

## ABSTRACT

Title: EVALUATING KNOWLEDGE, ATTITUDES,  
AND BEHAVIORS ASSOCIATED WITH  
WHOLE GRAIN CONSUMPTION

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Whole grain foods reduce the risk of certain chronic diseases. Americans on an average consume less than one serving per day. We conducted a study to investigate barriers to consuming whole grains and to assess the effectiveness of printed nutrition materials (intervention). A questionnaire was administered to 125 adults before and after a 12-week mail intervention to determine knowledge and changes in attitude and behavior towards whole grain consumption using stages of change model of health behavior. We found a low awareness of whole grain recommendations and an inability to identify whole grains. Cost and availability of whole grain foods were identified as barriers. Post-intervention, there was a significant change in attitude to taste ( $P=0.0035$ ), cost ( $P=0.0384$ ), availability ( $P=0.0218$ ), willingness to buy whole grains ( $P=0.0343$ ) and willingness to buy a whole grain food that took longer to prepare ( $0.0082$ ). A significant movement across the stages of change was seen ( $P<0.0001$ ).

EVALUATING KNOWLEDGE, ATTITUDES, AND BEHAVIORS ASSOCIATED  
WITH WHOLE GRAIN CONSUMPTION

By

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## **Dedication**

This work is dedicated to my family who supported and motivated me every step of the way.

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## **Chapter 1: Literature Review**

Grain products form the base of the Food Guide Pyramid. Grains provide complex carbohydrates (starches), an important source of food energy, fiber and key vitamins and minerals. The 2000 edition of *Nutrition and Your Health: Dietary Guidelines for Americans*, for the first time included a specific guideline for grain foods, separate from fruits and vegetables, and recognized the unique health benefits of whole grains. In January of 2005, USDA and DHHS released the latest version of the *Dietary Guidelines for Americans*. One of the recommendations that incorporate the key findings is to increase the daily intake of whole grains (1).

Whole grains have been associated with a reduction of many chronic diseases such as heart disease, cancer, and diabetes mellitus. Evidence suggests that higher consumption of whole grains is linked to better health, as explained later in this chapter.

### **History of the Grains Guideline**

The grains component of the *Dietary Guidelines* has evolved over time to reflect a changing scientific research base and to simplify as well as clarify consumer educational messages. The early guidelines reflected emerging research on the relationships between excess consumption of energy, fat, cholesterol, sodium and sugars and chronic disease (2).

In 1980, emerging research associated fiber intake with reduced symptoms of chronic constipation, diverticulosis and some types of irritable bowel (3). By 1985, an

increased emphasis was placed on consuming a variety of fiber-rich foods due to the acknowledgement that various foods contained different types of fiber with varied chemical structures and biological effects (4).

In 1990, the guideline statement was revised to state, “Choose a diet with plenty of vegetables, fruits and grain products.” The focus shifted from consumption of food components such as starch and fiber to specific categories of foods that contained these components (5). The 1990 guidelines specified for the first time the minimum number of servings of grains and other foods that people should eat for good health. The guidelines recommended that most consumers should include 6-11 servings of grains daily, depending on calorie intake, but did not specify the number of servings of whole grains, recommending only that consumers include “several” servings daily.

The Food Guide Pyramid was developed in 1992 as a way of representing the revised food guidance system to help consumers integrate servings to eat from five major food groups (6).

In 1995, the guideline statement was reworded to “Choose a diet with plenty of grain products, vegetables and fruits” to reflect the positioning of grain products at the base of the pyramid and their role as the largest source of energy (7). The 1995 Dietary Guidelines highlighted the most recent scientific evidence linking components in grains, fruits and vegetables (in addition to fiber and complex carbohydrates) to reduced risk of heart disease and some cancers.

In 2000, the new guideline statement was “Choose a variety of grains daily, especially whole grains” (8). For the first time, a guideline was established for grain

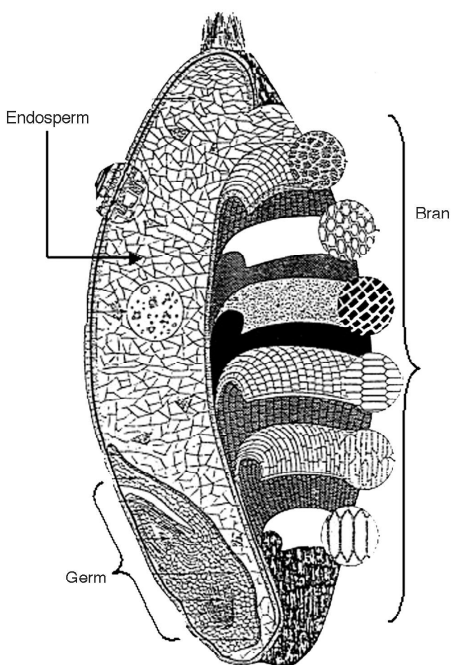
products separate from that for fruits and vegetables, and variety in grain consumption was stressed. Also, for the first time whole grains were specifically mentioned in the guideline statement.

The sixth edition of *Nutrition and Your Health: Dietary Guidelines for Americans* (1) was released on January 12, 2005. There were 41 key recommendations (23 are for the general public and 18 are for specific populations) grouped into 9 categories. One of the key recommendations that are a part of the 'Food Groups to Encourage' category is "Consume 3 or more ounce-equivalents of whole grain products per day, with the rest of the recommended grains coming from enriched or whole grain products. In general, at least half the grains should come from whole grains".

### **What are Whole grains?**

The American Association of Cereal Chemists has defined a whole grain ingredient as '.... the intact, ground, cracked or flaked caryopsis, whose principle anatomical components, the starchy endosperm, bran and germ, are present in substantially the same relative proportions as they exist in the intact caryopsis' (9).

That means that for whole grain ingredients such as flour, the three major components (bran, endosperm and germ) must be present in the same amounts that occur in the grain's native state (see Figure 1). In effect, whole grains are those grains that have not had any of their nutrient-rich layers removed.



**Figure 1: Structure of a whole grain (10)**

The cereal grains mainly consumed around the world include wheat, rice, and maize, with oats, barley, soy, sorghum, and millet as minor grains. In the U.S., the most commonly consumed grains are wheat, oats, rice, maize, and rye with wheat constituting 66-75% of the total (11). The typical cereal grain provides three major products after traditional dry fractionation.

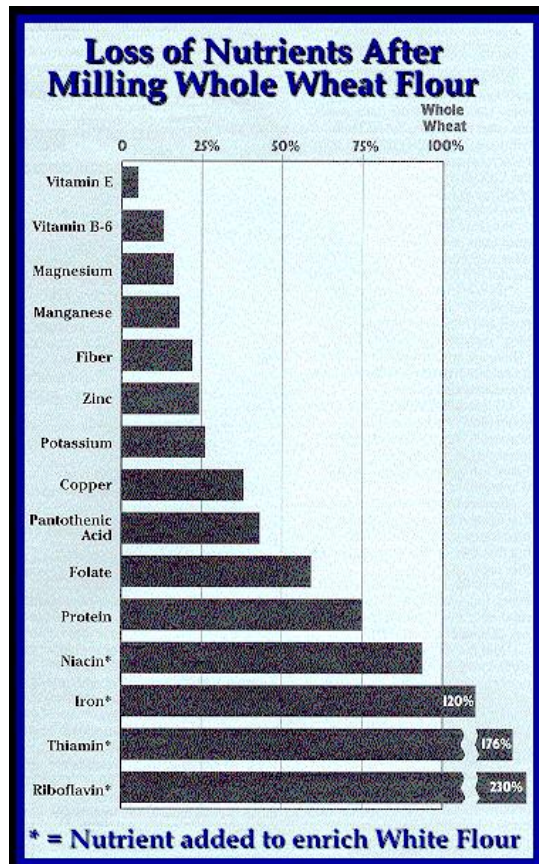
### ***The Starchy Endosperm***

This is compositionally the most homogeneous of the major grain fractions. About 50-75% of the endosperm is starch, and it is the major energy supply for the embryo during germination of the kernel. The endosperm also is composed of 8-18% storage proteins, and contains cell-wall polymers. Relatively few vitamins, minerals, or phytochemicals are located in the endosperm fraction and it is also low in fiber (12).

### ***Bran and Germ***

The bran and the germ fractions derived from conventional milling provide a majority of the biologically active components found in the grain. These include high concentrations of B-vitamins (thiamin, niacin, riboflavin and pantothenic acid), minerals (calcium, magnesium, potassium, phosphorous, sodium, and iron), and basic amino acids (e.g. arginine and lysine). Numerous phytochemicals, some common in many plant foods (phytates and phenolic compounds) and some unique to grain products (avenanthramides and avenalumic acid), are responsible for the high antioxidant activity of whole grain foods.

One of most intriguing aspects of the grain structure and its nutritional attributes relates to the effects of processing on nutrient availability. In the U.S. and Europe, grains are generally subjected to some type of processing, milling, or heat extraction during the manufacturing process to produce flour. The refining process discards the bran and germ layers to yield a more delicate flour that is lower in nutrients than whole grain flour. Some of the vitamins and minerals (folate, iron, niacin, thiamin, riboflavin) are replaced, but some are not. Aside from the vitamin and mineral loss, the refining process also depletes the grain of fiber, antioxidants, lignans, phytochemicals, and phytoestrogens (see Figure 2) that may reduce the risk of heart disease, cancer and diabetes. Thus, refined grains are more concentrated in starch, but are lower in other nutrients (11).



**Figure 2: Loss of nutrients after milling whole wheat flour (13)**

### **The Consumer and Whole grains**

Accurately tracking the whole grain consumption of consumers has been unsuccessful. Several studies have documented the health benefits of whole grains; in more recent years, whole grain intake has been shown to be positively associated with lowering the risk cancer, stroke, diabetes and heart disease (14, 15, 16).

### ***Dietary Recommendations***

Since the inclusion of a separate guideline for whole grains in the Dietary Guidelines for Americans, the American Dietetic Association recommends at least 3 servings per day of whole grains. Healthy People 2010 (17) is a set of health

objectives for the nation to achieve during the first decade of the 21<sup>st</sup> century. Healthy People 2010 was developed through a broad scientific consensus and has two specific goals: Increase the quality and years of healthy life and eliminate health disparities among different segments of the population. One of its many broad objectives is to achieve a target of 3 whole grain servings a day out of the total 6-11 servings recommended by the USDA.

### ***Actual Consumption***

The Continuing Survey of Food Intakes by Individuals (CSFII) is a nationally representative survey that measures foods eaten by individuals. The most recent CSFII, conducted in 1994-1996, provides data for individuals of all ages on their food and nutrient intakes over two consecutive days (18).

The data from this CSFII show that white individuals over the age of two consumed only 1.1 servings of whole grains per day. Blacks over the age of two consumed only 0.7 servings a day and Mexican Americans of the same age consumed 0.8 daily servings. There were also data that showed that adult white males 20 years of age and over ate more whole grains than adult females (1.2 servings vs. 0.9 servings). When black adult males were compared to black adult females, the former consumed 0.7 servings/day compared to 0.6 servings/day consumed by the latter. Adult Mexican American males and females ate the same amount of whole grains – 0.6 servings per day. White males and females over age 60 consumed more whole grains daily than any other age group (males=1.3 servings/day, females=1.0 serving/day). Blacks consumed more as children than at any other age – 1.0 serving per day for males between ages 2-5 and 0.8 servings for females of the same age. For

Mexican Americans, males between the ages of 2 and 20 consumed the same amount of 0.8 servings, while female teenagers between ages 12-19 consumed 1.2 servings of whole grains per day.

