FOLATE INTAKE IN OLDER OKLAHOMA MEN:

PERCEPTIONS AND THE EFFECTS

OF AN INTERVENTION

By

TAWNI WELK HOLMES

Bachelor of Science
Oklahoma State University
Stillwater, Oklahoma
1992

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1993

Submitted to the Faculty of the
Graduate College of
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December, 2000

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Thesis Approved:

Gail Gates

Thesis Adviser

Kathryn S. Keim

Janice Hermann

C. J. Witt

Alfred Carlozzi

Dean of the Graduate College

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to my major advisor, Dr. Gail Gates for her guidance, support, and endless hours. Her mentoring inspired and motivated me to pursue this degree and my future career. I would also like to thank my other committee members Dr. Kathryn Keim, Dr. Janice Hermann, and Dr. Carolyn Wilken for their help and encouragement. I would like to thank those who provided suggestions and assistance for this study: Dr. Elizabeth Droke, Dr. Edralin Lucas, and Andrea Shotton.

I wish to express my sincere gratitude to special friends, Marisela Contreras and Kimberly Sasser, who provided friendship, support, assistance, and encouragement without which I would not have succeeded. Thanks also goes to the men and women who volunteered to participate in my research, and Oklahoma Medical Research Foundation Clinical Pharmacology Department whose assistance helped make this research possible.

I would also like to give special appreciation to my husband Brandon for his love, patience, and understanding throughout this whole process, and my parents Dick and Judy Segress, for their endless support and encouragement in all aspects of my life enabling me to focus on this one. Thanks also goes to the rest of my family and friends who continually encourage me to achieve my goals.

Finally, I would like to thank the Department of Nutritional Sciences, students, staff, and faculty for supporting me through the years, and providing a place that prepared, educated, and made me proud to be a "Cowboy."

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CHAPTER I

INTRODUCTION

The global population is aging at a rate unprecedented in history. In the U.S., the population age 65 and older is expected to double by 2030 (National Institutes of Health 2000). The average age of the U.S. population is also increasing. Life expectancy is now 75.5 years, compared with 47 years at the beginning of the century (Centers for Disease Control 2000). The nutrient needs of this population may perhaps be more varied than in any other time in the life span due to the differences in physiologic and psychological changes. Although the number of elderly living in nursing homes has increased substantially many people continue to work and lead active lives into their 70's and beyond (Schlenker 1998). Information on nutritional status and prevention of chronic disease is necessary for the aging, as life expectancy of the population continues to climb.

Elderly people are likely to have one or more chronic diseases or degenerative conditions. The most prevalent chronic condition in the elderly is cardiovascular disease. Diseases of the heart are the leading cause of death in this age group (Centers for Disease Control 2000). In addition, heart disease is the leading killer of Oklahomans, and the death rate in our state is one of the highest in the U.S. (American Heart Association 1999). Diet is one of a number of risk factors that are associated with the development of this chronic condition.

High plasma homocysteine (hcy) concentrations are considered an independent risk factor for cardiovascular disease (Eikelboom et al. 1999; Refsum et al. 1998; Verhoef et al. 1997; Verhoef et al. 1996; VonEckardstein et al. 1994; Genest et al. 1990;

Pancharuniti et al. 1994; Lussier-Cacan et al. 1996). Homocysteine, an amino acid, when elevated in the blood can have deleterious effects on endothelial or smooth muscle cells affecting the vascular wall structure (Tsai et al. 1994) and blood coagulation system (McDonald 1964). Current scientific evidence is accumulating that folate (folic acid), one of the B vitamins, is involved in the prevention of cardiovascular disease by decreasing plasma hcy concentrations (Ubbink 1997; Brattstrom et al. 1994; Malinow et al. 1997; Jacques et al. 1999b). Because of this evidence, interest in determining folate's relationship to hyperhomocysteinemia has increased.

In the United States, the Recommended Dietary Allowances (RDAs) have been established to suggest the amount of nutrient needed to meet the requirements for adequate nutrition of healthy people (Institute of Medicine 1998). The RDAs have been updated approximately every ten years since the 1940's. In 1993, the Food and Nutrition Board conducted a symposium to review the RDAs. In 1994, it was determined that with the new knowledge and technology available, the RDAs could be reviewed to provide better information about nutrients. It was at this time that groups were formed to develop the Dietary Reference Intakes (DRI) (Institute of Medicine 1998). The DRIs include not only the RDAs but also an Estimated Average Requirement (EAR) and Tolerable Upper Intake Level (TUL) for each nutrient. The EAR is defined as the amount of nutrient that is needed to meet the needs of 50% of the population. The RDA is estimated from the EAR by correcting for population variance and is defined as the average daily dietary intake level sufficient to meet the nutrient requirements of approximately 98% of the population (Bailey 1998).

Folate is the generic term used to refer to various chemical forms of this water-soluble vitamin. Folic acid is the form used in vitamin supplements and fortified foods (Suitor & Bailey 2000). In the final report it was determined that the RDA for folate is 400 μg DFE/day and the EAR is 320 μg DFE/day (Institute of Medicine 1998). DFEs or Dietary Folate Equivalents differentiate between food folate and synthetic folic acid (used in supplements and fortification) based on differences in bioavailability between the two. DFEs are used to convert all forms of dietary folate, including synthetic folic acid in fortified products, to an amount that is equivalent to food folate.

Folic acid from fortified foods and supplements is more bioavailable than naturally occurring folate in foods. The polyglutamate side chain of food folate must be cleaved before absorption can occur. This converts food folate to the monoglutamate form, which is taken up by a specific carrier in the cell membrane of the small intestine (Shane 1995). Natural food folate in the polyglutamate form is estimated to be 50-67% bioavailable (Gregory 1997; Sauberlich et al. 1987). When a synthetic folic acid (monoglutamate) is consumed as a supplement without food, it is nearly 100% bioavailable (Gregory 1997). In contrast, when folic acid is consumed with food, as is always the case with fortified cereal grain products, its absorption is reduced by a small percentage so the estimated bioavailability is about 85% (Cuskelly et al. 1996; Pfeiffer et al. 1997; Institute of Medicine 1998). It is estimated that folic acid in fortified products or taken with food is 1.7 times more bioavailable than food folate (Institute of Medicine 1998). For example, 100 μg provided as food folate (e.g. spinach) would equal 100 μg DFE, and 100 μg provided as folic acid in a serving of fortified breakfast cereal would equal 170 μg DFE (Bailey 1998). Since a typical diet would contain a combination of food folate and synthetic folic acid the DFE would be calculated as [μg food folate + (1.7 x μg synthetic folic acid)]. An analysis of a large representative sample of the U.S. population's (NHANES II) mean folate intake of 242 μg/day was far below the current RDA of 400 μg (Subar 1989). As a result of new U.S. Food and Drug Administration regulations (Food and Drug Administration 1996b), folic acid has been added to enriched cereal grains. It has been estimated that the level of folic acid fortification recommended by the FDA (140 μg per 100 g of cereal grain products) would increase folic acid intake by 70 to 120 μg per day in adults older than 50 years (Malinow et al. 1998).

The prevalence of health problems with nutritional implications (e.g. heart disease) suggests that immediate benefits could be gained through improved nutritional status (e.g. dietary folate). One way to make these improvements is through nutrition education. A major goal of nutrition education is to increase nutrition knowledge for improvement of nutritional adequacy. The U.S. Department of Health and Human Services defines nutrition education for older persons as the provision of knowledge, skills and/or assistance to older adults to enable them to eat nutritiously, thus contributing to the maintenance of optimum health (Contento 1995). The major finding from a comprehensive review of interventions is that nutrition education "works" (Contento 1995). Interventions in all population categories that used educational methods directed at behavior change as a goal were more likely to result in at least some behavioral change than interventions that focused on dissemination of information with the assumption that such information will result in changes in attitudes and behaviors. Educational strategies that enhance awareness and motivation, are personally relevant to the participant, and use self-assessment and active participation are most effective for success (Contento 1995).

As a result of the changes in fortification regulations there is a need to know if the folate intake is adequate in the diets of Oklahoma men. More information is needed about men's beliefs and influences regarding food intake, and preventive strategies that would increase the awareness of and use of foods high in folic acid. In this way, nutrition education can be addressed to more effectively increase the folate intake in this population. An intervention using nutrition education and folic acid fortified foods (cereal) can provide evidence of folic acid's effectiveness in lowering plasma homocysteine levels.

Objectives

The goal of this project, using funds from the Targeted Research Initiative Program (TRIP) of the Oklahoma Agricultural Experiment Station, was to assess the effectiveness of nutrition education and daily consumption of ready-to-eat (RTE) cereals fortified with folic acid in reducing cardiovascular risk in older Oklahoma men.

Objective 1 was to assess the factors that influenced the food consumption behaviors of men over age 60 in Oklahoma, educational methods and strategies that these men found acceptable, and their perceptions and beliefs about folate-rich foods and supplements; and determine how folate intake in older Oklahoma men compares to the recommended amounts based on dietary intake records.

Objective 2 was to investigate the effects of nutrition education and a high folate diet on homocysteine in older Oklahoma men.

Research Questions

Question I: What are older men's perceptions about influences on their consumption of folate containing foods?

Question II: What strategies do men find most acceptable for increasing their consumption of folate containing foods?

Question III: How will the men's wives perceptions about their husband's consumption compare to their husbands?

Question IV: How will the men's dietary intake of folate compare to the recommendations for this population?

Question V: What is the difference in change in dietary folate intake, serum and red blood cell (RBC) folate, and homocysteine concentrations between the experimental group and the control group participants?

Question VI: What is the effect of the treatment on serum and RBC folate and hcy concentration 3 months after the intervention ended?

Assumptions

-The nutrient databases used provided an accurate estimate of the amount of folate in foods.

-The procedures used to determine biochemical measures provided an accurate estimate of the amount of biomarkers in the blood.

-The sample reflected the actual amounts of folate intake in older men from Oklahoma.

-The dietary intake that was recorded accurately represented usual food intake.

Limitations

-Memory may be a limitation for subjects when recording food intake.

-Keeping the dietary record can modify subjects food intake.

-The accuracy of the dietary assessment methods depends on the respondent's perception of portion sizes.

-Reported influences may not be true influences on food choice based on subjects' actions.

-Inductive analysis introduces chance for researcher bias.

-Subjects were aware they were being tape recorded introducing the chance for reactive measurement.

-Use of a convenience sample limits the generalizability to a broader population.

-Intervention was not placebo controlled or blinded to either the subjects or researcher.

-The control group may have learned what the treatment group was doing therefore changed their behavior.

-Subjects were recruited from academic and former research participant populations in addition to the general community.

Definitions of Unusual Terms

*Adequate Intake (*AI): average observed or experimentally derived intake by a defined population or subgroup that appears to sustain a defined nutritional state, such as normal circulating nutrient values, growth, or other functional indicators of health.

Atherogenesis: formation of atheromatous lesions in arterial walls.

Bioavailability: the degree to which a drug or other substance becomes available to the target tissue after administration.

Coagulability: the capability of forming or of being formed into clots.

Cobalamin: collective term given to the many forms in which vitamin B-12 may appear in animal tissues, all of which contain cobalt as an integral part of the molecule.

