabetes, as evidenced by the attenuation of whole grains’ impact on incident type 2 diabetes after adjusting for these two components in many of the prospective studies.\textsuperscript{83,85,86} Whole grain foods containing higher amounts of soluble fibers, such as oats, rye and barley, slow digestion and the absorption of carbohydrates and are more effective at controlling blood glucose and insulin concentrations compared to foods higher in insoluble fibers, such as whole wheat.\textsuperscript{13} Higher whole grain intakes were associated with lower fasting insulin concentrations amongst middle aged adults in the Framingham Offspring Study and the Insulin Resistance Atherosclerosis Study (IRAS) as well as among young adults in the CARDIA study.\textsuperscript{89-91} The association between whole grain intake and fasting insulin remained significant after adjustments for BMI in the Framingham Offspring Study, yet was attenuated after adjustments for dietary fiber and magnesium also suggesting that these nutrients play a role in insulin regulation.\textsuperscript{89} Pereira et al. estimated that replacing two servings of white bread with whole grain foods could result in a 15% lower fasting insulin concentration in their study of young adults.\textsuperscript{91} Liese et al. calculated similar findings in their study of Tehranian adults; an increase of one daily serving of whole grains, in addition to the already consumed average 0.8 servings of whole grains a day, was associated with 6.3% lower fasting insulin and a 13.5% higher insulin sensitivity.\textsuperscript{90} Higher whole grain intake was significantly associated with lower fasting glucose concentrations in \textasciitilde 500 older adults.
residing in Boston. Ye et al. supports the above findings in their recent meta-analysis of 12 randomized control trials which calculated small but significantly lower fasting glucose and insulin concentrations, weighted mean differences of -0.93 mmol/L and -0.29 pmol/L respectively, with higher whole grain intakes. Whole grain’s association with improved insulin sensitivity and lower glycemic response may contribute towards reduced diabetes risk as well.

Other Health Conditions

While numerous studies document the inverse association between whole grain intake and CVD, diabetes and excess body weight, evidence also suggests that eating whole grains impact gastrointestinal health, certain cancers and metabolic syndrome, although the body of scientific literature is limited.

Gastrointestinal Health. Dietary fiber, non-digestible carbohydrates within whole grains, are shown to improve gastrointestinal health. Dietary fibers are often classified according to their solubility in water. Insoluble fibers do not dissolve in water, possess a greater capacity to retain water and are only minimally fermented by bacteria in the colon. These insoluble fibers help soften the stool, increase fecal volume and accelerate stool transit times which ultimately increase stool frequency and can alleviate constipation. Soluble fibers dissolve in water and are fermented by a variety of bacteria in the colon. The fermentation of soluble fibers increases both fecal and bacterial biomass, alters pH in the colon and produces short chain fatty acids. All whole grains contain both soluble and insoluble fibers, although the proportions of each vary based on the kind of grain. Most whole grains, such as whole wheat and brown rice, contain more
insoluble fibers than soluble fibers. Oats, rye and barley contain greater amounts of soluble fibers than most whole grains.\textsuperscript{9,22,78}

Inulin, found in high concentrations in whole wheat, rye and barley, is primarily fermented by bifidobacteria and bacteroides in the colon.\textsuperscript{92,93} Resistant starch is another fermentable fiber found in corn, whole wheat and barley; it is estimated that these grains contain 31\%, 27\% and 33\% resistant starch respectively, based on in-vitro canine models. The flours derived from these three grains contain lesser amounts of resistant starch.\textsuperscript{9}

Fermentation of both inulin and resistant starch increase fecal mass, stimulate the growth of probiotics or beneficial intestinal bacteria, and generate short-chain fatty acids.\textsuperscript{9,22,92-95}

In a randomized crossover study involving eleven males and females, greater resistant starch intake was associated with greater fecal mass and fecal output.\textsuperscript{95}

The effects of short chain fatty acids within the colon are many; they inhibit the growth of harmful bacteria by lowering pH, stimulate blood flow, increase tone, promote colonocyte proliferation, and reverse atrophy associated with low fiber diets.\textsuperscript{9,22,96}

Production of the short-chain fatty acid, butyrate, is particularly prolific upon the fermentation of resistant starch and is proportional to the resistant starch content of the whole grain. Whole wheat and corn rank as the highest producers of butyrate, followed by barley and oats, and rice produces the least butyrate. Butyrate is the primary energy source for colonic epithelial cells and is essential for maintaining the health of these cells.\textsuperscript{9}

**Colorectal Cancer.** Whole grain consumption and its impact on cancer is strongest regarding colorectal cancer. According to the American Cancer Society, colorectal cancer is the third most common type of cancer in the United States and ranks
as the third leading cause of cancer death among both males and females.\textsuperscript{97} A 2011 meta-analysis of six prospective cohort studies found that three daily servings of whole grains was associated with a 17\% lower risk of colorectal cancer and also revealed a dose-response relationship in that higher intakes were associated with even lower risks.\textsuperscript{98} These findings are similar to that of the NIH-AARP Diet Health Study involving approximately 490,000 male and female older adults, aged 50 to 71 at baseline. Whole grain intake was assessed using a self-administered food frequency questionnaire and compared to colorectal cancer incidence over five years of follow-up. A statistically significant 21\% lower risk of colorectal cancer was found in the highest quintile (1.3 servings/1000 calories/day) compared to the lowest quintile of whole grain intake; these results remained significant and remained relatively unchanged after adjusting for fiber intake suggesting that additional components within whole grains contribute to this decreased risk. The reduction in risk was stronger for rectal cancer (36\%) in comparison to colon cancer (14\%).\textsuperscript{99} The relationship between whole grain intake and other cancers is less studied and often yields conflicting outcomes.\textsuperscript{93}

**Metabolic Syndrome.** As studies indicate whole grain intake to be inversely related to many of the risk factors associated with metabolic syndrome, a reduced risk of this syndrome with whole grain consumption would be expected. Yet few studies have explored this association and outcomes are inconsistent. Metabolic syndrome increases a person’s risk of heart disease, type 2 diabetes and stroke and is characterized by the following risk factors: abdominal obesity, hypertension, elevated blood triglycerides, low HDL (high-density lipoprotein) cholesterol and elevated fasting plasma glucose.\textsuperscript{58}
In a cross sectional study of ~ 500 older adults, aged 60 to 98, adults who ate ~ 3 servings of whole grains a day, as assessed via a three-day food record, had a 36% lower prevalence of metabolic syndrome than did adults who ate less than one serving of whole grains a day. The associated risk factors of BMI and fasting glucose concentration were also significantly lower among those in the highest quartile of whole grain intake. These findings are similar to additional cross sectional studies, one involving middle aged adults and the other, Tehranian adults, in which the odds of metabolic syndrome was approximately 30% lower in those with highest whole grain intakes. Not only was whole grain intake inversely associated with the prevalence of metabolic syndrome, but refined grain intake was positively associated with the syndrome in two of these studies. Conversely, a significant association between whole grain intake and metabolic risk factors was not shown in a cohort of biracial young adults (mean age of 29.6) from the Bogalusa Heart Study.

In conclusion, eating whole grains is one dietary measure associated with many health benefits including the reduced risk of chronic diseases. Promoting whole grains in their entirety, as opposed to specific nutrients, supports the food based approach to eating emphasized in the current Dietary Guidelines, USDA’s MyPlate and the 2013 American Heart Association/American College of Cardiology Guideline of Lifestyle Management to Reduce Cardiovascular Risk. Further evidence from well-designed randomized clinical trials is needed to strengthen the findings thus far as well to infer causality.

**Barriers to Whole Grain Consumption**

Barriers that limit a consumer’s consumption of whole grains are many and include: unacceptable taste or texture, perceived higher cost, limited availability
(particularly when dining away from home) and lack of (or limited) knowledge about preparation methods and the health benefits of whole grains. Many are confused about how to accurately identify and select whole grains and whole grain foods. As the whole grain content of a food cannot be determined based on appearance or texture, the consumer must rely on the product’s label. Yet, the labeling of foods made with whole grains lacks uniformity and varies from product to product. There is little standardization to assist the consumer. Partial whole grain foods, containing both whole grain and non-whole grain ingredients, are particularly challenging to the consumer. 

Whole Grain Labeling and Identification

There are a variety of strategies that consumers can use to identify the grain content of foods and can aid in the selection of whole grain foods; however, each has its limitations. Some whole grain foods may bear a whole grain stamp developed by the Whole Grains Council, a non-profit consumer advocacy group. The stamp features a sheaf of grain on a golden background with a black border. Each food bearing this stamp contains at least a half serving, or 8 grams of whole grains, per serving. The stamp also denotes the number of grams of whole grains in one serving of that food. If a food product contains at least 16 g of whole grains per serving and all the grains in the product are whole grains, the stamp will have a 100%. A manufacturer must be a member of the Whole Grains Council, pay annual fees and submit information on each qualifying food product in order to use this symbol. As the use of this stamp is voluntary, many whole grain foods do not bear this stamp.
A food package can bear a U.S. FDA-approved whole grain health claim if the food contains at least 51% whole grain ingredients by weight “per reference amount customarily consumed.” (A reference amount customarily consumed or RACC refers to the serving size or amount used for food labeling). Examples of these health claims include: "Diets rich in whole grain foods and other plant foods and low in total fat, saturated fat, and cholesterol, may help reduce the risk of heart disease and certain cancers” and "Diets high in plant foods - i.e., fruits, vegetables, legumes and whole-grain cereals - are associated with a lower occurrence of coronary heart disease and cancers of the lung, colon, esophagus and stomach.” The first health claim quoted above was approved in 1999 and can be used on all foods that meet the whole grain requirements whereas foods bearing the latter health claim, approved in 2003, must meet fat content requirements, in addition to, whole grain requirements. While whole grain foods
with lower moisture content can often meet the FDA’s whole grain health claim requirements, it is more difficult for higher moisture foods, such as breads, to meet these same requirements as a higher percentage of the total weight can be attributed to water.\textsuperscript{106}

The ingredients list is the most consistent way to determine grain content as this list is required on all food products. Yet a whole grain ingredient placed farther down the list, or foods containing multiple whole grain ingredients, are more challenging. How far down the list can a whole grain ingredient be placed and still be considered a whole grain rich food choice? Instructions vary based on the reference source. For example, the 2010 Dietary Guidelines states that a whole grain ingredient should be the first or second ingredient after water. In foods containing many whole grain ingredients, the whole grain ingredients should be located “near the beginning of the ingredients list.”\textsuperscript{1} USDA’s MyPlate instructs consumers to choose foods that show a whole grain listed first on its ingredients list.\textsuperscript{3} These mixed, and sometimes vague, messages add to a consumer’s confusion. In addition, the ingredient list does not specify the relative proportions of grain ingredients contained in the food product. For example, if a partial whole grain food lists a whole grain as its second ingredient, and enriched flour is its first ingredient; what is the amount of this first ingredient? If the product contains 96% enriched flour, there is little of the whole grain, but if this product contains 30% enriched flour, then it could contain as much as 29% whole grain. The relative proportions of grain ingredients are uncertain by reading the ingredients list.\textsuperscript{106}

**Whole Grain Intake and Older Adults**

The daily consumption of whole grains in the older adult population is particularly low (1.1 and 0.9 servings for males and females, 71+ years, respectively) and
of concern for many reasons.\textsuperscript{4} The number and proportion of older adults in the United States, aged 65 years and older, is on the rise. In 2011, there were 40.4 million older adults, representing 13.3\% of the population.\textsuperscript{110} By 2030, it is projected that the number of older adults will be an estimated 72.1 million and represent 19\% of the population; approximately one in every five will be an older adult.\textsuperscript{111} Life expectancy is also increasing; those reaching 65 years of age have an average life expectancy of 19.2 more years. The fastest growing segment nationally is those 85 years or older.\textsuperscript{1,112} Projections indicate that 14.1 million Americans will be 85 years or older in 2040, an increase from 5.7 million in 2011.\textsuperscript{110}

The aging process increases both the prevalence and risk of disease and chronic health conditions. Approximately 80\% of older adults have one chronic health condition; 50\% have at least two.\textsuperscript{110,113} Data from 2009 to 2011 revealed the most frequently occurring health conditions in this population to be arthritis (51\%), heart disease (31\%), cancer (24\%), diabetes (20\% in 2007-2010) and hypertension (72\% in 2007-2010).\textsuperscript{110} The six leading causes of death in those 65 years or older in 2010, in ranking order, were heart disease, cancer, chronic lower respiratory disease, cerebrovascular disease, Alzheimer’s disease and diabetes mellitus.\textsuperscript{114} Poor diet quality is associated with four of these leading health conditions and causes of death, that of heart disease, cancer, diabetes and hypertension. A healthy diet may help reduce the risk and progression of disease, aid in disease management as well as reduce associated complications.\textsuperscript{1,115}

Growing older generally increases nutrition risk as well; this population is more vulnerable to inadequate nutrition and nutrient deficiencies. Chronic disease, disability and illness, as well as physical, psychological, social and economic changes can reduce
appetite, alter food choices, impair energy and nutrient intake, alter the absorption, utilization and excretion of nutrients, and limit food accessibility. Poor nutritional status can impact an individual’s health, independence, functioning, quality of life, morbidity and mortality.\textsuperscript{112,116-123} In a prospective study of 205 hospitalized patients, aged 75 years or older, mortality rates during nine months of follow up were significantly higher in malnourished, 44\%, compared to nonmalnourished patients, 18\%.\textsuperscript{121,124}

Undernutrition and malnutrition can also result in greater utilization of health care services and premature institutionalization, yielding financial burdens on the individual and society. The average hospital stay of malnourished patients is 40\% to 70\% longer.\textsuperscript{122} The mean daily expenses of malnourished hospitalized patients were found to be 60.5\% higher than well-nourished patients in a cost analysis of 709 hospitalized patients.\textsuperscript{119,121} Older adults over the age of 65 account for more than one-third of the total U.S. health care expenditures.\textsuperscript{125} Adequate nutritional status, however, has been associated with decreased health care costs; it can reduce recuperation times, decrease the number and length of hospital stays, and contain the utilization of health care resources.\textsuperscript{117,126} Hence, a diet that emphasizes high-quality, nutrient-dense foods, inclusive of whole grains, is important to maximize health, aid in disease risk reduction and management, and lessen the strain on health care resources often associated with this population.

Published research on whole grain nutrition education specific to older adults is minimal. In 2005, Ellis et al. implemented a five session whole grain education program involving 84 older adult congregate meal recipients in Georgia. The program emphasized ways to identify whole grain foods, the disease protection benefits of whole grains and intake recommendations. Participants significantly, but modestly, increased
their intake of select whole grain foods and were better able to suggest ways to identify whole grain foods after the program, based on pre- and post-test responses.\textsuperscript{127,128}

**Whole Grain Intake and Young Adults**

Spanning the opposite end of the adult spectrum is the young adult population, more specifically college students. This age group has been exposed to health messages about the importance of whole grains since elementary school. The *Dietary Guidelines for Americans* first provided specific whole grain serving recommendations in 2005.\textsuperscript{129,130} But have these messages and serving quantifications improved their knowledge and intake of whole grains?

The mean whole grain daily intake of young adults, aged 19 to 30, is lower than that of both the average adult and that of older adults at 0.7 and 0.6 ounces for males and for females respectively.\textsuperscript{4} Cross sectional-data obtained from Project Eating Among Teens (Project EAT)-II revealed the whole grain daily intake of young adults, with a mean age of 20.5 years, to be 0.68 ± 0.03 and 0.58 ± 0.03 servings for males and females respectively.\textsuperscript{131}

There is limited research, overall, regarding the whole grain knowledge and consumption of younger adults as well.\textsuperscript{131-134} Greater nutrition knowledge was related to healthier eating patterns and food choices in a cross sectional study of 200 college students from a northeastern university in the United States. Whole grain intake was specifically associated with nutrition knowledge in this study; students consuming the recommended amount of whole grains exhibited significantly higher nutrition knowledge scores compared to students eating less than the recommended amount.\textsuperscript{133}
Mixed results have been shown in two studies that examined the impact of a university nutrition course on college students’ whole grain intake. Significant increases in whole grain consumption were demonstrated upon completion of an introductory nutrition course in a study of 80 college students at a Midwestern U.S. university. At the end of the course, students’ repertoire of whole grain foods consumed also increased from 7 to 11. This nutrition course followed a traditional lecture style yet incorporated interactive, hands-on activities including a whole grain taste test. A study at a Canadian university compared the knowledge, perception and intake of whole grains amongst students who had completed an introductory nutrition course with students who had not. In those who had received nutrition education, their perceptions regarding the health benefits of whole grains were higher yet their intake and knowledge of whole grains were not significantly different from those students who had not received nutrition education.
CHAPTER 2

OBJECTIVES

With low whole grain intake amongst older adults, limited consumer whole grain knowledge and confusion surrounding the identification of whole grain foods, a whole grain nutrition education program for older adults, entitled *Is It Whole Grain?*, was designed to boost whole grain consumption in this population. A pilot study was conducted to evaluate the effectiveness of this program in meeting program objectives.

With limited research available on college students’ whole grain eating behaviors and their greater exposure to whole grain messaging compared to that of older adults, their whole grain knowledge and intake was also explored in an effort to gain insight into whole grain approaches suited for this younger population. The following objectives were developed to further investigate these topics:

1. Further implement the *Is It Whole Grain?* program in New Hampshire.
2. Evaluate the effectiveness of the *Is It Whole Grain?* program to improve older adults’ knowledge, identification and consumption of whole grains and whole grain foods.
3. Assess the whole grain knowledge and intake of young adults, specifically University of New Hampshire college students, compare to that of the older adults (pre-intervention) and strategize whole grain education interventions tailored for this age group, based on data compiled from the older adult program’s outcomes and knowledge differences between the two populations.
CHAPTER 3

MATERIALS AND METHODS

Approvals by the UNH Institutional Review Board for the Protection of Human Subjects were requested and received prior to the start of this study (Appendix A).

*Is It Whole Grain? Program for Older Adults*

Program Development

The whole grain nutrition education program for older adults, *Is It Whole Grain?* was developed in advance and independently of this thesis project. This program was part of the USDA multi-state research projects, NE-1023 and NE-1039, entitled *Changing the Health Trajectory for Older Adults through Effective Diet and Activity Modification*. The initial research and development of the program occurred under NE-1023, in effect from September 2004 through September 2009. Researchers from five universities (University of New Hampshire, University of Massachusetts, University of Minnesota, University of District of Columbia, and University of Maryland) examined how older adults utilized food product packages to determine whole grain content. The University of New Hampshire Cooperative Extension then developed the *Is It Whole Grain?* program. They conducted five focus group interviews with older adults in Manchester, NH to ascertain what older adults wanted to know about whole grains and their preferences regarding the format and structure of an education program. Five to
seven of these focus group participants worked with UNH Cooperative Extension researchers to further develop the *Is It Whole Grain?* program. This project continued under NE-1039, effective from October 2009 to September 2014. Researchers from UNH Cooperative Extension and Iowa State University Extension and Outreach implemented the *Is It Whole Grain?* program in their respective states and tested its effectiveness in meeting program objectives.

**Program Design**

The design of the *Is It Whole Grain?* program is practical, interactive and activity based. Educational topics introduced in the first session and reinforced in each subsequent session include basic whole grain information (such as the definition of a whole grain, health benefits, intake recommendations and examples of foods equivalent to one serving of whole grains) and a simplified three step process that can be used to determine the grain content of foods (Appendix G). The steps in this process, termed “3 steps to 3 servings of whole grains” are:  First, examine the front of the package for key phrases such as “100% whole wheat” or “whole oats.” Second, read the ingredient list to see if any or all of the first 3 ingredients contain the word “whole” such as “100% whole wheat flour,” “whole oats,” or “whole rye flour.” Third, examine the other panels of the package for whole grain health claims, whole grain stamps and symbols to further support the above findings. In addition to learning this process, participants are given many opportunities to apply and practice this method throughout the program.