Income levels seemed to be related positively to the consumption of whole grains. Individuals under 131% of poverty level consumed only 0.7 servings daily, while those at 131-350% of poverty level consumed 1.0 serving daily and those over 350% of poverty level consumed 1.1 servings per day (18).

### **The Discrepancy between Recommendations and Consumption**

Food labels and advertising may influence consumer behavior (19). For example, increased sales and consumption of oatmeal and Cheerios occurred after campaigns that promoted the claim “soluble fiber from whole grain oat foods can help reduce cholesterol (when included in a diet low in saturated fat and cholesterol)” on food labels, as well as through television advertisements.

The nutrition community and food industry have been unable to convince consumers to eat more whole grain foods. The explanation could be the approach or, rather, the lack of it. Consumers generally are not aware of the benefits of whole grain foods. According to Market Facts (20), 67% of consumers would eat whole grain products more often if they believed this would help reduce their risk of heart disease and cancer. It has been seen in studies and case histories that Americans act upon nutrition beliefs if they are given a compelling reason to do so. A telephone survey conducted by the International Food Information Council (21) of over 1,000 individuals revealed that 95% of the consumers agreed, “Certain foods may reduce

the risk of certain diseases.” When asked which foods reduce the risk of disease, consumers mentioned foods such as broccoli, oranges, other fruits and vegetables, fish/fish oil, milk. None of the individuals mentioned whole grains. There were only 10% of respondents who associated fiber and whole grains with a lower risk for heart disease (22).

Another issue is that many consumers and health professionals don’t know how to identify whole grain products. The concept of “whole grains” has been unclear to many focus groups conducted by USDA. Initial focus groups by USDA responded by saying that eating whole grains was important (23). However, the increase in consumption was hampered by taste, cost, inaccessibility and family eating habits. In 2000, the Wheat Foods Council conducted four focus groups which included a total of 39 women (ages 21-55). In each group, subjects reported that “whole grain” implies natural and healthy, but many focus group participants were uncertain exactly what constituted a whole grain product and how and why it was better. Most agreed that whole grain foods do not taste good (24).

A graduate student at the University of Nevada (25) conducted research to determine attitudes among low-income adolescents towards consuming more whole grain foods, fruits and vegetables and dairy foods. Seven focus groups were done with a total of 34 students. Participants were less familiar with whole grain foods compared to other foods. However, they did identify fiber as being a beneficial nutrient that was “low in calories” and would help reduce weight. Participants felt that telling people whole grain foods are good for health or that they taste good might encourage people to eat more (25).

There have been several barriers identified by consumers and health professionals to increasing whole grain consumption. First, consumers have expressed difficulty in identifying foods that contain whole grains because of the confusion in interpreting food ingredient labels. Second, there has been a lack of strong and consistent messages that clearly communicate to the public the health benefits of eating more whole grains (26). It is therefore necessary to effectively communicate the importance of whole grain consumption. It is also important that the nutrition community now focus on the consumer's thoughts, needs, and wants when developing nutrition messages for whole grains. Past campaigns, such as those addressing fruit and vegetable intake and cancer (5-A-Day), have demonstrated that consumers are responsive to positive diet and health messages that are clear, actionable and sustained (27).

### **Protectiveness of Whole grains**

Epidemiological studies suggest that whole grains are protective against certain chronic diseases, including diabetes, colon and gastric cancer, and cardiovascular disease (28). During refining, the outer nutrient-rich bran and germ are removed; thus substantially reducing the overall nutritional quality of whole grains. Vitamins and minerals are added back to some products, but fiber and phytonutrients are not restored. The impact of an individual component may not be significant, but the sum of all nutrients can be significant and synergistic with respect to health. Thus, the potential benefits of whole grains should be considered in the context of the entire diet (11).

There are several classes of compounds in plant foods that have been recognized as having the potential to reduce the risk of chronic disease. These include carotenoids, phytates, phenolics, vitamins and minerals. Whole grain foods contain varying levels of many of these compounds, including phytins, phenolics, phytoestrogens (lignans) and phytosterols (29) and fiber, which is also an important component of whole grains.

### ***Fermentable Carbohydrates***

Whole grains are rich sources of fermentable carbohydrates (those which are easily fermented by microorganisms in vivo and serve as substrates for bacterial acid production) including dietary fiber, resistant starch, and oligosaccharides. Some common oligosaccharides are oligofructose and inulin. These are thought to have effects similar to those of soluble fibers in the human gut i.e. cholesterol lowering effects and improved glucose response. Moreover, studies have found that oligosaccharides are able to alter the human fecal flora. Undigested carbohydrates that reach the colon are fermented by the intestinal microflora to short-chain fatty acids such as acetate, butyrate, and propionate, and gases such as hydrogen sulphide and carbon monoxide (30). Short-chain fatty acid production lowers the intestinal pH; this in turn inhibits the conversion of primary bile acids to secondary bile acids. At low pH, the solubility of free bile acids is reduced, diminishing their availability for carcinogenic activity (31). Undigested carbohydrates increase fecal bulk and speed intestinal transit.

There have been several mechanisms proposed to explain the protective effects of dietary fiber. Increased fecal bulk and decreased transit time allow less opportunity for fecal mutagens to interact with the intestinal epithelium (31).

Whole grain foods have also shown to slow digestion and absorption of carbohydrates. Post-prandial glucose and insulin responses have shown to be affected by food structure (32). Consumption of refined grains increases glycemic response, and thus consumption of whole grains should reduce glycemic response (33).

### ***Antioxidants***

Whole grains contain a variety of antioxidants, and are good sources of vitamin E, especially tocotrienols (34). Vitamin E is an intracellular antioxidant that protects polyunsaturated fatty acids in cell membranes from oxidative damage. It is a cancer inhibitor that acts by preventing the formation of carcinogens from precursor compounds (35). Antioxidants inactivate free radicals and are essential in maintaining an oxidative-antioxidative balance. Hundreds of antioxidants occur in the typical diet, mostly derived from plant sources. Epidemiological studies have shown that diets high in antioxidant activity give protection against chronic diseases (36, 37). Fruits and vegetables were considered to be the main sources of antioxidants, but recent research has revealed that grains also have high antioxidant activity (38).

Oxidative materials are constantly present in humans in the form of free radicals. There are several defense mechanisms in the body that include a variety of antioxidative mechanisms to scavenge these free radicals. If the oxidative attack is beyond what the body's repair mechanisms are capable of, then chronic diseases including cancers, heart disease or stroke may result (39). Whole grains are also rich

sources of selenium, copper, zinc, and manganese, which are found in the outer layers of the grains and act as antioxidants.

Selenium, like vitamin E, is removed from the grain in the refining process. The amount of selenium found in the grain is proportional to the selenium content of the soil it was grown in. Selenium functions as a cofactor for glutathione peroxidase, an enzyme that protects against oxidative tissue damage (38).

Grains also have abundant amounts of phenolic acids (found in the bran layer) and phytic acid, which is found in concentrated amounts in grains. The latter forms chelates with various metals, which suppress damaging iron-catalyzed redox reactions (40). Phytic acid might also suppress oxidant damage to the intestinal epithelium and neighboring cells.

### ***Lignans/Phytoestrogens***

Lignans are hormonally active compounds that may protect against hormonally mediated diseases such as breast cancer and prostate cancer (41). Cereals grains are good sources of lignans. They are assumed to be present only in whole grain foods, and are concentrated in the bran layer of whole grain wheat, whole grain oats and rye meal (42). Mammalian lignans (produced from plant lignans) are hypothesized to bind strongly to estrogen-binding sites and reduce the cancer-promoting effect of estrogens. Lignans have been shown to inhibit steroid-synthesis enzymes, thereby reducing estrogen concentration.

### ***Sterols***

Common plant sterols are sitosterol, campesterol and stigmasterol. Consumption of these sterols is known to reduce cholesterol by about 10%. The average Western

diet contains an estimated 250-550mg of plant sterols per day (43); and if grain products consumed were from whole grains, the amount of grain sterols contributed could be >200mg per day, out of the 550mg consumed. Although this amount is lower than that recommended for a significant cholesterol reduction, small contributions by all the dietary sterols and phytonutrients to the diet could be an important part of the total contribution for cholesterol reduction (44). Another potential function of sterols is cancer reduction by mechanisms that include signal transduction pathways that regulate tumor growth, apoptosis, immune function, membrane structure and effect on enzyme activities. As seen from above, sterols have important biological functions and a diet rich in whole grains could provide nutritionally significant amounts of phytosterols as a part of its overall health benefits.

### ***Sphingolipids***

Whole grains are good sources of sphingolipids which are constituents of mammalian cellular membranes and lipoproteins. Sphingolipids are critical to the maintenance of membrane structure and modulate growth factors, cytokines, differentiation factors, and cholecalciferol. Sphingolipids may also inhibit colon cancer by inducing apoptotic responses in the cancer cells, reduce serum levels of low-density lipoprotein (LDL) cholesterol, and elevate high-density lipoprotein (HDL) cholesterol levels (45).

### ***Tocotrienols***

Tocotrienols are concentrated in the bran fraction of the grain, and are structurally similar to tocopherols, but differ in physiological properties. Tocotrienols are

antioxidants, inhibit cholesterol synthesis by blocking hydroxymethylglutaryl CoA reductase (46), and are reported to have cancer-suppressive activity (47). A 15% reduction in cholesterol was observed in humans when a dose of about 150 mg of tocotrienols per day was administered, which is 5-10 times the amount available from a diet in which all grain products consumed are whole grains (46).

## **The Health Benefits of Whole grains**

### ***Whole grains and risk of Type 2 Diabetes Mellitus***

Statistics from the National Center for Health Statistics (48) indicate that an estimated 60% of all adult Americans are overweight. With this in mind, it is also interesting to note that the incidence rate of type 2 diabetes mellitus (DM) is rapidly rising. In the U.S., the disease currently affects approximately 13.5 million individuals. From 1980-2002, the number more than doubled from 5.8 million to 13.3 million (49).

Animal studies suggest that diets high in fat and low in fiber increase the risk of insulin resistance or hyperinsulinemia, which can ultimately lead to type 2 DM. Traditionally, carbohydrates have been classified as simple (sugars) or complex (starches) on the basis of the number of sugar molecules in their chemical structure. It was assumed that starchy foods (complex carbohydrates) cause smaller rises in blood glucose than do simple sugars. Two classification systems have been devised to assess the physiologic impact of different foods on plasma glucose and insulin. The glycemic index (GI) measures and ranks the impact of carbohydrates on postprandial plasma glucose (50, 51). Insulinemic index does the same for postprandial plasma insulin (52). At present, relatively little data on the insulin index are available. The GI

depends for the most part on the rate of digestion and rapidity of absorption of the carbohydrate, which result in an increase or decrease of blood glucose.

Whole grain products that have the bran and germ intact typically have lower GI values than refined carbohydrate-containing foods, and tend to be more slowly digested than refined grains. They have a lower GI because the intact bran layer and high content of viscous fiber hamper the ability of digestive enzymes to break down and absorb carbohydrates (53). Moreover, whole grains and whole grain products have different physical structure than refined grains and refined grain products (54). In contrast, foods containing refined grains, such as white bread, tend to have higher GI values because grinding or milling of cereals removes most of the bran and much of the germ. This reduces the particle size, allowing for a more rapid attack by the digestive enzymes. Dietary fiber, especially soluble fiber, has been shown to decrease levels of postprandial glucose and concentrations of insulin and serum lipids (55, 56).