Core foods: foods that are consumed more than three times a week.

Cyancobalamin: the commercially available form of vitamin B-12.

Cysteine: a sulphur-containing amino acid produced by enzymatic or hydrolysis of proteins.

Cytotoxicity: specific toxic action upon cells of special organs.

Dietary Reference Intake (DRI): a set of at least four nutrient-based reference values that can be used for planning purposes. These reference values are RDA, EAR, AI, and UL.

Estimated Average Requirement (EAR): the intake that meets the estimated nutrient need of 50 percent of the individuals in that group.

Folate: water soluble B vitamin. Folates contain from one to six glutamate molecules joined in a peptide linkage to the γ-carboxyl of glutamate. Its main function is related to one-carbon metabolism.

Folic acid: synthetic form of folate composed of a *p*-aminobenzoic acid molecule linked at one end to a pteridine ring and at the other end to one glutamic acid molecule.

Food fortification: process by which vitamins and/or minerals have been added to food products in excess of what was originally found in the product.

Food frequency questionnaire: a questionnaire listing foods on which individuals indicate how often they consume each listed item during certain time intervals (daily, weekly, or monthly). Standard portion sizes are used on the questionnaire.

Food record: method by which the subject records kinds and amounts of food and beverages eaten for a specific number of days.

Good source of folate: contains a substantial amount of folate in relation to its calorie content and contributes at least 10 percent of the RDA (400 μg/day) for folate in a selected serving size.

Homocysteine: a demethylated product of methionine; a homolog of cysteine. Present in cells as an intermediate metabolite; capable of conversion to methionine by direct transfer of a methyl group from compounds such as choline and betaine.

Hyperhomocysteinemia: increased blood levels of homocysteine.

Methionine: an essential amino acid; participates in methylation reactions; hence it is important in protein and fat metabolism.

Multiple pass 24-hour food recall: a dietary recall method that consists of three passes. In the first pass, a trained interviewer asks the subject to remember all foods and beverages consumed during the previous 24 hours. Second, the interviewer verifies and clarifies all the foods and beverages with specific serving size and reminds the subject about any other foods that could be forgotten (snacks, candies, cookies). Third, the interviewer asks details about the foods (brand names, way of preparation, items added to foods, etc.), if anything is added to specific foods such as sugar on cereal or coffee, milk on cereal, cream in coffee, butter on bread or vegetables) and review all the 24-hour recall.

Peripheral foods: foods that are consumed once a month or less.

Peroxidation: formation of peroxides as a result of the action of oxygen on polyunsaturated fatty acids. Some vitamins can reduce lipid peroxidation in cells by interrupting free radical reactions that otherwise can cause membrane damage.

Radioimmunoassay: a highly sensitive and specific assay method that uses the competition between radiolabeled and unlabeled substances in an antigen-antibody reaction to determine the concentration of the unlabeled substance, which may be an antibody or a substance against which specific antibodies can be produced.

Recommended Dietary Allowance (RDA): the intake that meets the nutrient need for almost all (97 to 98 percent) healthy individuals in a group.

Secondary core: foods that are consumed between two times a week and two times a month.

Stenosis: narrowing or contraction of a body passage or opening as in aortic; narrowing of the aortic orifice of the heart or of the aorta itself.

Thrombotic: clot formation.

Tolerable Upper Intake Level (UL): the maximum intake by an individual that is unlikely to pose risks of adverse health effects in almost all (97 to 98 percent) healthy individuals.

Vasoactive: exerting an effect, contraction or expansion, of blood vessels.

Vasodilation: increase in the capacity of blood vessels, leading to an increase in blood supply.

Abbreviations

AI	Adequate Intake
CAD	Coronary Artery Disease
CSFII	Continuing Survey of Food Intake by Individuals
CVD	Cardiovascular disease
DFE	Dietary Folate Equivalent
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
hcy	Homocysteine
HDL	High Density Lipoprotein
HPLC	High performance liquid chromatography
LDL	Low Density Lipoprotein
NHANES	National Health and Nutrition Examination Surveys
RBC	Red blood cell
RDA	Recommended Dietary Allowance
RTE	Ready to Eat
TUL	Tolerable Upper Limit

CHAPTER II

LITERATURE REVIEW

In Americans over the age of 65, heart and cerebrovascular diseases cause 360 per 1000 deaths in women and 414 per 1000 deaths in men (U.S. Bureau of the Census 1989). Over half of all myocardial infarctions occur in this age group, and 85% of those who die of CHD are age 65 or older (American Heart Association 1999).

Homocysteine and Cardiovascular Disease

The high occurrence of premature vascular disease in people with hyperhomocysteinemia led to the formulation of the hcy theory of arteriosclerosis as early as 1969 (McCully 1969). Elevated plasma homocysteine levels have been associated with increased risks of coronary, cerebral, and peripheral vascular diseases (Clark et al. 1991; Ueland & Refsum 1989). A recent meta-analysis suggested that about 10% of cardiovascular related deaths are the result of elevated plasma hcy concentrations (Boushey et al. 1995). Considerable research has shown that a high hcy level in the blood is an independent risk factor for coronary artery disease (CAD) (Verhoef et al. 1997, 1996; VonEckardstein et al. 1994; Genest et al. 1990; Pancharuniti et al. 1994; Lussier-Cacan et al. 1996). A 5 μmol/L increase in hcy is associated with ~ 70% increase in relative risk of cardiovascular disease in adults (Boushey et al. 1995; Graham et al. 1997; Ueland et al. 1992). One prospective study, Physicians Health Study, showed hcy was slightly but significantly higher for patients with CAD than controls (Stampfer et al.

1992). Women and men with CAD have similar hcy levels (Dalery et al. 1995; Aronow et al. 1997). A study involving the elderly Framingham Study population demonstrated a twofold increase in all-cause cardiovascular disease mortality among those in the highest quartile of hcy compared with those in the lowest hcy quartile (Bostom et al. 1999).

Several studies found that plasma hcy levels increased with age (Nygard et al. 1998; 1995; Tonstad 1997). NHANES II data showed that total hcy concentrations increased across age groups and were higher in males than females (Jacques 1999a). This is consistent with observations from other large samples of adult men and women (Selhub et al. 1993; Nygard et al. 1995). Hcy is thought to contribute to coronary artery disease (CAD) by promoting oxidative damage to LDLs (low density lipoproteins) (Hirano et al. 1994; Blom et al. 1995; Krumdieck & Prince 2000), proliferation of smooth muscle cells (Tsai et al. 1994; Dalton et al. 1997), cytotoxicity (Stamler et al. 1993; Van der Berg et al. 1995; Dudman et al. 1991), vascular endothelium growth (Celermajer 1993; Levine et al. 1995), platelet activation and enhanced coagulability (McDonald 1964), or thrombosis (Stampfer et al. 1992; Brattstrom et al. 1990; Duell & Malinow 1997; Koehler et al. 1997; D'Angelo & Selhub 1997). None are mutually exclusive and, indeed, all may be involved simultaneously (Kurmdieck & Prince 2000). The occurrence of hyperhomocysteinemia indicates that hcy metabolism has been disrupted and the cell exports excess hcy that has accumulated in the cell. This prevents toxicity to the cell but leaves vascular tissue exposed to the possibly deleterious effects of excess hcy (Selhub 1999). Years of exposure to moderately elevated hcy levels may contribute to hcy's spontaneous chemical reaction with many biologically important proteins, resulting in loss of function of the derivatized molecules (Krumdieck & Prince 2000). In addition, hcy modifies the release or activity of small molecules of endothelial origin, primarily nitric oxide, which have pronounced vasoactive effects in response to blood flow (Bellamy & McDowell 1997; McDowell & Lang 2000; Stamm & Reynolds 1999). This altered vasodilation, not constriction, in the blood vessels may increase blood pressure and lead to physical damage of the endothelial cells. This damage may then provide an opportunity for other hcy related mechanisms (smooth muscle cell proliferation, impaired flow mediated vasodilation, lipid peroxidation etc.) to further damage the endothelium. This damage manifests itself as vascular disease (Stamm & Reynolds 1999).

Homocysteine and Folate

Experimental studies in animals and humans provide compelling evidence that vitamin B-6, vitamin B-12, and folate play an important role in transulferation and remethylation in hcy metabolism (Shimakawa et al. 1997; Herzlich et al. 1996; Ubbink et al. 1993a, 1996; Ueland et al. 1992; Brattstrom et al. 1988).

Of vitamins B-6, B-12, and folic acid, Ubbink (1997) indicated that the latter is the most powerful hcy-lowering agent, as determined from a summary of intervention trials to lower circulating hcy. Plasma hcy concentrations increase when inadequate quantities of folates are available to donate the methyl group that is required to convert hcy to methionine (Institute of Medicine 1998). Selhub (1999) suggested that folic acid deficiency is associated with an increase in plasma lipid peroxidation and enhanced susceptibility of erythrocytes to free radicals. Subjects in observational studies with low folate levels in diet or blood had higher hcy levels (Lussier-Cacan et al. 1996; Dalery et al. 1995; Tonstad 1997; Schwartz et al. 1997; Shimakawa et al. 1997; Ubbink et al.

1993b, 1997; Kang et al. 1987; Selhub et al. 1995, 1993). For example, Kang et al. (1987) showed that at least 84% of individuals with subnormal serum folate concentrations also had hyperhomocysteinemia. Many elderly subjects in the Framingham study with "normal" serum vitamin concentrations had increased hcy and methyl malonic acid levels indicating a metabolic deficiency in cobalamin or folate (Lindenbaum et al. 1994; Naurath et al. 1995). Joosten and coworkers (1993) demonstrated that 14.4% of the variation in plasma hcy concentrations in elderly subjects was explained by plasma folate concentrations. Hence, folic acid offers the prospect of an effective, safe and economical therapy for mild hyperhomocysteinemia (McDowell & Lang 2000).

Homocysteine and Folate and Cardiovascular Disease

The relationship between folate and hcy links folate status to CAD. Men and women with premature CAD who had low serum or red cell folate levels had impaired hcy metabolism, and when treated daily with folic acid and vitamin B-6, normalization of hcy occurred (Dudman et al. 1993). Studies on elderly individuals by Selhub and coworkers (1993) and Aronow et al. (1997) found that plasma concentrations of folate and B-6 and the level of folate intake were inversely associated with risk of carotid artery stenosis prevalence and that high hcy was greatest among subjects with low folate status. Other researchers have also found significant negative correlations between plasma homocysteine and folate, and increased risk of CAD with the lowest folate concentrations (Pancharuniti et al. 1994; Hopkins et al. 1995; Loehrer et al. 1996; Voutilainen et al. 2000).

Several intervention trials results suggest that B vitamins have a protective effect against CVD (Ueland et al. 2000). A combination of folic acid, vitamin B-6, and vitamin B-12 was reported to halt the rate of progression of carotid artery plaque area in 38 subjects with hcy concentrations of > 14 μmol/L (Peterson & Spence 1998). In another study, 70 patients with post-methionine load hyperhomocysteinemia were given a combination of folate and vitamin B-6, and they had the same incidence rate of new cardiovascular events as did 162 patients with normal hcy concentrations (de Jong et al. 1999). A recent placebo-controlled trial of 158 healthy siblings of patients with premature atherothrombotic disease who used a supplement with a combination of folic acid and vitamin B-6 showed a reduced occurrence of abnormal exercise electrocardiogram tests and reduced fasting and post-methionine load hcy concentrations (Vermeulen et al. 2000). These preliminary findings are the first indications that hcy lowering therapy may protect against CVD (Vermeulen et al. 2000; van der Griend et al. 1999).