The *Is It Whole Grain?* program consists of three one to 1.25-hour sessions, spaced one week apart preferably. Each session focuses on a different meal and includes at least one activity. Session one focuses on breakfast. The main activity for this week
involves comparing pairs of cereal packages to determine which one contains more whole grains. Session two focuses on lunch and afternoon snacks. In this session, participants attempt to determine the whole grain content of different “unidentified” sample breads based on taste and appearance. The adults then examine the labels of these breads to determine their grain content and compare their findings with their guesses. The last session focuses on dinner and evening snacks. This session solidifies all of the information learned throughout the course as participants’ problem solve whole grain scenarios in small groups and share their solutions with the larger group. For example, one of the scenarios requires participants to brainstorm ways to increase whole grains when given a one-day typical diet. Please refer to Appendix H for many of the handouts used with these activities.

Also in each session, participants are encouraged to think of a way to add more whole grains to their diet, record their goal(s) on a “Goal Setting Worksheet” provided (Appendix H) and share their goals. Snacks are distributed at every session to allow participants the opportunity to taste test a variety of foods made with whole grains. These whole grain snacks include: breakfast cereals, granola bars, crackers, whole grain breads, popcorn and whole grain dinner options such as pasta, quinoa and whole grain rice pilaf. Participants receive a booklet about whole grains, weekly handouts, a folder to store the written materials and many recipes using whole grain ingredients. Two versions of the program were developed, the only difference being the way in which the same basic whole grain information was delivered, either through PowerPoint or using handouts.
Program Assessment

Eligible participants were asked to complete a set of forms in sessions 1 and 3. In session 1, participants completed a registration form (Appendix B), a consent form (Appendix C) a whole grain pre-questionnaire (Appendix D) and a dietary screening tool. Participants completed a whole grain post-questionnaire (Appendix E), a program evaluation (Appendix F) and the same dietary screening tool in the final session, session 3. (Data from the dietary screening tool are reported elsewhere). Prior to completion of the forms, the older adults were instructed that participation was voluntary and that confidentiality of all records would be maintained. The paper pre- and post- whole grain questionnaires were identical and evaluated the programs objectives including participants’ grain knowledge, skill in identifying whole grains and grain intake. Each consisted of 48 questions. Thirty-one questions evaluated whole grain knowledge including the health benefits of whole grains, whole grain definition, intake recommendations and grain identification (of foods and product package indicators). To assess intake, the intake frequency of ten grain foods (7 whole grain and 3 refined or “some whole grain” foods) was surveyed. In this study, a “some whole grain” food was defined as a food containing a mixture of both whole and refined grains. The seven remaining questions explored participants’ opinions about whole grains, such as their taste preferences, perceived cost and perceived ability to select whole grain foods as well as meal preparation habits, that of grocery shopping, meal planning and cooking. In addition, the pre-questionnaire included questions on demographics. The post-questionnaire asked participants to assess their intent to eat more whole grains foods and to rate their strength of intention on a scale of 1 to 7.
Program Data Collection

The *Is It Whole Grain?* program was implemented from the fall of 2012 through the winter of 2014. The independent living older adult participants, aged 60 +, were recruited from senior centers, congregate meal sites, subsidized housing facilities and agencies servicing older adults in Iowa and New Hampshire. Methods of recruitment included telephone calls and mailings; posters were distributed to advertise the program.

Whole Grain Survey for Young Adults

The same pre-intervention whole grain questionnaire distributed to the older adults was delivered to the 283 undergraduate students enrolled in *Nutrition 400: Nutrition in Health and Well-Being* via an online format during week 3 of the spring 2014 semester at the University of New Hampshire, Durham campus (Appendix J). A few minor wording changes were made to the survey for clarification purposes as the students completed the survey online independently and in the absence of a program educator (unlike the older adults). The survey was added onto the end of the College Wellness Survey, or *College Health and Nutrition Assessment Survey (CHANAS)*, routinely completed by Nutrition 400 students each semester. Students signed a consent form (Appendix I) prior to the completion of the survey. Participation in the survey was voluntary. Students received two extra credit points on the course’s final project as an incentive for participating. The survey was administered prior to any nutrition education on whole grains in the Nutrition 400 course.
Statistical Analysis

All statistical analyses for both the older and younger adult populations were conducted using IBM SPSS Statistics for Windows, Version 21.0. Descriptive statistics variables (frequencies for categorical variables; means, standard deviations and normal distribution of scores for continuous variables) were obtained for all. The standard for determining statistical significance was set at $p \leq 0.05$.

Older Adults

Older adult program participants, aged 60+ years, who completed both the pre- and post-whole grain questionnaires and attended all three sessions of the education program were included in the final analysis. Pre- and post-survey responses pertaining to whole grain knowledge (questions #1 through #7) were recoded as incorrect or correct; opinion responses (question #9, a-d) as yes or no/don’t know. A McNemar’s test was performed on all non-parametric categorical knowledge variables to determine statistically significant changes in the proportion of correct/incorrect responses before and after the intervention. A McNemar’s test was performed on the four pre-/post-opinion variables to assess significant changes as well.

Knowledge variables were then transformed from categorical data into continuous data by calculating a “total whole grain knowledge score” for each participant based on the total number of correct responses. Responses were recoded for scoring purposes, correct responses received a “1” and incorrect, omitted or don’t know responses received a “0”, the highest possible score was 31. A Wilcoxon Signed Rank Test was used to compare knowledge scores before and after the intervention as the knowledge scores
were negatively skewed. To estimate the strength of association or effect size, an r value was calculated using the formula: \( r = \frac{z}{\text{square root of total number of observations over the two time points}} \). Effect size was based on Cohen’s (1988) criteria of 0.1=small, 0.3=medium and 0.5=large.\(^{136}\)

The pre- and post- “total whole grain knowledge scores” were transformed via reflection and square root to obtain normal distribution as well. Upon transformation, the Shapiro Wilk’s tests (p >.05) and visual inspection of the histograms, normal Q-Q plots and boxed plots revealed that the scores were approximately normally distributed with a skewness of 0.223 (SE=0.194) and 0.106 (SE=0.194) and a kurtosis of 0.090 (SE=0.385) and 0.146 (SE=0.385) respectively. A paired sample t-test was performed to determine statistically significant differences between pre- and post- mean whole grain knowledge scores.

Three sub analyses of the “total whole grain knowledge score” were performed on questions #1 through #3, #4 and #6 to obtain a “basic whole grain knowledge score,” a “grain content identification score” and a “product package indicator score” respectively. The “basic whole grain knowledge score” explored participants’ knowledge about whole grain health benefits, intake recommendations and definition of a whole grain. The grain content identification of 11 foods, five of which were whole grain, comprised the “grain content identification score.” The “product package indicator score” involved identifying the five product package indicators of whole grains from the ten indicators listed. A Wilcoxon Signed Rank Test was performed to compare changes in these pre- and post-intervention scores; an r value was calculated to estimate effect size.
Pre- and post- self-reported consumption data (from question #8) was recoded and transformed into continuous data by scoring each frequency category based on the average number of times the grain product was consumed weekly. For example, the original “< 1 x/week category” received a score of 0 representing that the grain product was consumed 0 times in a week. The “1 x/week category” received a score of 1; the 2-3 x’s/week category, a score of 2.5; the 4-6 x’s/week category, a score of 5 and the 1+ times/day category, a score of 7. A weekly “total whole grain consumption score” was calculated by adding together the intake frequencies of each of the seven whole grain products surveyed (oatmeal, brown rice, whole grain cold cereal, whole grain pasta, whole grain bread, whole wheat crackers and popcorn); the total score indicates the approximate number of times the specified whole grain products were consumed in a week. This same process was employed to determine a weekly “total refined grain consumption score” as well; refined grain products being white bread, brown or “wheat” bread, and multigrain bread. As the intake data was positively skewed, the Wilcoxon Sign Rank Test was used to compare intake for individual grain products as well as total grain consumption prior to and following the intervention. (Normal distribution was unable to be achieved via transformation).

A Spearman’s Rank Order Correlation was performed, utilizing participants’ post-intervention “total whole grain knowledge scores” and “total whole grain consumption scores,” to investigate if there was a relationship between post-intervention whole grain knowledge and consumption. In addition, data from participants excluded from the above analyses but who attended two of the three sessions and completed both the pre- and post-whole grain questionnaires were analyzed using the same aforementioned
statistical techniques (i.e., McNemar’s test on all non-parametric categorical knowledge variables, Wilcoxon Signed Rank Test on continuous knowledge and intake scores).

State specific changes in pre-/post- “total whole grain knowledge scores” and weekly “total whole grain consumption scores” of 3-session attendees within each state were assessed and compared using the Wilcoxon Signed Rank Test. A Mann Whitney U test was used to compare differences in “total whole grain knowledge scores” and “total whole grain consumption scores” between the two states.

**Young adults**

UNH college students, between the ages of 17 and 25 years, who completed the online whole grain questionnaire were included in the final analysis. Using the same procedure as that for the older adults, survey responses pertaining to whole grain knowledge (questions #57 through #63) were recoded as incorrect or correct; omitted responses received an incorrect score. Opinion responses (question #65, a-d) were recoded as yes or no/don’t know. A Chi-square test for independence (with Yates Continuity Correction) was performed on all non-parametric categorical knowledge variables to compare the proportion of correct /incorrect responses obtained from the young adults whole grain survey and the pre-intervention older adult whole grain questionnaire. A phi coefficient was also generated upon execution of the Chi-square test and was used to measure the strength of association between age (younger vs. older adult) and each knowledge variable; a higher value indicated a stronger association, based on Cohen’s criteria. A Yate’s chi-square test was also performed on the four opinion variables to compare statistically significant differences between the older and younger adult populations.
Using the same procedure as that for the older adults, discussed in the previous older adult section, knowledge variables were transformed from categorical data into continuous data by calculating a “total whole grain knowledge score” for each participant based on the total number of correct responses. As normal distribution was unable to be achieved via transformation, the non-parametric Mann Whitney U test was used to compare differences in “total whole grain knowledge scores” between the younger adult and pre-intervention older adult populations. To estimate effect size, an r value was calculated using the formula: \( r = \frac{z}{\sqrt{\text{total number of cases}}} \). A median “total whole grain knowledge score” and associated interquartile ranges were also obtained for each group. As with the older adults, three sub analyses of this “total whole grain knowledge score” were performed on questions #57 through #59, #60 and #62 to obtain a “basic whole grain knowledge score,” a “grain content identification score” and a “product package indicator score” respectively. A Mann Whitney U test was used to compare differences between each of these subscores and the two age groups (young adults and pre-intervention older adults); median values and interquartile ranges for these sub scores in each age group were also obtained.

Self-reported whole grain and refined grain consumption categorical data (from question #64) was recoded and transformed into continuous data using the same procedure as that of the older adult, outlined in the previous section, in order to obtain a “total whole grain consumption score” and a “total refined grain consumption score” for each young adult. As a normal distribution was unable to be obtained, a Mann Whitney U test, and an associated r value, was calculated to compare differences in whole- and refined-grain consumption scores, for individual grain products as well as total grain.
consumption, amongst the young adults and pre-intervention older adults. Median values, and associated interquartile ranges, for these whole- and refined-grain consumption scores were obtained as well. As with the older adults, a Spearman’s Rank Order Correlation was performed to quantify the relationship between the young adults’ whole grain knowledge and consumption of whole grains.
CHAPTER FOUR

RESULTS

Older adults

Demographics

A total of 157 older adults were included in the final analysis. Two-thirds of the participants resided in New Hampshire (n=104); one-third in Iowa (n=53). Participants younger than 60 years old, who did not complete the pre- and post-whole grain questionnaires or did not attend all three sessions were excluded from the analysis. There were 16 participants, 10 from NH and 6 from Iowa, who did not attend all three sessions.

Based on self-reported data, the participants were predominantly female (89.2%) and of white race/ethnicity (96.2%). Ages were equally distributed among the following age brackets: 60 to 70 years, 71 to 80 years and 81 to 90 years old. Educational status was evenly distributed overall; approximately one third achieved a Bachelor’s degree or higher, one third an Associate’s degree, technical school or some college and the remaining third, a GED, high school degree or less. Over one-half (52%) reported a history of hypertension and/or hypercholesterolemia, 28% a bowel disorder such as constipation or diverticulosis, and approximately 16 to 22% a history of diabetes, cancer or heart disease. The majority did their own grocery shopping (85%), planned (75%) and cooked (83%) their own meals. Fifty seven percent (n=89) of the participants attended
the PowerPoint format and 43% (n=68), the discussion based format of the program (Table 1).

**Whole Grain Knowledge**

Overall, the participants demonstrated significant increases in whole grain knowledge based on their pre- and post-questionnaire responses. The mean pre-intervention “total whole grain knowledge score” of 15.46 ± 0.38 was statistically different from the post-survey “total whole grain knowledge score” of 21.96 ± 0.31 (p=0.000), with the highest possible score being 31.0 (Table 2, Figure 3). The median pre-intervention “total whole grain knowledge score” of 16.0 (IQR 13.0, 18.0) was also statistically different (p=0.000) from that of the post-survey median score of 22.0 (IQR 19.5, 24.0) with a large effect size of 0.60 (Table 3).

Statistical analysis of individual pre- versus post-questionnaire answers also revealed significant increases in the proportion of participants who provided correct responses for 27 of the 31 possible whole grain questions. The change in correct post-survey responses about the grain content (or lack thereof) of three foods (wheat bread, flax seed and a bran muffin) and identification that whole grains do not reduce colds was not significantly different from pre-survey responses.

**Health Benefits.** The older adults’ median “basic whole grain knowledge score,” (the highest possible score being 8.0) increased significantly from 5.0 (IQR 3.0, 5.5) pre-intervention to 6.0 (IQR 5.0, 6.0) post-intervention with a medium effect size of 0.45; p=0.000 (Table 4). Over half of the participants were knowledgeable about the whole grain health benefits supported by research prior to the intervention. The proportion of participants pre-intervention who correctly identified that whole grains can help reduce
the risk of bowel conditions, heart disease, Type 2 diabetes and cancer was 83%, 69%, 59% and 54% respectively. Post intervention, these proportions significantly increased to 93%, 90%, 77% and 86% respectively (p=0.000 with the exception of bowel conditions, p=0.004). Knowledge about the false health benefits was low pre-intervention. A small proportion, 11% and 18.5%, were able to correctly identify that whole grains did not reduce memory loss and colds/respiratory disease respectively. Post intervention, a significant change in correct responses for memory loss was shown (p=0.035), yet responses for colds was insignificant (p=0.736).

Defining “Whole Grain” and Recommended Servings. A high proportion, 85.7%, correctly identified the definition of a whole grain pre-intervention; post intervention almost all of the participants, 98.7%, successfully identified the whole grain definition (p=0.000). The proportion of participants who were able to identify the recommended number of servings of whole grains each day was 48.1% pre-intervention and 78.2% post-intervention; p=0.000 (Table 5).

Identifying Grain Foods. Median pre- to post- “grain content identification scores,” (the highest possible score being 11.0) significantly increased from 4.0 (IQR 3.0, 5.0) to 7.0 (IQR 5.0, 8.0) with a large effect size of 0.52; p=0.000 (Table 6, Figure 5). Post-survey responses revealed statistically significant changes in the accurate identification of the grain content of eight of the eleven foods listed. Significantly more participants were able to accurately identify all four of the whole grain foods (oatmeal, brown rice, popcorn, whole wheat bread), two of the three refined grain foods (white bread, pumpernickel bread), one of the two non-grain foods (beans) and one of the two “some whole grain foods” (multigrain bread) after the intervention (Table 7, Figure 6).
“some whole grain food” was defined as a food containing a mixture of refined and whole grains. The proportion of participants that correctly identified oatmeal, brown rice, whole wheat bread and popcorn as whole grain foods on the pre-survey was 61%, 59%, 43% and 29% respectively. Post-survey correct identification increased significantly to 89%, 92%, 76% and 89% respectively (p=0.000). Correct identification of white bread and pumpernickel bread as made with refined grains was respectively 52% and 18% pre-intervention, 68% and 35% post-intervention (p=0.001). Beans were correctly identified as “not a grain food” by 31% of the participants pre-intervention and 42% post-intervention (p=0.036). Fifty-two percent of the participants, pre-survey, and 71%, post-survey, correctly identified multi-grain bread as made from “some whole grain”; p=0.001. Significant changes in the correct identification of wheat bread, flax seed and the bran muffin were not shown (p=0.312, 0.230 and 0.897 respectively) following the intervention (Table 7).

Identifying Product Package Indicators. The older adults’ median post-intervention “product package indicator score” of 8.0 (IQR 7.0, 9.0) was also significantly higher than their pre-intervention median score of 6.0 (IQR 4.0, 8.0) with a large effect size of 0.54 (p=0.000); the highest possible score was 10.0 (Table 8, Figure 7). On the post-survey questionnaire, significantly more participants correctly discerned and identified all ten of the true and false product package indicators of whole grains listed (p=0.000 for all indicators except the ingredient list, p=0.003). The proportion of participants that correctly identified the ingredients list, FDA whole grain health claim, Whole Grain Councils’ whole grain logo, the American Heart Association’s Whole Grain Heart Check Mark and “100% whole grain in the name or on the front of the package” as
positive indicators of whole grain content was respectively 75%, 28%, 62%, 75% and 64% pre-survey and 88%, 52%, 97%, 90% and 93% post-survey. In addition, participants learned that the Nutrition Facts label, color, and the terms “wheat”, “multigrain” and “stoneground” were not indicators of whole grain content; the proportion of pre- versus post- correct responses respectively was 43% versus 72%, 76% versus 94%, 71% versus 88%, 58% versus 83% and 47% versus 73% (Table 9, Figure 8).

Identifying Three Step Process; Using Ingredient List. Correct post-survey responses of a simplified three step process that could be used to determine whole grain content was significantly higher than pre-survey responses, 69% and 48% respectively; p=0.000 (Table 10, Figure 14). Sixty-eight percent of participants post-intervention, compared to 39% pre-intervention, were able to accurately discern from the ingredients list of a multigrain bread that the bread was not a good source of whole grains; p=0.000 (Table 10, Figure 14).

Class Format Differences. To assess differences in the effectiveness of the PowerPoint and discussion based formats of the program, pre- versus post-intervention “total whole grain knowledge scores” for each of the groups was compared. Both groups demonstrated statistically significant increases (p<0.001) in these scores from pre- to post-intervention with a substantial strength of association, indicated by the large effect size of 0.60. The median difference in scores, however, was the same (6.0) for both groups, suggesting that the effectiveness of the two teaching approaches was similar (Table 11).
Whole Grain and Refined Grain Consumption

Significant differences in grain consumption scores were shown following the intervention (p=0.000). The median weekly “total whole grain consumption score” of 8.0 (IQR 4.0, 11.0) pre-intervention significantly increased to 10.0 (IQR 7.0, 13.5) post-intervention with a medium effect size (r=0.31, p=0.000). The median weekly refined grain score significantly decreased from 5.0 (IQR 2.0, 7.0) pre-intervention to 2.5 (IQR 0, 5.0) post-intervention with a small effect size; r=0.24, p=0.000 (Table 12, Figures 9 and 10). These results reveal that the frequency of whole grains consumed increased from 8 to 10 times a week and that the frequency of refined grains was reduced by half and decreased from 5 to 2.5 times a week.