Several epidemiological studies have linked whole grain intake to a lower fasting insulin and glycemic response (57, 58, 59). In the Nurses Health study (60), 75,521 healthy female nurses aged 38-63 years, were studied for a 10-year follow-up period, during which time there were 1,879 confirmed cases of type 2 DM. After adjustment for total energy intake and age, no association was observed between total grain intake and risk of type 2 DM. However, a statistically significant inverse association was observed between whole grain intake and risk of type 2 DM and a statistically significant positive association between refined grain intake and risk of type 2 DM.

In the Iowa Women's Health Study (61), 1,141 cases of diabetes were self-reported over a 6-year follow-up period in a prospective cohort of 35,988 healthy postmenopausal women. After adjusting for age, total energy intake, BMI, waist-to-hip ratio, education, cigarette smoking, alcohol intake and physical activity, intake of whole grains, dietary fiber, cereal fiber, and magnesium showed a significant inverse association with risk of type 2 DM.

The Health Professional Follow-up Study (62) followed 42,898 men aged 40-75 years for 12 years. A reduced risk of type 2 DM (RR=0.63) was associated with consuming 3 servings/day of whole grains. Replacing refined grains and refined grain products with whole grains and whole grain products, may help curb the rising incidence of type 2 diabetes in developed as well as in developing countries.

### ***Whole grain intake and Risk of Coronary Heart Disease***

Coronary heart disease (CHD) and stroke are the first and third leading causes of death respectively, in the United States and account for approximately 40% of all deaths (61 million Americans) each year (48). Data from the same two cohorts that were used to examine effects of whole grains on type 2 DM have also been used to examine the association between intake of whole grains and cereal fiber and incidence of CHD.

In the Iowa study, Jacobs et al (61) verified that there was an inverse relationship between whole grain intake and ischemic heart disease. After age and total energy adjustment, RR was 0.60 for women in the highest quintile of whole grain intake (median = 22.5 servings per week) compared to those in the lowest

quintile (median = 1.5 servings per week). There was no association between intake of refined grain and incidence of ischemic heart disease.

The Nurses' Health Study further supported the hypothesis that a diet rich in whole grains offers protection against CHD. Liu et al (63) demonstrated that after adjustment for age and smoking, increased whole grain intake was associated with decreased risk for CHD. After adjusting for age, cigarette smoking, BMI, use of postmenopausal hormones, alcohol intake, use of multivitamins and vitamin E supplements, physical activity and types of dietary fat, it was observed that there was almost a 25% lower risk of CHD among women who ate nearly 3 servings of whole grains a day compared to those who ate less than a serving per week.

The Adventist Health study which examined the relationship of individual foods to the risk for CHD in 31,028 white men and women in California over a six-year period, reported an inverse association between intake of whole wheat bread and risk of myocardial infarction (64). After adjustment for non-dietary risk factors and consumption of other foods, whole wheat bread intake was associated with an RR for CHD incidence of 0.56 compared to that for intake of white bread. In addition, this study found that the reduction in risk associated with higher whole grain intake was almost identical for fatal and nonfatal CHD.

The biological mechanisms by which whole grain foods exert their protective effects are not clear but may involve a synergistic effect of multiple constituents.

### ***Whole grain Intake and Cancer Prevention***

The World Cancer Research Fund (WCRF) and American Institute for Cancer Research (AICR) in 1997 provided a comprehensive report of epidemiological

reviews of foods, food groups and cancer. The report stated “diets high in dietary fiber possibly decrease risk of colorectal cancer.” Cereal-grain foods were referred to as offering possible protection against gastric cancers, whereas diets high in refined cereals possibly increased the risk of esophageal cancer. The report also indicated that whole grain cereals and cancer were negatively linked and therefore whole grains were more beneficial than refined cereal foods.

*Mechanisms by which cereal-based foods protect against colon cancer*

A number of possible mechanisms have been suggested for the reduction in colon cancer by dietary fiber. These are increasing stool bulk, binding toxic/mutagenic metabolites, lowering fecal pH, altering bacterial fermentation and short-chain fatty acid (SCFA) production, and preventing insulin resistance. Other components in the outer layers of the whole grain such as phytates, phenolics, lignans, and phytosterols have also been shown to have significantly improved colon function and decreased oxidative stress (65).

***Whole grains, Obesity and Body Weight Regulation***

Obesity prevalence has dramatically increased in the past few decades and obesity is a leading public health issues in the United States. Few studies have focused on the role of whole grain foods in body weight regulation (66). It has been proposed that whole grain food intake is inversely associated with body fat or weight gain (51).

The ingestion of fiber is thought to suppress energy intake by inducing satiety. Grains such as oats and barley, which are rich in viscous soluble fibers, tend to

increase intraluminal viscosity thus prolonging gastric emptying and nutrient absorption in the small intestine (66).

Several studies have investigated the effect of whole grain consumption on weight and body mass index (BMI). In the Framingham Offspring Study (59), diets rich in whole grains were inversely associated with BMI and with the waist-to-hip ratio. Body weight was 1 to 2 kilograms higher among those with the lowest intake of whole grains compared to those in the highest quintile of whole grain intake. Liu et al. (1999) did not find any appreciable variation in BMI across quintiles of whole grain intake among 75,521 nurses. However, the same cohort used later in 2003 showed that women who consumed more whole grains consistently weighed less than did women who consumed less whole grains. In the Iowa Women's Health Study (61), whole grain intake was inversely associated with body weight and fat distribution. In the CARDIA study (Coronary Artery Risk Development in Young Adults), the whole grain intake was inversely related to BMI at 7-year follow-up of participants (57). Finally, in the Health Professionals Follow-Up Study, an increase in whole grain intake was inversely associated with long-term weight gain (67).

Body weight regulation may be an important mechanism by which whole grains operate to lower the risk of diabetes and heart disease. Although further research is needed in this area, adoption of a diet rich in fiber from whole grains should be encouraged.

### **The Stages of Change Model**

The stages of change model, one of the key elements of the Transtheoretical Model, is one of the best-known and validated models for studying human behavior.

It was developed by Dr. James Prochaska in 1979 (68). The stages of change is one of the four constructs of the Transtheoretical Model and helps to explain how people change their behavior. The other three constructs are decisional balance, self-efficacy and processes of change. It evolved from work with smoking cessation conducted by Dr. James Prochaska and his colleague Dr. Carlo DiClemente (69), and the treatment of drug and alcohol addiction, and has recently been applied to a variety of other health behaviors. The basic premise is that behavior change is a *process*, not an event, and that individuals are at varying levels of motivation, or readiness, to change. People at different points in the process of change can benefit from different interventions, matched to their stage at that time.

There are five distinct stages, which are described below:

PRE-CONTEMPLATION – Unaware of the problem; no desire to change

- Individuals in this stage do not want to change their behavior.
- Individuals will insist that their behavior is acceptable.

CONTEMPLATION – Thinking about change, in the next six months

- Individuals at this stage are thinking about changing their behavior; however, they are not ready to commit to making a change.
- They are apprehensive about changing the behavior possibly because they have tried in the past and have failed.

PREPARATION/DECISION - Making a plan to change

- These individuals are ready to change their behavior and plan to do so within the next thirty days.

- These individuals need assistance in developing concrete plans and setting gradual goals.

ACTION – Implementation of specific action plans (i.e. they have already quit smoking)

- Individuals at this stage are actively engaging in the behavior for less than six months.
- As part of the follow-up plan, they would require feedback from health care provider, as well as aiding in problem solving. Continual social support and reinforcement increase chances of sustaining the behavior (a smoke free lifestyle).

MAINTENANCE – Continuation of desirable actions, or repeating periodic recommended step(s).

- Individuals at this stage are maintaining the change in behavior for six months or more.
- Counseling for coping with the change in lifestyle, constant reminders to sustain the behavior, finding alternatives to keep the interest alive and counseling for relapse prevention are necessary at this time.

This model has been previously used in various research strategies. A study was done by Havas et al (27) for the WIC 5-a-day promotion program for fruits and vegetables over a period of two years. The pretest showed that 47.7% of the participants were in the *action stage* or *maintenance stage*. Two months post-intervention, 62.4% of the participants were in these stages.

Vallis et al (70) provided an assessment of dietary change using the transtheoretical model. About 768 overweight individuals with diabetes enrolled in a randomized behavioral intervention trial. Their results validated the model, where those in the action stage displayed healthier eating.

Curry et al (71) assessed the applicability of the stage of change model to dietary change by assessing the stage of dietary fat reduction in adult males and females. Males and females differed in their distribution across the five stages, with more males than females in the precontemplation stage and more females than males in the maintenance stage.

The stage of change model has also been used in primary-care interventions for patients on a DASH (Dietary Approaches to Stop Hypertension) diet (72). Three DASH patients were picked to undergo a nutrition intervention where the stage of change model was used to identify the three patients to be in the precontemplation, contemplation and preparation stages. Health care providers then assisted these patients to move on to the next stage by providing adequate nutrition intervention.

Some researchers state that the application of the stage of change model to dietary behavior could be problematic due to the difference in nature between dietary behaviors and the behaviors upon which the model was originally based. However, the stage of change model is an appropriate behavior change model that can be used on an individual or group of individuals, since counseling is done based on where they are in the stages of change (73, 74).

The understanding how variables based in behavior-change theory mediate change is very limited in the area of consumption of whole grain products. Until

future research can improve the understanding of the individual, social, environmental, and behavioral factors that influence the intake of whole grain foods, results observed from the promotion of fruits, vegetables, and low-fat, high-fiber foods can be applied.

## Chapter 2: Research Question and Hypothesis

A large body of evidence shows the potential health benefits of whole grain foods as well as data showing low consumption. It is essential that nutrition education programs cater to consumers, to increase understanding and knowledge of whole grain foods.

The objectives of this study were:

1. To establish if consumers are able to identify whole grain foods
2. To find out if consumers are aware of the health benefits of whole grain foods
3. To identify the barriers that prevent consumers from purchasing whole grain food products
4. To identify whether consumers are willing to increase their consumption of whole grain foods
5. To find out the extent to which a single mail intervention will affect attitudes and behavior

Through this research we hope to gain a better understanding of why consumers often avoid purchasing and consuming whole grain foods. We also hope to develop insights in how to motivate consumers to positively change behavior so that more effective nutrition education programs and interventions can be developed in the future.

The study hypothesized that:

1. The dietary intake of whole grain foods and the awareness and knowledge of whole grains will be low.

2. A single nutrition intervention will improve the stage of change and bring about a change in consumers' attitude and behavior.

## **Chapter 3: Methodology**

### **Sample Selection**

Maryland Cooperative Extension county educators from Frederick, Queen Anne's, and Dorchester counties provided databases of names from which the subjects were randomly selected. The Frederick County database consisted of 325 names, the Queen Anne's County consisted of 150 names and the Dorchester County database consisted of 125 names. All names from the three counties were pooled to obtain a final population size of 600. The Random Number Generator Add-In tool in Microsoft Excel 2003 was used to randomly select 300 names. A sample of 300 was considered appropriate since a limited budget was available to us for this project. The budget was sufficient to cover costs of printing and photocopying of surveys, educational materials, and mailing the surveys. The resources required for a sample of 300 subjects were well within budget.