Folate Status

The prevalence of low folate concentrations varies from 0-30% depending on the elderly population under study, the cutoff value used, and the method of biochemical assessment (Weggemans et al. 1997). Folate status may be evaluated biochemically by serum folate (a reflection of recent intake), erythrocyte (RBC) folate (an indication of long-term folate status), or plasma hcy levels (an indication of tissue folate coenzyme activity) (Bailey 1990; O'Keefe et al. 1995; Fanelli-Kuczmarski et al. 1990; Lindenbaum & Allen 1995). In the Framingham cohort, 50% of the subjects had low plasma folate concentrations. In the NHANES III population, white men and women had significantly higher adjusted serum and RBC folate concentrations than did African-American and Mexican-Americans (Ford & Bowman 1999). Age, dietary folate consumption, and cereal consumption showed the largest correlation with serum and RBC folate, and adult men and women who consumed ≥ 150 fruits and vegetables per month had higher concentrations (Ford & Bowman 1999). Low dietary intake is the most common cause of compromised folate status (Sauberlich 1990).

Prior to fortification most Americans consumed less folate than 400 μg which is the current RDA (Institute of Medicine 1998) and the amount that is recommended to reduce the risk of heart disease (Selhub et al. 1993; Subar et al. 1989). According to 1989-91 CSFII data, women aged 60 and over consumed 240 μg and men consumed 296 μg of folate (Tippet et al. 1995). Elderly women in the 1988-91 NHANES III consumed 193 μg and men consumed 242 μg folate per day (Alaimo et al. 1994). Albertson & Marquart (1999) found that in a large national sample of 4000 households from the Market Research Corporation of America Menu Census surveys, older males (+65) reported the highest daily folate intake (274 μg per day). Mean folate intakes for males over 60 in the 1994-1996 CSFII were 279 μg/ day, and only 17.5% of men and women over 60 consumed at least the new recommendation of 400 μg folate/day (Holmes et al. 1999).

deBree et al. (1997) concluded that a dietary folate intake of at least 350 μg is desired to prevent an increase in plasma hcy levels based on reports that hcy concentrations do not reach a reduced plateau until folate intakes approach 400 μg/day (Verhoef et al. 1996; Stampfer et al. 1992; Selhub et al. 1993; Jacob et al. 1994; Davis et al. 1994) and serum folate reaches about 15 nmol/L (Lewis et al. 1992; Selhub et al. 1993).

Data from folate status assessment and epidemiological studies support an estimated average requirement (EAR) for men and women 51 years and older of 320 μg of dietary folate equivalents (DFE) (Institute of Medicine 1998). Dietary folate equivalents are equal to 1 μg food folate, 0.6 μg folic acid from fortified food or supplements consumed with food, or 0.5 μg of synthetic folic acid (Institute of Medicine 1998). About 74% of the men and women sampled in the 1994-1996 CSFII consumed less than the EAR from food sources (Holmes et al. 1999).

Strategies to Improve Folate Status

Three methods could be used to increase folate intake: promote use of folic acid supplements; encourage consumption of naturally folate-rich foods such as liver, legumes and dark green vegetables; or fortify foods with folic acid.

Supplements

Research on supplementation with folic acid has focused on reducing plasma homocysteine levels. Several studies have shown that subjects who take supplemental folic acid lower their plasma homocysteine levels by 30 - 60% (Ubbink 1993b, 1997; 1994; Chauveau 1996; Rasmussen 1996; Landgren et al. 1995; Naurath 1995; Franken 1994; Van der Berg et al. 1994; Arnadottir et al. 1993; Brattstrom 1988; Brattstrom et al. 1990). Another study using a sample of 640 middle-aged subjects from the Atherosclerosis Risk in Communities (ARIC) study found a negative relationship between the amount of folic acid supplement consumed and homocysteine levels (Shimakawa et al. 1997). Brattstrom et al. (1988; 1990) found that 5 mg folic acid supplementation normalized plasma homocysteine concentrations in hyperhomocysteinemic men and women with vascular disease and markedly reduced normal plasma homocysteine concentrations in non-folate deficient healthy subjects. Ubbink (1997; 1994) found that a daily dose of 650 μg supplemental folic acid normalized elevated plasma homocysteine levels, however, folate supplementation was ineffective in reducing homocysteine concentration in patients with B-12 deficiency. Brouwer et al. (1999) concluded that supplemental doses of folic acid as low as 250 μg/day, in addition to usual dietary intake, significantly decreased hcy in healthy young women (N=144). Brouwer et al. (1999) also showed a significant increase in plasma and RBC folate in 66 men and women aged 18-45 y, and a decrease in plasma hcy after a 4 week intervention in both a dietary folate group consuming vegetables and citrus fruit (560 μg/day) and in a group receiving 500 μg/d folic acid as a supplement compared to a control group. In a study of 20 blood donors with upper normal hcy values (> 13 μmol/L) who received folic acid (5 mg orally) plasma hcy was lowered by 25% and flow mediated dilation was enhanced significantly compared to placebo (Bellamy et al. 1999). Other findings suggest that regular intake of common multivitamins containing 200 to 400 μg folic acid effectively reduced plasma hcy concentrations (Ward et al. 1997; O'Keefe et al. 1995; Brattstrom et al. 1994). In a group of 101 men aged 30-49 years with mildly elevated hcy, supplementation with B vitamins (1mg folic acid, 7.2 mg pyridoxine, .02 mg cyanobalamin) with or without antioxidants for 8 weeks reduced hcy by 27.9% (Woodside et al. 1998).

Food Sources

For men to receive all of the needed folate from food sources, they need to consume at least the minimum number of servings from each food group as recommended by the Food Guide Pyramid (U.S. Department of Agriculture 1992; Food and Drug Administration 1996b) and select good sources of folates within each food group. In the 1994-1996 CSFII the major food sources of folate for 2,734 men and women over 60 were RTE cereal, yeast breads and rolls, citrus fruit and juices, vegetables, and legumes (Holmes et al. 1999). Two of the nation's Year 2010 health goals (U.S. Department of Health and Human Services 1991) are to increase fruit and vegetable intake to five or more daily servings and grains to six or more daily servings with a least three being whole grains to help decrease the risk of chronic diseases such as cardiovascular diseases and cancer. Two of the current dietary guidelines suggest choosing a variety of fruits and vegetables daily, and choosing a variety of grains daily, especially whole grains (U.S. Department of Agriculture 2000).

Only 32% of American adults met the minimum intake goal for fruit and vegetable servings in the 1989 to 1991 CSFII (Krebs-Smith et al. 1995a) and most adults needed to almost double their fruit and vegetable intake (Patterson et al. 1990). Cleveland et al. (1997) observed that women 60 years and older consumed 2.9 vegetable and 1.6 fruit servings per day and men 60 years and over consumed 3.6 vegetable and 1.9 fruit servings per day using the 1989 to 1991 CSFII data. Serdula et al. (1995) reported that only 24% of adults over the age of 65 years ate the recommended 5 or more servings per day in the 1990 Behavioral Risk Factor Surveillance System (BRFSS) data. The little data available on the specific vegetables and fruit consumed indicates that many are not good sources of folate (Keim et al. 1997; Krebs-Smith et al. 1995c). In the CSFII 1989 to 1991 study, french fries accounted for 11% of the vegetables or 8% of the total vegetables and fruits consumed (Krebs-Smith et al. 1995a).

Although the consumption of grain products (in grams) has increased by 40 percent since the late 1970's, whole grain servings still fall short of the recommendations (USDA 1999). The average servings of grains consumed in the 1994-96 CSFII was 6.7 per day, which is near the bottom of the recommended range of 6-11, and when recommended servings are based on an individual's recommended energy intake only 4 out of 10 met the recommendation for grains (USDA 1999). At the present time little is known regarding the grain intake of older Americans. Cleveland et al. (1997) reported that women 60 years and older consumed 4.6 grain servings per day and men 60 years and over consumed 6.1 grain servings per day using the 1989 to 1991 CSFII data. Albertson & Marquat (1999) reported that grain products were the most significant source of dietary folate among all age groups contributing greater than 30% of daily folate intake.

Tucker et al. (1996b) found that plasma homocysteine and folate were related to consumption of high folate foods (cereal, fruits and vegetables) in elderly subjects. Nygard et al. (1998; 1995) found that folate intake and frequency of consumption of fruits and vegetables were negatively correlated with plasma homocysteine levels in healthy adults. Another study conducted with 310 healthy Norwegian men found that the consumption of foods that are important folate sources in the diet were independent determinants of a low plasma homocysteine level (Oshaug et al. 1998). Boushey et al. (1995) estimated that increasing intake of fruits and vegetables by 2 or more servings a day would increase folate intake by 100 μg and result in an average decrease in homocysteine of about 2 μmol/L.

Other research using fruits and vegetables has shown positive effects of folate intake on hcy. One recent study found that daily consumption of orange juice containing about 270 μg folate reduced lipoprotein peroxidation, one of the hypothesized mechanisms of action of homocysteine (Harats et al. 1998). Another study that provided 20 ounces of orange juice containing 150 μg folate increased daily folate intake in the diet to 421 μg/day (McGill & Lawrence 1998). Daily orange juice consumption increased plasma folate and decreased plasma hcy concentrations significantly at 30 days (McGill & Lawrence 1998). A study of 66 healthy men and women (18-45 y) used 3 treatment groups: dietary folate group receiving a diet high in vegetables and citrus fruit (~ 560 μg folate) plus placebo; folic acid group receiving a low folate diet (~ 210 μg) plus 500 μg folic acid and placebo on alternate days; and placebo group receiving the same low folate diet plus a placebo (Brouwer et al. 1999). After 4 weeks in both the dietary folate and folic acid groups subjects showed an increase in folate status and a decrease in hcy indicating that a diet high in fruits and vegetables can have a significant impact on hcy. Similarly, Broekmans and colleagues (2000) demonstrated that a group of 47 male and female adults eating a high fruit and vegetable diet (500 g. daily) containing approximately 228 μg folate had 11% lower hcy and 15% higher plasma folate concentrations after 4 weeks than those on a low fruit and vegetable diet (100 g. daily) containing 131 μg folate. Appel et al. (2000) found that in a group of 113 middle-aged adults, a controlled diet high in fruits, vegetables and low-fat dairy products, and reduced in saturated and total fat (418 μg folate) increased serum folate and reduced hcy more than control (168 μg folate) or intermediate (314 ug folate) diets.