Whole Grain Consumption. Small but significant increases in the weekly intake frequency of five of the seven specific whole grain foods, that of oatmeal, whole grain cereal (cold), whole grain bread, whole wheat crackers and popcorn, were also shown upon comparing pre- and post- self-reported consumption data. The number of times that oatmeal was consumed in a week increased significantly with a small effect size (r=0.25), however the change is not reflected in the median score of 1.0 (IQR 0, 2.5) pre-survey and post-survey (p=0.000). The pre- to post- median consumption of whole grain cold cereal and whole grain bread increased from 1.0 (IQR 0, 2.5 for cereal; IQR 0, 5.0 for bread) to 2.5 (IQR 0, 5.0) with a small effect size of 0.15 for cereal (p=0.007) and 0.14 for bread (p=0.016), inferring that the frequency of cereals and whole breads consumed increased from 1 to 2.5 times per week. The intake of whole wheat crackers increased from pre-intervention (Md=0; IQR 0, 1.0) to post-intervention (Md=1.0; IQR 0, 2.5) with a small effect size (r=0.23, p=0.000), inferring that the intake frequency of whole wheat
crackers increased from less than once a week to once a week. Popcorn consumption also increased from pre- to post-intervention with a small effect size of 0.23 (p=0.000), although the change is not reflected in the median score of 0.0 (IQR 0, 1.0) pre-survey and post-survey (p=0.000). Significant changes in the consumption of brown rice (p=0.471) and whole grain pasta (p=0.242) were not shown (Table 13).

**Refined Grain Consumption.** Small but significant decreases in the weekly intake frequency of all three of the surveyed refined or “some whole grain” foods was also demonstrated upon assessing pre- and post-consumption data. The median frequency of brown or “wheat” bread decreased from 2.5 (IQR 0, 3.75) pre-intervention to 0 (IQR 0, 2.5) post-intervention with a small effect size (r=0.14, p=0.016), suggesting a reduction in frequency of brown or wheat bread consumed from 2.5 to less than 1 time a week. The pre- to post-median intake of multigrain bread decreased from 1.0 (IQR 0, 2.5) to 0.0 (IQR 0, 2.5) with a small effect size (r=0.13, p=0.024), inferring that participants ate multigrain bread once a week pre-intervention and less than once a week post-intervention. The weekly intake frequency of white bread also decreased significantly (p=0.005) from a median score of 0.0 (0, 1.0) to 0.0 (0, 0) pre- to post-intervention with a small effect size; r=0.16 (Table 13).

Spearman’s Rank Order Correlation indicated no statistically significant correlation between the participants’ post-intervention whole grain knowledge (as measured by the post-intervention “total whole grain knowledge score”) and whole grain consumption (as measured by the post-intervention “total whole grain consumption score”); r=0.136, p=0.089 (Table 14).
Additional Findings

Opinions: Intake Intention. Of the four questions surveying taste preferences, perceived cost and perceived ability to select whole grain foods (# 9, a-d on the questionnaire), significant differences were observed in two of the responses after the intervention. A greater proportion of older adults, 7.4% more, reported that they liked the taste of whole grain foods (p=0.019) and 43.6 % more reported that they knew how to use the food package to select whole grain foods; p=0.000 (Table 15). In addition, 89% of the participants reported on the program evaluation that they intend to eat more whole grains (Table 16); almost two-thirds (63.7%) rated their strength of intention as strong and approximately one-third (35.6%) as moderate (Table 17).

Two-session Attendees. In regards to the 16 two-session attendees, their pre-intervention median “total whole grain knowledge score” of 15.0 (IQR: 10.5, 19.75) was statistically different from their post-intervention median “total whole grain knowledge score” of 23.0 (IQR 19.25, 24.0) with a large effect size (r=0.60, p=0.001). However, upon analysis of the itemized questionnaire responses, the change in the proportion of correct responses before and after the intervention was overall insignificant for 26 of the 31 questions. Only significant changes regarding the daily recommended number of whole grain servings, the grain content of popcorn, whole grain’s health benefit to reduce cancer, and identification of two whole grain product package indicators (American Heart Association’s Whole Grain Heart Check Mark and “100% whole grain in the name or on the package” were shown. Data for the two session attendees can be found in Tables 34-39.
State Differences. Within each state, statistically significant increases in both whole grain knowledge and intake scores were shown. Pre- to post- median “total whole grain knowledge scores” increased from 16.0 (IQR 13.0, 18.0) to 22.5 (IQR 20.0, 24.0) in New Hampshire and from 16.0 (IQR 11.5, 19.0) to 21.0 (IQR 19.0, 24.0) in Iowa with large effect sizes in both states, 0.61 and 0.59 in New Hampshire and Iowa respectively (Table 18). Pre- to post- median “total whole grain consumption scores” increased from 7.25 (IQR 3.5, 11.0) to 10.0 (IQR 7.0, 13.5) in New Hampshire with a medium effect size of 0.34 and from 9.0 (IQR 5.75, 10.75) to 9.5 (IQR 7.0, 12.75) in Iowa with a small effect size of 0.24 (Table 19). The Iowa sample contained a greater percentage of participants between the ages of 81 and 90 than that of the New Hampshire sample, 51% versus 21% respectively. Conversely, the percentage of participants between the ages of 60 and 70 was much higher within the New Hampshire sample than the Iowa sample, 39% versus 9% respectively. (Percentages within the remaining two age brackets, 71 to 80 years and 91 to 100 years, were similar between the two states).

Upon comparing the two states, the pre-intervention median “total whole grain knowledge” scores were the same for each state, that of 16.0. After the intervention, the median difference in “total whole grain knowledge” scores was 1.5 higher for New Hampshire than Iowa, yet the difference was not statistically significant (p=0.190). Median pre-intervention “total whole grain consumption” scores were 1.75 higher in Iowa than that of New Hampshire, but the difference was not statistically significant (p=0.175). Iowa residents ate whole grain foods 9 times per week whereas New Hampshire residents ate whole grain foods 7.25 times per week. After the intervention, however, the median differences in “total whole grain consumption” scores were 2.25
higher in New Hampshire than Iowa but the difference was not statistically significant (p=0.792). Hence, the resultant post-intervention whole grain consumption scores were similar for New Hampshire and Iowa, 10.0 and 9.5 respectively.

**Young Adults**

**Demographics**

There were 256 young adults from the University of New Hampshire included in the final sample size. A total of 257 younger adults completed the online survey, yet one respondent exceeded the age limitation and was thus was excluded from the final analysis. Based on self-reported data, approximately two-thirds of the students were female (61.3%). Ninety-five percent were of white race / ethnicity. Their mean age was 18.9 years. Eighty-eight percent of the students reported their primary residence as New England. Approximately 6% specified their major as “Allied Health” or “Nutrition”; the rest as “other.” The majority of respondents, 88.3%, lived on campus. Almost 70% ate a minimum of 14 meals a week in the university dining halls. One-third reported grocery shopping on a regular basis and 1/5 regularly cooked their meals. The highest reported surveyed health conditions were high blood cholesterol (5.1%, n=13), intolerance to gluten and a bowel disorder (each 4.3%, n=11) (Table 21).

**Whole Grain Knowledge**

The median “total whole grain knowledge score” of the younger adult respondents was 18.0 (IQR 15.0, 20.0) out of 31.0 (Table 22, Figure 11). Their median
“basic whole grain knowledge score” was 5.0 (IQR 4.0, 6.0) out of a maximum score of 8.0 (Table 23, Figure 13).

Defining “Whole Grain” and Recommended Servings. Examination of individual knowledge variables within this score revealed that 84% correctly identified the definition of a whole grain. Less than half, 44.9%, selected “3” as the correct number of whole grains servings recommended for an adult each day (Table 24).

Health Benefits. Of the six health benefits surveyed, over two-thirds correctly identified that whole grains may reduce the risk of heart disease (82%), bowel conditions (82%) and Type 2 diabetes (67%) whereas only one-third (34%) recognized that whole grains are also associated with the reduced risk of cancer. Approximately 1/3 of the respondents, 37% and 35% respectively, correctly identified that whole grains did not reduce the risk of memory loss or colds/respiratory infections (Table 24).

Identifying Grain Foods. The younger adults’ median “grain content identification score,” was 4.0 (IQR 3.0, 6.0) out of a possible 11.0 (Table 25, Figure 13). Students showed the greatest accuracy in the identification of white bread as refined grain and whole wheat bread as whole grain, 72% and 69% respectively. The proportion of young adults able to correctly identify brown rice, oatmeal and popcorn as whole grain foods was 49%, 30% and 3% respectively. Popcorn generated the lowest scores among the foods surveyed. Correct identification of the remainder of the refined grain foods, pumpernickel bread and wheat bread, was 21% and 11% respectively. Over half of the respondents correctly identified multigrain bread as made with “some whole grain” (59%), beans as “not a grain food” (52%) and a bran muffin as made with refined grains
or some whole grain (61%). Less than 1/5th of the respondents (18%) accurately identified that flax seeds were “not a grain food” (Table 26).

Identifying Product Package Indicators. The students’ median “product package indicator score” was 7.0 (IQR 6.0, 9.0) out of 10.0 (Table 27, Figure 13). The majority successfully identified the five product package indicators of whole grains from the list of ten possible indicators. Over 80% correctly identified four of the positive indicators of whole grain content, that of the Whole Grain Councils’ whole grain logo (82%), the ingredients list (86%), the American Heart Association’s Whole Grain Heart Check Mark (86%) and the wording, “100% whole grain” in the name or on the front of the package (83%). Sixty-eight percent correctly identified the other positive whole grain product package indicator, the FDA whole grain health claim. Over half were able to discern that color and the terms “stoneground”, “wheat” and “multigrain” were not indicators of whole grain content, 71%, 70%, 63% and 52% respectively. The least number of respondents, 29%, correctly identified that the Nutrition Facts Label was not an indicator of whole grain content (Table 28).

Identifying Three Step Process; Using Ingredients List. Most, 86%, were able to accurately select a simplified three step process that could be used to help determine the whole grain content of a food from three possible choices (Table 29, Figure 14). Over half reported that they knew how to use the product package to select whole grain foods, yet only 32% were able to accurately discern from the ingredients list of a multigrain bread that the bread was not a good source of whole grains (Table 29 and 32, Figure 14).
Whole Grain and Refined Grain Consumption

Based on respondents intake frequency of the ten grain foods surveyed, the younger adults ate whole grain foods almost twice as often as refined grain foods each week. The median weekly “whole grain consumption score” was 6.0 (IQR 3.5, 9.5) whereas the median weekly “refined grain consumption score” was 3.5 (IQR 2.0, 5.0) (Table 30, Figure 15). Of the seven whole grain foods surveyed, whole grain cold cereal, whole grain pasta, whole grain bread and popcorn were consumed the greatest number of times each week; each was consumed a median of 1.0 time/week. Oatmeal, brown rice and whole wheat crackers were the whole grain foods consumed the least. Out of the seven refined grain breads surveyed, brown or “wheat” bread was consumed more often ($Md = 1.0$) than white or multigrain bread (Table 31). Regarding respondents’ whole grain taste preferences, 80% reported that they liked the taste of whole grain foods yet almost half (45%) preferred the taste of white bread over whole wheat bread (Table 32). In addition, Spearman’s Rank Order Correlation indicated no statistically significant relationship between the respondents’ whole grain knowledge (as measured by the “total whole grain knowledge score”) and whole grain consumption (as measured by the “total whole grain consumption score”); $r=0.074$, $n=256$, $p=0.238$ (Table 33).

Older and Young Adult Whole Grain Knowledge and Consumption Differences

Whole Grain Knowledge

A Mann Whitney U Test revealed that the “total whole grain knowledge score” of young adults ($Md=18.0$ (IQR 15.0, 20.0), $n=256$) was significantly higher than that of the pre-intervention older adults ($Md=16.0$ (IQR 13.0, 18.0), $n=157$) with a small effect size
of 0.22; p=0.000 (Table 22, Figure 11). The highest possible “total whole grain knowledge score” was 31.0. The young adults scored significantly higher in two of the three sub scores also analyzed using the Mann Whitney U test, that of the “basic whole grain knowledge score” (p=0.023; Table 23) and “product package indicator score” (p=0.000; Table 27).

**Health benefits.** The young adults median “basic whole grain knowledge score” was 5.0 (IQR 4.0, 6.0) whereas the older adults median score was 5.0 (IQR 3.0, 5.0) with a small effect size of 0.11 (Table 23). The maximum possible “basic whole grain knowledge score” was 8.0. Examination of each individual health benefit and their associated chi-squares revealed significantly more young adults, compared to older adults, correctly identified that whole grains may reduce the risk of heart disease yet do not reduce the risk of colds/respiratory infections or memory loss. A greater proportion of older adults, compared to young adults, however, did correctly identify that whole grains may reduce the risk of cancer. The greatest difference in scores was observed regarding whole grains and memory loss; chi square=32.693, p=0.000, phi coefficient=0.29 (medium effect size=0.30) (Table 24).

**Identifying Product Package Indicators.** The young adults median “product package indicator score” was 7.0 (IQR 6.0, 9.0) compared to the older adults median score of 6.0 (IQR 4.0, 8.0) with a small effect size of 0.28 (Table 27). The highest possible “product package indicator score” was 10.0. Chi square results revealed that the proportion of young adults that correctly identified the five positive indicators of whole grain content was significantly higher than that of the older adults. The Whole Grain Council logo, “100% whole grain in the name or on front of package” and the FDA
whole grain health claim yielded the greatest differences with phi coefficients of 0.26 (small effect size), 0.25 (small effect size) and 0.41 (medium effect size) respectively. Of the product package indicators not indicative of whole grain content, differences between the two groups were insignificant with the exception of the nutrition facts label and “stoneground” in the name. A significantly greater proportion of young adults were able to identify that “stoneground” in the name was not an indicator of whole grain content (chi square=26.293, phi coefficient=0.26, p=0.000) yet a greater proportion of older adults discerned that the nutrition facts label was not an indicator of whole grain content; chi-square=4.84, phi coefficient=-0.11, p=0.028 (Table 28).

Identifying Grain Foods. The Mann Whitney U test did not reveal significant knowledge differences between the two age groups and the correct identification of the grain content of foods. The median “grain content identification score” of both groups was 4.0, with an 11.0 being the highest possible score (Table 25). Chi squared analyses of the eleven foods surveyed support these findings. Significantly more young adults were able to correctly identify the grain content of whole wheat bread, white bread, beans and flax seed. Whereas a significantly greater proportion of older adults correctly identified the grain content of oatmeal, wheat bread and popcorn (Table 26).

Identifying Three Step Process; Using Ingredients List. Compared to older adults, a significantly greater proportion of younger adults correctly identified a simplified three step process that could be used to determine the whole grain content of a food (chi square=67.606, phi coefficient=0.41 (medium effect size), p=0.000. Based on Chi squared analyses, significant differences were not observed for the remaining whole grain
knowledge question: discernment of the grain content of a multigrain bread using the ingredients list (Table 29).

Whole Grain and Refined Grain Consumption

**Whole Grain Consumption.** Based on respondents intake frequency of the ten grain foods surveyed, the Mann Whitney U test revealed that older adults ate whole grain foods more often than young adults (p=0.009), although the calculated effect size was small (0.13). The median weekly “whole grain consumption score” of older adults and young adults was 8.0 (IQR 4.0, 11.0) and 6.0 (IQR 3.5, 9.5) respectively (Table 30, Figure 12). Of the whole grain foods surveyed, a significantly greater proportion of older adults consumed oatmeal, whole grain cereal, whole grain bread and whole wheat crackers more frequently than younger adults. Whereas, a significantly greater proportion of younger adults ate brown rice, whole grain pasta and popcorn more frequently than older adults (Table 31).

**Refined Grain Consumption.** The Mann Whitney U Test revealed that there was no significant difference between the two age groups and the frequency of refined grain foods consumed (Table 30). Chi squared analyses of the three refined grain foods surveyed did reveal, however, that a significantly greater proportion of young adults ate white bread more frequently (p=0.006) whereas a significantly higher proportion of older adults ate multigrain bread with greater frequency (p=0.009); small effect sizes of 0.13 were calculated for each of these variables (Table 31).
Additional Findings

Of the four questions surveying taste preferences, perceived cost and perceived ability to select whole grain foods, significant differences were observed in only one of the questions. A greater proportion of young adults reported that they preferred the taste of white bread to whole wheat bread; the estimated effect size was small/medium; chi square=32.643, phi coefficient=-0.29, p=0.000 (Table 32).
CHAPTER FIVE

DISCUSSION

The *Is It Whole Grain?* program was shown to be effective in improving older adults’ whole grain knowledge and ability to identify and select whole grains, as evidenced by the participants’ pre- and post- questionnaire responses. Participants’ mean pre- to post- whole grain knowledge scores significantly improved from $15.46 \pm 0.38$ to $21.96 \pm 0.31$; $p<.001$ (Table 2, Figure 3). The proportion of participants who provided correct responses for 27 of the 31 possible whole grain knowledge questions significantly increased from pre- to post-intervention. The seven questions, in which participants showed the greatest improvements, in descending order, were: the grain content identification of popcorn and brown rice, the Whole Grain Council stamp as a whole grain product package indicator (brown rice and the WGC stamp were tied), the grain content identification of whole wheat bread, the health benefit of whole grains to reduce cancer risk, whole grain intake recommendations and the grain content identification of a multigrain bread using the ingredients list (Figure 4).

The greatest sub score improvements were observed in older adults’ abilities to accurately identify the grain content of foods and to identify the valid and invalid whole grain product package indicators as demonstrated by their “grain content identification scores” and “product package indicator scores.” Median “grain content identification scores” increased significantly from 4.0 (IQR 3.0, 5.0) to 7.0 (IQR 5.0, 8.0) out of 11.0
with a large effect size of 0.52; p=0.000 (Table 6, Figure 5). A significantly greater proportion of participants accurately identified the grain content of eight of the eleven foods surveyed after the program, with greatest improvements shown in the correct identification of the whole grain foods, popcorn, brown rice and whole wheat bread (Table 7, Figure 6).

A similar large effect size of 0.54 was also calculated for the older adults’ “product package indicator score” in which the median score increased from 6.0 (IQR 4.0, 8.0) to 8.0 (IQR 7.0, 9.0) out of 10.0; p=0.000 (Table 8, Figure 7). Participants displayed significant improvements in the correct identification of all valid and invalid whole grain product package indicators after the program with greatest improvements shown in the recognition of the Whole Grain Council stamp and “100% whole grain in the name or front of the package” as valid and the nutrition facts label as an invalid whole grain product package indicator (Table 9, Figure 8).

Outcomes from this program show that not only did participants display increased knowledge and ability to identify whole grains, they also gained confidence and were better able to apply their whole grain knowledge in the identification and selection of whole grain foods. The number of correct post questionnaire responses to question #7, in which participants were asked to determine whether a multigrain bread was a good source of whole grains from the ingredient list, increased by 30% from pre- (39%) to post- (68%) intervention; p=0.000 (Table 10). These findings suggest that participants were better able to use and accurately interpret an ingredient list to determine whole grain content, which in turn, may facilitate increased selection and consumption of whole grain foods. Forty-four percent more participants reported knowing how to use the product
package to select whole grain foods (96% post- versus 52% pre-, p=0.000, Table 15) and almost all (99%) reported feeling confident in discerning whole grain foods using the product label after the program (Table 20). Consumers who possess greater confidence in the ability to identify whole grain foods and feel successful in this skill are more apt to select whole grain foods, also boosting consumption.