In order to validate the survey questionnaire, 15 subjects were selected, other than the ones in the final 300, to complete the questionnaire and provide any comments regarding the comprehension of any of the questions on the survey. The subjects were not picked from the pooled database from the three counties but were acquaintances of the primary investigator of this study. Based on the results of the questionnaire and the comments provided by the subjects, a final version of the survey questionnaire was prepared.

Approval to perform this study was obtained from the Institutional Review Board of the University of Maryland, College Park.

## **Survey Instrument**

The survey instrument consisted of 7 questions that addressed knowledge, attitude, and behavior with respect to whole grains. The survey was designed to address topics such as knowledge of different types of whole grain foods and the health benefits of whole grains, ability to recognize whole grain foods from product labels, frequency of whole grain consumption and perceived barriers to consumption. The stages of change model of health behavior was utilized to initially assign a stage and then to assess movement to another stage after a period of 12 weeks.

The first survey was mailed in the last week of December 2003, along with a cover letter explaining the purpose and significance of the study, and the importance of each subjects' contribution to the outcome of the study and to future research. A consent form was also included which explained the study procedures and time commitment. If the subject agreed to participate after reading the consent form, he or she was asked to sign and return the consent form with their completed questionnaire. The subjects were requested to mail the completed questionnaires back by mid-January 2004. A total of 125 subjects returned the completed surveys.

## ***Mail Intervention***

In early June 2004, a mail intervention was conducted wherein each subject received educational materials in the mail. The purpose of the mail intervention was to provide the subjects with enough materials to increase awareness of whole grain benefits and if possible bring about a positive change in attitude towards whole grain consumption. The handouts not only had to be informative but also provide additional information that touched upon the ways to alleviate common consumer concerns such

as reading food labels, inability to identify whole grain foods, mixed messages regarding benefits of whole grains and whole grain recipes. With these criteria in mind, the following handouts were chosen to be included in the educational package:

- *Nutrition to Go* (A nutrition newsletter from the University of Rhode Island, the University of Connecticut Nutrition Awareness Project and the University of Maryland, College Park Family Nutrition Program): This handout contained a number of whole grain recipes that the subjects were encouraged to try out during a six week period. The handout also contained useful information on fiber and its benefits.
- *Get on the Grain Train* (Home and Garden Bulletin No. 267-2): This handout was developed by the U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. This contained information on the 2000 Dietary Guidelines for Americans, what whole grain foods are, what their benefits are, what the recommended number of servings are and the different whole grain foods available for consumers.
- *The Whole Grain Bonus* (2000 General Mills, Inc.): This handout included information on the structure of whole grains, the various nutrients found in the different parts of a whole grain kernel, how to identify a whole grain product from a food label, and health claims. This handout was part of an educational package prepared by General Mills in collaboration with Wheat Foods Council. It was specially designed for nutrition professionals to utilize for promotion of whole grain consumption.

- *Food Guide Pyramid and Dietary Guidelines for Americans (2000 General Mills, Inc.):* This was obtained from General Mills and Bell Institute of Health and Nutrition. It summarized information about the Food Guide Pyramid, including recommended number of serving sizes, and provided information on the 2000 Dietary Guidelines for Americans, with respect to whole grains.

These handouts were mailed to each subject along with a cover letter requesting that each subject spend some time reading the handouts and trying out some of the recipes.

In early September 2004, about 12 weeks after the educational materials were mailed out; a second survey instrument (the post-intervention survey) was sent to the subjects. This survey was sent as a follow-up to the intervention. The questions on this survey mainly focused on determining whether the subjects had moved to a later stage of change, and to assess any change in attitude towards whole grains since the educational materials had been sent to them. The follow-up survey contained 5 questions and was designed to be similar to the pre-intervention survey. A few questions pertaining to the stage of change and perceived barriers were repeated, and a few new questions were added. The new questions addressed topics such as usefulness of the educational materials and recipes that the subjects tried out. The subjects were asked to return the completed surveys by late October 2004.

### ***Data Analysis***

Data were manually entered into an Excel database and imported into SAS, version 8.2 (SAS Institute Inc.; Cary, NC). Frequencies were determined for all categorical variables. Differences in attitude measurements between baseline values

prior to the nutrition education intervention and 12-week follow-up values were analyzed using Generalized Estimating Equations. The distribution of stages as well as movement across stages was compared using Chi-square tests. Differences and associations were considered statistically significant for values of  $p < 0.05$ .

## Chapter 4: Results

### Characteristics of the Study Sample

This study was conducted with the assistance of three Maryland Cooperative Extension county educators who provided lists of people who previously participated in county extension education programs. A sample size of 300 was considered appropriate for this study. Of the 300 subjects who were mailed surveys, 125 subjects (41.6%) returned their completed surveys. Therefore, the final sample size for the remainder of the study was 125.

**Table 1** presents the characteristics of the study sample. More than 90% (n=116) were females; only 7.2% (n=9) were males. The mean age of the sample was 58.5 years with a range of 20-84 years. Almost 56% (n=51) were 60 years of age or older and only 14% (n=17) were less than 39 years. The rest of the sample, 35% (n=42), were between 40 and 59 years of age.

91% of the study sample was White with less than 1% being of Asian descent. The sample contained 5.8% African-Americans and 1.7% Hispanics. Half the subjects had a bachelor's degree or higher.

**Table 1: Demographic data of participants**

	N	%
Total = 125**		
Gender		
Male	9	7.2
Female	116	92.8
Race		
White	109	90.8
African American	7	5.8
Hispanic	2	1.7
Asian	1	0.8
Other	1	0.8
Age Range (y)		
0-39	17	14.1
40-59	42	35.0
>=60	61	55.9
Mean(y)* = 58.5 $\pm$ 1.38		
Education		
High-school Diploma	37	31.1
Junior College	5	4.2
Associate Degree	18	15.1
Bachelors Degree	32	26.9
Graduate Degree or higher	27	22.7

\*mean  $\pm$ S.E

\*\*Not all respondents answered all questions

One of the objectives of our study was to determine the subjects' knowledge of certain issues relevant to whole grains, including the recommended number of servings and health benefits. **Table 2** indicates the extent of knowledge of the subjects with respect to the current whole grain recommendations. Less than half of the subjects (44.3%, n=54) correctly answered '2-3' servings of whole grains per day while 20.5% (n=25) chose '6-11' servings per day (which is the servings recommendation for all grain foods). 28.7% (n=35) of the subjects chose '4-5' servings/day, while 6.6% (n=8) thought the recommendations was '1' serving per day.

**Table 2: Knowledge of recommended number of servings of whole grains per day.**

Servings per day	N	% (S.E)
1	8	6.5 ( $\pm$ 2.23)
2-3	54	44.2 ( $\pm$ 4.49)
4-5	35	28.7 ( $\pm$ 4.09)
6-11	25	20.5 ( $\pm$ 3.65)

As seen in **Table 3**, 71.2% (n=89) of subjects correctly identified heart disease as a chronic disease risk that can be lowered by consumption of whole grains. However, only 16.8% correctly indicated the whole grain consumption was associated with a lower risk of diabetes. Almost 70% (69.6%, n=87) of the subjects were of the opinion that the risk of cataracts can be lowered by whole grain consumption, although there is little evidence of this. 98% of the subjects correctly indicated that the common cold was a disease whose risk could not be lowered through whole grain consumption. 62.4% thought that risk of Alzheimer's disease could be lowered by whole grain consumption. The greatest knowledge gap was with respect to diabetes, as 83.2% (n=104) did not think that whole grain consumption could reduce the risk of diabetes.

**Table 3: Knowledge of association between whole grains and risk of chronic disease.**

	Yes, whole grains lower the risk N (% , S.E)	No, whole grains do not lower the risk N (% , S.E)
Cataracts	87 (69.6, $\pm$ 4.11)	38 (30.4, $\pm$ 4.11)
Diabetes	21 (16.8, $\pm$ 3.34)	104 (83.2, $\pm$ 3.34)
Heart Disease	89 (71.2, $\pm$ 4.05)	36 (28.8, $\pm$ 4.05)
Common Cold	3 (2.4, $\pm$ 1.36)	122 (97.6, $\pm$ 1.36)
Alzheimer's Disease	78 (62.4, $\pm$ 4.33)	47 (37.6, $\pm$ 4.33)

The ability of the subjects to identify whole grain foods is shown in **Table 4**. Of the foods listed, the ones most likely to be whole grain foods are brown rice, bulgur, oatmeal, popcorn, tabouli salad, and whole-wheat bread. Among these foods, brown rice, oatmeal, and whole-wheat bread were most likely to be correctly identified as whole grain foods. (86%, n=104, 87%, n=107 and 87.8%, n=108 respectively). Tabouli salad was correctly identified by only 26.8% (n=32) of the subjects while couscous was correctly identified by 39.5% (n=47) of the subjects. Rye bread, which may or may not be a whole grain food, was the only food where the percentage of subjects that identified it as a whole grain food (48.3%) was similar to the percentage that did not know/never heard of the food (43.4%). The other whole grain foods, bulgur and popcorn, were correctly identified by a majority of subjects (60.1%, and 59.8%, respectively). On the other hand, 80.2% (n=97) of the subjects indicated don't know/never heard of the food for enriched white rice, while 17.3% (n=21) incorrectly identified it as a whole grain food. Interestingly, only 2.5% (n=3) correctly understood it was not a whole grain food. A similar finding occurred for enriched wheat flour, as 32.4% (n=39) identified it as a whole grain food and only 3.3% (n=4) correctly recognized it as not being a whole grain food. The foods that a majority of subjects incorrectly identified as whole grain foods were stone-ground wheat bread (67%, n=81), seven-grain bread (63.6%, n=77), and multigrain bread (59.8%, n=73).

**Table 4: Ability of subjects to identify of whole grain foods**

Food	Yes, this is a whole grain food N (% , S.E)	No, this is not a whole grain food N (% , S.E)	Don't know or never heard of the food N (% , S.E)
Bran flakes	81 (66.9, $\pm$ 7.34)	3 (2.5, $\pm$ 2.43)	37 (30.5, $\pm$ 7.19)
Brown rice*	104 (86.0, $\pm$ 3.15)	1 (0.8, $\pm$ 0.80)	16 (13.2, $\pm$ 3.07)
Bulgur*	74 (60.1, $\pm$ 3.82)	40 (32.5, $\pm$ 4.22)	9 (7.3, $\pm$ 2.34)
Couscous	47 (39.5, $\pm$ 4.48)	31 (26.0, $\pm$ 1.26)	41 (34.4, $\pm$ 4.35)
Enriched wheat flour	39 (32.5, $\pm$ 4.27)	4 (3.3, $\pm$ 1.63)	77 (64.1, $\pm$ 4.37)
Enriched white rice	21 (17.3, $\pm$ 3.43)	3 (2.5, $\pm$ 1.41)	97 (80.2, $\pm$ 3.62)
Multigrain bread	73 (59.8, $\pm$ 4.43)	7 (5.7, $\pm$ 2.09)	42 (34.4, $\pm$ 4.30)
Oatmeal*	107 (87.0, $\pm$ 4.04)	3 (2.4, $\pm$ 1.38)	13 (10.6, $\pm$ 2.78)
Popcorn*	73 (59.8, $\pm$ 4.43)	8 (6.5, $\pm$ 2.23)	41 (33.6, $\pm$ 4.27)
Rye bread <sup>?</sup>	59 (48.3, $\pm$ 4.52)	10 (8.2, $\pm$ 2.48)	53 (43.4, $\pm$ 4.48)
Seven-grain bread	77 (63.6, $\pm$ 4.37)	9 (7.4, $\pm$ 2.37)	35 (28.9, $\pm$ 4.12)
Stone-ground wheat bread	81 (67.0, $\pm$ 3.56)	5 (4.1, $\pm$ 1.80)	35 (28.9, $\pm$ 4.12)
Tabouli salad*	32 (26.8, $\pm$ 4.06)	66 (55.4, $\pm$ 4.55)	21 (16.8, $\pm$ 3.42)
Whole-wheat* bread	108 (87.8, $\pm$ 2.95)	1 (0.8, $\pm$ 0.80)	14 (11.4, $\pm$ 2.86)

\* Typical whole grain foods, ? May or may not be a whole grain food.