Fortification

In 1998, the FDA began requiring that all producers of enriched fortified cereal grain add folic acid to their products (FDA 1996b). The level of fortification recommended by the FDA (140 μg/100 g) was estimated to increase folic acid intake by 70 to 120 μg in adults over 50 (Malinow et al. 1998). Three studies concerning the potential benefits of this level of fortification estimated that fortification would increase adult folate intake by 28% and allow about 50% of the population to consume at least 400 μg folate (Tucker et al. 1996a; Romano et al. 1995; Koehler et al. 1997). Anderson (1999) estimated that if the minimum 80 μg of folic acid in grain products was added to the average dietary folate intake on a cereal eating day males could consume 446 μg per day. This level of folic acid intake may be associated with reduced risk for coronary heart disease (Rimm et al. 1998). In a population of middle-aged and older adults from the Framingham Offspring Study cohort, the fortification of enriched grain products with folic acid was associated with a substantial improvement in folate status (Jacques 1999). It was calculated that fortification of food with folic acid would reduce the annual mortality of the U.S. population by 50,000 (Boushey et al. 1995).

When looking at data for women aged 15 to 50 years in the General Mills Dietary Intake Study, Albertson et al. (1997) concluded that regular consumption of fortified ready-to-eat cereal positively affects mean daily folate intake and folate density of the diet. More cereal eaters met the RDA for folate than did non-cereal eaters (Albertson et al. 1997, Albertson & Marquart 1999). Albertson & Marquart (1999) found that adults in 3 large national samples of men and women 19 and older who regularly included RTE cereals in their diets had significantly higher mean dietary folate intakes compared with adults who did not consume RTE cereal. The older age groups tended to have a greater proportion of cereal eaters than the younger groups. Before fortification the highest folate intake level reported was 301 μg for male cereal eaters 65+ years old. Several groups of cereal eaters on cereal-eating days demonstrated that it is possible to approach the daily value of 400 μg by dietary means if fortified RTE cereal is included in the diet (Albertson & Marquat 1999).

Pfeiffer et al. (1997) provided evidence of effective absorption of folic acid in fortified grain products using a single dose dual labeled isotope protocol. Consuming folic acid after a light breakfast meal led to only a small reduction in absorption relative to the folic acid taken without food. They concluded that folic acid added during fortification is highly available to improve the folate status of the population. When folic acid fortified foods were removed from the diets of 21 adult women for 12 weeks, folic acid intake decreased 78 $\pm$ 56 μg/day, and red blood cell folate concentrations were significantly reduced (Cuskelly et al. 1999).

There is research showing the effect of RTE cereal consumption on plasma hcy concentration. Ninety-four healthy adults, who were not consuming vitamin supplements or breakfast cereals prior to fortification, and were therefore consuming negligible amounts of fortified or supplemental folic acid were asked to consume either fortified cereals containing 200 μg folic acid per serving or an unfortified cereal daily for 24 weeks (Schorah et al. 1998). Fasting blood samples were taken immediately before the cereal was issued and repeated at weeks 4, 8, and 24 weeks and analyzed for plasma hcy, vitamin B-12, cysteine, and serum and red blood cell folate. There were no significant changes in any measured parameter in those eating the unfortified cereal. There were no changes in vitamin B-12 or cysteine for either group. Consuming folic acid fortified cereal (666 μg/100 g) for 24 weeks led to significant increases in serum folate at 4 weeks, 8 weeks and 24 weeks, and a decrease in plasma homocysteine at 8 and 24 weeks. The decrease in hcy was primarily seen in those who initially had the highest plasma hcy or lowest serum folate. Red cell folate did not change significantly until 24 weeks. These results show that consuming an extra 200 μg of folic acid, delivered through a fortified breakfast cereal led to an increase (66%) in serum folate that preceded an increase in red cell folate. The increase in the blood folate was associated with a small (10%) but significant decrease in hcy

Malinow et al. (1998) also tested the effects of fortified breakfast cereals on plasma hcy and folate in 75 men and women with coronary artery disease. Using breakfast cereals with 3 levels; 127 μg, 499 μg, and 665 μg folic acid daily for 5 weeks compared to placebo in a crossover design, plasma folic acid increased and plasma hcy decreased proportionately with the folic acid content of the cereal. Plasma folate increased 30.8, 64.8, and 105.7%, respectively. Plasma hcy decreased 3.7, 11, and 14%, respectively. Fortification of breakfast cereals with folic acid levels approximating the increased daily intake specified by the FDA's enrichment policy (127 μg/30 g cereal) did not have a significant effect on hcy but had a moderate effect on plasma folate. However, levels four to five times as high lowered plasma hcy and increased plasma folate levels significantly.

In 491 adults with established risk factors for cardiovascular disease, a fortified prepared meal plan (PMP) which contained 2 times the RDA for folate was eaten for 10 weeks. This resulted in increased intakes of folic acid and increased serum concentrations of folate and vitamin B-12. Mean folate intakes for those on the PMP (601 $\pm$ 143 μg) at week 10 compared with participants on a self-selected diet (SSD) (270 $\pm$ 107 μg) were higher. With the PMP, serum total hcy fell between weeks 0 and 10; no change was seen with the SSD. The change in serum hcy was associated with the increased intakes of folate, vitamins B-12 and B-6 and with increased serum and red blood cell folate and serum vitamin B-12 concentrations (Chait et al. 1999).

Framework to Improve Folate Intake of Older Men

According to Malinow (1994), the ideal approach to decreasing plasma homocysteine is to increase the consumption of folate-rich foods. Only one small study has investigated whether nutrition education to increase folate rich foods will lower homocysteine levels. Ubbink et al. (1993b) found that nutrition education to increase folate intake was not as effective in lowering homocysteine as supplements containing 1 mg folic acid (and .05 mg cyanobalamin, 12.2 mg pyridoxine) in 22 men ages 18-65 years old with elevated homocysteine levels. All the men were given the supplement initially for 6 weeks, thereafter it was discontinued for 18 weeks at which time no dietary advice was given. The subjects were then split into two groups based on whether or not their hcy was again elevated. Group A (hcy in reference range) were given dietary information on folate-rich foods, and group B (those with elevated hcy) were given the supplement again for 6 weeks, discontinued, and then supplied with the same dietary information to increase folate intake. For the dietary advice the men were instructed to consume five portions per day from food products on a list that contained 16-36 μg folate per serving (i.e. egg), one portion per day from a list of foods containing 42–68 μg folate (i.e. orange) and one portion per week from a list of foods containing 130–385 μg folate (i.e. spinach), totaling approximately 200 μg folate per day. Actual folate intake from food was not reported. Initial vitamin supplementation reduced hcy 54.7%, however group B participants required a second 6 week period of vitamin therapy to normalize hcy again after a period without supplementation. This same group when given dietary advice failed to maintain normal plasma hcy although both groups had increased plasma folate, PLP, and cobalamin levels (Ubbink et al. 1993b). This may indicate that some individuals may require vitamin supplement therapy, however, clearly the amount of folate intake from food was not as high as that supplied from the supplement in this study. Therefore this study was not a fair comparison of the effectiveness of nutrition education versus supplement.

Nutrition education interventions must be targeted toward a specific group and built around a theory to change behavior (Contento et al. 1988; Murphy 1997). Nutrition education programs in the past have had minimal effect, due at least in part to limited use of a behavior change theory in planning the nutrition education intervention (Balch 1995; Lytle 1995). A behavior change theory that has been studied in several population groups is social cognitive (Bandura 1986; Reynolds 1997; Cusatis & Shannon 1996). When learning about the target audience in order to plan an intervention, the inquiry needs to be based on the behavior change theory that will be used to develop the nutrition education intervention (Doner 1997).

The nutrition education intervention was planned using the systematic process, Intervention Mapping (IM) (Cullen et al. 1998). The social cognitive (social learning) and an anthropological theory of food patterning (Bandura 1986; Jerome 1976; Bennett 1942) provided the framework for choosing the intervention methods in this study.

Intervention Mapping

Intervention Mapping (IM) provides a structure for the application of theory and program planning that is based on an understanding of the decision about intervention methods and strategies. The five steps of IM include writing program objectives, selecting theoretical methods (i.e. SCT), developing practical strategies to produce the desired objectives, planning for adoption and implementation, and creating evaluation plans and instruments. The process begins with a needs assessment of a health problem, which for the SCT, includes identification of the behaviors and environmental conditions associated with the problem and their determinants. *External determinants* are defined as factors outside of the individual that can directly influence the health behavior or environmental condition. For example, in this case the external determinants considered were the role of the spouse in purchasing and preparing target foods, and the availability and accessibility of the food (e.g. providing cereal). *Personal determinants*, those factors within the individual under their direct control, were behavioral capability (knowledge and skills), self-efficacy, and self-regulatory behavior (self-control). Intervention methods for influencing these determinants are then chosen and translated into practical and fun strategies.

Social Cognitive Theory

The Social Cognitive Theory (SCT) was first introduced by Bandura and addresses both the psychosocial dynamics affecting health related behavior and the strategies of promoting behavioral change (Baranowski et al. 1997). According to the Social Cognitive Theory, personal attributes such as attitudes and perceptions, environmental influences such as availability of foods, and the person's behaviors all interact to determine a new behavior (Bandura 1986). The simultaneous and continued interaction of those factors is labeled as *reciprocal determinism.* Personal characteristics of an individual include instincts, drives, traits, and other motivational factors within an individual. The environment refers to the physical, social, and institutional factors affecting behavior. Behavior, the final domain of reciprocal determinism, is the action taken by the individual. The three domains interact and a change in one affects the others. The concept of reciprocal determinism guides the formation of the other constructs that are important in understanding health-related behavior (Baranowski et al. 1997).

Self-efficacy is a key construct of the SCT that refers to the person's confidence in overcoming difficulties to performing a particular behavior or activity (AbuSabha & Achterberg 1997). If a person feels confident about their knowledge and their ability to make appropriate change, they will be more likely to make and maintain dietary modifications. An intervention has the potential to be more effective if it helps to identify anxieties and offer solutions for dealing with them.

The *behavioral capacity* construct is the knowledge and skill necessary for a particular action (Baranowski et al. 1997). An individual must be aware of the appropriate behavior and how to perform it. For example, providing information on adequate folate intake should include sources of folate and methods to incorporate those sources into the diet.

Self-control, another of the major concepts of SCT is the personal regulation of goal-directed behavior. One of the goals of health education is to bring the performance of health behavior under the control of the individual. A sub-function of this construct is self-monitoring (Glanz & Rimer 1997).

Environment, which includes providing opportunities and social support, is also part of this theory (Reynolds 1997; Strecher et al. 1986). Providing opportunities such as making foods available can provide cues about acceptable types of behavior. Examples of the social environment include family members, friends, and peers at work. Social support encompasses those social networks that can influence the thoughts and behaviors of the receiver (Glanz & Rimer 1997). Social ties, especially with spouses, can play an important social control role for the older person in affecting routine health behaviors.

The literature on social support and social integration yields convincing evidence that involvement in social relationships enhances individual well-being, both physical and psychological (Umberson 1987; Burke et al. 1999). The Alameda study (Berkman & Breslow 1983), one of the first large-scale studies of preventive health behavior, showed that family relationships were particularly instrumental in protecting individual health. Health of the individual and family are intimately and complexly linked; while individuals have their own unique experiences, individual experiences are profoundly influenced by family relationships and family dynamics (Padula 1996). These relationships are seen as providing the individual with a sense of meaning and purpose as well as a set of important obligations. In turn, the sense of meaning and obligation affect the individual's motivations and lifestyle (Durkheim 1951). Among the relationships examined, the marital relationship is one of the most consistently important categories of social contact in predicting mortality (Berkman & Breslow 1983). In particular, the aging couple represents an important family unit for study. Long-term married couples are believed to rely on each other in health-related matters and in making health decisions. Social networks tend to diminish with age, and married couples become increasingly interdependent over time. Elderly couples are hypothesized to have much to gain in assisting one another to maintain functional health (Padula 1996).