Based on the grain foods surveyed, small but significant increases in whole grain frequency intake and decreases in refined grain frequency intake among the older adult participants were also shown. From pre- to post- intervention, the median “total whole grain consumption score” increased from 8.0 (IQR 4.0, 11.0) to 10.0 (IQR 7.0, 13.5) with a medium effect size of 0.31, and the median “total refined grain consumption score” decreased from 5.0 (IQR 2.0, 7.0) to 2.5 (IQR 0.0, 5.0) with a small effect size of 0.24 while median total grain consumption scores remained similar, 13.0 and 12.5, respectively (Table 12, Figures 9 and 10). These results suggest that the older adults increased their frequency proportion of whole to refined grain foods consumed, relative to the frequency of total grain foods consumed. It is important to note that the grain consumption scores reflect consumption of only the grain foods surveyed and thus represent a partial view of grain intake. Refined grain intake, in particular, was limited to three refined grain bread products. Hence, from pre- to post intervention, whole grain foods comprised 62% versus 80% of the total grain consumption score respectively and refined grain foods, specifically refined grain breads, comprised 38% and 20% of the total grain consumption score respectively. The participants ate whole grain foods two more times a week and halved their consumption of refined grain breads at the end of the program.
These findings infer that participants replaced their intake of refined grains with whole grains, as opposed to adding whole grain foods to their present refined grain intake. The substitution of whole grains was reinforced in this program and is emphasized in the current Dietary Guidelines as well as USDA’s ChooseMyPlate.gov. Breakfast foods, that of oatmeal and whole grain cereal, ranked as two of the three whole grain foods (the other being whole wheat bread) eaten most frequently by older adults based on survey responses; these findings are consistent with the literature that older adults eat the majority of their daily whole grains (64%) at breakfast.

Given the short three week time span of the Is It Whole Grain? program to make changes in eating behaviors, participants’ intention to eat more whole grain foods may be indicative of behavior change as well. In this pilot study, 89% of the participants designated on the program evaluation that they intend to eat more whole grains; approximately two-thirds (63.7%) rated their strength of intention as strong and over one-third (35.6%) as moderate (Tables 16 and 17). Intention as a predictor of behavior change is an underlying principle in many social and health psychology theories and is supported by evidence from both correlation and experimental studies. For example, a meta-analysis of 422 correlation studies showed a strong association between intentions and behavior and calculated a large effect size. The causal effect of intention on behavior was shown in a meta-analysis of 47 experimental studies in which a medium to large change in intentions had a small to medium effect on behavior change. While intention alone is insufficient to produce behavior change, intention is often viewed as the first step in behavior change. Intention, coupled with action planning or implementation intentions, can promote behavior change. Those with stronger intentions are
more likely to implement their plans.\textsuperscript{138,141} Stronger intention as a predictor of behavior change was illustrated in a recent study involving African American women in Washington, D.C. following a nutrition education program. Women with higher post-intervention intention scores were eating more fruits and vegetables at four months follow-up; a difference of 0.13 servings was observed for each additional point scored (p=0.03).\textsuperscript{142}

Many of the findings in this pilot study are similar to those in the study by Ellis et al. involving older adults in Georgia. Over half of the participants in each study, pre-intervention, were knowledgeable about the health benefits of whole grains to help reduce the risk of bowel conditions, heart disease, Type 2 diabetes and cancer; correct responses for these variables ranged from 54\% to 83\%. The intake frequency of select whole grain foods, specifically cereal, whole grain bread and crackers, also significantly increased post intervention in both of the studies. This pilot study revealed a significant increase in the consumption of popcorn as well. Improvements in whole grain identification were also shown in both studies. The frequency of whole grain foods consumed pre-intervention was lower in this study (\textit{Md}=8 times/week) compared to the older adults in Georgia (mean=10.5 times/week), however a greater number of whole grain foods were surveyed in the Georgia study compared to the present study, 11 versus 7, and likely contributes towards the differences shown.\textsuperscript{127,128}

A compilation of factors contribute to the positive outcomes generated from this program. Most notably, the program design was based on extensive research involving the target population. The content and structure of the program was developed with the
help and input of older adults, thereby creating a program tailored to their needs and their learning preferences.

The *Is it Whole Grain?* program incorporates many of the intervention strategies outlined in Sayhoun et al.’s framework for designing an older adult nutrition education program, such as: hands on activities, regular contact with a health professional, incentives, active participant involvement in the setting of goals, and messages that are “practical, simple, specific, limited in number and reinforced.” Sayhoun et al.’s framework was based on the review of 25 community-based interventions targeting older adults, aged 55 years or older, published between 1990 and 2003. More recently, Lyons encouraged the use of Sayhoun et al.’s framework in her review of nutrition education intervention studies involving community-living older adults published between 2003 and 2012.

Common characteristics of other successful older adult nutrition education programs, that of the *Evergreen Action Nutrition (EAN)* programs and *Healthy Eating for Life Program (HELP)*, are exhibited within the *Is It Whole Grain?* program as well. These characteristics include an interactive format, discussion and participants’ receipt of written information and recipes. Socialization, recipes and food tasting were also found to promote behavior change in an evaluation of *EAN* food workshops conducted over three years. Taste testing gives older adults the opportunity to try unfamiliar foods before purchasing them as many are hesitant to spend their limited income on new foods that they may not like.

The design of the *Is It Whole Grain?* program also contains the four essential elements of a nutrition education program proposed by Krinke: commitment, cognitive
processing, capability and confidence. According to Krinke, a program must have these elements in order to achieve and maintain dietary behavior change. Commitment motivates the older adult to adopt and maintain a food behavior. In the *Is It Whole Grain?* program, participants made a commitment to attend all three sessions and were also encouraged to set, record and work towards achieving specific, individualized goals to increase whole grain intake in their diets. A program with cognitive processing helps the older adult understand the health benefits associated with the new food behavior and helps the individual plan how to practically fit the new food behavior into his or her current lifestyle. Both the health benefits of whole grains and a variety of ways to incorporate whole grains into their diets were explored throughout the *Is It Whole Grain?* program. A program with the element of capability provides the skills necessary to practice the new food behavior. Through the *Is It Whole Grain?* program, participants learned the skills needed to identify and select whole grain foods in order to increase whole grain consumption. And lastly, a program with the element of confidence instills both self-confidence and self-assurance so that the older adult can be successful in this new food behavior. Increased confidence in the identification of whole grains was an outcome measure shown in the post-intervention whole grain questionnaire. Thus, this program met all of these criteria.  

Upon comparing the “total whole grain knowledge scores” and “total whole grain consumption scores” of the younger adults to that of the pre-intervention older adults, the younger adults scored significantly higher in knowledge yet significantly lower in consumption, although the findings were modest with small effect sizes of 0.22 and 0.13 respectively (p=0.000). The median “total whole grain knowledge score” of the younger
adult and older adult respondents respectively was 18.0 (IQR 15.0, 20.0) and 16.0 (IQR 13.0, 18.0) out of 31.0 (Table 22, Figure 11).

Although the young adult median “total whole grain knowledge score” was higher than that of the older adults, their score of 58% is overall low and highlights the need for increased whole grain education in this population. Similar to that of the pre-intervention older adults, their “grain content identification score” yielded the lowest median scores among the three sub scores, 4.0 out of 11.0, which translates to a 36%. Based on these findings, education that expands younger adults’ repertoire of grain foods and their grain content is needed. Their median “basic whole grain knowledge score” was also low, 63%, particularly in the areas of intake recommendations and some of the health benefits (Tables 23, 25, 27; Figure 13). In the cross sectional analysis of data from Project EAT (Eating Among Teens)-II, involving approximately 2500 adolescents and young adults (with a mean age of 17.2 and 20.5 years respectively), whole grain consumption was significantly and positively associated with concerns about health among adolescent males and young adults of both sexes. These results suggest that educating younger adults about the health benefits of whole grains may facilitate increased intake in this population.

While the majority of young adults were able to identify a simplified three step process that could be used to determine the grain content of a food in question #61 and over half reported that they knew how to use the product package to select whole grain foods in question #65d, less than one-third were able to determine the correct grain content of a multigrain bread from an ingredients list in question #63 (Table 29 and 32, Figure 14). This highlights a discrepancy between young adults’ whole grain knowledge
and application of this knowledge. Hands on activities in which young adults determine the grain content of foods using food packages would encourage the transfer of this knowledge, provide opportunities to practice concepts learned and may facilitate the selection of whole grain foods in the future.

While the median “total whole grain consumption” score was 6.0 (IQR 3.5, 9.5) in young adults compared to 8.0 (IQR 4.0, 11.0) in the older adults, inferring that the young adults ate whole grain foods a total of six times a week and two less times a week than the older adults, the frequency proportion of whole to refined grains consumed, relative to total grains consumed, was very similar. Overall, young adults ate grain foods less often, 9.5 times a week, compared to older adults, 13 times a week. The frequency of whole to refined grains consumed by the young adults was 63% and 37% respectively, compared to that of 62% and 38% respectively in older adults (Table 30, Figure 12 and 15). The intake of refined grain foods in this study was limited to three refined grain bread products and thus does not provide a comprehensive assessment of refined grain intake. In addition the grain consumption measure in this did not take into account serving sizes consumed. Even with these limitations however, the median weekly frequency of all grains consumed, including total bread (whole and refined) intake, by the young adult population appeared low and may reflect the influence of current fitness and fad diet plans.149,150

Whole grain cold cereal, whole grain pasta, whole grain bread and popcorn were the whole grain foods consumed most frequently by young adults. These findings are consistent with research which compared whole grain consumption patterns based on eating occasion and age. While the majority of whole grains are consumed at breakfast
by all age groups, snacks make a greater contribution to total whole grain intake in younger aged groups; 17.4% of whole grains are consumed as snacks in those 18 to 34 years of age.\textsuperscript{6} In this present study, the frequency of whole grain cold cereals was similar for both age groups, yet older adults ate more oatmeal and younger adults ate more popcorn in comparison.

Spearman’s Rank Order Correlation indicated no statistically significant relationship between whole grain knowledge and intake in younger adults, suggesting additional factors may play a role in whole grain consumption (Table 33). One of the barriers associated with whole grain consumption, and explored in the whole grain survey completed by both the young and older adults, was that of taste. Interestingly, the majority of young adults, as well as pre-intervention older adults, reported that they liked the taste of whole grain foods yet 45% of young adults also stated they preferred the taste of white bread compared to whole wheat bread. This latter finding was statistically different from that of older adults (Table 32).

Taste as a barrier in the whole grain consumption of young adults was shown in the Project EAT II study as well. Taste preference for whole grain bread was significantly and positively associated with whole grain intake and was the strongest indicator of intake out of the personal factors explored among male adolescents and young adults of both sexes.\textsuperscript{131} Outcomes from a recent focus group study involving British volunteers from the WHOLEheart study found that some participants’ preconceived dislike of certain whole grain foods prior to the study changed over the course of the study, lending credence that the use of taste tests can provide opportunities to challenge these preconceived taste “beliefs”. Also observed was an increased
preference for whole grain foods over time in that participants “learned to like” whole grain foods upon repeated consumption.\textsuperscript{103}

These observations suggest that younger adults would benefit from whole grain education similar in content to that of the older adults. Their overall scores in whole grain knowledge and consumption were low. When compared to the scores of pre-intervention older adults, their overall whole grain knowledge was greater yet their consumption was less; the effect sizes of both scores were small. Both groups displayed similar knowledge deficits in their grain content identification scores and ability to determine the grain content of a bread from an ingredients list. Significant improvements in both of these variables were shown in the older adults after the program. The college students’ knowledge regarding whole grains health benefits is limited and taste may be a barrier to consumption. Education which emphasizes the practical application of knowledge, expands their repertoire of grain foods and their grain content, and provides exposure to whole grain foods and taste testing would be beneficial to the young adults.

\textbf{Limitations}

Valuable lessons were learned throughout this thesis project. A validated whole grain screener appropriate to older adults is needed to further substantiate the positive findings demonstrated in this pilot study and yield results with greater measurement accuracy. Pilot-testing questionnaires with the target populations to ensure that instructions and questions are clear and easily understood by the populations involved is important. Caution should be exercised when comparing and interpreting the survey results of the younger adults and the pre-intervention older adults as the delivery of the instrument differed, online versus pencil and paper.
The self-reported nature of the data is a limitation. Self-reporting is subject to over- and under-estimating. Responses can be influenced by participants’ feelings at the time the survey is completed. Social desirability bias, in which participants present themselves in a favorable or acceptable manner, can occur. Self-reporting is also prone to recall bias in that participants can misremember facts and details. The self-administered questionnaire format of the survey may increase the occurrence of omitted answers as well.

The older adults in this study exhibited a wide range of cognitive functioning and an assessment of participants’ cognitive functioning was not performed. Hence, the validity of the study may be compromised as participants may have misunderstood or misinterpreted some of the questions surveyed. As the sample population of young adults was limited to college students, the findings may not be generalizable to all young adults. In addition, the sample of college students originated from a nutrition course and their knowledge base on whole grains may not be representative of the average college student based on their choice of this course. (As previously stated, however, approximately 95% of the students did not declare nutrition or allied health as their major).

Several factors impacted the grain intake results in particular. Intake frequency was limited to ten surveyed foods only, yet additional grain foods were likely consumed and unaccounted for. The serving size of grain foods was not considered as the survey assessed only frequency and not the amount consumed. For example, eating two versus 20 whole wheat crackers impacts total grain intake estimations. Participants’ misclassification of foods likely skewed the intake results as well. For example, a
participant may incorrectly or mistakenly categorize a bread as whole grain when it is not. Specific to older adults, studies have shown that self-reported dietary intake is often unreliable in this population and that additional dietary records can be helpful to confirm data obtained via this method.\textsuperscript{146} In addition, the three week time span of the program may make the assessment of behavioral changes in grain intake difficult. While the intention to eat more whole grains was explored, its relevance is limited as this variable was assessed in the post-questionnaire only.
This pilot study showed that the *Is It Whole Grain?* program significantly improved older adults’ whole grain knowledge, identification and intake frequency of whole grain foods as evidenced by pre- and post- self-reported questionnaire responses. These findings suggest progression to the next step, that of refining the assessment tool to obtain results with greater measurement accuracy.

The following measures can be considered. Consider narrowing the scope of the evaluation to reduce respondent burden and focus exclusively on grain consumption and the grain identification of foods, specifically the grain content of foods, product package indicators and the application of knowledge. Determine face and content validity of the questionnaires by submitting them to a panel of experts in nutrition and gerontology. Establish test-retest reliability with a small sample of the target population. Utilize a brief cognitive screener so that only those mentally capable of understanding and answering the questions could be included in the final analysis. Pilot test the questionnaires with the target audience to ensure questions are clear, easy to understand and respondent burden is minimal. Incorporate longer-term follow-up of whole grain intake, via a brief survey by telephone or by mail, approximately three months after the program to better assess sustained changes in whole grain intake. Expand the list of refined grain food surveyed and add a limited number of portion size estimations, such as...
slices of bread or number of crackers consumed, to better quantify grain intake. With the soon to-be-released *Dietary Guidelines for Americans 2015*, review and modify, if necessary, the content of the program to ensure consistency with these new guidelines.

Designing a “user friendly” whole grain screener geared for the older adult is a challenging task however and further highlights the need for a reliable and valid standardized whole grain screener appropriate for this population. It will be important to consider potential limitations of the older adult population such as declining vision, hearing loss, and differences in cognition, upon designing an assessment tool. Studies reveal that older adults have the tendency to refuse or partially complete surveys and many are opposed to written evaluations; observations from this pilot study concur these findings. If a written questionnaire is used, questions that are worded simply and limited in number can help reduce respondent burden.

Despite the younger adults’ greater exposure to whole grain education, their overall whole grain knowledge and intake was low, as evidenced by a median “total whole grain knowledge score” of 58% and a median “total whole grain consumption score” of 6.0, inferring that younger adults ate whole grains a median six times a week. Younger adults would benefit from whole grain education similar in content to that provided for the older adults. Education and activities that particularly reinforce the grain content of foods, include taste testing opportunities and encourage the practical application of whole grain concepts are suggested. Based on the positive outcomes generated from the older adult program, working directly with the target population and incorporating their input in the development of whole grain education, such as through focus group interviews, would further develop the findings from this study. A valid
whole grain assessment tool that is pilot tested before use is recommended to evaluate the effectiveness of the study. As suggested with the older adults, administration of another brief intake survey approximately three to six months after the education, in addition to the pre- and post-intervention surveys, would better capture sustained changes in whole grain intake. Incorporation of these measures would facilitate the design of a program tailored to the needs and interests of younger adults as well as yield results measured with greater accuracy.