Another important objective of this study was to determine whether the nutrition education materials had any impact in changing the attitudes of the subjects towards whole grains. **Table 5** shows the changes in attitudes with respect to the degree of “sureness” of being able to perform a particular task related to whole grains. The GENMOD Procedure (Generalized Estimating Equations, GEE) was conducted to estimate an overall change in attitude post-intervention, for each of the variables measured. Prior to the intervention, 86% (n=104) of the subjects were sure they could ‘Eat 1 serving of whole grain food each day’ while only 53.2% (n=65) were sure they could ‘Eat 2-3 servings of whole grain

**Table 5: Change in attitudes towards whole grain consumption (extent of sureness)**

	Baseline [n (%)] **			Post-intervention [n (%)] **			
<b>How sure are you that you can.....?</b>	<b>Sure</b>	<b>Somewhat Sure</b>	<b>Unsure</b>	<b>Sure</b>	<b>Somewhat Sure</b>	<b>Unsure</b>	<b>P*</b>
Eat 1 serving of whole grain food each day	104 (86)	11(9.0)	6 (5.0)	98 (82.3)	21 (17.7)	0 (0)	<b>0.5646</b>
Eat 2-3 servings of whole grain food each day	65 (53.2)	37 (30.3)	20 (16.3)	83 (69.1)	25 (20.8)	12 (10.0)	<b>0.0087</b>
Eat whole grain bread instead of white bread	93 (76.9)	22 (18.1)	9 (7.4)	106 (88.3)	10 (8.3)	4 (3.3)	<b>0.0235</b>
Choose a whole grain cereal that is new to you	90 (74.3)	22 (18.1)	9 (7.4)	106 (88.3)	13 (10.8)	1 (0.8)	<b>0.0046</b>
Try a whole grain food that you never ate before	73 (60.3)	29 (24.0)	19 (15.7)	75 (62.50)	38 (31.7)	7 (5.8)	<b>0.3711</b>
Prepare a whole grain food that is new to you	65 (53.7)	40 (33.0)	16 (13.2)	80 (67.2)	31 (26.0)	8 (6.7)	<b>0.0232</b>

\*P <0.05, Generalized Estimating Equations used to determine an overall change in attitude for each variable.

\*\*Each category has different numbers of missing values.

foods per day.’ A little over half the subjects (53.7%, n=65) were sure that they could ‘Prepare a whole grain food that was new’ to them. This percentage increased to 67.2% (n=80) after the intervention (P=0.0232). The percentage of subjects also increased over 10% for those who were “Sure” they could ‘Eat 2-3 servings of whole grain foods per day’ (53.2% to 69.1%, P=0.0087), ‘Eat whole grain bread instead of white bread’ (76.9% to 88.3%, P=0.0235), and ‘Choose a whole grain cereal that is new to you’ (74.3% to 88.3%, P=0.0046). In contrast, the number of subjects who were in the “Unsure” category for all the variables prior to the intervention was reduced after the intervention.

From **Table 5**, it is clear that there was a significant change in attitude in the subjects who felt they could ‘Eat 2-3 servings of whole grain food each day’ (P=0.0087), ‘Eat whole grain bread instead of white bread’ (P=0.0235), ‘Choose whole grain cereal that is new to them’ (P=0.0046) and ‘Prepare a whole grain food that is new to them’ (P=0.0232). However, there was no significant difference in the way people felt they could ‘Eat 1 serving of whole grain food each day’ (P=0.5646) and ‘Try a whole grain food that they never ate before’ (P=0.3711).

From **Table 6**, it can be seen that there was significant change in attitude towards whole grain consumption for 7 of the 9 variables measured. This table shows changes in attitudes in terms of the subjects’ degree of “agreement” with different aspects of whole grain foods. There were 5 categories that were used to measure the subjects’ view of whole grains, namely “Agree a lot,” “Agree a little,” “Not sure,” “Disagree a little,” and “Disagree a lot.” Prior to the intervention, 63% (n=77) agreed a lot that ‘Whole grain foods taste good’; post-intervention this increased to 79%

**Table 6: Changes in attitudes towards whole grain consumption (degree of agreement)**

N (%)	Agree a lot		Agree a little		Not Sure		Disagree a little		Disagree a lot		P*
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Whole-grain foods taste good	77 (63.1)	94 (79.0)	34 (27.8)	24 (20.1)	6 (4.9)	0 (0)	4 (3.2)	1 (0.8)	1 (0.8)	0 (0)	<b>0.0035</b>
Whole-grain foods cost too much	11 (9.0)	8 (6.7)	44 (36.0)	31 (25.8)	24 (19.7)	24 (20.0)	27 (22.1)	34 (28.3)	16 (13.1)	23 (19.1)	<b>0.0384</b>
Whole-grain foods are difficult to prepare	3 (2.4)	2 (1.7)	17 (13.9)	15 (12.5)	22 (18.0)	10 (8.3)	46 (37.7)	60 (50.0)	34 (27.9)	33 (27.5)	<b>0.3331</b>
Whole-grain foods are difficult to find at the store	3 (2.5)	5 (4.17)	41 (33.6)	21 (17.5)	11 (9.0)	8 (6.7)	34 (27.9)	42 (35.0)	33 (27.5)	44 (36.7)	<b>0.0191</b>
The stores where I shop sell a variety of whole grain foods	56 (45.0)	75 (62.0)	45 (36.9)	32 (26.4)	16 (13.1)	4 (3.3)	5 (4.1)	7 (5.8)	0 (0)	3 (2.5)	<b>0.0218</b>

**Table 6 contd.**

N (%)	Agree a lot		Agree a little		Not Sure		Disagree a little		Disagree a lot		P*
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Whole-grain foods are convenient to eat	55 (45.0)	56 (46.7)	48 (39.3)	50 (41.7)	9 (7.4)	8 (6.7)	9 (7.4)	4 (3.3)	1 (0.8)	2 (4.1)	<b>0.5532</b>
My family wants to eat whole-grain foods	34 (27.9)	43 (35.8)	37 (30.3)	49 (40.8)	21 (17.2)	14 (11.7)	22 (18.0)	9 (7.5)	8 (6.6)	5 (4.1)	<b>0.0069</b>
I would buy whole-grain foods if I knew they were healthful	68 (55.7)	82 (68.3)	34 (27.9)	27 (22.5)	11 (9.0)	6 (5.0)	7 (5.7)	2 (1.7)	2 (1.6)	3 (2.5)	<b>0.0343</b>
I would buy a food that took longer to prepare if I knew it was healthier	51 (41.8)	67 (55.8)	45 (36.9)	43 (35.8)	17 (13.9)	5 (4.2)	9 (7.4)	5 (4.2)	0 (0)	0 (0)	<b>0.0082</b>

\*P <0.05; Generalized Estimating Equation used to determine an overall change in attitude for a variable.

\*\*Each variable has different numbers of missing values

(n=94). Almost 1% (0.8%, n=1) were in the category of “Disagree a lot” for this variable, which went down to 0% post-intervention ( $P=0.0035$ ). When subjects were asked if they felt ‘Whole grain foods cost too much,’ 36% (n=44) agreed a little prior to the intervention, whereas after the intervention, the percentage went down to 25.8% (n=31,  $P=0.0384$ ). The percentage of subjects in any of the aforementioned 5 categories, prior to or after the intervention, was less than 37% for this variable.

Prior to the intervention, 37.7% (n=46) “Disagreed a little” that ‘Whole grain foods are difficult to prepare.’ Post-intervention, 50% (n=60) fell into the same category. Only 2.4% (n=3) were in the category of “Agree a lot” for this variable prior to the intervention and this went down to 1.7% (n=2) after the intervention. However, this change was not significant ( $P=0.3331$ ). Subjects were also asked if they felt ‘Whole grain foods are difficult to find at the store.’ Almost 34% (n=41) of subjects “Agreed a little”, while 17.5% (n=21) felt the same way after the intervention. However, the percentage of subjects who “Disagreed a lot” on this aspect went up after the intervention, from 27.5% (n=33) to 36.7% (n=44). These were seen as significant changes in attitudes ( $P=0.0191$ ). Forty-six percent of subjects “Agreed a lot” that ‘The stores where they shop sell a variety of whole grain foods’ prior to the intervention. Post-intervention there were more subjects who “Agreed a lot” about the same i.e. 62% (n=75). On the other hand, none of the subjects fell into the category of “Disagree a lot” prior to the intervention; however, 2.5% (n=3) fell into this category after the intervention. These changes in attitudes were also significant ( $P=0.0218$ ).

There was no significant change observed in attitudes of subjects when they were asked if “Whole grain foods are convenient to eat” ( $P=0.5532$ ). A significant change in attitude was observed in subjects who “Agreed a lot” that ‘Their family wants to eat whole grain foods’ – 35.8% ( $n=43$ ) of subjects were in this category after the intervention as opposed to 27.9% ( $n=34$ ) prior to the intervention ( $P=0.0069$ ). Apart from this, 30.0% ( $n=37$ ) of subjects who were in the category “Agree a little” for the same variable, significantly increased to a little over 10% after the intervention to 40.8% ( $n=49$ ). Another question on the survey asked subjects if they would ‘Buy whole grain foods if they knew they were healthful.’ A little over 55% (55.7%,  $n=68$ ) “Agreed a lot” on this issue before the intervention occurred and 68.3% ( $n=82$ ) felt the same way after the intervention. A similar trend was seen in those who were in the category “Agree a little.” However, this was not seen for those in “Disagree a little.” There were 5.7% ( $n=7$ ) of subjects in this category prior to the intervention and it went down to 1.7% ( $n=2$ ) after the intervention. These results were all significant ( $P=0.0343$ ).

One of the essential changes we wanted to observe were those of behavior by measuring the Stage of Change. **Table 7** shows the distribution of the subjects with regards to the various stages prior to and after the intervention and whether these changes were significant or not. Six variables were measured and the table shows that the changes for each of them were significant. For the variable “Eating more whole grain breads daily,” only 8.2% ( $n=10$ ) of subjects were in the preparation stage prior to the intervention, but after the intervention those in the *Preparation* stage rose to 16.8% ( $n=21$ ). Most of the subjects were in the *Maintenance* stage, with 45.9%

(n=56) subjects in this stage prior to the intervention and after the intervention. The 16.3% (n=20) who were in the *Action* stage prior to the intervention rose to 27.2% (n=33) after the intervention. A similar trend was seen for the variable “Eating more whole grain cereals daily” where most of the subjects were in the *Maintenance* stage both prior to and after the intervention – 46.3% (n=57) and 47.1% (n=58) respectively. Again, there were more subjects in the *Action* stage after the intervention i.e. 14.6% (n=18) prior to the intervention and 21.9% (n=27) after the intervention.