One investigation of 412 married couples $\geq$ 50 years of age by Depner & Ingersoll-Dayton (1985) examined social support by focusing on three forms of support: emotional support, respect, and health-related support (Kahn 1979). Emotional support encompasses the degree to which the spouse comforts, advises and supports the other. The literature on sex differences suggests that husbands receive more emotional support from their spouses than wives do (Stinnett et al. 1970), and men generally use their wives as confidants whereas women frequently turn to other family members for emotional support (Kohen 1983). Respect can be explained by two feelings; deference, the sense of being accorded higher status (e.g. a feeling that others look up to one), and regard, the perception that one's thoughts, feelings, and wishes are being considered by the other. One can assume that, with age, one becomes increasingly dependent upon the spouse as a source of both forms of respect (Depner & Ingersoll-Dayton 1985). In relation to health support, women have traditionally been responsible for health care in the family (Troll 1982) and men were more likely than women to rely exclusively on the spouse as the sole source of health care and consultation (Depner & Verbrugge 1980).

One study that evaluated these types of support used data from the Social Networks in Adult Life survey (Depner & Verbrugge 1980). They found, in contrast to the literature, that older respondents provided their spouses less of each kind of support than younger respondents, even though there was an increased need for support in later life. In addition, as expected, women perceived less social support within marriage than men. Women were less likely to report that they received emotional support, respect, or health support from men, and women were less likely to perceive that they provided their spouses with the three types of support. This may indicate that women may not "count" emotional support that is within the normal bounds of traditional roles, or they may use stricter criteria in assessing the presence of social support.

Umberson (1987) proposed a conceptual model of social control as a dimension of the social environment to illustrate how marital roles affect health behaviors. She proposed that family relationships involve elements of meaning and control that contribute to social control; that social control is a mechanism by which social relationships affect health behaviors; and that health behaviors affect health outcomes. Social control can influence behavior either indirectly or directly. Indirectly, individuals may perceive norms or responsibility toward a spouse, and as a result may control their own behaviors. Directly, spouses may tell or remind an individual to engage in a health behavior or to avoid taking risks. For example, family members may regulate health behaviors such as controlling the type and amount of food available to the individual if the person has a nutrition related health problem. Using data from a national survey (n=1,826) of respondents in the U.S., the impact of marital ties on health behaviors was evaluated (Umberson 1987). Findings suggested that being married was associated with the lowest rates of negative health behaviors such as drinking, substance use/abuse, orderly lifestyle (lack of), and risk taking. The unmarried state was more detrimental to men's health behavior than to women's, for example, divorced men were more likely to have a drinking problem than unmarried women.

To further investigate the hypothesized model Umberson (1992) attempted to determine why and how gender and marital status affect mortality and health behavior. Women generally possess more knowledge about health-related issues than men, are more likely to monitor their own health status, and are less likely to engage in a number of risky health behaviors such as excessive alcohol (Nathanson 1977). Traditional gender role socialization not only encourages females to guard their own health and safety, but to be nurturing and attentive to the needs of others. If women assume these nurturing roles within marriage, then they are likely to monitor their spouses' health and health behaviors and to take some responsibility for their spouses' health. There is some evidence that women are more likely than men to assume responsibility for the health of their spouse. Women were more likely to organize living habits, such as preparing food and monitoring health supplies and prescriptions, that can have an impact on the health of household members (Depner & Ingersoll-Dayton 1985).

Using data from a national survey conducted in 1986 (n=3617) and 1989 (n=2867) with adults aged 24 and older in the U.S., Umberson (1992) hypothesized that marriage may be beneficial to health because many spouses monitor and attempt to control their spouses' health behaviors. Results showed that marriage was associated with receipt of substantially more efforts to control health for men than women. Social control was measured by asking "how often does anyone tell or remind you to do anything to protect your health?" Females were more likely to attempt to control the health of others than males. Married persons were most likely to identify a spouse as their primary social control agent, and men (80%) were more likely to name a spouse than women (59%). There was some support for the benefit of social control and health behaviors among the married over time which indicates that those who stay married were more likely to reap some benefit to their health. Finally, the transition from married to unmarried status was associated with an increase in negative health behavior. These changes in health behavior may occur, in part, because there is no longer a spouse available to facilitate, monitor, and attempt to affect one's health.

Broman (1993) tested the hypothesis that those with social relationships were more likely to avoid health-damaging behaviors, and he also looked at patterns regarding specific social ties and particular health behaviors. Using the National Survey of Personal Health Practices and Consequences from 1979 (n= 3025) and 1980 (n=2485), he found that different relationships were related to different health behaviors. Consistent with other research, he found that those with higher levels of education and income, and older people were more likely to engage in preventive health behaviors (Berkman & Breslow 1983). In agreement with Umberson (1987), men were found to be more likely to engage in health damaging behavior than women. People who were married had lower levels of smoking, drinking, and heavy drinking. He also discovered that a change in social relationships can have a significant impact on health behavior.

Davis et al. (2000) found that different relationships were also related to dietary quality. They examined the association of living arrangements with dietary quality using NHANES III (1988-1994) data for 6525 adults aged 50-64 y and ≥ 65 y. They found that those who live with a spouse only (not with other people also) had better diet quality than those who lived alone or with other people. Living arrangements were more strongly associated with dietary patterns for older men than for older women. Those older men who were not living with a spouse, even if they were living with other people, were at higher risk of poor dietary intake. Men who lived with a spouse were more likely to take vitamin/mineral supplements, and were less likely to smoke. However, they were more likely to consume alcohol. More men who lived alone smoked and were in fair/poor health. This study suggests that the social support of merely living with someone was not the main criterion for dietary intake; the presence of the spouse had more significance (Davis et al. 2000).

Wickrama et al. (1995) also looked at how marital experiences affect health through risky behaviors. They used data (n=320) from men living in the rural Midwest. They found a direct effect of positive marital interaction on risky lifestyle; those who were married were less likely to engage in risky behaviors. Although married couples generally engaged in lower rates of health damaging behavior (Umberson 1987, 1992), it was not only marriage per se, but also the quality of marriage which had a positive influence on health. Gove & Umberson (1985), for example, found that intimate and expressive interactions were strongly related to well-being. Thus, Wickrama et al. (1995) predicted that positive marital involvement would be associated with lower rates of potentially health damaging behaviors by husbands. As predicted, frequent and pleasurable marital interactions, as measured by frequency of specific joint activities involving husbands and wives and by observational ratings of the quality of marital interactions, were associated with a less risky lifestyle.

Padula (1996) conducted a qualitative study of 59 elderly couples in long-term marriages using structured interviews about health behaviors. The majority (60.3%) of the couples said that they made decisions jointly. Approximately 52% of the couples indicated that wives were the primary deciders in the event that a health decision had to be made. Most participants, but particularly wives (86%), desired to change something about their spouses' health behavior. Women most frequently stated (36%) that their husbands needed to be more careful about their diet. A variety of strategies were used in the attempt to change spousal behavior. Seventy-eight percent of wives talked with, discussed, or reminded husbands, as compared to 28% of husbands. Women used more strategies overall, including worrying, watching, making appointments and controlling what their spouses did. Women were also more likely to say they preached to or nagged their husbands. Several women, but no men, verbalized frustration at their inability to successfully influence their spouses' health behavior, and their tendency to use "negative" strategies as a result. Aging or illness of the self or spouse were identified as reasons for increased desire to change the spouses' health behavior over time. This finding is understandable. When directly encountering the realities of aging, accompanied by increased likelihood of decreasing functional abilities, individuals may perceive an increased need to keep their spouses well. Trying to change their spouses' health behavior appears to be one strategy used (Padula 1996).

A meta-analysis and an intervention that looked at the influence of social support on high-risk health behaviors were done by Black et al. (1990) and Bovjberg et al. (1995). In a meta-analysis of couples weight-loss programs, Black et al. (1990) compared weight loss programs that formally involved partners in treatment to similar programs in which subjects participated alone. Based on their finding, couples programs were significantly superior in mean weight loss compared to subject-alone programs at post-treatment ($p<.05$), and a nearly significant ($p=.06$) difference was seen at 2- to 3-month follow-up, but not after. The couples programs differed in the kinds of social support provided however, the most productive kind of social support was not identified. The weight loss programs reflected varying views of how a partner should provide support, and none of them addressed the issue of how partners can provide support after treatment.

Bovbjerg et al. (1995) examined the association between spouse support and maintenance of low-fat diets in 254 men with hypercholesterolemia for 24-months. The Evaluation of Spouse Support questionnaire was administered after the last of eight dietary classes and at three intervals post-instruction. There was evidence of increasing likelihood of dietary goal achievement with increasing levels of social support. Social support included the spouse being invited but not required to attend diet classes, and spouse involvement was emphasized throughout the study. Couples were asked to work together, negotiate, use problem-solving techniques, and arrive at mutually agreeable solutions. However, end of class social support was not associated with achieving dietary goals, indicating that initial participation by the spouse did not guarantee long-term support. Overall, diet-specific social support was an important determinant of dietary goal attainment for lipid-lowering diets in a high-risk population. Participants with the highest level of social support were more likely to attain their dietary goals over the course of the follow-up, and social support became increasingly important in maintaining changes as time from the intervention increased.

In addition to social support, other Social Cognitive Theory constructs have been used in planning interventions which have resulted in behavior change of participants. The Stanford Heart Disease Prevention Program (Meyer & Henderson 1974) and the Multiple Risk Factor Intervention Trials (MRFIT) (Grimm 1983) are two interventions based on the social cognitive theory that were successful in changing behaviors of high risk men. The Stanford Heart Disease Prevention Program used a behavior modification strategy based on the constructs of identifying goals, modeling the behavior, selective reinforcement, and self-reward (Meyer & Henderson 1974). The MRFIT program enlisted many behavioral techniques into its intervention including: self-monitoring, stimulus control of the environment, goal setting, feedback, reinforcement, self-reward, modeling, guided participation, and support systems (Benfari 1981).

Two programs, the Heart Healthy Program and The Minnesota Heart Health Program (MHHP) developed interventions based on SCT for school-age children and their parents (Coates et al. 1981; Perry et al. 1987); both programs resulted in behavior change. The Heart Healthy Program used five social learning strategies to encourage behavior change: models of desired behaviors, behavioral rehearsal, goal specification, feedback of results, and reinforcement of behavior change. Using these resulted in family eating patterns becoming more heart healthy (Coates et al. 1981). One of the many health behavior interventions from the MHHP used a model based on the social learning theory for a third grade class. In order to change behavior, students experienced reducing barriers, role-modeling, peer support, self-monitoring, and self-reinforcement. As reported by Perry et al. (1987) the parents reported that their children were eating fewer sweets, less salt, and more fruits and vegetables. Another study targeting black families using the social cognitive theory noted less frequent consumption of high sodium foods by the boys in these families (Baranowski et al. 1990).