The results from this pilot study add to the body of evidence that older adults can benefit from nutrition education. Programs specific for this age group can impact changes in nutrition knowledge and behavior. Its positive outcomes highlight the importance of involving the target population in the design and development of a nutrition education program, thereby creating a program tailored to the needs, knowledge base and learning preferences of the intended audience. It also suggests that young adults would benefit from whole grain nutrition education in spite of their greater exposure to whole grain messaging compared to that of the older adults.
Table 1. Demographics, Descriptive Characteristics of Older Adult Participants, N=157

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<td>Diabetes</td>
<td>19.1 (30)</td>
<td>23.1 (24)</td>
<td>11.3 (6)</td>
</tr>
<tr>
<td>Cancer</td>
<td>22.3 (35)</td>
<td>22.1 (23)</td>
<td>22.6 (12)</td>
</tr>
<tr>
<td>Heart disease or Heart attack</td>
<td>15.9 (25)</td>
<td>16.3 (17)</td>
<td>15.1 (8)</td>
</tr>
<tr>
<td>High blood cholesterol</td>
<td>51.6 (81)</td>
<td>52.9 (55)</td>
<td>49.1 (26)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>52.2 (82)</td>
<td>53.8 (56)</td>
<td>49.1 (26)</td>
</tr>
<tr>
<td>Bowel Disorder</td>
<td>28.0 (44)</td>
<td>26.0 (27)</td>
<td>32.1 (17)</td>
</tr>
<tr>
<td>Celiac Disease (treated by gluten-free diet)</td>
<td>1.3 (2)</td>
<td>1.9 (2)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Food Allergy to any grain</td>
<td>3.2 (5)</td>
<td>1.0 (1)</td>
<td>7.5 (4)</td>
</tr>
<tr>
<td>Meal Preparation(^3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grocery shops</td>
<td>85.4 (134)</td>
<td>86.5 (90)</td>
<td>83.0 (44)</td>
</tr>
<tr>
<td>Plans own meals</td>
<td>75.2 (118)</td>
<td>81.7 (85)</td>
<td>63.5 (33)</td>
</tr>
<tr>
<td>Cooks own meals</td>
<td>82.8 (130)</td>
<td>84.6 (88)</td>
<td>79.2 (42)</td>
</tr>
</tbody>
</table>

1. Three session attendees
2. Subsidized: Commodity meal site, low income senior apartment
3. Pre-survey responses
### Older Adult Three-Session Pre- and Post-Intervention Data: Tables 2-20

#### Table 2. Older Adult Mean Total Whole Grain Knowledge Score

<table>
<thead>
<tr>
<th>Score&lt;sup&gt;1,2&lt;/sup&gt;</th>
<th>Pre-Survey n=157</th>
<th>Post-Survey n=157</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>15.46 ± 0.384</td>
<td>21.96 ± 0.310</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1. Maximum possible score: 31
2. Correct responses reported as mean ± SEM; paired samples t-test

#### Table 3. Older Adult Median Total Whole Grain Knowledge Score

<table>
<thead>
<tr>
<th>Score&lt;sup&gt;1,2&lt;/sup&gt;</th>
<th>Pre-Survey n=157</th>
<th>Post-Survey n=157</th>
<th>z</th>
<th>p-value</th>
<th>r&lt;sup&gt;3&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>16.0 (13.0, 18.0)</td>
<td>22.0 (19.5, 24.0)</td>
<td>-10.646</td>
<td>0.000</td>
<td>.60</td>
</tr>
</tbody>
</table>

1. Maximum possible score: 31
2. Correct responses reported as median (interquartile range); Wilcoxon signed rank test
3. \( r = \frac{z}{\text{square root of total number of observations over the 2 time points}} \)
   Calculated effect size criteria: 0.1=small, 0.3=medium, 0.5=large
Table 4. Older Adult Basic Whole Grain Knowledge Score

<table>
<thead>
<tr>
<th>Score</th>
<th>Pre-Survey n=157</th>
<th>Post-Survey n=157</th>
<th>z</th>
<th>p-value</th>
<th>r&lt;sup&gt;3&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>5.0 (3.0, 5.5)</td>
<td>6.0 (5.0, 6.0)</td>
<td>-7.947</td>
<td>0.000</td>
<td>0.45</td>
</tr>
</tbody>
</table>

1. Includes health benefits, intake recommendations, WG definition
2. Maximum possible score: 8
3. Correct responses reported as median (interquartile range); Wilcoxon Signed Rank Test
4. \( r = \frac{z}{\sqrt{\text{total number of observations over the 2 time points}} \) 
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 5. Older Adult Knowledge Questions: Health Benefits, Servings and Definition

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Survey n=157</th>
<th>Post-Survey n=157</th>
<th>p-value&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces risk of memory loss</td>
<td>11.0 (17)</td>
<td>19.4 (30)</td>
<td>0.035</td>
</tr>
<tr>
<td>Reduces risk of cancer&lt;sup&gt;3&lt;/sup&gt;</td>
<td>54.2 (84)</td>
<td>85.8 (133)</td>
<td>0.000</td>
</tr>
<tr>
<td>Reduces risk of heart disease</td>
<td>69.0 (107)</td>
<td>90.3 (140)</td>
<td>0.000</td>
</tr>
<tr>
<td>Reduces risk of colds/respiratory infections</td>
<td>18.5 (28)</td>
<td>20.5 (31)</td>
<td>0.736</td>
</tr>
<tr>
<td>Reduces risk of bowel conditions</td>
<td>83.4 (131)</td>
<td>93.0 (146)</td>
<td>0.004</td>
</tr>
<tr>
<td>Reduces risk of Type 2 diabetes</td>
<td>58.7 (91)</td>
<td>76.9 (120)</td>
<td>0.000</td>
</tr>
<tr>
<td>Recommended WG servings/day</td>
<td>48.1 (75)</td>
<td>78.2 (122)</td>
<td>0.000</td>
</tr>
<tr>
<td>Definition of a WG</td>
<td>85.7 (132)</td>
<td>98.7 (152)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
3. WG benefits supported by research are bolded.
Table 6. Older Adult Grain Content Identification Score

<table>
<thead>
<tr>
<th>Score(^1,2)</th>
<th>Pre-Survey (n=157)</th>
<th>Post-Survey (n=157)</th>
<th>(z)</th>
<th>p-value</th>
<th>(r^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0(3.0, 5.0)</td>
<td>7.0 (5.0, 8.0)</td>
<td>-9.187</td>
<td>0.000</td>
<td>0.52</td>
<td></td>
</tr>
</tbody>
</table>

1. Maximum possible score: 11
2. Correct responses reported as median (interquartile range); Wilcoxon Signed Rank Test
3. \(r = \frac{z}{\text{square root of total number of observations over the 2 time points}}\)
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 7. Older Adult Knowledge Questions: Grain Content Identification of Foods

<table>
<thead>
<tr>
<th>Food: Correct Response</th>
<th>Pre-Survey(^1) (n=157)</th>
<th>Post-Survey(^1) (n=157)</th>
<th>p-value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal: 100% WG</td>
<td>61.1 (91)</td>
<td>89.3 (133)</td>
<td>0.000</td>
</tr>
<tr>
<td>Brown rice: 100% WG</td>
<td>58.6 (89)</td>
<td>92.1 (140)</td>
<td>0.000</td>
</tr>
<tr>
<td>Beans: Not a grain food</td>
<td>30.8 (41)</td>
<td>42.1 (56)</td>
<td>0.036</td>
</tr>
<tr>
<td>Whole wheat bread: 100% WG</td>
<td>43.0 (65)</td>
<td>76.2 (115)</td>
<td>0.000</td>
</tr>
<tr>
<td>White bread: Refined grain</td>
<td>52.0 (77)</td>
<td>67.6 (100)</td>
<td>0.001</td>
</tr>
<tr>
<td>Wheat bread: Refined grain</td>
<td>34.7 (50)</td>
<td>29.2 (42)</td>
<td>0.312</td>
</tr>
<tr>
<td>Multigrain bread: Some whole grain</td>
<td>51.7 (74)</td>
<td>71.3 (102)</td>
<td>0.001</td>
</tr>
<tr>
<td>Pumpernickel bread: Refined grain</td>
<td>18.1 (27)</td>
<td>34.9 (52)</td>
<td>0.001</td>
</tr>
<tr>
<td>Popcorn: 100% WG</td>
<td>28.6 (42)</td>
<td>89.1 (131)</td>
<td>0.000</td>
</tr>
<tr>
<td>Flax seed: Not a grain food</td>
<td>6.80 (10)</td>
<td>11.6 (17)</td>
<td>0.230</td>
</tr>
<tr>
<td>Bran muffin: Refined or some whole grain</td>
<td>65.4 (100)</td>
<td>64.1 (98)</td>
<td>0.897</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
Table 8. Older Adult Product Package Indicator Score

<table>
<thead>
<tr>
<th>Score(^{1,2})</th>
<th>Pre-Survey n=157</th>
<th>Post-Survey n=157</th>
<th>z</th>
<th>p-value</th>
<th>r(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0 (4.0, 8.0)</td>
<td>8.0 (7.0, 9.0)</td>
<td>-9.575</td>
<td>0.000</td>
<td>0.54</td>
<td></td>
</tr>
</tbody>
</table>

1. Maximum possible score: 10
2. Correct responses reported as median (interquartile range); Wilcoxon Signed Rank Test
3. \( r = \frac{z}{\text{square root of total number of observations over the 2 time points;}} \)
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 9. Older Adult Knowledge Questions: Product Package Indicators

<table>
<thead>
<tr>
<th>Information</th>
<th>Pre-Survey(^1) n=157</th>
<th>Post-Survey(^1) n=157</th>
<th>p-value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Whole Grain Logo by Whole Grain Council(^3)</strong></td>
<td>61.9 (91)</td>
<td>96.6 (142)</td>
<td>0.000</td>
</tr>
<tr>
<td>Nutrition Facts label</td>
<td>42.6 (60)</td>
<td>72.3 (102)</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Ingredients list</strong></td>
<td>75.3 (110)</td>
<td>88.4 (129)</td>
<td>0.003</td>
</tr>
<tr>
<td>Picture or color of food</td>
<td>76.2 (109)</td>
<td>94.4 (135)</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Whole grain health claim</strong></td>
<td>28.1 (39)</td>
<td>51.8 (72)</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>100% WG in name or on front of package</strong></td>
<td>63.8 (95)</td>
<td>92.6 (138)</td>
<td>0.000</td>
</tr>
<tr>
<td>“Wheat” in name</td>
<td>70.8 (102)</td>
<td>88.2 (127)</td>
<td>0.000</td>
</tr>
<tr>
<td>“Multigrain” in name</td>
<td>58.4 (87)</td>
<td>82.6 (123)</td>
<td>0.000</td>
</tr>
<tr>
<td>“Stoneground” in name</td>
<td>46.8 (65)</td>
<td>72.7 (101)</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Whole Grain Heart Check Mark by American Heart Association</strong></td>
<td>74.5 (114)</td>
<td>90.2 (138)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
3. Whole grain indicators are bolded.
Table 10. Older Adult Knowledge Questions: Steps; Using Ingredients List

| Question | Pre-Survey\(^1\)  
n=157 | Post-Survey\(^1\)  
n=157 | p-value\(^2\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Steps</td>
<td>47.8 (75)</td>
<td>69.4 (109)</td>
<td>0.000</td>
</tr>
<tr>
<td>Grain content using ingredients list</td>
<td>38.9 (61)</td>
<td>67.5 (106)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test

Table 11. Older Adult Median Total Whole Grain Knowledge Scores\(^1\) by Class Format

| Teaching Approach | Pre-Survey\(^2\)  
n=89 | Post-Survey\(^2\)  
n=89 | Median Difference |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerPoint, n=89</td>
<td>17.0 (13.5, 19.0)</td>
<td>23.0 (20.0, 25.0)</td>
<td>6.0</td>
</tr>
<tr>
<td>Discussion based, n=68</td>
<td>15.0 (11.0, 18.0)</td>
<td>21.0 (18.25, 24.0)</td>
<td>6.0</td>
</tr>
</tbody>
</table>

1. Maximum possible score: 31
2. Correct responses reported as median (interquartile range); Wilcoxon signed rank test

Table 12. Older Adult Weekly Total Grain Consumption Score\(^1\)

| Grain          | Pre-Survey\(^2\)  
n=157 | Post-Survey\(^2\)  
n=157 | z     | p-value | R\(^3\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grain</td>
<td>8.0 (4.0, 11.0)</td>
<td>10.0 (7.0, 13.5)</td>
<td>-5.459</td>
<td>0.000</td>
<td>0.31</td>
</tr>
<tr>
<td>Refined Grain</td>
<td>5.0 (2.0, 7.0)</td>
<td>2.5 (0, 5.0)</td>
<td>-4.315</td>
<td>0.000</td>
<td>0.24</td>
</tr>
</tbody>
</table>

1. Times per week consumed
2. Reported as median (interquartile range); Wilcoxon Signed Rank Test
3. \(r = z/\sqrt{\text{total number of observations over the 2 time points}}\); Calculated effect size criteria: .1=small, .3=medium, .5=large
Table 13. Older Adult Weekly Consumption$^1$ of Specific Grain Foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Pre-Survey$^3$ n=157</th>
<th>Post-Survey$^3$ n=157</th>
<th>z</th>
<th>p-value</th>
<th>r$^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td>1.0 (0,2.5)</td>
<td>1.0 (0,2.5)</td>
<td>-4.502</td>
<td>0.000</td>
<td>0.25</td>
</tr>
<tr>
<td>Brown rice</td>
<td>0.0 (0, 1.0)</td>
<td>0.0 (0, 1.0)</td>
<td>-0.721</td>
<td>0.471</td>
<td></td>
</tr>
<tr>
<td>WG cereal (cold)</td>
<td>1.0 (0, 2.5)</td>
<td>2.5 (0, 5.0)</td>
<td>-2.696</td>
<td>0.007</td>
<td>0.15</td>
</tr>
<tr>
<td>WG pasta</td>
<td>0.0 (0, 1.0)</td>
<td>0.0 (0, 1.0)</td>
<td>-1.170</td>
<td>0.242</td>
<td></td>
</tr>
<tr>
<td>Brown or “wheat” bread</td>
<td>2.5 (0, 3.75)</td>
<td>0.0 (0, 2.5)</td>
<td>-2.405</td>
<td>0.016</td>
<td>0.14</td>
</tr>
<tr>
<td>White bread</td>
<td>0.0 (0, 1.0)</td>
<td>0.0 (0,0)</td>
<td>-2.809</td>
<td>0.005</td>
<td>0.16</td>
</tr>
<tr>
<td>Multigrain bread</td>
<td>1.0 (0, 2.5)</td>
<td>0.0 (0, 2.5)</td>
<td>-2.255</td>
<td>0.024</td>
<td>0.13</td>
</tr>
<tr>
<td>WG bread</td>
<td>1.0 (0, 5.0)</td>
<td>2.5 (0, 5.0)</td>
<td>-2.411</td>
<td>0.016</td>
<td>0.14</td>
</tr>
<tr>
<td>Whole Wheat crackers</td>
<td>0.0 (0, 1.0)</td>
<td>1.0 (0, 2.5)</td>
<td>-4.078</td>
<td>0.000</td>
<td>0.23</td>
</tr>
<tr>
<td>Popcorn</td>
<td>0.0 (0, 1.0)</td>
<td>0.0 (0, 1.0)</td>
<td>-4.026</td>
<td>0.000</td>
<td>0.23</td>
</tr>
</tbody>
</table>

1. Times per week consumed
2. Whole grain foods are bolded.
3. Reported as median (interquartile range); Wilcoxon Signed Rank Test
4. $r = z$/square root of total number of observations over the 2 time points;
   Calculated effect size criteria: 0.1=small, .3=medium, .5=large

Table 14. Older Adult Whole Grain Knowledge and Consumption Correlation

<table>
<thead>
<tr>
<th></th>
<th>Spearman’s Rho$^1$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention, n=157</td>
<td>0.135</td>
<td>0.092</td>
</tr>
<tr>
<td>Post-intervention, n=157</td>
<td>0.136</td>
<td>0.089</td>
</tr>
</tbody>
</table>

1. Spearman’s Rank Order Correlation
### Table 15. Older Adult Opinion Questions: Taste, Cost, Selection Knowledge

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Survey(^1) n=157</th>
<th>Post-Survey(^1) n=157</th>
<th>p-value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like taste of WG foods</td>
<td>86.6 (129)</td>
<td>94.0 (140)</td>
<td>0.019</td>
</tr>
<tr>
<td>Prefer taste of white to WW bread</td>
<td>15.6 (24)</td>
<td>13.6 (21)</td>
<td>0.648</td>
</tr>
<tr>
<td>WW bread is more expensive than white</td>
<td>51 (80)</td>
<td>51 (80)</td>
<td>1.0</td>
</tr>
<tr>
<td>Know how to use package to select WG foods</td>
<td>51.9 (80)</td>
<td>95.5 (147)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1. Proportion of responses reported as % (n).
2. McNemar’s Test

### Table 16. Post-Survey: Older Adult Intent to Eat More Whole Grain Foods, n=157

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>89.1 (139)</td>
</tr>
<tr>
<td>No</td>
<td>1.3 (2)</td>
</tr>
<tr>
<td>Not sure</td>
<td>9.6 (15)</td>
</tr>
</tbody>
</table>

1. Reported as % (n).

### Table 17. Post-Survey: Older Adult Strength of Intent to Eat Whole Grain Foods, n=157

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong</td>
<td>63.7 (93)</td>
</tr>
<tr>
<td>Moderate</td>
<td>35.6 (52)</td>
</tr>
<tr>
<td>Do Not Intend</td>
<td>0.7 (1)</td>
</tr>
</tbody>
</table>

1. Reported as % (n).
### Table 18. Older Adult Median Total Whole Grain Knowledge Scores¹ by State

<table>
<thead>
<tr>
<th>State</th>
<th>Pre-Survey²</th>
<th>Post-Survey²</th>
<th>z</th>
<th>p-value</th>
<th>r³</th>
<th>Median difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH, n=104</td>
<td>16.0 (13.0, 18.0)</td>
<td>22.5 (20.0, 24.0)</td>
<td>-8.774</td>
<td>0.000</td>
<td>0.61</td>
<td>6.5</td>
</tr>
<tr>
<td>Iowa, n=53</td>
<td>16.0 (11.5, 19.0)</td>
<td>21.0 (19.0, 24.0)</td>
<td>-6.030</td>
<td>0.000</td>
<td>0.59</td>
<td>5.0</td>
</tr>
</tbody>
</table>

1. Maximum possible score: 31
2. Correct responses reported as median (interquartile range); Wilcoxon signed rank test
3. r = z/square root of total number of observations over the 2 time points;
   Calculated effect size criteria: 0.1=small, 0.3=medium, 0.5=large

### Table 19. Older Adult Weekly Whole Grain Consumption Scores by State

<table>
<thead>
<tr>
<th>State</th>
<th>Pre-Survey¹</th>
<th>Post-Survey¹</th>
<th>z</th>
<th>p-value</th>
<th>r²</th>
<th>Median Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH, n=104</td>
<td>7.25 (3.5, 11.0)</td>
<td>10.0 (7.0, 13.5)</td>
<td>-4.858</td>
<td>0.000</td>
<td>0.34</td>
<td>2.75</td>
</tr>
<tr>
<td>Iowa, n=53</td>
<td>9.0 (5.75, 10.75)</td>
<td>9.5 (7.0, 12.75)</td>
<td>-2.456</td>
<td>0.014</td>
<td>0.24</td>
<td>0.50</td>
</tr>
</tbody>
</table>

1. Reported as median (interquartile range); Wilcoxon signed rank test
2. r = z/square root of total number of observations over the 2 time points;
   Calculated effect size criteria: 0.1=small, 0.3=medium, 0.5=large
Table 20. Older Adult Program Evaluation Responses, n=139

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating more WG after program</td>
<td>36 (50)</td>
<td>53.2 (74)</td>
<td>8.6 (12)</td>
<td>0.7 (1)</td>
<td>1.4 (2)</td>
</tr>
<tr>
<td>Confident in discerning WG foods by product label</td>
<td>57.6 (80)</td>
<td>41.0 (57)</td>
<td>1.4 (2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Program activities helped apply info.</td>
<td>60.9 (84)</td>
<td>36.2 (50)</td>
<td>2.9 (4)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Handouts/booklet helped apply info.</td>
<td>59.1 (81)</td>
<td>37.2 (51)</td>
<td>3.6 (5)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Would recommend program</td>
<td>62.3 (86)</td>
<td>34.8 (48)</td>
<td>2.9 (4)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Reported as % (n).
Table 21. Demographics, Descriptive Characteristics of Younger Adults\(^1\), n= 256