The variable “Trying a whole grain product that is new to you” showed a different pattern. A decrease in the number of subjects in the *Contemplation* stage was seen after the intervention, where 33.3% (n=41) decreased to 12.2% (n=15). However, more subjects moved to the *Preparation* stage after the intervention since there were 35% (n=43) of subjects after the intervention as opposed to 17% (n=21) prior to the intervention. On the other hand, 10.6% (n=13) of subjects were placed in the *Maintenance* stage prior to the intervention while 13.8% (n=17) of subjects were seen after the intervention. This is opposite to the pattern observed with the earlier variables. Eighty percent of subjects were in the *Maintenance* stage for the variable “Read food labels when shopping” both prior to and after the intervention. This was the highest percentage of subjects seen for any variable at any stage.

**Table 7: Change in behavior by stage of change categories**

	Stage of Change	Eating more whole grain breads daily	Eating more whole grain cereals daily	Trying a whole-grain product that is new to you	Eating 2-3 servings of whole-grain foods daily	Reading food labels when shopping
<b>Pre-intervention</b> N (%)	Precontemplation	18 (14.7)	22 (17.9)	37 (30.0)	27 (21.9)	10 (8.10)
	Contemplation	18 (14.7)	7 (5.7)	41 (33.3)	16 (13.0)	12 (9.8)
	Preparation	10 (8.2)	12 (9.8)	21 (17.0)	22 (17.9)	7 (5.7)
	Action	20 (16.3)	18 (14.6)	11 (8.9)	13 (10.6)	14 (11.4)
	Maintenance	56 (45.9)	57 (46.3)	13 (10.6)	45 (36.6)	80 (65.0)
<b>Post-intervention</b> N (%)	Precontemplation	5 (4.13)	7 (5.7)	17 (13.8)	8 (6.5)	5 (4.0)
	Contemplation	7 (5.8)	12 (9.8)	15 (12.2)	17 (13.8)	4 (3.2)
	Preparation	15 (12.4)	19 (15.4)	43 (35.0)	21 (17.0)	14 (11.4)
	Action	33 (27.2)	27 (21.9)	31 (25.2)	27 (21.9)	21 (17.0)
	Maintenance	61 (50.4)	58 (47.1)	17 (13.8)	50 (40.6)	80 (65.0)
	<b>Overall change**</b>	↑ = 45 ↓ = 3	↑ = 40 ↓ = 7	↑ = 76 ↓ = 7	↑ = 55 ↓ = 2	↑ = 26 ↓ = 2
	<b>P*</b>	<b>&lt;0.0001</b>	<b>&lt;0.0001</b>	<b>&lt;0.0001</b>	<b>&lt;0.0001</b>	<b>&lt;0.0001</b>

\*P <0.05, Chi-square analysis to determine movement across stages.

\*\*Arrows indicate number of subjects that moved up or down a stage for each variable.

**Table 8** shows the frequency of consumption of various grain foods, including whole grain foods. Among the grain foods that were consumed, a very low percentage of subjects consumed whole grain foods daily. Less than 3% of the subjects consumed barley, brown rice, bulgur, groats, or whole-wheat bread daily. However, 13.8% (n=17) of subjects consumed oatmeal just about every day. 28.5% of subjects consumed white bread several times a week while 42.6% (n=52) consumed white rice 1-4 times per month. Further details are provided in Table 8.

**Table 8: Frequency of consumption of various grain foods**

Food	Not at all, N (%)	1-5 times last year, N (%)	6-12 times last year, N (%)	1-4 times per month, N (%)	Several times per week, N (%)	Just about every day, N (%)
Bagels	27 (21.9)	29 (23.6)	24 (19.5)	29 (23.6)	11 (8.9)	3 (2.4)
Barley*	46 (37.4)	58 (47.1)	14 (11.4)	5 (4.0)	0 (0)	0 (0)
Brown rice*	22 (17.9)	47 (38.2)	28 (22.8)	21 (17.0)	4 (3.2)	1 (0.8)
Bulgur*	92 (74.8)	22 (17.9)	4 (3.2)	3 (2.4)	1 (0.8)	1 (0.8)
Donuts	33 (26.8)	40 (32.5)	33 (26.8)	13 (10.6)	4 (3.2)	0 (0)
Groats*	98 (79.7)	16 (13.0)	2 (1.6)	3 (2.4)	3 (2.4)	1 (0.8)
Oatmeal*	10 (8.1)	9 (7.3)	26 (21.1)	32 (26.0)	29 (23.6)	17 (13.8)
Pita bread <sup>?</sup>	31 (25.2)	41 (33.3)	32 (25.2)	17 (13.8)	2 (1.6)	0 (0)
Rye bread <sup>?</sup>	25 (20.3)	35 (28.5)	29 (23.6)	21 (17.1)	10 (8.1)	3 (2.4)
White bread	22 (17.9)	22 (17.9)	11 (8.9)	26 (21.1)	35 (28.5)	7 (5.7)
White rice	9 (7.4)	19 (15.6)	32 (26.2)	52 (42.6)	9 (7.4)	1 (0.8)
Whole-wheat bread*	3 (2.4)	19 (15.5)	24 (19.5)	39 (31.7)	4 (3.2)	3 (2.6)

\* Typical whole grain foods, ? May or may not be whole grain food

We were also interested in knowing whether the educational materials that were sent to the subjects were useful and informative. **Table 9** describes the extent of usefulness of each of the handouts that was mailed along with the survey. Over 50% of the subjects found 4 of the 5 handouts ‘Very Useful,’ namely, “Get On The Grain Train” (53.6%, n=67), “The Whole grain Bonus and In Search of a Whole grain” (63.2%, n=79), “Nutrition to Go” (69.9%, n=87) and “Skillet Meals” (63.2%, n=79). Less than 5% of the subjects felt that any of the handouts was “Not Useful.” Most subjects felt the handouts were either “Very Useful” or “Somewhat Useful.”

**Table 9: Usefulness of educational materials**

<b>Title and Description</b>	<b>Very Useful N (% , S.E)</b>	<b>Somewhat Useful N (% , S.E)</b>	<b>Not Useful N (% , S.E)</b>	<b>Did not read or don't remember N (% , S.E)</b>
Get On The Grain Train	67 (53.6, ± 4.46)	41 (32.8, ± 4.19)	4 (3.2, ± 1.57)	13 (10.4, ± 2.73)
The Whole grain Bonus and In Search of a Whole grain	79 (63.2, ± 4.31)	33 (26.4, ± 3.94)	4 (3.2, ± 1.57)	9 (7.2, ± 2.31)
Food Guide Pyramid and Dietary Guidelines for Americans	59 (47.2, ± 4.46)	52 (41.6, ± 4.40)	6 (4.8, ± 1.91)	8 (6.4, ± 2.18)
Nutrition to Go	87 (69.9, ± 4.10)	26 (20.8, ± 3.63)	2 (1.6, ± 1.12)	10 (8.0, ± 2.42)
Skillet Meals	79 (63.2, ± 4.31)	31 (24.8, ± 3.86)	5 (4.0, ± 1.75)	10 (8.0, ± 2.42)

## Chapter 5: Discussion

The objectives of this study were to evaluate the awareness, knowledge, attitudes and behaviors of consumers with respect to whole grain consumption. We sought to determine how knowledgeable the subjects were of the benefits of whole grains, what their current whole grain consumption was, what the perceived barriers to consuming whole grains were and more importantly whether the educational materials our subjects received aided in changing their attitudes and behaviors towards whole grain consumption.

### *Knowledge*

One of the questions addressed on the survey was the knowledge of current whole grain recommendations. The current Dietary Guidelines for Americans recommend 3 servings of whole grains per day as part of a healthy diet. Americans consume approximately one serving of whole grain foods per day (18). Few data exist on whether consumers know the specific recommendations; however research indicates that they are unclear about the dietary recommendations for whole grains and find them ambiguous. Results from focus groups and interviews indicate that the awareness and knowledge of whole grain foods is limited (25). With this in mind, we did not expect to find a high percentage of subjects to be aware of the dietary recommendations. Our initial hypothesis was that subjects' awareness of the recommendations would be low. In this study, a little over 44% of the subjects

correctly indicated that a person should eat 2-3 servings of whole grains/day for good health.

In a study conducted by the University of Minnesota in 2003 among a group of dietitians, it was found that only 21% correctly identified the whole grain recommendations (75). This is less than half of that reported in our study. The results from the reported study and our study can be compared since both studies referred to the 2000 edition of Dietary Guidelines (our study was conducted before the 2005 Guidelines were released). It is interesting to note that the study conducted by the University of Minnesota consisted of dietitians and hence one would expect that they would be aware of the recommendations. The subjects in our study were selected from lists of participants who previously attended Maryland Cooperative Extension nutrition education programs. If the subjects in our study were randomly chosen from the general public, knowledge and awareness would have probably been lower. Nonetheless, in the past two to three years, there has been increasing media attention on whole grains.

With emphasis being placed on the whole grain health claims appearing on product boxes, consumers' interest in acquiring more information about the benefits of whole grains is expected. These health claims can be seen on all whole grain products from General Mills, as mentioned on their website, such as Cheerios, Wheaties, Total, Wheat Chex, Oatmeal Crisp to name a few. In addition, advertisements on television have also captured the attention of viewers by stressing the benefits of high-fiber or cholesterol lowering foods. A case in point is the

advertising campaign launched by General Mills for Cheerios cereal, which caught the attention of consumers and increased the sales of this product dramatically (19).

However, many consumers remain confused or uninformed about whole grains. One-fifth of our subjects confused the recommendations for whole grains (2-3 servings/day), with that of total grains (6-11 servings/day). This is consistent with past research suggesting consumers are not able to differentiate between grain foods and whole grain foods (25). The basis for this confusion could be the lack of an understanding of the value of whole grains among health professionals themselves. Health professionals are a source of information for consumers but there appears to be a lack of knowledge among health professionals which in turn leads to their inability to encourage clients to consume more whole grain foods.

The extent of consumer knowledge of health benefits of whole grains was another element of this study. One of the surprising results was that close to 70% of subjects thought that the risk of cataracts could be lowered by whole grain consumption and 71.2% felt the same about heart disease. There is little evidence to link whole grains with cataracts but there has been extensive research done on heart disease and whole grain consumption. It was unexpected to find a similar number of people thought that the risk of both cataracts and heart disease can be reduced by whole grain consumption. This further suggests that the information being provided to consumers regarding whole grains is either incorrect or unclear. This also consistent with previous research and shows that consumers are largely unaware of benefits of whole grain foods. Studies have shown that consumers would eat whole grain products more often if they believed these foods could reduce the risk of heart

disease and cancer (76). The confusion about the health benefits could also exist because although consumers are confident that certain foods may reduce the risk of certain diseases, they do not know what those foods are. A survey conducted by IFIC in 2000 (77) revealed that 48% of those surveyed were aware of an association between antioxidants and cancer while the rest of the 52% were not. Although cancer was not one of the diseases mentioned in our survey, it is clear that the lack of knowledge still exists among consumers.