Baranowski et al. (1993) used the SCT theory of reciprocal determinism to plan focused interview questions for 4th and 5th grade students. This approach was successful in revealing general factors most likely to increase fruit and vegetable consumption in these children (Baranowski et al. 1993). In a group of 414 third graders, data was gathered using five predictors from SCT: availability, modeling, nutrition education, motivation (i.e. self-efficacy, outcome expectancies, food preferences), and knowledge. Availability and motivation were most consistently related to consumption and to other constructs in the model (Reynolds et al. 1999).

Food Patterning

The study of food patterns in populations has been the subject of study because of the close relationships between society and culture (Linton 1936). At the beginning of this century, anthropologists developed theories about the interrelationships between society and culture (Linton 1936), and how changes in culture can affect diet patterns in the population (Jerome 1980). Linton (1936) explained that culture and society are dependent on each other. Food patterns are the food habits of a group of people seen as a part of the social structure of the population based on their customs. Food patterns are developed in the population based on parental influence, availability of foods, nutrition knowledge, and culture (Guthe & Mead 1945).

Food patterns depend on influences such as the kind of food people like, seasons of the year, when people eat specific foods, and relations of the type of food with the mealtime (Guthe & Mead 1945). For instance, seasonal variability is important because fresh foods are not always readily available or are more expensive during periods of the year when these foods are not produced.

Using the food-patterning model, the target group is interviewed and studied to learn about the beliefs and practices of interest. Jerome (1976) was one of the first anthropologists to describe dietary patterns by categorizing available foods by their frequency of use: foods used daily, weekly, and rarely or for special occasions constitute, respectively, the core, secondary core, and peripheral diet. Jerome (1976) suggested that in cultures' in which the amount and types of food are abundant, significant dietary change occurs by a process described as diet individuation. This involves first, incorporation of new foods into the non-core diet (expansion/variation), with subsequent incorporation of preferred foods into the core diet (expansion/stabilization), and secondly, selection of foods from the core diet through rhythmic patterns of inclusion, exclusion, and replacement. The idea that foods people typically eat are categorized based on frequency of consumption into primary core or staple items; secondary core or those items that are either added to or substituted for the basic core; and peripheral diet components which are those used infrequently by most people was further substantiated by Jerome (1976, 1980) in the cases of Caribbean Blacks and Black-American in-migrants.

When designing a nutrition education intervention, primary and secondary core foods are emphasized because these foods are already included in the participants' diet. The core foods, beliefs, and practices may be categorized into neutral, healthy, less healthy, or uncertain. The healthy foods and beliefs are encouraged and the less healthy foods or beliefs are improved or dissuaded. Kristal et al. (1990) used this model when discovering patterns of dietary behavior associated with low fat diets in participants aged 45 to 59 years old. The diet individuation in this case involved including and then preferentially selecting lower-fat foods in the core and peripheral core diet using four dimensions of dietary behavior: exclusion, modification, substitution, and replacement. Their conclusion was that using all dimensions of this food-patterning model was appropriate for designing nutrition education interventions. Compared to SCT and others this theory has not been as widely studied.

Summary

Folate status in older men is important because of the relationship between folate intake and hyperhomocysteinemia. Elevated levels of homocysteine have been implicated as a risk factor for cardiovascular diseases. Older men do not consume enough folate to lower their risk for cardiovascular diseases. In the present study in-depth interviews were used to determine men's perceptions about folate containing foods and the best methods and strategies to use to influence increased consumption of these foods. Dietary intake of foods fortified with folic acid is one method that can be used to increase consumption of this nutrient. This study assessed the effect of consumption of fortified ready to eat cereal along with targeted nutrition education on folate intake and plasma homocysteine levels in a group of older men. Determining men's perceptions about folate, and the effects of fortified cereal on men's folate intake will help nutrition educators develop the best strategies to use to increase the folate intake of this age group.

CHAPTER III

METHODS

Two separate studies were conducted. Interviews with older Oklahoma men and their wives were conducted to determine perceptions they have regarding influences on folate intake. Based on these findings, an intervention study was conducted using a separate group of older Oklahoma men. This research was approved by the Institutional Review Board at Oklahoma State University (Appendix A).

Methods for Study One

In order to determine factors that influence food consumption, acceptable educational methods and strategies, and perceptions and beliefs about folate rich foods and supplements, in-depth structured interviews were conducted. Subjects were 40 Oklahoma men $\geq$ 60 years who were free-living and able to complete a detailed food record. Men with a variety of ethnic and socioeconomic backgrounds were recruited from the local community, the university, and close metropolitan cities (Appendix B). Because the men who were interviewed indicated such a strong reliance on their wives regarding their eating habits, structured telephone interviews with 20 of these men's wives were conducted at a later time. The wives chosen were a convenience sample based on those willing to be interviewed. The wives were asked similar questions regarding their husband's food intake. All participants signed an informed consent form (Appendix C) and completed a sheet with demographic questions prior to the interview. Compensation for the study participants included the chance to win a drawing for a free meal for two at a local restaurant.

In-depth interview

The interview technique involved a face-to-face meeting during which the interviewer systematically obtained information from the subject via questioning and observations. This has long been recognized as the most penetrating method available for assessing a person's knowledge and/or attitudes (Achterberg & Shepherd 1992). The researcher conducted all face-to-face interviews.

The researcher used the Social Cognitive Theory (SCT) as the theoretical framework to generate the interview questioning sequence. Environmental, personal, and behavioral factors were studied with detailed open-ended questions using key constructs of SCT. This complex theory includes many concepts that are important to understanding health-related behavior including self-control, behavioral capacity, environment and self-efficacy (Baranowski et al. 1997; Glanz & Rimer 1997). An explanation of the SCT and its constructs can be found in the literature review.

The structured interview questioning sequence was pilot-tested on individuals in the age group being studied to ensure understanding of the questions and to make sure the questions produced the expected quality and quantity of responses. Participant responses helped the researcher revise and finalize the interview script. The structured interview script (Appendix D) served as a guide for the interviewer to elicit the men's perceptions and meet the research objectives.

Questions regarding influences on food selection were asked to generate information on the domains of SCT. Older men were then asked a set of questions about each of the food categories known to be high in naturally occurring folate or fortified with folic acid: fruit, vegetables and grains. For example, the subject was asked what fruits they ate, what influenced the types of fruit purchased, how many servings of fruit they thought they should be eating, whether or not they were getting adequate servings, and if not, what prevents them from getting adequate servings. This line of questioning was repeated for vegetables and grains to give insight into the SCT domains for each specific food category.

Following the food group questions, each subject was asked for their suggestions for educating older men about eating more fruits, vegetables and grains. The interviewer probed for the type of information to include in education and clues about what would motivate them to follow the advice. The next line of questions dealt with eating out and the perceived availability of these foods when eating away from home.

The final questions dealt with attitude towards supplement use, whether they would prefer to increase folate through foods or supplement and why, and a specific question about whether they would notice a health claim about folate on the packaging of fortified RTE cereals. The questioning sequence portion of the interview was audiotaped. Total interview time was approximately 45 minutes.

The wives who were interviewed were asked a similar set of questions as the questioning sequence of the men (Appendix D). The women were interviewed and audiotaped over the telephone. Verbal consent was given, and demographic information was collected. Total interview time was approximately ½ hour.

Transcript generation

The audiotapes were transcribed verbatim by the Oklahoma State University Bureau for Social Research. The transcript for each tape was typed on a computer using word processing software. Once transcribed, the researcher or one of two trained student assistants reviewed the printed transcripts for accuracy by reading the transcript while listening to the tape. Corrections were made to the transcripts.

Transcripts were analyzed using content analysis (Achterberg & Shepherd 1992). Content analysis is a technique that provides an objective and systematic description of the presence, intensity, or frequency of a characteristic (e.g. word, concept, or phrase) in samples of text (Carney 1972). Once transcripts were generated, the researcher reviewed the interview scripts and developed a coding sheet by listing all possible responses to the questions (Appendix E). Each transcript was then read separately and a mark was made next to the appropriate answer on the coding sheet according to themes. Frequency of responses for each interview question was obtained by pooling the responses. Reliability was calculated by response agreement between the researcher and a trained student assistant for 7 transcripts. The number of agreements were divided into the sum of agreements and disagreements. Inter-rater reliability for the transcripts was .90, and intra-rater reliability was .80 for 6 transcripts. Values greater than .75 are indicative of good reliability (Portney & Watkins 2000).

Dietary Assessment

Upon completion of the interview the subjects were asked to fill out a demographic form that included personal characteristics, frequency of consumption of each meal, frequency of meals eaten away from home, and frequency and type of supplements and medications used (Appendix F).

Male subjects were then asked to complete a food frequency questionnaire (FFQ), with assistance if needed, and then received detailed instructions (Appendix G) on how to complete a 4-day food record. The first day of the food record was completed by the interviewer as a 24-hour recall to provide each subject with a guideline of how to record both quality and quantity of foods and beverages for the next 3 days. Total interview time was approximately 1.5 hours.

Food frequency questionnaire

Food frequency methods are commonly used to rank study subjects by their frequency of consumption of specific foods or by estimated nutrient intake. The food frequency method was selected to collect food consumption data because it is easily administered and requires little time for respondents to complete (Kristal 1997; Thompson & Byers 1994). The interviewer assisted the participants in filling out the food frequency questionnaire.

The semi-quantitative food frequency questionnaire (Appendix H) asked respondents to report their usual frequency of consumption and usual portion size of each food from a list of 100 foods over the past year. The 100-item food frequency used in the Health Habits and History Questionnaire (HHHQ) provided relative consumption frequency of foods (Block et al. 1990a; 1990b; Briefel et al. 1992; Krebs-Smith et al. 1995b).

Food frequency methods provide information on usual food consumption choices. Inclusion of portion sizes and frequency of consumption allows for limited quantification of nutrient intake (Thompson & Byers 1994). Food frequencies tend to overestimate intake (Briefel et al. 1992; Krebs-Smith et al. 1995b) however, less than 3% of subjects in longitudinal validation studies of the food frequency questionnaire method were incorrectly classified in nutrient intake categories (Gibson 1990; Rimm et al. 1992). This 100-item food frequency includes foods that represent 93% of energy, 97% of calcium, 96% of vitamin A, and 96% of vitamin C intake (Block et al. 1992; Block et al. 1990b; Block et al. 1986). According to our analysis, this questionnaire includes foods that represent 96% of dietary folate of men and women over 60 (Holmes et al. 1999).

Jacques et al. (1993) found that folate intake estimated by a 116 item semi-quantitative food frequency questionnaire correlated r=0.49 with plasma folate. When adjusted for energy intake, the correlation increased to r=0.63. They concluded that the food frequency questionnaire provided a valid estimate of folate intake. Estimated folate intake from a 24-item food frequency questionnaire was consistent with serum folate in adolescents (Bailey et al. 1984, 1982a, 1982b).