<table>
<thead>
<tr>
<th>Variables(^2)</th>
<th>(n=256)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>18.9</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>37.9 (97)</td>
</tr>
<tr>
<td>Female</td>
<td>61.3 (157)</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>95.3 (244)</td>
</tr>
<tr>
<td>Black</td>
<td>1.6 (4)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>2.7 (7)</td>
</tr>
<tr>
<td>American Indian/Alaska Native</td>
<td>0.4 (1)</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>4.7 (12)</td>
</tr>
<tr>
<td><strong>Current Living Situation</strong></td>
<td></td>
</tr>
<tr>
<td>On Campus</td>
<td>88.3 (226)</td>
</tr>
<tr>
<td>Off Campus</td>
<td>10.9 (28)</td>
</tr>
<tr>
<td><strong>Major</strong></td>
<td></td>
</tr>
<tr>
<td>Allied Health</td>
<td>5.1 (13)</td>
</tr>
<tr>
<td>Nutrition</td>
<td>0.4 (1)</td>
</tr>
<tr>
<td>Other</td>
<td>94.5 (240)</td>
</tr>
<tr>
<td><strong>Primary Residence</strong></td>
<td></td>
</tr>
<tr>
<td>US Regions: New England</td>
<td>87.9 (225)</td>
</tr>
<tr>
<td>Mid Atlantic</td>
<td>7.8 (20)</td>
</tr>
<tr>
<td>Midwest, Southwest, South</td>
<td>2.7 (7)</td>
</tr>
<tr>
<td>Outside the US</td>
<td>0.4 (1)</td>
</tr>
<tr>
<td><strong>History of Select Diseases/Conditions</strong></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.8 (2)</td>
</tr>
<tr>
<td>High blood cholesterol</td>
<td>5.1 (13)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3.1 (8)</td>
</tr>
<tr>
<td>Bowel Disorder</td>
<td>4.3 (11)</td>
</tr>
<tr>
<td>Celiac Disease (treated by gluten-free diet)</td>
<td>0.8 (2)</td>
</tr>
<tr>
<td>Intolerance to gluten</td>
<td>4.3 (11)</td>
</tr>
<tr>
<td>Food Allergy to any grain</td>
<td>0.8 (2)</td>
</tr>
<tr>
<td><strong>Meal Preparation (on regular basis)</strong></td>
<td></td>
</tr>
<tr>
<td>Grocery shops</td>
<td>33.2 (85)</td>
</tr>
<tr>
<td>Plans own meals</td>
<td>50.8 (130)</td>
</tr>
<tr>
<td>Cooks own meals</td>
<td>20.3 (52)</td>
</tr>
<tr>
<td><strong>Eating habits</strong></td>
<td></td>
</tr>
<tr>
<td>Meals/week in dining hall</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6.6 (17)</td>
</tr>
<tr>
<td>1-13</td>
<td>24.6 (63)</td>
</tr>
<tr>
<td>14-20</td>
<td>51.2 (131)</td>
</tr>
<tr>
<td>21+</td>
<td>17.6 (45)</td>
</tr>
<tr>
<td>Times/week in fast food restaurant</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>55.9 (143)</td>
</tr>
<tr>
<td>1-2</td>
<td>40.6 (104)</td>
</tr>
<tr>
<td>3-6</td>
<td>3.5 (9)</td>
</tr>
</tbody>
</table>

1. Self-reported  
2. Continuous variables reported as mean; categorical variables reported as % (n)  
3. 0.8% (2) chose not to answer  
4. 0.4% (1) chose not to answer; students given option to choose more than one  
5. 1.2% (3) invalid or chose not to answer
# Table 22. Young/Older Adult Median Total Whole Grain Knowledge Score

<table>
<thead>
<tr>
<th>Score $^{1,2}$</th>
<th>Older Adults n=157</th>
<th>Young Adults n=256</th>
<th>U value $^{3}$</th>
<th>z</th>
<th>p-value</th>
<th>r$^{4}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.0 (13.0, 18.0)</td>
<td>18.0 (15.0, 20.0)</td>
<td>14767.5</td>
<td>-4.539</td>
<td>0.000</td>
<td>0.22</td>
<td></td>
</tr>
</tbody>
</table>

1. Maximum possible score: 31
2. Correct responses reported as median (interquartile range)
3. Mann-Whitney U Test
4. $r = z / \sqrt{\text{total number of cases}}$
   - Effect size criteria: 0.1 = small, 0.3 = medium, 0.5 = large
Table 23. Young/Older Adult Basic Whole Grain Knowledge Score

<table>
<thead>
<tr>
<th>Score$^{1-3}$</th>
<th>Older Adults$^{4}$ n=157$^4$</th>
<th>Young Adults$^{2}$ n=256</th>
<th>U value$^6$</th>
<th>z</th>
<th>p-value</th>
<th>$r^7$</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 (3.0, 5.0)</td>
<td>5.0 (4.0, 6.0) $^5$</td>
<td>17472.5</td>
<td>-2.277</td>
<td>0.023</td>
<td>0.11</td>
<td></td>
</tr>
</tbody>
</table>

1. Includes health benefits, intake recommendations, WG definition
2. Maximum possible score: 8
3. Correct responses reported as median (interquartile range)
4. Pre-survey responses
5. Indicates direction of difference (group with greater consumption)
6. Mann-Whitney U Test
7. $r = z$/square root of total number of cases
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 24.
Young/Older Adult Knowledge Questions: Health Benefits, Servings, Definition

<table>
<thead>
<tr>
<th>Question</th>
<th>Older Adults$^{1,2}$ n=157</th>
<th>Young Adults$^{2}$ n=256</th>
<th>Chi-square$^3$</th>
<th>p-value</th>
<th>Phi value$^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces risk of memory loss</td>
<td>11.0 (17)</td>
<td>37.1 (95)</td>
<td>32.693</td>
<td>0.000</td>
<td>0.29</td>
</tr>
<tr>
<td>Reduces risk of cancer$^5$</td>
<td>54.2 (84)</td>
<td>34.0 (87)</td>
<td>14.488</td>
<td>0.000</td>
<td>-0.19</td>
</tr>
<tr>
<td>Reduces risk of heart disease</td>
<td>69.0 (107)</td>
<td>82.0 (210)</td>
<td>9.743</td>
<td>0.002</td>
<td>0.16</td>
</tr>
<tr>
<td>Reduces risk of colds/respiratory infections</td>
<td>18.5 (28)</td>
<td>35.2 (90)</td>
<td>11.392</td>
<td>0.001</td>
<td>0.17</td>
</tr>
<tr>
<td>Reduces risk of bowel conditions</td>
<td>83.4 (131)</td>
<td>81.6 (209)</td>
<td>0.110</td>
<td>0.740</td>
<td>-0.02</td>
</tr>
<tr>
<td>Reduces risk of Type 2 diabetes</td>
<td>58.7 (91)</td>
<td>67.2 (172)</td>
<td>2.752</td>
<td>0.097</td>
<td>0.09</td>
</tr>
<tr>
<td>Recommended WG servings/day</td>
<td>48.1 (75)</td>
<td>44.9 (115)</td>
<td>0.214</td>
<td>0.644</td>
<td>-0.02</td>
</tr>
<tr>
<td>Definition of a WG</td>
<td>85.7 (132)</td>
<td>84.0 (215)</td>
<td>0.000</td>
<td>1.000</td>
<td>-0.00</td>
</tr>
</tbody>
</table>

1. Pre-survey responses
2. Proportion of correct responses reported as % (n).
3. With Yates Continuity Correction
4. Calculated effect size criteria: 0.1=small, 0.3=medium, 0.5=large
5. Health benefits of whole grains supported by research are bolded.
Table 25. Young/Older Adult Grain Content Identification Score

<table>
<thead>
<tr>
<th>Score</th>
<th>Older Adults n=157</th>
<th>Younger Adults n=256</th>
<th>U value</th>
<th>z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 (3.0, 5.0)</td>
<td>4.0 (3.0, 6.0)</td>
<td>19091.5</td>
<td>-0.866</td>
<td>0.386</td>
<td></td>
</tr>
</tbody>
</table>

1. Maximum possible score: 11
2. Correct responses reported as median (interquartile range)
3. Pre-survey responses
4. Mann-Whitney U Test

Table 26. Young/Older Adult Knowledge Questions: Grain Content Identification of Foods

<table>
<thead>
<tr>
<th>Food: Correct Response</th>
<th>Older Adults n=157</th>
<th>Younger Adults n=256</th>
<th>Chi-square</th>
<th>p-value</th>
<th>Phi value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal: 100% WG</td>
<td>58.6 (92)</td>
<td>30.1 (77)</td>
<td>32.744</td>
<td>0.000</td>
<td>-0.28</td>
</tr>
<tr>
<td>Brown rice: 100% WG</td>
<td>56.7 (89)</td>
<td>48.8 (125)</td>
<td>2.103</td>
<td>0.147</td>
<td>-0.08</td>
</tr>
<tr>
<td>Beans: Not a grain food</td>
<td>27.4 (43)</td>
<td>51.6 (132)</td>
<td>22.311</td>
<td>0.000</td>
<td>0.24</td>
</tr>
<tr>
<td>Whole wheat bread: 100% WG</td>
<td>42.6 (66)</td>
<td>68.8 (176)</td>
<td>28.261</td>
<td>0.000</td>
<td>0.26</td>
</tr>
<tr>
<td>White bread: Refined grain</td>
<td>50.3 (79)</td>
<td>71.9 (184)</td>
<td>18.631</td>
<td>0.000</td>
<td>0.22</td>
</tr>
<tr>
<td>Wheat bread: Refined grain</td>
<td>32.5 (51)</td>
<td>10.9 (28)</td>
<td>27.830</td>
<td>0.000</td>
<td>-0.27</td>
</tr>
<tr>
<td>Multigrain bread: Some whole grain</td>
<td>49.7 (78)</td>
<td>59.0 (151)</td>
<td>3.043</td>
<td>0.081</td>
<td>0.09</td>
</tr>
<tr>
<td>Pumpernickel bread: Refined grain</td>
<td>17.2 (27)</td>
<td>21.1 (54)</td>
<td>0.706</td>
<td>0.401</td>
<td>0.05</td>
</tr>
<tr>
<td>Popcorn: 100% WG</td>
<td>26.8 (42)</td>
<td>3.1 (8)</td>
<td>48.856</td>
<td>0.000</td>
<td>-0.35</td>
</tr>
<tr>
<td>Flax seed: Not a grain food</td>
<td>6.40 (10)</td>
<td>17.6 (45)</td>
<td>9.643</td>
<td>0.002</td>
<td>0.16</td>
</tr>
<tr>
<td>Bran muffin: Refined or some whole grain</td>
<td>65.0 (102)</td>
<td>61.2 (161)</td>
<td>0.103</td>
<td>0.748</td>
<td>-0.02</td>
</tr>
</tbody>
</table>

1. Pre-survey responses
2. Proportion of correct responses reported as % (n).
3. With Yates Continuity Correction
4. Calculated effect size criteria: 0.1=small, 0.3=medium, 0.5=large
### Table 27. Young/Older Adult Product Package Indicator Score

<table>
<thead>
<tr>
<th>Information</th>
<th>Older Adults $^{1,2}$ n=157</th>
<th>Young Adults $^{2}$ n=256</th>
<th>U value$^{4}$</th>
<th>z</th>
<th>p-value</th>
<th>$r^5$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Score</strong> $^{1-2}$</td>
<td>6.0 (4.0, 8.0)</td>
<td>7.0 (6.0, 9.0)</td>
<td>13442.5</td>
<td>-5.706</td>
<td>0.000</td>
<td>0.28</td>
</tr>
</tbody>
</table>

1. Maximum possible score: 10  
2. Correct responses reported as median (interquartile range)  
3. Pre-survey responses  
4. Mann-Whitney U Test  
5. $r = z / \sqrt{\text{total number of cases}}$  
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

### Table 28. Young/Older Adult Knowledge Questions: Product Package Indicators

<table>
<thead>
<tr>
<th>Information</th>
<th>Older Adults $^{1,2}$ n=157</th>
<th>Young Adults $^{2}$ n=256</th>
<th>Chi-square$^{3}$</th>
<th>p-value</th>
<th>Phi value$^{4}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Whole Grain Logo by Whole Grain Council</strong>$^{5}$</td>
<td>58.0 (91)</td>
<td>81.6 (209)</td>
<td>26.276</td>
<td>0.000</td>
<td>0.26</td>
</tr>
<tr>
<td>Nutrition Facts label</td>
<td>39.5 (62)</td>
<td>28.5 (73)</td>
<td>4.840</td>
<td>0.028</td>
<td>-0.11</td>
</tr>
<tr>
<td><strong>Ingredients list</strong></td>
<td>71.3 (112)</td>
<td>85.9 (220)</td>
<td>12.248</td>
<td>0.000</td>
<td>0.18</td>
</tr>
<tr>
<td>Picture or color of food</td>
<td>70.7 (111)</td>
<td>70.7 (181)</td>
<td>0.000</td>
<td>1.000</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Whole grain health claim</strong></td>
<td>26.1 (41)</td>
<td>68.0 (174)</td>
<td>66.640</td>
<td>0.000</td>
<td>0.41</td>
</tr>
<tr>
<td><strong>100% WG in name or on front of package</strong></td>
<td>60.5 (95)</td>
<td>83.2 (213)</td>
<td>25.250</td>
<td>0.000</td>
<td>0.25</td>
</tr>
<tr>
<td>“Wheat” in name</td>
<td>66.2 (104)</td>
<td>62.5 (160)</td>
<td>0.440</td>
<td>0.507</td>
<td>-0.04</td>
</tr>
<tr>
<td>“Multigrain” in name</td>
<td>57.3 (90)</td>
<td>52.3 (134)</td>
<td>0.782</td>
<td>0.376</td>
<td>-0.05</td>
</tr>
<tr>
<td>“Stoneground” in name</td>
<td>43.9 (65)</td>
<td>69.9 (179)</td>
<td>26.293</td>
<td>0.000</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>Whole Grain Heart Check Mark by American Heart Association</strong></td>
<td>72.6 (114)</td>
<td>86.3 (221)</td>
<td>11.074</td>
<td>0.001</td>
<td>0.17</td>
</tr>
</tbody>
</table>

1. Pre-survey responses  
2. Proportion of correct responses reported as % (n).  
3. With Yates Continuity Correction  
4. Effect size criteria: 0.1=small, 0.3=medium, 0.5=large  
5. Whole grain indicators are bolded.
Table 29. Young/Older Adult Knowledge Questions: Steps, Using Ingredients List

<table>
<thead>
<tr>
<th>Question</th>
<th>Older Adults¹,²</th>
<th>Young Adults²</th>
<th>Chi-square³</th>
<th>p-value</th>
<th>Phi value⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Steps</td>
<td>47.8 (75)</td>
<td>85.9 (220)</td>
<td>67.606</td>
<td>0.000</td>
<td>0.41</td>
</tr>
<tr>
<td>Grain content using ingredients list</td>
<td>38.9 (61)</td>
<td>32.4 (83)</td>
<td>1.501</td>
<td>0.221</td>
<td>-0.07</td>
</tr>
</tbody>
</table>

1. Pre-survey responses
2. Proportion of correct responses reported as % (n).
3. With Yates Continuity Correction
4. Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 30. Young/Older Adult Weekly Total Grain Consumption Score¹

<table>
<thead>
<tr>
<th>Grain</th>
<th>Older Adults²</th>
<th>Young Adults²</th>
<th>U value³</th>
<th>z</th>
<th>p-value</th>
<th>r⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grain</td>
<td>8.0 (4.0, 11.0)</td>
<td>6.0 (3.5, 9.5)</td>
<td>17020.5</td>
<td>-2.614</td>
<td>0.009</td>
<td>0.13</td>
</tr>
<tr>
<td>Refined Grain</td>
<td>5.0 (2.0, 7.0)</td>
<td>3.5 (2.0, 5.0)</td>
<td>18032.0</td>
<td>-1.764</td>
<td>0.078</td>
<td>0.09</td>
</tr>
</tbody>
</table>

1. Times per week consumed
2. Median (interquartile range)
3. Mann-Whitney U Test
4. r = z/square root of total number of cases
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large
Table 31. Young/Older Adult Weekly Consumption\(^1\) of Specific Grain Foods

<table>
<thead>
<tr>
<th>Food(^2)</th>
<th>Older Adults(^3)  n=157</th>
<th>Young Adults(^3) n=256</th>
<th>U value(^5)</th>
<th>z</th>
<th>p-value</th>
<th>r(^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td>1.0 (0,2.5) ↑(^4)</td>
<td>0.0 (0,1.0)</td>
<td>16270.5</td>
<td>-3.701</td>
<td>0.000</td>
<td>0.18</td>
</tr>
<tr>
<td>Brown rice</td>
<td>0.0 (0, 1.0)</td>
<td>0.0 (0,1.0) ↑(^4)</td>
<td>16371.0</td>
<td>-3.609</td>
<td>0.000</td>
<td>0.18</td>
</tr>
<tr>
<td>WG cereal (cold)</td>
<td>1.0 (0, 2.5) ↑(^4)</td>
<td>1.0 (0, 2.5)</td>
<td>16410.0</td>
<td>-3.292</td>
<td>0.001</td>
<td>0.16</td>
</tr>
<tr>
<td>WG pasta</td>
<td>0.0 (0, 1.0)</td>
<td>1.0 (0, 2.5) ↑(^4)</td>
<td>15826.0</td>
<td>-3.931</td>
<td>0.000</td>
<td>0.19</td>
</tr>
<tr>
<td>Brown or “wheat” bread</td>
<td>2.5 (0, 3.75)</td>
<td>1.0 (0, 2.5)</td>
<td>19686.5</td>
<td>-0.361</td>
<td>0.718</td>
<td>0.02</td>
</tr>
<tr>
<td>White bread</td>
<td>0.0 (0, 1.0)</td>
<td>0.0 (0,1.0) ↑(^4)</td>
<td>17352.0</td>
<td>-2.722</td>
<td>0.006</td>
<td>0.13</td>
</tr>
<tr>
<td>Multigrain bread</td>
<td>1.0 (0, 2.5) ↑(^4)</td>
<td>0.0 (0,1.0)</td>
<td>17240.0</td>
<td>-2.607</td>
<td>0.009</td>
<td>0.13</td>
</tr>
<tr>
<td>WG bread</td>
<td>1.0 (0, 5.0) ↑(^4)</td>
<td>1.0 (0, 2.5)</td>
<td>16181.0</td>
<td>-3.504</td>
<td>0.000</td>
<td>0.17</td>
</tr>
<tr>
<td>Whole Wheat crackers</td>
<td>0.0 (0, 1.0) ↑(^4)</td>
<td>0.0 (0,1.0)</td>
<td>17602.5</td>
<td>-2.490</td>
<td>0.013</td>
<td>0.12</td>
</tr>
<tr>
<td>Popcorn</td>
<td>0.0 (0, 1.0)</td>
<td>1.0 (0, 1.0) ↑(^4)</td>
<td>16578.5</td>
<td>-3.327</td>
<td>0.001</td>
<td>0.16</td>
</tr>
</tbody>
</table>

1. Times per week consumed
2. Whole grain foods are bolded.
3. Median (interquartile range)
4. Indicates direction of difference (group with greater consumption)
5. Mann-Whitney U Test
6. \( r = z/\text{square root of total number of cases} \)
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 32. Young/Older Adult Opinion Questions: Taste, Cost, Selection Knowledge

<table>
<thead>
<tr>
<th>Question</th>
<th>Older Adults n=157</th>
<th>Young Adults n=256</th>
<th>Chi-square</th>
<th>p-value</th>
<th>Phi value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like taste of WG foods</td>
<td>86.8 (129)</td>
<td>79.6 (203)</td>
<td>2.944</td>
<td>0.086</td>
<td>0.09</td>
</tr>
<tr>
<td>Prefer taste of white to WW bread</td>
<td>16.7 (26)</td>
<td>44.7 (114)</td>
<td>32.643</td>
<td>0.000</td>
<td>-0.29</td>
</tr>
<tr>
<td>WW bread is more expensive than white</td>
<td>51.8 (80)</td>
<td>41.2 (105)</td>
<td>3.371</td>
<td>0.066</td>
<td>0.10</td>
</tr>
<tr>
<td>Know how to use package to select WG foods</td>
<td>51.9 (80)</td>
<td>54.1 (138)</td>
<td>0.105</td>
<td>0.746</td>
<td>-0.02</td>
</tr>
</tbody>
</table>

1. Pre-survey responses
2. Proportion of correct responses reported as % (n).
3. With Yates Continuity Correction
4. Effect size criteria: 0.1=small, 0.3=medium, 0.5=large
Table 33. Young Adult Whole Grain Knowledge and Consumption Correlation, n=256

<table>
<thead>
<tr>
<th>Spearman’s Rho(^1)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.074</td>
<td>0.238</td>
</tr>
</tbody>
</table>