In our initial survey, 83.2% of the subjects indicated that whole grains do not lower the risk of diabetes, although well-designed studies have indicated that diabetes risk can be lowered by consumption of whole grains. According to a 2000 survey conducted by the International Food Information Council, the top three health concerns of consumers are heart disease (32%), cancer (31%) and diabetes (14%). However, 20% of the adults surveyed felt that reports about diabetes appearing in the media (print and/or broadcast) made them confused. (50% said nutrition itself was made confusing by the media) (77). It is presumed that new research data on the link between diabetes and whole grains, has not reached the consumer. Disseminating such information to the consumer is challenging since it takes time for new research to filter down to the public. This is probably true even for consumers who have been previously exposed to nutrition education programs.

We investigated whether consumers could identify whole grain foods from other grain foods. Whole grain foods that are most commonly consumed such as oatmeal, brown rice and whole-wheat bread were identified by a majority of the subjects. There were some whole grain foods, such as rye bread, that were identified

by less than 50% of the subjects. It might be interesting to note that foods such as enriched wheat flour and enriched white rice were two foods that consumers were unable to categorize as being whole grain or not. It is very unlikely that the subjects had never heard of these foods, so it is assumed that they didn't know whether these were whole grain foods. One reason could be that they were confused by the word "enriched." Today, numerous food products are fortified or enriched with essential nutrients that are lost during processing. Advertising and marketing techniques may mislead consumers into believing that certain foods are whole grain foods. Unless consumers are informed that "enriched" is not the same as the original whole grain food, there will continue to be unaware customers. Food such as seven-grain bread, multigrain bread and stone-ground wheat bread were also categorized as being whole grain foods by 60% or more of the subjects. A possible reason for this is that health professionals themselves may be unable to explain the terms "multigrain" or "stone-ground." A phone survey of military food specialists found that 90% of the respondents thought they were serving whole grain bread, when in reality only 22% of them actually were serving it (78). Consumers are interested in learning how to distinguish whole grain products (79) and more efforts should be put into helping them do so.

### *Attitudes*

One of the other objectives of this study was to determine if the educational materials that were sent to the subjects produced a significant change in attitude. We also investigated the barriers to the consumption of whole grains and to what extent these barriers could be overcome by providing specific and clear information about

whole grains through the educational materials provided during the intervention program. A significant change was seen in all except two of the variables that we measured. We measured attitudes of the subjects in two ways: (1) the extent to which subjects were 'sure' they could include whole grain foods in their lifestyle and, (2) the barriers to consumption before and after the intervention. For the first survey item on attitude change, there was a significant change with respect to eating the recommended 2-3 servings of whole grains per day, switching to eating whole grain bread instead of white bread, choosing a whole grain cereal that was new to the subjects, and preparing a whole grain dish that was new to them. This change towards more positive attitudes about whole grains may be due to an increased self-efficacy of the subjects with regards to whole-grains i.e. the belief of their ability to consume more whole-grains foods.

The results pertaining to a change in attitude are consistent with data from focus groups and surveys which show that a high percentage of Americans act upon their nutrition beliefs if they are given a compelling reason to do so. The IFIC telephone survey conducted in 1998 (76) revealed that 53% act on their beliefs and eat specific foods for perceived health benefits. Similarly, results from other focus groups (25) found that telling people that whole grain foods are good for them might encourage individuals to eat more of them. Table 5 showed that the number of subjects who were "Sure" of being able to incorporate whole grains in their diet increased after the intervention, and the number of "Unsure" subjects decreased.

In order to investigate the barriers to whole grain consumption, we asked the subjects to what extent they agreed with a list of barriers on the survey. The questions

on the survey were based on taste, cost, difficulty of preparation, availability, variety and convenience of whole grains, which have been found to be the chief barriers to consumption. Previous studies have shown taste and texture, cost, convenience and availability to be the top barriers to consumption (80, 81). Looking at results we obtained after the intervention, 79% of subjects agreed a lot that whole grain foods taste good, only 6.7% of subjects agreed a lot that whole grain foods cost too much, only 4.17% agreed a lot that whole grain foods are difficult to find at stores and almost 47% agreed a lot that whole grain foods are convenient to eat. There were a fair number of people who did “Agree a little” that whole grains cost too much and are difficult to find at the store. But the percentages for these two variables decreased after the intervention. Not all of the above results are consistent with the trend seen in earlier studies. Cost and availability were identified as barriers to whole grain consumption, albeit by a small number of subjects. A survey conducted by IFIC in 2001 (81) revealed that the major barrier to consuming whole grain breads was ‘color of the inside’ while taste ranked sixth. Difficulty in preparation of whole grain dishes has also been a barrier to whole grain consumption (25), but in the present study this was not an issue.

With efforts in recent years being placed on encouraging consumers to buy whole grain foods through advertising, more whole grain products are available at stores and eating places. Whole grain foods with improving taste and lower costs are now seen in the form of snacks, breakfast meals, lunches and side meals, and are being incorporated into popular meals such as pizzas, puddings, soups and casseroles. Cereals, bagels, whole-wheat sandwiches, pitas and oats are all now found as

packaged products and on-the-go meals. In addition, recipes that use whole grain foods are now being made accessible to consumers. This could be a reason why attitudes about taste, cost and availability are slowly changing and were not considered important barriers in our study. By effectively promoting the benefits of whole grains the remaining barriers to consumption of whole grains may continue to decline.

Our survey also revealed that subjects were interested in eating healthily. 68% of subjects agreed a lot that they would buy a whole grain food if they knew it was healthful. This suggests that with effective communication that whole grains are healthy, more consumers would probably buy whole grain foods. Similarly, a majority of our subjects were willing to spend more time preparing a food if they knew it was healthier.

As previously mentioned, all of the subjects in our study were past participants of county extension education programs. Hence, they might have already known most of the information that was provided to them, and their change in attitude might have been ongoing. This could also explain why the barriers to consumption were not as expected.

### ***Behavior***

We were also keen to find out how much of whole grains the subjects in this study consumed. The survey included non whole grain foods as well. It is known that Americans on average consume only 1 serving of whole grains per day and so we did not expect the consumption to be high. The only whole grain food that was frequently consumed almost everyday was oatmeal (17% of subjects). This is surprising in view

of the fact that other foods such as whole-wheat bread, bagels and brown rice are presumably more popular among consumers. A possible explanation is that oatmeal is a quick and simple food to prepare, is soft and easy to swallow, and may be popular among older people (the mean age of our subjects was 58.5 years). According to an IFIC survey in 2001 (81) among a nationally representative sample of 1000 adults, the claimed consumption of whole grain bread averages 3-4 times a week. In the study sample, only 3.2% consumed whole-wheat bread several times a week. Again, this sample may not be representative of the general population. However, it is consistent with other food consumption surveys.

One of the key findings of this study was the significant change in behavior of subjects based on the stage of change. We attempted to evaluate whether the stage of change model of behavior could be used to estimate the change in behavior of the subjects. We wanted to determine the initial stage of change the subjects were in with regards to eating whole grain foods, and if the educational materials caused a movement across stages. Our results revealed that statistically significant change in behavior was seen among the subjects for all the variables we measured. We also found that when it came to eating whole grain breads daily, a majority of subjects were already doing it for more than 6 months. This was also true in the case of eating whole grain cereals daily, eating 2-3 servings of whole grain foods daily and reading food labels when shopping. One reason could be that extraneous events (or other influences) that occurred during the ongoing intervention could have also contributed to the way the subjects felt after the intervention. Moreover, the mere fact of being tested (before and after the intervention) could have created the effect that we were

looking for; in this case, a change in behavior. We also observed that there were more subjects than expected in the *Action* stage. It is possible that they were previously counseled about eating healthy foods, including whole grains and were already active in increasing their whole grain consumption.

Understanding factors affecting dietary change is key to effective nutrition education, but limited research has focused on factors that relate to intake of whole grains. This study attempted to use one of the many behavior change models to bring about a dietary change with respect to whole grains. Kantor et al (82) addressed individual and market level factors that influence whole grain consumption; other studies specifically examining consumer attitudes, perceptions, and behaviors regarding whole grain consumption are limited.

Perhaps the most well-known and efficient use of the stage of change model was during the 5-A-Day promotion program. Havas et al (27) used the stage of change model to increase the consumption of fruits and vegetables. One year post-intervention, mean consumption of fruits and vegetables had increased an additional 0.27 servings in both intervention and control participants. Vallis et al (70) applied this model to dietary counseling of type 1 and type 2 diabetic participants by identifying diabetes-related characteristics of the individuals at different stages of readiness to change to healthy, low-fat eating. They found that those in the 'Action' stage displayed healthier eating.

Our study attempted to classify subjects in the different stages of change and then bring about a positive movement within them after an intervention. It may be argued that the stage of change model was not the most appropriate model to use in

this study and that individual behavior change strategies would have been more effective. Behavior change models such as the Theory of Planned Behavior, Bandura's Social Cognitive Theory, which primarily focus on individual behavior change and the theory of Self-Efficacy, could be applied to this study too. These models can also be combined with the stage of change, by using specific theories for each stage the individual is in. For example, in the Contemplation stage perceived self-efficacy can be important. Those with higher confidence in their ability to buy and eat healthier foods are more likely to do so. In the Action stage, continued reinforcement for performing the behavior, social support and problem-solving skills are important as people incorporate the dietary change into their lifestyle (Social Cognitive Theory). The Theory of Planned Behavior has been applied in earlier studies to promote consumption of whole grain foods by dieticians (75). Due to time constraints and logistics, we could not take on individual counseling or one-on-one meetings. However, it is promising to see that a small change in behavior and attitude was seen with this group of subjects only with just one intervention. Well-planned interventions for the elderly (over 55 years of age) have successfully shown that utilizing one or two educational messages, reinforcing messages, access to health professionals and appropriate theories of behavior change are effective intervention methods (83).

*Limitations of the study:* The extrapolation of the findings of this study to the general population may be limited. Subjects from this study were chosen from a database provided by County Extension Educators and it is possible that some of these subjects may have been exposed to previous nutrition education programs. The

logistics of the study did not allow one-on-one intervention or any personal contact with the subjects, which may have been a more effective way of bringing about an attitude and behavior change. The demographic characteristics of the non-respondents were not known; hence non-response error could not be addressed.

### **Conclusion**

In summary, this study showed that there exists some uncertainty in the minds of consumers about the recommendations and benefits of whole grain foods. It also reaffirmed our hypothesis that the consumption of whole grains was low and that few consumers identified whole grain foods correctly. Fortunately, there was a willingness to change eating habits with regards to whole grains among consumers. Product availability and cost were identified as barriers to consumption. It was also seen that some consumers were already eating the recommended amounts of whole grain foods, preparing new whole grain foods and reading food labels while shopping. These were probably the consumers who had been learning and implementing the information they had sought or obtained through various sources. And lastly, the educational intervention may have contributed to the behavior change observed among the subjects.

### **Future directions for whole grains**

The next step for whole grain awareness would be to create a coalition of scientists, educators, health professionals and the government to increase whole grain consumption. Some of the barriers can be addressed on a broader scale by using the expertise of these different sectors. Some of the ways this can be achieved are:

- Develop a consumer-friendly whole grain definition based on existing research and then modifying it as new research emerges.
- Develop and sustain messages that advocate whole grains as being essential to healthy eating – Build relevance to the consumers' lifestyle by tactical ideas such as developing a separate whole grain section in stores.
- Acquire policy support for whole grains – Work together with government agencies to maintain grains at the base of the Food Guide Pyramid and continue emphasis on whole grains in future versions of the Dietary Guidelines for Americans and Healthy People. Also seek and secure funding for whole grain consumer research as well as scientific research. This will help probing deeper into consumer understanding and attitudes about whole grains.
- Train and educate health professionals and food manufacturers to convey the whole grain research and messages to media and the consumers – Propagate the message of healthy eating and the value and benefit of whole grain foods.
- Strike up a relationship between dietitians, nutritionists, physicians and the media so that the whole grain message can be reached to a wider audience.
- Develop innovative products to attract key targets – Find alternatives for taste, texture and appearance of whole grain foods such as breads and bagels.
- Focus on developing age-targeted intervention programs for whole grains: An effective way to reach the consumers is to target the appropriate consumer. The youth are a primary target since they influence most household purchases. By involving older adults one would reach a generally receptive audience.