Responses to the food frequency questionnaires were entered using a microcomputer version of the data entry and analysis software program specifically designed for the selected instrument (DIETSYS Program). We updated the nutrient database to reflect folic acid fortification of grain products. The software computed nutrient intake by multiplying the nutrient composition of the listed foods in the specified serving size by the frequency of consumption. Nutrient composition of the diet during the specified period was then derived by summing the nutrient composition of all foods consumed (Thompson & Byers 1994). The frequency of intake of foods in the HHHQ were calculated as times per day ("daily"=1; "weekly"=.14; "monthly"=.033).

Food record with 24-hour dietary recall

Investigators obtained four one-day food records (Appendix I) from the subjects starting at the initial interview. Prior to administering the food record, investigators trained participants on the level of detail needed to adequately describe foods and portion size estimation by using a 24-hour recall as the first day. Underreporting of food consumption is a constant problem in dietary intake studies and all methods experience this difficulty to some degree (Epstein et al. 1978; McCoy et al. 1984; Baranowski et al. 1991; McIntyre & Shah 1986; Seltzer & Mayer 1970; Gustafson-Larson & Terry 1992). Underreporting occurs when people report food intakes so much lower than their energy expenditure that they are not biologically plausible (Schoeller 1990). Underreporting can lead to misleading conclusions about associations between diet and health (Johnson et al. 1998). Based on 3-day weighed diet records in 81 older men and 56 older women, underreporting is worse among older women than in older men (Johnson et al. 1994). To minimize underreporting of foods each subject was trained using non-biasing food models for portion size estimates (Johnston 1985; Posner et al. 1992). These models, constructed of dried beans and nylon mesh, were used to illustrate portion sizes from 1 cup to ¼ cup.

The multiple-pass 24-hour recall (U.S. Department of Agriculture 1998) was used on the first day of the food record during the first visit. The multiple-pass 24-hour food recall begins with the respondent being asked to report everything he ate or drank the previous day between midnight and midnight. The interviewer does not interrupt the respondent during this initial listing of the day's intake. On the second pass, a detailed food description and amount consumed is asked for each food and drink that has been listed. A third pass through the day probes for additional foods eaten before the first eating occasion, in between listed occasions, after the occasion listed, and commonly forgotten items such as condiments and beverages (U.S. Department of Agriculture 1998). The initial 24-hour recall provided the interviewer with an opportunity to familiarize the subject with how to properly record the quality and quantity of foods consumed. Trained interviewers conducted all of the 24-hour recalls.

Data from food records is labor-intensive to collect and time-consuming to code and enter for analysis; however, this method provided quantitatively accurate information on food consumption during the recording period (Thompson & Byers 1994). It also allowed us to compare detailed information on folate intake with the estimate of folate intake from the food frequency questionnaire.

Food records were analyzed using the dietary software program Food Processor (version 7.4, ESHA Research, 1999). The Food Processor program calculates macronutrients, including saturated, monounsaturated and polyunsaturated fatty acids, complex carbohydrates and sugars, calories, dietary fiber (total, soluble and insoluble), 16 vitamins and vitamin precursors, 15 minerals, and 18 amino acids. Nutrient data is compiled from the latest USDA data and other scientific sources. Manufacturers supply additional food and brand name product data. Validation studies of this diet analysis software show that it is equivalent to using the USDA databanks and has a low frequency of missing values (Lee et al. 1995). This software allows new foods and specialty food items to be readily added to the database and uses the nutrient retention factor method of recipe calculation as recommended (Powers & Hoover 1989; Perloff 1989).

The adequacy of the diet was evaluated using total nutrient intakes (Pao & Mickle 1981; Edelstein et al. 1992). The dietary standards used to evaluate intake were the Recommended Dietary Allowances and the Estimated Average Requirement (EAR) (Institute of Medicine 1998).

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) 9.0 for Windows (SPSS 2000). The level of significance for this study was $p \leq 0.05$ (Steel & Torrie 1980).

The following hypotheses were analyzed:

1. Older men's perceptions, attitudes, and beliefs about folate-containing foods will be positive.

   Statistical procedure: Descriptive statistics

2. Older men's perceptions, attitudes, and beliefs about folate-containing foods will be similar to their wives' perceptions, attitudes, and beliefs about folate-containing foods when asked the same questions.

   Statistical procedure: Cross tabs

3. There will be no difference in estimated folate intake between the food frequency questionnaire, and 4-day dietary record.

   Statistical procedure: Analysis of variance and paired t tests

4. The folate intake in older men in Oklahoma will be lower than the EAR and the RDA for the appropriate age.

   Statistical procedure: one-sample *t* tests

Methods for Study Two

This study used a pre/post-test with delayed post-test design (Figure 1). Subjects for this study were 41 men ($\geq$ 58 years of age) with no known serious medical condition who were not taking supplements that contained folate or medications known to affect hcy. In order to participate, potential subjects who were taking a folic acid containing supplement went through a 12 week washout phase in which they discontinued taking any folic acid containing supplements. Men with a variety of ethnic and socioeconomic backgrounds were recruited locally. Recruitment brochures (Appendix B) were mailed to a list of participants from the interview portion of the research, and male employees at Oklahoma State University. The researcher also recruited with brochures from a pool of research participants at Oklahoma Medical Research Foundation (OMRF), and by dropping off brochures at community agencies. A newspaper advertisement was used to recruit participants from the general community.

Baseline Measures

At the initial visit (visit 1) the subjects were asked to sign a consent form (Appendix C), and complete a survey of demographic characteristics (Appendix F) and provide a list of medications and supplements they were taking. Also at the first visit, after careful instructions, each participant started five 1-day food records (Appendix I). The first day of the record consisted of a multiple-pass 24-hr-recall (U.S.Department of Agriculture 1998) completed by the interviewer to provide each subject with a guideline of how to record both quality and quantity of foods and beverages for the next 4 days (Payette & Gray-Donald 1991). All subjects were given food record supplies (measuring cups, spoons, and beanbag standard measures) to increase the accuracy of their record (Chambers et al. 2000), and an instruction sheet (Appendix G) with tips for estimating amounts. All subjects then completed a food frequency questionnaire (HHHQ).

At baseline, approximately 1 week after the first visit, a fasting blood sample was drawn, subjects returned the food record and the participant was randomized into one of the two groups. Subjects were randomized into either the experimental group (n=21) or a control group (n=20). Subjects in the experimental group received targeted nutrition education, a self-monitoring folder and fortified ready-to-eat cereal. Those in the control group received only general nutrition education. They were not provided with cereal or a self-monitoring folder.

Nutrition Education

The education for the experimental group was planned using the systematic process of Intervention Mapping (IM). To begin the IM process an overall goal of increasing dietary folate intake to at least 400 μg/day was set. Performance objectives (e.g. evaluate food intake using an individualized folate counter) were then listed. Each objective had several knowledge/skills associated with it that influenced both internal and external determinants (e.g. recognize frequently eaten adequate sources of folate). Internal determinants are those factors within the individual under their direct control (e.g. self-efficacy), whereas external determinants are those factors outside the individual that can directly influence health behaviors or environmental conditions (e.g. spouse). Each objective also included a self-evaluation tool (e.g. daily monitoring log). A list of practical strategies helped guide the nutrition education session to meet that particular objective (e.g. provide guided practice filling out monitoring log). The complete IM framework for this research can be seen in Appendix J.

Those subjects who were randomized into the control group were instructed on a healthy diet using the Food Guide Pyramid (Appendix K). A handout regarding increasing fruit, vegetable, grain and cereal consumption was also provided to the control subjects (Appendix L).

Self-monitoring folder

Subjects who were randomized into the experimental group received a self-monitoring folder at the baseline visit and were instructed on ways to increase folate in their diet using behavioral constructs from the social cognitive and food patterning theories. The self-monitoring folder contained an individualized "folate in foods" counter (Appendix M) developed from their initial food frequency questionnaire using the food patterning model. Foods marked by the subject as something they ate at least 3-4 times per week were considered core foods, those they ate between two times a week and two times a month were considered secondary core foods. Foods from the FFQ that were high in folate and also were the subject's core or secondary core foods were included on their individualized "folate in foods" counter along with a point value. The folder also contained a self-monitoring log (Appendix N) for recording folate food intake; and a list of folate containing foods (Appendix O), a note directed to the subject's wife (Appendix P) regarding his participation in the study, and a study visit schedule (Appendix Q). The subjects were instructed on the use of the self-monitoring log and ways to increase folate in the diet including how to choose high folate foods from a restaurant menu and how to determine amount of folate from a food label.

At the week 4 visit no new nutrition education concepts were introduced. The self monitoring log was reviewed to make sure subjects were correctly recording their intake, and the use of the folate counter and self-monitoring log were reinforced by re-explaining their use and importance at weeks 4 and 8. At the week 8 and 20 visits, dietary analysis from the baseline and week 8 food records were explained and discussed in relation to the total diet but especially focusing on folate intake. This discussion was used to again reinforce the importance of getting adequate amounts of folate in the diet.

Ready-to-eat cereal

The experimental group was provided with fortified ready-to-eat cereals that provided 400 µg of folic acid daily for 8 weeks in addition to their usual diet. Subjects were able to choose between: 1 cup (50 g.) General Mills Total Raisin Bran™; ¾ cup (30 g.) General Mills Whole Grain Total™; 1 cup (30 g.) General Mills Multigrain Cheerios Plus™; and 1 cup (50 g.) Kellogg's Smart Start™ (Appendix R). The servings were pre-measured, and the appropriate number of bags of cereal (about 30) were given at both the baseline and week 4 visit. The exact number of bags given was recorded. The subjects were instructed to keep all empty bags, and return both the empty bags and full bags at the week 4 and week 8 visits. The bags were counted to determine compliance.

As an alternative to eating the cereal, the subjects were instructed to choose the equivalent amount of folate using a point system where subjects would choose foods that equaled 10 points (each point was equivalent to 40 ug folic acid). Points were calculated based on the amount of naturally occurring folate in the food plus the amount of folic acid times 1.7 to account for the added bioavailability of the synthetic folic acid (Bailey 1998). The amount of calculated folate was then divided by 40 to determine a point value for that particular food based on a given serving size. The subjects were allowed to either eat the cereal or the 10 points worth of food on a daily basis. If the subjects chose to eat foods with naturally occurring folate (i.e. legumes, fruits, vegetables) as opposed to the fortified cereal they were required to consume 40% more folate due to the difference in bioavailability of naturally occurring vs. synthetic folic acid in the fortified cereal (Bailey 1998).

Each subject in the experimental group was given an individualized list of folate-containing foods they frequently ate that was developed from their initial FFQ. Foods were assigned an appropriate point value. They were able to choose foods from this list based on the number of servings that would provide an equivalent amount of folate as the provided cereal (10 points).

The self-monitoring log was provided so subjects could record what foods they chose to eat for the stated amount of folic acid. If they ate the provided cereal they simply had to indicate on the monitoring log that they had eaten the cereal that day. The amount of cereal consumed and self-monitoring logs were reviewed to evaluate daily compliance at the week 4 and 8 visits.

Self-monitoring and changing the environment (i.e. providing the cereal) are both constructs of the social cognitive theory, and were expected to cause a change in behavior. By providing an individualized food counter for the participants based on the folate rich foods each subject commonly consumed, we were using the food patterning model.