1. Spearman’s Rank Order Correlation

**Older Adult Two-Session Pre- and Post-Intervention Data: Tables 34-39**

Table 34. Older Adult Median Total Whole Grain Knowledge Score

<table>
<thead>
<tr>
<th>Score(^1,2)</th>
<th>Pre-Survey(^n=16)</th>
<th>Post-Survey(^n=16)</th>
<th>p-value</th>
<th>(r^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0 (10.5, 19.75)</td>
<td>23.0 (19.25, 24.0)</td>
<td>0.001</td>
<td>.60</td>
<td></td>
</tr>
</tbody>
</table>

1. Maximum possible score: 31
2. Correct responses reported as median (interquartile range); Wilcoxon signed rank test
3. \(r = z/\text{square root of total number of observations over the 2 time points}\)
   Effect size criteria: 0.1=small, 0.3=medium, 0.5=large

Table 35. Older Adult Knowledge Questions: Health Benefits, Servings and Definition

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Survey(^1)(^n=16)</th>
<th>Post-Survey(^1)(^n=16)</th>
<th>p-value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces risk of memory loss</td>
<td>26.7 (4)</td>
<td>20.0 (3)</td>
<td>1.000</td>
</tr>
<tr>
<td>Reduces risk of cancer(^2)</td>
<td>26.7 (4)</td>
<td>80.0 (12)</td>
<td>0.021</td>
</tr>
<tr>
<td>Reduces risk of heart disease</td>
<td>71.4 (10)</td>
<td>85.7 (12)</td>
<td>0.500</td>
</tr>
<tr>
<td>Reduces risk of colds/respiratory infections</td>
<td>35.7 (5)</td>
<td>14.3 (2)</td>
<td>0.0375</td>
</tr>
<tr>
<td>Reduces risk of bowel conditions</td>
<td>81.3 (13)</td>
<td>81.3 (13)</td>
<td>1.000</td>
</tr>
<tr>
<td>Reduces risk of Type 2 diabetes</td>
<td>80.0 (12)</td>
<td>80.0 (12)</td>
<td>1.000</td>
</tr>
<tr>
<td>Recommended WG servings/day</td>
<td>18.8 (3)</td>
<td>75.0 (12)</td>
<td>0.022</td>
</tr>
<tr>
<td>Definition of a WG</td>
<td>93.8 (15)</td>
<td>100.0 (16)</td>
<td>ND(^4)</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
3. True health benefits of whole grains are bolded.
4. Not determined
Table 36. Older Adult Knowledge Questions: Grain Content Identification of Foods

<table>
<thead>
<tr>
<th>Food: Correct Response</th>
<th>Pre-Survey&lt;sup&gt;1&lt;/sup&gt; n=16</th>
<th>Post-Survey&lt;sup&gt;1&lt;/sup&gt; n=16</th>
<th>p-Value&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal: 100% WG</td>
<td>68.8 (11)</td>
<td>93.8 (15)</td>
<td>0.125</td>
</tr>
<tr>
<td>Brown rice: 100% WG</td>
<td>43.8 (7)</td>
<td>75.0 (12)</td>
<td>0.063</td>
</tr>
<tr>
<td>Beans: Not a grain food</td>
<td>40.0 (6)</td>
<td>46.7 (7)</td>
<td>1.000</td>
</tr>
<tr>
<td>Whole wheat bread: 100% WG</td>
<td>43.8 (7)</td>
<td>81.3 (13)</td>
<td>0.070</td>
</tr>
<tr>
<td>White bread: Refined grain</td>
<td>37.5 (6)</td>
<td>75.0 (12)</td>
<td>0.109</td>
</tr>
<tr>
<td>Wheat bread: Refined grain</td>
<td>26.7 (4)</td>
<td>6.7 (1)</td>
<td>0.375</td>
</tr>
<tr>
<td>Multigrain bread: Some whole grain</td>
<td>62.5 (10)</td>
<td>81.3 (13)</td>
<td>0.250</td>
</tr>
<tr>
<td>Pumpernickel bread: Refined grain</td>
<td>0 (0)</td>
<td>46.2 (3)</td>
<td>ND&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Popcorn: 100% WG</td>
<td>26.7 (4)</td>
<td>93.3 (14)</td>
<td>0.002</td>
</tr>
<tr>
<td>Flax seed: Not a grain food</td>
<td>0 (0)</td>
<td>18.8 (3)</td>
<td>ND&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bran muffin: Refined or some whole grain</td>
<td>75.0 (12)</td>
<td>68.8 (11)</td>
<td>1.000</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
3. Not determined
Table 37. Older Adult Knowledge Questions: Product Package Indicators

<table>
<thead>
<tr>
<th>Information</th>
<th>Pre-Survey(^1) n=16</th>
<th>Post-Survey(^1) n=16</th>
<th>p-Value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grain Logo by Whole Grain Council(^3)</td>
<td>53.3 (8)</td>
<td>93.3 (14)</td>
<td>0.070</td>
</tr>
<tr>
<td>Nutrition Facts label</td>
<td>35.7 (5)</td>
<td>64.3 (9)</td>
<td>0.125</td>
</tr>
<tr>
<td><strong>Ingredients list</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture or color of food</td>
<td>78.6 (11)</td>
<td>92.9 (12)</td>
<td>0.625</td>
</tr>
<tr>
<td>Whole grain health claim</td>
<td>28.6 (4)</td>
<td>50.0 (7)</td>
<td>0.375</td>
</tr>
<tr>
<td><strong>100% WG in name or on front of package</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Wheat” in name</td>
<td>73.3 (11)</td>
<td>100 (16)</td>
<td>ND(^4)</td>
</tr>
<tr>
<td>“Multigrain” in name</td>
<td>64.3 (9)</td>
<td>78.6 (11)</td>
<td>0.625</td>
</tr>
<tr>
<td>“Stoneground” in name</td>
<td>46.7 (7)</td>
<td>86.7 (13)</td>
<td>0.031</td>
</tr>
<tr>
<td><strong>Whole Grain Heart Check Mark by American Heart Association</strong></td>
<td>60.0 (9)</td>
<td>86.7 (13)</td>
<td>0.125</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
3. Whole grain indicators are bolded.
4. Not determined

Table 38. Older Adult Knowledge Questions: Steps; Using Ingredients List

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Survey(^1) n=16</th>
<th>Post-Survey(^1) n=16</th>
<th>p-Value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Steps</td>
<td>62.5 (10)</td>
<td>81.3 (13)</td>
<td>0.250</td>
</tr>
<tr>
<td>Grain content using ingredients list</td>
<td>56.3 (9)</td>
<td>62.5 (10)</td>
<td>1.000</td>
</tr>
</tbody>
</table>

1. Proportion of correct responses reported as % (n).
2. McNemar’s Test
Table 39. Older Adult Opinion Questions: Taste, Cost, Selection Knowledge

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Survey(^1) n=16</th>
<th>Post-Survey(^1) n=16</th>
<th>p-Value(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like taste of WG foods</td>
<td>93.3 (14)</td>
<td>100.0 (16)</td>
<td>ND</td>
</tr>
<tr>
<td>Prefer taste of white to WW bread</td>
<td>18.8 (3)</td>
<td>0 (16)</td>
<td>ND</td>
</tr>
<tr>
<td>WW bread is more expensive than white</td>
<td>56.3 (9)</td>
<td>50.0 (8)</td>
<td>1.000</td>
</tr>
<tr>
<td>Know how to use package to select WG foods</td>
<td>46.7 (7)</td>
<td>86.7 (13)</td>
<td>0.125</td>
</tr>
</tbody>
</table>

1. Proportion of responses reported as % (n).
2. McNemar’s Test
Figure 3. Mean Total Whole Grain Knowledge Scores of Older Adults; Maximum possible score = 31.0; p < 0.001

Figure 4. Older Adult Whole Grain Knowledge Variables with Greatest Increases; p < 0.001
Figure 5. Median Grain Content Identification Scores of Older Adults; Maximum possible score=11; p < 0.001

Figure 6. Improvements in Grain Content Identification Variables; p ≤ 0.04
Figure 7. Median Product Package Indicator Scores of Older Adults; Maximum possible score=10; p < 0.001

Figure 8. Improvements in Product Package Indicator Variables; p ≤ 0.003
Figure 9. Median Weekly Whole Grain Consumption of Older Adults; p < 0.001

Figure 10. Median Whole and Refined Grain Consumption of Older Adults; p < 0.001
Figure 11. Median Total Whole Grain Knowledge Scores of Older and Young Adults; Maximum possible score=31.0; p < 0.001

Figure 12. Median Weekly Whole Grain Consumption of Older and Young Adults; p= 0.009
Figure 13. Median Whole Grain Knowledge Sub scores of Young Adults

Figure 14. Correct Responses of Young Adults: Questions #61, #65d and #6
Figure 15: Median Whole and Refined Grain Consumption of Older and Young Adults; Whole grain, p=0.009; Refined Grain, p=0.078
LIST OF REFERENCES


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APPENDICES*

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APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVALS

University of New Hampshire
Research Integrity Services, Service Building
51 College Road, Durham, NH 03824-3581
Fax: 603-862-3564

12-Jun-2012

Violette, Catherine A
Coop Ext - Family Development, Kendall Hall
Durham, NH 03824

IRB #: 5495
Study: Is It Whole Grain?: Evaluating the Effectiveness of an Education Program for Older Adults
Approval Date: 12-Jun-2012

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved the protocol for your study as Expedited as described in Title 45, Code of Federal Regulations (CFR), Part 46, Subsection 100.

Approval is granted to conduct your study as described in your protocol for one year from the approval date above. At the end of the approval period, you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the attached document, Responsibilities of Directors of Research Studies Involving Human Subjects. (This document is also available at http://unh.edu/research/irb-application-resources.) Please read this document carefully before commencing your work involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2093 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Director

cc: file

Two extensions, in 2013 and 2014, have been received since the original approval in 2012.
28-Jan-2014

Morrell, Jesse Stabile
MCBS, Kendall Hall 418
Durham, NH 03824

IRB #: 5524
Study: College Health & Nutrition Assessment Survey
Approval Expiration Date: 09-Aug-2014
Modification Approval Date: 27-Jan-2014
Modification: Addition of questions to wellness survey

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your modification to this study, as indicated above. Further changes in your study must be submitted to the IRB for review and approval prior to implementation.

Approval for this protocol expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, Responsibilities of Directors of Research Studies Involving Human Subjects. This document is available at http://unh.edu/research/irb-application-resources or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Director

cc: File
    Reilly, Ruth
    Dylewski, Maggie
University of New Hampshire
Research Integrity Services, Service Building
51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

16-Jul-2014

Marrell, Jesse Stabile
MCBS, Kendall Hall 418
Durham, NH 03824

IRB #: 5524
Study: College Health & Nutrition Assessment Survey
Review Level: Full
Approval Expiration Date: 09-Aug-2015

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your request for time extension for this study. Approval for this study expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects. If your study is still active, you may apply for extension of IRB approval through this office.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, Responsibilities of Directors of Research Studies Involving Human Subjects. This document is available at http://unh.edu/research/irb-application-resources or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 503-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpso
Director

cc: File
Reilly, Ruth
Dylewski, Maggie
APPENDIX B:  *IS IT WHOLE GRAIN?* PARTICIPANT REGISTRATION FORM

Registration

“Is It Whole Grain?” Program

Participant Registration Form
*(Please Print)*

Name: ___________________________________________________________

Address: ___________________________________________________________________

City: ___________________________ Zip Code: ____________

Phone: _______________________________

Email: __________________________________________

Age: _________________

Program Site: _____________________________________________________________________

*Office Use Only*

**Required Forms:**

<table>
<thead>
<tr>
<th>Form</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signed IRB Consent Form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dietary Screening</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre Participant Evaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Participant Evaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Evaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Keep in a secure, locked location separate from data collection forms.*
APPENDIX C: IS IT WHOLE GRAIN? CONSENT FORM

Consent Form For Participation in a Research Study

Title of Research Study
- “Is It Whole Grain?”: Evaluating the Effectiveness of an Education Program for Older Adults
- Catherine Violette, PhD, RD, LD, Extension Professor and State Specialist, UNH Cooperative Extension

What is the Purpose of This Study?
The purpose of this study is to see if participating in a 3-session education program will help you to learn more about whole grains, improve your skill in using food product packages to select whole grain foods, and to include more whole grain foods in your diet.

What Does Your Participation in the Study Involve?
You will be asked to attend all three sessions of the “Is It Whole Grain?” program. If you can’t, please tell your instructor. During the first session you will be asked to complete a set of forms. One form asks you questions about whole grains and the second one asks you questions about your diet. At the end of the three sessions, we will ask you to complete another set of forms. We will assign you an identification number which will be used to track the forms you complete so we can compare the forms you complete during the first session with those you complete at the end of the third session.

What are the Possible Risks of Participating in this Study?
You will be responsible for traveling from your home to the site where the program will be held. You will have an opportunity to taste test whole grains foods. Please let us know if you have food allergies or other dietary restrictions so we can provide you with the information you need to make an informed choice.
What Happens if I Get Sick or Hurt From Taking Part in this Study?
You understand that if you are injured or require medical treatment, you may seek treatment from your primary care provider. The University of New Hampshire is not responsible for the cost of any care required as a result of your participation in this study.

What are the Possible Benefits of Participating in this Study?
You will have an opportunity to participate in an education program designed by older adults like yourself. You will learn about the benefits of eating whole grain foods and gain skills and confidence in reading product packages so you know you are buying a whole grain food. You will have an opportunity to participate in fun activities to learn about whole grain foods with other adults. Your participation in this study will help us to determine if the “Is It Whole Grain?” program is effective in helping older adults learn.

If You Choose to Participate in this Study, Will It Cost You Anything?
There is no cost to participate in the “Is It Whole Grain?” program. You will be responsible for your own transportation to and from the meeting site.

Will You Receive Any Compensation for Participating in this Study?
You will not be compensated or paid for your participation in this study.

What Other Options are Available if You Do Not Want to Take Part in this Study?
You understand that your consent to participate in this research is entirely voluntary, and that your refusal to participate will involve no prejudice, penalty or loss of benefits to which you would otherwise be entitled. You are welcome to participate in the education program even if you do not volunteer for the study.

Can You Withdraw From This Study?
If you consent to participate in this study, you are free to stop your participation in the study at any time without prejudice, penalty, or loss of benefits to which you would otherwise be entitled.

How Will the Confidentiality of Your Records be Protected?
We will maintain the confidentiality of the forms you complete for this research study. We will assign you an identification number which will be used on the forms you complete. All forms will be kept in a locked file cabinet. Only the researchers and students working on this project will
access the data. The results of this study will be published in a professional journal and through presentations to other professionals. The results will also be used to revise the “Is It Whole Grain?” program so that it better helps older adults identify and select whole grain foods.

**Who Do You Contact if You Have Questions About This Study?**

If you have any questions about this research study you can contact Catherine Violette at 603-862-2496 or Catherine.violette@unh.edu.

If you have questions about your rights as a research subject you can contact Dr. Julie Simpson in UNH Research Integrity Services, 603-862-2003 or Julie.Simpson@unh.edu to discuss them.

I, __________________ CONSENT/AGREE to participate in this research study.

_________________________  ______________
Signature of Subject/Participant  Date
APPENDIX D: PRE WHOLE GRAIN QUESTIONNAIRE, OLDER ADULTS
(Correct answers are indicated where applicable)

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.”

<table>
<thead>
<tr>
<th>Disease/Condition</th>
<th>Yes</th>
<th>No</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory loss</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colds and respiratory infections</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Bowel conditions (constipation, diverticulosis)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Food</th>
<th>100% Whole Grain</th>
<th>Some Whole Grain</th>
<th>Refined Grains</th>
<th>Not a Grain Food</th>
<th>Don’t Know/Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown rice</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Whole wheat bread</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat bread</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multigrain bread</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumpernickel bread</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popcorn</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flax seed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Bran muffin</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. What are 3 steps you can take to quickly and accurately determine if a food is whole grain? *Check (v) 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.

<table>
<thead>
<tr>
<th>Information</th>
<th>Yes</th>
<th>No</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grain Logo by the WholeGrainsCouncil.org</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition Facts label (calories, fat, sodium, etc.)</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Ingredient list</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture or color of the food</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Whole grain health claim</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% whole wheat or whole grain in the name of the food or on the front of the package</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Wheat” in the name</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>“Multigrain” in the name</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>“Stoneground” in the name</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Whole Grain Heart Check Mark by the American Heart Association</td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 (v) in the column that best answers the question for you.*

<table>
<thead>
<tr>
<th>Food</th>
<th>Less than 1/week</th>
<th>Once a week</th>
<th>2-3 times a week</th>
<th>4-6 times a week</th>
<th>1 or more times a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain cereal (cold)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain pasta or noodles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown or “wheat” bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-grain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat crackers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popcorn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Please answer the following questions by placing a check mark (✓) in the column that best fits your answer.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like the taste of whole grain foods?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you prefer the taste of white bread to whole wheat bread?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat bread is more expensive than white bread.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know how to use the food package to select whole grain foods.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you grocery shop?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you plan the meals you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you cook the meals you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 [v] 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 E: POST WHOLE GRAIN QUESTIONNAIRE. OLDER ADULTS

ID # ______

POST
“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.”

<table>
<thead>
<tr>
<th>Disease/Condition</th>
<th>Yes</th>
<th>No</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colds and respiratory infections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bowel conditions (constipation, diverticulosis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How many servings of whole grain are recommended for adults each day? Please check (✓) only one answer.
   //Five options are listed, with one correct answer marked with a check mark.

   _____ 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.

<table>
<thead>
<tr>
<th>Food</th>
<th>100% Whole Grain</th>
<th>Some Whole Grain</th>
<th>Refined Grain</th>
<th>Not a Grain Food</th>
<th>Don’t Know/Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown rice</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multigrain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumpernickel bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popcorn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flax seed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bran muffin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. What are 3 steps you can take to quickly and accurately determine if a food is whole grain? Check (v) 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 (v) the Yes if the information tells you it is whole grain, No if it doesn’t, or if you don’t know.*

<table>
<thead>
<tr>
<th>Information</th>
<th>Yes</th>
<th>No</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grain Logo by the WholeGrainsCouncil.org</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition Facts label (calories, fat, sodium, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingredient list</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture or color of the food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain health claim</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% whole wheat or whole grain in the name of the food or on the front of the package</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Wheat” in the name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Multigrain” in the name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Stoneground” in the name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole Grain Heart Check Mark by the American Heart Association</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.*

<table>
<thead>
<tr>
<th>Food</th>
<th>Less than 1/week</th>
<th>Once a week</th>
<th>2-3 times a week</th>
<th>4-6 times a week</th>
<th>1 or more times a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain cereal (cold)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain pasta or noodles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Brown or “wheat” bread</td>
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</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-grain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat crackers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popcorn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Please answer the following questions by placing a check mark (v) in the column that best fits your answer.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like the taste of whole grain foods?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you prefer the taste of white bread to whole wheat bread?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat bread is more expensive than white bread.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know how to use the food package to select whole grain foods.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you grocery shop?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you plan the meals you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you cook the meals you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.*

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not intend to eat more whole grain</td>
<td>Moderately intend to eat more</td>
<td>Strongly intend to eat more whole grain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX F: IS IT WHOLE GRAIN? PROGRAM EVALUATION

"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.