School education programs, partnerships with food service companies and organizing health awareness events are encouraging ways to get attention towards whole grains.

Thus, a realistic and simple whole grain strategy that involves efforts to increase knowledge about whole grains and enhance dietary intake with focus on behavioral interventions should be the next step in furthering the message of whole grains.

## **Appendix A: Pre-intervention Survey**

### **FOOD AND NUTRITION SURVEY**

**This survey is about foods, nutrition, shopping, eating, and other related topics.**

**It is divided into 7 sections. Please read the instructions at the beginning of each section.**

**This survey asks about YOU, not about your children or other people in your household. When you choose your response, think about YOURSELF.**

**There are no right or wrong answers – just tell us how YOU feel and think, and what YOU do.**

**If you are not sure about an item, just do your best.**

**Please complete the entire survey.**

**This survey asks about whole grain foods. A whole grain food is a food that contains as its main ingredient the entire grain kernel.**

1. Which of the following foods do you think is a whole grain food? Please place a check (x) in the box that shows what YOU think.

<b>Food</b>	<b>YES, this is a whole grain food</b>	<b>NO, this is not a whole grain food</b>	<b>Don't know or never heard of food</b>
Bran flakes			
Brown rice			
Bulgur			
Couscous			
Enriched wheat flour			
Enriched white rice			
Multigrain bread			
Oatmeal			
Popcorn			
Rye bread			
Seven-grain bread			
Stone-ground wheat bread			
Tabouli salad			
Whole wheat bread			

2. How many servings of whole grain foods do YOU think a person should eat each day for good health? Please place a check (x) in the proper box.

1

2-3

4-5

6-11

3. For which of the following diseases do YOU think a diet rich in whole grain foods may help reduce the risk? Please place a check (x) in the proper box.

	<b>YES, whole grains lower the risk</b>	<b>NO, whole grains do not lower the risk</b>
Cataracts		
Diabetes		
Heart disease		
Common cold		
Alzheimer's disease		

4. For each item below, please check (x) the box that shows how sure YOU are.

<b>How sure are you that you can ...</b>	<b>A Sure</b>	<b>B Somewhat sure</b>	<b>C Unsure</b>
Eat 1 serving of a whole grain food each day			
Eat 2-3 servings of a whole grain food each day			
Eat whole grain bread instead of white bread			
Choose a whole grain cereal when you eat cereal			
Try a whole grain food that you never ate before			
Prepare a whole grain food that is new to you			

5. For each item below, please check (x) the box that shows what YOU think.

<b>I think:</b>	<b>A</b> <b>Agree</b> <b>a Lot</b>	<b>B</b> <b>Agree</b> <b>a Little</b>	<b>C</b> <b>Not</b> <b>Sure</b>	<b>D</b> <b>Disagree</b> <b>a Little</b>	<b>E</b> <b>Disagree</b> <b>a Lot</b>
Whole grain foods taste good					
Whole grain foods cost too much					
Whole grain foods are difficult to prepare					
Whole grain foods are difficult to find at the store					
The stores where I shop sell a variety of whole grain foods					
Whole grain foods are convenient to eat					
My family wants to eat whole grain foods					
I would buy whole grain foods if I knew they were healthful					
I would buy a food that took longer to prepare if I knew it was healthier					

6. This section asks about some of the foods YOU ate in the past year. Look carefully at the list, and put a check (x) in ONE box showing how often you ate the food.

<b>Food</b>	<b>Not at all</b>	<b>1-5 times last year</b>	<b>6-11 times last year</b>	<b>1-3 times per month</b>	<b>1-3 times per week</b>	<b>4-6 times per week</b>	<b>1 or more times per day</b>
Bagels							
Barley							
Brown rice							
Bulgur							
Donuts							
Groats (kasha)							
Oatmeal							
Pita bread							
Rye bread							
White bread							
White rice							
Whole wheat bread							

7. This section asks about what you might be thinking of doing, planning to do, or are already doing. Please check (x) the box that shows what YOU think.

	<b>Not thinking about it</b>	<b>Thinking about starting in the next 6 months</b>	<b>Definitely planning to start in the next month</b>	<b>Already doing it for <u>less</u> than 6 months</b>	<b>Already doing it for <u>more</u> than 6 months</b>
Eating more whole grain <u>bread</u> s daily					
Eating more whole grain <u>cereals</u> daily					
Trying a whole grain product that is new to you					
Eating 2-3 servings of whole grain foods daily					
Reading food labels when shopping					

## **Appendix B: Post-intervention Survey**

### **FOOD AND NUTRITION SURVEY**

**This survey contains 5 sections. Please read the instructions before each question carefully.**

**This survey asks about YOU; when you choose your response, think about YOURSELF.**

**There are no right or wrong answers – just tell us how YOU feel and think.**

**If you are not sure about an item, just do your best.**

**Please complete the entire survey.**

**This survey asks about whole grain foods.**

**It also asks about your feedback on the educational materials that were mailed to you earlier.**

**Name: \_\_\_\_\_**

1. Please give your opinion of how useful you felt the educational materials were that you previously received. **Check only 1 box in each row**

Title and description	Very Useful	Somewhat useful	Not useful	Did not read or Don't remember
<b>Get On the Grain Train</b> 4-page green brochure from USDA				
<b>The Whole Grain Bonus and In Search of a Whole Grain</b> Green page with the diagram of the parts of a whole grain				
<b>Food Guide Pyramid and Dietary Guidelines for Americans</b>				
<b>Nutrition to Go</b> – blue sheet with information on fiber				
<b>Skillet Meals</b> – blue sheet with 4 recipes				

2. Did you try any of the recipes?

If yes, please check the recipe(s) you tried.

- a. Quick Pasta and Broccoli
- b. Rice Lasagna
- c. Easy Brown Rice and Black Beans
- d. Skillet Meals

No, I did not try any of the recipes.

3. For each item below, please check (x) the box that shows how sure you are NOW.

<b>How sure are you NOW that you can ...</b>	<b>A Sure</b>	<b>B Somewhat sure</b>	<b>C Unsure</b>
Eat 1 serving of a whole grain food each day			
Eat 2-3 servings of a whole grain food each day			
Eat whole grain bread instead of white bread			
Choose a whole grain cereal when you eat cereal			
Try a whole grain food that you never ate before			
Prepare a whole grain food that is new to you			

4. For each item below, please check (x) the box that shows what you think NOW.

<b>I think:</b>	<b>A</b> <b>Agree</b> <b>a Lot</b>	<b>B</b> <b>Agree</b> <b>a Little</b>	<b>C</b> <b>Not</b> <b>Sure</b>	<b>D</b> <b>Disagree</b> <b>a Little</b>	<b>E</b> <b>Disagree</b> <b>a Lot</b>
Whole grain foods taste good					
Whole grain foods cost too much					
Whole grain foods are difficult to prepare					
Whole grain foods are difficult to find at the store					
The stores where I shop sell a variety of whole grain foods					
Whole grain foods are convenient to eat					
My family wants to eat whole grain foods					
I would buy whole grain foods if I knew they were healthful					
I would buy a food that took longer to prepare if I knew it was healthier					

5. This section asks about what you might be thinking of doing, planning to do, or are already doing. Please check (x) the box that shows what you think **NOW**.

	<b>Not thinking about it</b>	<b>Thinking about starting in the next 6 months</b>	<b>Definitely planning to start in the next month</b>	<b>Already doing it for <u>less</u> than 6 months</b>	<b>Already doing it for 6 or <u>more</u> months</b>
Eating more whole grain <u>bread</u> s daily					
Eating more whole grain <u>cereals</u> daily					
Trying a whole grain product that is new to you					
Eating 2-3 servings of whole grain foods daily					
Reading food labels when shopping					

**Thank you again for participating in my research project.**

**Please insert this survey in the enclosed, postage-paid envelope and mail to:**

**Meera Simha  
Dept. of Nutrition and Food Science  
0112 Skinner Bldg  
University of Maryland  
College Park, MD 20742**

## **Appendix C: Institutional Review Board – Consent Form**

### **INFORMED CONSENT FORM**

#### **Title**

Evaluating Knowledge, Attitudes and Behaviors Associated With the Consumption of Whole Grain Foods.

#### **Statement of Age of Subject**

I state that I am over 20 years of age and wish to participate in a program of research conducted by Ms. Meera Simha in the Department of Nutrition and Food Science at the University of Maryland, College Park.

#### **Purpose**

The purpose of this research is to determine attitudes and behaviors associated with consumption of various kinds of foods. This information may be useful in developing education programs to help people lead healthier lives.

#### **Procedures**

The procedures involve two surveys and one education session. The surveys will ask me about food labels, attitudes and beliefs towards foods, and frequency of consumption. I will be assigned to either an Intervention group or a Control group. If I am assigned to the Intervention group, I will be invited to attend an education session lasting about an hour where I will learn more about reading food labels, the Dietary Guidelines for Americans and benefits of healthy eating. This educational session is completely optional and I am not obligated to attend. If I am assigned to the Control group, I will receive educational materials in the mail, which will provide me

with similar information as above. The surveys will take me 10-15 minutes to complete and will include a question about age, gender, race, and education.

I understand that I should fill out the questionnaires to the best of my ability, but I am under no obligation to fill out the entire questionnaires. I also understand that it is important that the information I give researchers is as accurate as possible.

### **Confidentiality**

I understand that I will include my name on the questionnaires only so that the researchers can contact me if something in my responses was not clear to them, but this is unlikely to happen. I further understand that all the information I provide will be strictly confidential, meaning that I will never be identified or associated with any of my answers. When the questionnaires are analyzed, my answers will be grouped with the others. Any reports or publications that may result from this research will only include the group averages and no names will be mentioned in any reports. Furthermore, only the researchers will ever get to see the answered questionnaires and all questionnaires will be destroyed after the research project is completed.

### **Risks**

There are no risks associated with my participating in this project.

### **Benefits, Freedom to Withdraw and Ability to Ask Questions**

The research is not designed to help me personally, but to help the investigator learn more about knowledge, attitudes and behaviors towards certain foods and that more education programs and interventions may be designed and implemented in the future. I am free to ask questions or withdraw from participation at any time and without penalty.

### **Medical Care**

The University of Maryland does not provide any medical or hospitalization insurance for participants in this research study nor will the University of Maryland provide any compensation for any injury sustained as a result of participation in this research study, except as required by law.

### **Contact Information of Investigators**

Principle Investigator:

Mark A. Kantor

Dept. of Nutrition and Food Science

University of Maryland, College Park

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Email : [mk4@umail.umd.edu](mailto:mk4@umail.umd.edu)

Student Investigator:

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University of Maryland

College Park 20742

Tel no: 301-405-4506

Email: [msimha@wam.umd.edu](mailto:msimha@wam.umd.edu)

Name of Subject \_\_\_\_\_

Signature of Subject \_\_\_\_\_

Date \_\_\_\_\_

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