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)

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)

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)

4. The aspect I liked best about the "Is It Whole Grain?" program was:
5. The aspect I liked least about the “Is It Whole Grain?” program was:

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)

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)

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)

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 ___________________________

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)
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)

12. The length of the “Is It Whole Grain?” sessions were:
   a. Too long; please answer 12a (1)
   b. Too short; please answer 12b (2)
   c. The right length (3)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>12a</td>
<td>If you said the “Is It Whole Grain?” sessions were too long, how long do you think they should last?</td>
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</thead>
<tbody>
<tr>
<td>12b</td>
<td>If you said the “Is It Whole Grain?” sessions were too short, how long do you think they should last?</td>
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</table>

13. Please add any other suggestions or comments you have about the “Is It Whole Grain?” program:
Grains
- Grains are the seeds of grasses. Examples of grains include: wheat, buckwheat, rye, oats, barley, rice, and corn.
- Grain seeds or kernels have three distinct parts:
  1. Bran: outer portion that provides fiber, B vitamins and some minerals
  2. Germ: inner segment that provides B vitamins, vitamin E and antioxidants
  3. Endosperm: starchy inside that provides carbohydrates and protein

Whole Grains
- A whole grain has all three parts of the original intact kernel (bran, germ, and endosperm).
- Examples of whole grains include:
  - Whole wheat flour (bread, pasta, cereal)
  - Brown Rice
  - Oatmeal
  - Popcorn
  - Whole rye flour
  - Whole corn tortillas
  - Whole wheat pasta
Refined Grains
- The bran and/or germ have been removed leaving just the endosperm.
- Examples of refined grains include:
  - White rice
  - White enriched flour (bread, pasta, cereal)

Some Whole Grain Foods
- Products made with a combination of whole grain and refined grain flour.

Health Benefits of Whole Grains
Reduces constipation
Helps with weight control
Reduces risk of diabetes
Reduces risk of heart disease
Reduces risk of some cancers

Make half your grains whole!
Aim for at Least 3 Servings of Whole Grains Every Day

1 serving is:

1 slice of whole grain bread
½ cup whole grain pasta, brown rice, oatmeal (cooked)
1 cup cold whole grain cereal
3 cups popcorn
5-7 whole grain crackers
1. Front of Package
   * Check the front of the package for key terms such as “100% whole wheat,” “whole oats,” “made with whole wheat.”

2. Ingredients
   * Read the ingredients to see if any or all of the first 3 ingredients contain key terms such as “100% whole wheat,” “whole rye flour,” “whole oats,” “whole wheat flour.”

3. Extra claims and logos
   * Examine the other panels of the package for whole grain health claims or whole grain stamps and symbols that will support your decision.

“Diets rich in whole grain foods and other plant foods and low in total fat, saturated fat and cholesterol may reduce the risk of heart disease and some cancers.”

Daily Goal = 3 servings of whole grains!
Look for these whole grains on food packages:

- Brown rice
- Oatmeal
- Whole oats
- Buckwheat
- Popcorn
- Whole rye
- Bulgur
- Whole grain barley
- Whole wheat

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APPENDIX H: IS IT WHOLE GRAIN? PROGRAM ACTIVITIES

Whole Grain Identification Worksheet

Directions: Compare the following food products and circle the food that contains more whole grains.

1.) Thomas® 100% Whole Wheat English Muffins
    Thomas’® Double Fiber Honey Wheat English Muffins

2.) Cheerios®
    Honey Nut Cheerios®

3.) Special K™
    Total®

4.) Quaker® Oatmeal
    Original Cream of Wheat®

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Whole Grains at Breakfast

What foods did you eat this morning, if any?

Directions:
1.) In the space below please list the foods you ate this morning.
2.) Place a check mark in the appropriate column if the food you ate was a grain.
3.) Place another check mark in the appropriate column if the grain food you ate was made with whole grain.

Food you ate this morning:

<table>
<thead>
<tr>
<th>Food</th>
<th>Grain</th>
<th>Whole Grain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Goal: How can you increase your intake of whole grains in the morning?
For example:

Ideas:
- Substitute whole grain bread for refined white bread
- Substitute a whole grain cereal for refined cereal
- Eat a larger portion of whole grain foods

My Goal: _____________________________________________________

*Keep track of your goal so you can see your progress*

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**Taste Testing Activity – Make a Guess!**

Based on taste, texture and appearance **CHECK** whether you think the following breads are: 100% Whole Grain, Some Whole Grain, or Refined.

<table>
<thead>
<tr>
<th></th>
<th>100% Whole Grain</th>
<th>Some Whole Grain</th>
<th>Refined</th>
<th><em>Answer</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread #1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bread #2</td>
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<tr>
<td>Bread #3</td>
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<tr>
<td>Bread #4</td>
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</tr>
<tr>
<td>Bread #5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bread #6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The University of New Hampshire Cooperative Extension is an equal opportunity educator and employer. University of New Hampshire, U.S. Department of Agriculture and N.H. counties cooperating.
Is it Whole Grain?
3 Steps to 3 Servings of Whole Grains

Taste-Testing Activity: Examine the Label

Directions:
Looking at the product package, answer the following questions to determine if the product is whole grain. Please circle your answer.

Hint: This uses the 3 Step Method.

1.) Is there anything on the front panel that makes you think this bread is whole grain?

   Yes  No

2) a. Is whole grain or 100% whole grain in the first 3 ingredients?

   Yes  No

   b. Are there any “whole grain” ingredients listed past the first 3 ingredients?

   Yes  No

3.) Is there a whole grain symbol or statement on the package?

   Yes  No

4.) From the above information, do you think this product is:

   Whole Grain       Some Whole Grain       Refined Grain
GOAL SETTING:

I will increase the amount of whole grains I eat by:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Notes/ideas/tips for helping you reach your goal
Whole Grain Scenarios

Working in groups of 2-3 people, read the following scenario. As a group, discuss the situation and how you would respond. Then list the possible ways to handle the situation and what you would say based on your knowledge, experience, and what you’ve learned about whole grains in the Is it Whole Grain? program.

1. Your friend, Jayne, accepted your invitation to dinner. As soon as she arrives you place a pot of brown rice on the stove to cook. Jayne asks you; “white rice is so easy to cook and doesn’t take long at all, so why are you spending so much extra effort to serve brown rice? Except for the color, isn’t brown rice the same as white rice?” How would you respond to your friend about your choice to cook and serve brown rice for dinner?

2. While at the grocery store, your neighbor, Paul, approaches you and asks for help in finding whole grain breads and cereals (he heard you recently attended an education program on whole grains). He knows whole grains are healthy but doesn’t know how to use product packages to determine which foods are whole grain and which aren’t. What would you say to your neighbor about how to use the product package to select whole grain foods? How would you help him so the next time he is grocery shopping he can make decisions on his own?
3. The following is an example of Sally’s diet on a typical day. How can she increase the whole grains in her diet? List your suggestions below. Hint: you can substitute whole grains for refined grains or add/delete foods to her menu.

<table>
<thead>
<tr>
<th>Typical Diet</th>
<th>Suggestions to Increase Whole Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breakfast:</strong></td>
<td></td>
</tr>
<tr>
<td>Corn flakes with sliced banana</td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
</tr>
<tr>
<td>Orange Juice</td>
<td></td>
</tr>
<tr>
<td><strong>Mid-morning snack:</strong></td>
<td></td>
</tr>
<tr>
<td>Ritz crackers with slices of cheddar cheese</td>
<td></td>
</tr>
<tr>
<td><strong>Lunch:</strong></td>
<td></td>
</tr>
<tr>
<td>Tuna sandwich on pumpernickel</td>
<td></td>
</tr>
<tr>
<td>Iced tea</td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td></td>
</tr>
<tr>
<td><strong>Dinner:</strong></td>
<td></td>
</tr>
<tr>
<td>Grilled chicken</td>
<td></td>
</tr>
<tr>
<td>Mashed potatoes</td>
<td></td>
</tr>
<tr>
<td>Green beans</td>
<td></td>
</tr>
<tr>
<td><strong>Evening snack:</strong></td>
<td></td>
</tr>
<tr>
<td>Chocolate chip cookie and milk</td>
<td></td>
</tr>
</tbody>
</table>
4. You are eating lunch at a local restaurant with your friend Martha and you both order sandwiches. The waiter asks you if you would like your sandwich on white bread, wheat bread, multigrain bread, or whole wheat bread. Since you attended the Is it Whole Grain? class, you choose the whole wheat bread while Martha chooses white bread. After the waiter leaves, Martha asks you why you chose the whole wheat bread, is there really a difference? Explain to Martha the difference between refined and whole grain bread. What about the wheat bread and the multigrain bread – are these breads whole grain?

5. John has been trying to eat more whole grains. However, John is getting bored with eating 100% whole wheat bread with his daily sandwich for lunch. Can you offer John some suggestions of other whole grain foods he could try? How can he eat more whole grains during breakfast, dinner or snacks?
APPENDIX I: CONSENT FORM, YOUNG ADULTS

College Health and Nutrition Assessment Survey
Consent Form

Purpose: The purpose of this project is to gather data on college-age adults regarding nutrition, health practices, and health status.

Description: This document requests the student's permission to use information collected in the NUTR 400 activities to better understand the collective health behaviors of college-age adults, 18 – 24 years old.

Participation involves sharing information collected in the following NUTR 400 activities over the course of one semester:
1. You will complete a health record and online health survey.
2. You will complete a three-day diet record and nutrient analysis.
3. You will come to a designated lab facility at a scheduled time in a fasted state. Trained personnel using universal precautions and established methods, will perform a finger prick blood test and analysis will be run on blood glucose and lipids. In addition, your height, weight, waist circumference, body composition, and blood pressure will be measured. Typically it will take about 45 minutes for these assessments to be completed.
4. You will track your physical activity by wearing a pedometer over the course of 7 days.
5. Your fitness level will be assessed via a one-mile walk, flexibility test, and push-up test.
6. Your fracture risk will be assessed by measuring the composition of your heel bone via ultrasonography.
7. Your demographic information (major, home address, academic year) will be collected from university records.

Please note that all students in NUTR 400 are expected to complete the above assessments (#1 - 7).

This consent form gives your permission for the researchers to share your results as part of more comprehensive research initiatives at the University of New Hampshire and/or other research projects.

In addition, some participants will be given the opportunity to participate in the additional research. If applicable, the researcher will explain the additional activities, any benefits and risks, and you will be given the opportunity to accept or decline participation.

Benefits and Risks:
This research will help to profile the health, nutrition and physical activity of the young adult population at UNH and help administrators in setting priorities to enhance student health.

Your privacy will be guarded to the fullest extent possible to minimize your risk, including the risk to participants who are < 21 years of age (i.e. questions and records related to alcohol intake). Personal identifiers (name, address) will be removed. Data will be stored in secured, password protected databases and/or locked cabinets/offices.

Confidentiality:
Every effort will be made to ensure participant confidentiality. When you enroll in the project you will be assigned a code (your initials and the last four numbers of your UNH ID) for data management purposes. Your results will not be associated directly with your name. All data is stored in locked cabinets/offices.

There are rare instances when a researcher is required to share personal identifiable information (e.g. in response to a complaint about the research or regulatory oversight regulations).
When data are presented for reports or presentations, data will be reported in summary format and no names or identifiable data will be used.

Please read the following statements and respond as to whether you are willing to participate.

1. I understand the use of human subjects in this project has been approved by the UNH Institutional Review Board for the protection of Human Subjects in Research.
2. I understand the purpose of the research project and the procedures to be followed.
3. I have received a description of the reasonable foreseeable risk and discomfort associated with my being a subject in this research, have had them explained and understand them.
4. I understand the confidentiality of all data and records associated with my participation in this research.
5. I confirm that no coercion of any kind was used in seeking my participation.
6. I understand that participation in this study is entirely voluntary and will have no bearing on my grade in NUTR 400. I also understand whether or not I choose to share my data I will need to complete all course assignments and assessments identified as part of the course requirements.
7. I understand that if I choose to participate, I may discontinue my participation at any time without any penalty. However, I understand that I still need to complete all course assignments and assessments identified as part of the course requirements.
8. I understand that if I have any questions pertaining to the research I can call Jesse Stabile Morrell at 603-862-2547 and be given the opportunity to discuss them. If I have questions pertaining to my rights as a research subject I can call Julie Simpson in the UNH Research Integrity Services office, 603-862-2003, to discuss them.
9. I understand that in most circumstances I will not be provided financial incentive for my participation by UNH. On occasion and when resources permit, small incentives (gift cards and/or raffles) may be offered to encourage participation in some optional activities.
10. I certify that I have read and fully understand the purpose of this research project and the risks and benefits have been presented to me as stated above.

YES, I ________________ consent & agree to participate in this research project.

(please print your name) Date ________________

(your signature)

<table>
<thead>
<tr>
<th>Initials (First Name, Last Name): ________________</th>
<th>Current Age: ________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Four Digits of UNH ID #: ________________</td>
<td>Gender: ____________________</td>
</tr>
</tbody>
</table>

OR

NO, I ________________ decline to participate in this research project.

(please print your name)
APPENDIX J: COLLEGE WELLNESS SURVEY QUESTIONS
(CONTAINS DEMOGRAPHIC AND WHOLE GRAIN QUESTIONS ONLY)

College Wellness Survey - Spring 2014

1. College Wellness Survey

This survey is being conducted by the NUTR 400 class and will collect information about your health. It should take approx. 15-20 minutes. Please answer the questions to the best of your ability.

Once collected, your responses will be coded and your name will be removed. Only pooled responses will be used in NUTR 400 activities.

Survey responses will also contribute to the on-going College Health & Nutrition Assessment Survey (UNH IRB #5524).
2. Section One: Demographics

1. Please provide the following:
   - First Name
   - Last Name
   - Last 4 Digits of Student ID#
   - Age at last birthday (in years)

2. Sex
   - Male
   - Female
   - Transgender or other
   - I choose not to answer

3. Which of the following best describes you?
   - Married
   - Divorced or separated
   - Widowed
   - Never Married
   - Member of an unmarried couple
   - I choose not to answer
**3. Section One: Demographics (cont).**

**4. Are you Hispanic or Latino?**
- [ ] Yes
- [ ] No
- [ ] I'm not sure
- [ ] I choose not to answer

**5. Which one or more of the following would you say is your RACE? (Check all that apply)**
- [ ] White
- [ ] Black or African American
- [ ] American Indian or Alaskan Native
- [ ] Asian or Pacific Islander
- [ ] I choose not to answer

Other (please specify):

---

**6. Where do you currently live?**
- [ ] College-affiliated dorm (no kitchen in room)
- [ ] College-affiliated apartment (with kitchen)
- [ ] Apartment (with kitchen)
- [ ] At home (permanent residence)
- [ ] I choose not to answer

Other (please specify):

---
College Wellness Survey - Spring 2014

6. Section One: Demographics (cont).

13. What is your home zip code?

(Please provide the zip code of your primary residence prior to attending college.)

*14. How long did/have you lived in this town/city?

- [ ] < 1 year
- [ ] 1 - 2 years
- [ ] 3 - 5 years
- [ ] 5 or more years
- [ ] Choose not to answer
16. Section Five: Food & Diet

28. How important do you think nutrition and food are to your general health & wellness?
   - Not important at all
   - Somewhat important
   - Very important
   - I choose not to answer

29. How many MEALS PER WEEK do you eat at a university/college dining hall?
   - None
   - 1 - 5
   - 6 - 13
   - 14 - 20
   - 21 or more
   - I choose not to answer

30. Considering that three (3) meals/day is desirable, how many meals a week do you skip?
   - None
   - 1 - 3
   - 4 - 7
   - 8 - 14
   - More than 14
   - I choose not to answer

31. On average, how many times a week do you eat in a restaurant or fast food chain?
   - None
   - 1 - 2
   - 3 - 4
   - 5 - 6
   - More than 6
   - I choose not to answer
26. Whole Grain - Knowledge - Page 1

The following questions are related to whole grains and will investigate your knowledge and preference for whole grains. Please select the answer that you believe is correct even if you are unsure.

57. Which of the following diseases/conditions do you think may be reduced by eating more whole grains?

<table>
<thead>
<tr>
<th>Disease</th>
<th>Yes</th>
<th>No</th>
<th>I Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Colds and respiratory infections</td>
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<td></td>
<td></td>
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<tr>
<td>Bowel conditions</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(constipation, diverticulosis)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Type 2 diabetes</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
27. Whole Grain - Knowledge - Page 2

The following questions are related to whole grains and will investigate your knowledge and preference for whole grains. Please select the answer that you believe is correct even if you are unsure.

58. How many servings of whole grains do you think are recommended for adults EACH DAY?
   ○ 2
   ○ 1
   ○ 2
   ○ 3
   ○ 4
   ○ 5 or more

59. Whole grains are defined as:
   ○ any grain that is brown and has a coarse 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.
28. Whole Grain - Knowledge - Page 3

The following questions are related to whole grains and will investigate your knowledge and preference for whole grains. Please select the answer that you believe is correct even if you are unsure.

60. Please indicate if the following foods are made from:

<table>
<thead>
<tr>
<th>Food</th>
<th>100% Whole Grain</th>
<th>Some Whole Grain</th>
<th>Whole grain (white enriched flour)</th>
<th>Not a grain Food</th>
<th>I Don’t Know / Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown rice</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Beans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multigrain bread</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Pumpernickel bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Popcorn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flax seed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bran muffin</td>
<td></td>
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</tr>
</tbody>
</table>

61. Which of the following 3 steps could you use to quickly and accurately determine if a food is whole grain?

- ○ 31: Look for brown color and coarse 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.
- ○ 31: 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 grain; #3: Look for the whole grain health claim or whole grain stamp or symbols.
- ○ 31: 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.
29. Whole Grain - Knowledge - Page 4

The following questions are related to whole grains and will investigate your knowledge and preference for whole grains. Please select the answer that you believe is correct even if you are unsure.

62. What information on a food product package would tell you if a food is whole grain? Please select “Yes” if the information tells you it is whole grain, “No” if it does not, or “I Don’t Know”.

<table>
<thead>
<tr>
<th>Information</th>
<th>Yes</th>
<th>No</th>
<th>I Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Grain Logo by the WholeGrainsCouncil.org</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition Facts label (calories, fat, sodium, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingredients list</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture or color of the food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain health claims</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% whole wheat or whole grain in the name of the food or on front of package</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Wheat” in the name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Multigrain” in the name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Stoneground” in the name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole Grain Heart Check Mark by the American Heart Association</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

63. Below is the ingredients list for 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.

Do you believe this bread is a good source of whole grains?

- No
- Yes
- I Don’t Know
The following questions explore your behaviors and opinions. Please select the answer that best fits YOU.

**64. On average, how many TIMES A WEEK do you eat these foods?**

<table>
<thead>
<tr>
<th>Food</th>
<th>Less than 1</th>
<th>1</th>
<th>2-3</th>
<th>4-6</th>
<th>1 or more times a DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oatmeal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain cereal (cold)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain pasta or noodles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown or “wheat” bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-grain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole grain bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat crackers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popcorn</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
65. For the following questions and statements, please select the answer that best fits you.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>I Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like the taste of whole grain foods?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you prefer the taste of white bread to whole wheat bread?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole wheat bread is more expensive than white bread.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know how to use the food package to select whole grain foods.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you regularly do your own grocery shopping?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you regularly plan the meals you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you regularly cook the meals you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### College Wellness Survey - Spring 2014

#### 32. Whole Grain - Demographics

The following question will help us describe the participants of the survey.

**66. Have you ever been told by a doctor, nurse or health professional that you have any of the following?**

<table>
<thead>
<tr>
<th>Condition</th>
<th>No</th>
<th>Yes</th>
<th>I'm not sure</th>
<th>I choose not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bowel disorder</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Celiac disease treated by a gluten-free diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Intolerance to gluten</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food allergy to any grain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
33. Thank You

You have now completed the College Wellness Survey for NUTR 400.