RTE cereal was chosen as the food to use in this study rather than the supplement (that the men in the preliminary study indicated would be easiest) because we wanted to promote use of foods, and the amount of fruits and vegetables that would have to be provided would be cost prohibitive. Research shows that men in this age group are regular cereal eaters (Albertson & Marquat 1999; Holmes et al. 1999) and most (87%) of the participants in the preliminary study indicated that cereal was one of the grain foods eaten most often. RTE cereal is convenient and affordable, criteria that may be a consideration for participants when making decisions to continue to purchase and consume these foods in the future.

Measures of Folate Intake

Three methods were used to estimate folate intake of the subjects in both the intervention and control groups: food frequency questionnaire, 24-hour recalls/food records, and biomarkers of folate status. When assessing dietary intake in a population, it is desirable to conduct a substudy to compare several methods of estimating intake to obtain a more accurate estimate (Riboli et al. 1997; Kaaks et al. 1995; Rimm et al. 1992; Liu et al. 1992). The food frequency questionnaire estimates intake over the past year; the 24 hour recalls/food records estimate intake over a recent short period; and biomarkers estimate recent intake (serum folate), body stores (erythrocyte folate), and tissue folate coenzyme activity (serum homocysteine) (Bailey 1990; Fanelli-Kucamarski et al. 1990; Lindenbaum & Allen 1995; O'Keefe et al. 1995).

All subjects provided unannounced 24-hour dietary recalls by telephone during weeks 3, 7 and 19. Studies have demonstrated that telephone contact is a feasible and acceptable way to collect data on food intake (Krantzler et al. 1982; Posner et al. 1982; Dubois & Bovin 1990). Tran et al. (2000) found no significant difference in average daily energy intake between the telephone and in-person interviews in adult women.

Five 1-day food records were administered at baseline, the completion of the study (after week 8), and 3 months after the intervention period (week 20). Details regarding the food frequency questionnaire, the 24-hr recall and the food records can be found in the previous methods section.

Biomarkers

All subjects provided fasting blood samples at baseline, on weeks 4, 8, and three months post-intervention (week 20). Blood samples were drawn by the same licensed phlebotomist or Registered Nurse either at the Oklahoma State University Student Health Center or the Oklahoma Medical Research Foundation on all four collection days. One 10 ml tube of whole blood without anticoagulant was collected to use for serum samples. One 10 ml tube of whole blood treated with EDTA as an anticoagulant was collected to use for plasma samples. For blood collected at Oklahoma State University, the plasma tube was then processed immediately while serum tubes were stored on ice for at least 30 minutes to allow clot formation. For those collected at Oklahoma Medical Research Foundation, all plasma and serum tubes were kept on ice for transport to Oklahoma State University. Transport of blood samples occurred within 4 hours of collection. To separate plasma and serum, blood samples were centrifuged at 3000 rpm for 15 minutes at 4° C in a Jouan CR3*i* centrifuge. Aliquots of plasma and serum were transferred into siliconized microcentrifuge tubes and frozen at -20° C until analysis. Each sample was thawed only once for analysis.

Hematology

On the day of blood collection, an aliquot of heparinized whole blood was removed for complete blood counts (ABX Vega, Montpellier, Cedex 04 or a Coulter T890). Analyses of hemoglobin, hematocrit, red blood cells (RBC), and mean corpuscular volume provided data on hematological status. All analyses were performed as soon as possible after blood collection.

Vitamin Analysis

Serum folate, vitamin B-12, and erythrocyte folate were analyzed by radioimmunoassay (Cobra II, Auto-Gamma Counter; Packard Instrument Co.) using the Dualcount Solid Phase No Boil Assay (Diagnostic Products Corp). The serum folate level was analyzed as an indicator of increased intake and compliance with the intervention, and erythrocyte folate was analyzed as an indicator of long-term folate status (Bailey 1990; Fanelli-Kucamarksi et al. 1990). Vitamin B-12 status was measured because it may influence plasma homocysteine levels (Ubbink et al. 1994, 1997). Serum samples were protected from light during analysis to protect serum and RBC folate.

Homocysteine measures

Plasma homocysteine was analyzed with high performance liquid chromatography using a modification of the methods of Vester and Rasmussen (1991) and Ubbink et al. (1991). Two hundred forty microliters of plasma was mixed with 60 μL of internal standard (2.5 mM acetylcysteine in 0.9% sodium chloride + 4 mM EDTA). Thirty microliters of 10% tri-*n*-butylphosphine in dimethylformamide were added, and the reduction allowed to proceed for 30 min at 4°C. Samples were then mixed with 300 μL of 0.6M perchloric acid with 1mM EDTA, left at room temperature for 10 min., then centrifuged at 3000 rpm for 10 min., to precipitate the proteins. Fifty microliters were taken from the middle of the supernatant and mixed with 125 μL of .125 potassium tetraborate, pH 9.5, containing 4mM EDTA, for reduction. Derivatisation was accomplished using 50 μL SBD-F (ammonium-7-fluorobenzo-2-oxa-1,3-diazole-4 sulphonate) dissolved in potassium tetraborate and allowed to incubate at 60°C for 1 hour. After cooling in an ice bath, the samples were ready for HPLC analysis. Five microliters of derivatized sample were used for each injection. Prior to sample injection the mobile phase (1L 0.1 M acetate buffer + 20 mL methanol; ph=4) was degassed and filtered through a .45 μm Millipore filter. Calibration standards were injected at the beginning and end of each run. HPLC separation and quantification were performed with a Waters Alliance HPLC using a 2690 separation module and equipped with a Waters C18 column protected by a Waters C18 guard column. Millenium 32 software was used. The fluorescence intensities were measured with excitation at 385 nm and emission at 515 nm, at a flow rate of 1.5 mL/min of mobile phase for 7 minutes per sample.

Hcy was calculated by taking the ratio of the area of the homocysteine peak to the area of the acetylcysteine peak. The ratio was then divided by the slope. Each of the samples were run in duplicate. The average of the two calculations was used to obtain μmol/L of hcy.

FRAP, lipids, and creatinine measures

Traditional lipid measures (total cholesterol, HDL, triglycerides), ferric reducing ability of plasma (FRAP), and creatinine were analyzed using the COBAS Roche FARA II chemistry system. The FARA system is a centrifugal analyzer which uses a horizontal light path to measure absorbance of plasma samples. Lipid, creatinine, and FRAP assays were performed using Roche reagents (Nutley, NJ). LDL cholesterol was calculated [Tchol – HDL – (TG/5)]. Creatinine was measured because it has a positive relationship with hcy. FRAP is presented as a measure of "antioxidant power" (Benzie & Strain 1996).

Compensation

Compensation for study participation included the measuring cups, spoons, beanbag measures, and a total of $100 if subjects completed the study. Subjects received $10 for first three blood samples and $15 for the follow-up blood sample and $15 for the first two completed food records and $25 for the follow up food record.

Data Analysis

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) 10.0 for Windows (SPSS 2000). The level of significance for this study was $p \leq 0.05$ (Steel & Torrie 1980). Data were log transformed to adjust for non normal distribution where necessary.

The following hypotheses were analyzed:

1. The folate intake for older men in Oklahoma will be lower than the EAR and the RDA for the appropriate age at the baseline visit.

   Statistical procedure: one-sample *t* tests

2. The folate intake in older men randomized to the experimental group will be higher than folate intake in older men randomized to the control group at the end of the Intervention period (week 8) and three months post-intervention (week 20).

   Statistical procedure: repeated measures analysis of variance

3. Serum folate and RBC folate will increase more for older men in the experimental group than for the older men in the control group.

   Statistical procedure: repeated measures analysis of variance

4. Total homocysteine concentration will decrease more for older men in the experimental group than for older men in the control group.

   Statistical procedure: repeated measures analysis of variance

5. Serum folate and erythrocyte folate will remain higher for older men in the experimental group than for older men in the control group at the follow-up visit (3 months post-intervention).

   Statistical procedure: independent-sample *t* tests

6. Total hcy concentration will remain lower for older men in the experimental group than for older men in the control group at the follow-up visit (3 months post-intervention).

   Statistical procedure: independent-sample *t* tests

7. Ferric reducing ability of plasma (FRAP) will be higher for older men in the experimental group than for older men in the control group at the follow-up visit (3 months post-intervention).

   Statistical procedure: independent-sample *t* tests

8. There will be no difference in dietary intake methods (dietary records, 24-hr recalls, FFQ) for estimates of folate from food.

   Statistical procedure: analysis of variance and independent sample *t*-tests

Study Two Flow Chart

	Phase I		Phase II					Phase III	
	Washout	Group	Randomize/ Baseline	Intervention				Post- Intervention	
Week	**-12**	**-1**	**0**	**3**	**4**	**7**	**8**	**19**	**20**
Visit	**0**	**1**	**2**		**3**		**4**		**5**
Informed consent	X	X							
Clinical assessment (ht, wt.)			X				X		X
Laboratory: HCY, Folate (serum/RBC), B12, HDL/TG/Total chol, CBC, FRAP, Creatinine			P*		P*		P*		P*
FFQ		X							
24-hr recall		X		O		O		O	
5 day food record		X (4-day)*					X*		X*
Receive self-monitoring kit **or** Generic instruction			X						
Dispense cereal			X		X				
Review monitoring record					X		X		
Subject return food record			X				mail 1 wk. later		Mail 1 wk. later

O no scheduled appointment needed; unannounced calls will be made
P phlebotomist needed
* Compensation will be given for these portions (total = $100)

Figure 3.1 Summary of study procedures for study two.

CHAPTER IV

INFLUENCES ON FOLATE INTAKE – PERCEPTIONS OF OLDER MEN AND THEIR SPOUSES

Department of Nutritional Sciences, College of Human Environmental Science

Oklahoma State University

Stillwater, Oklahoma 74078

Abstract

High plasma homocysteine (hcy) concentrations are an independent risk factor for cardiovascular disease. Folate may prevent cardiovascular disease by decreasing plasma hcy. Forty men ≥ 60 years participated in in-depth structured interviews based on the Social Cognitive Theory to assess attitudes and perceptions about foods containing folate. At a later time, wives (n=20) were interviewed by telephone. The interviews were analyzed using content analysis. Dietary data was collected from the men using a food frequency questionnaire and a 4-day diet record. About half (n=16) the men were not consuming recommended amounts of folate. Men who were married and ate cereal more often were more likely to consume adequate dietary folate. Themes influencing purchase of folate-containing foods were season, taste, habit, preference, health benefit, and cost. The wives, health professionals, and health crisis were influences on changing men's eating habits. Similarities were found between older men and their wives in overall perceptions and beliefs about folate rich foods, however wives more often thought cereal

would be the best way to increase the intake of folate in older men, and their husbands thought supplements would be easiest. Subjects were aware of the need to consume foods high in folate, although few were aware of amounts of these foods that are recommended and the reasons why their intake was important. Nutrition educators can use this information to design more effective interventions in order to reach the 40% of older men not consuming adequate amounts of folate.

Introduction

Diseases of the heart are the leading cause of death in Americans over age 65 (Centers for Disease Control 1997). Diet is one of a number of risk factors that are associated with the development of this chronic condition. Scientific evidence is accumulating that folate, one of the B vitamins, is involved in the prevention of cardiovascular disease (CVD) by decreasing plasma homocysteine (hcy) concentrations (Ubbink 1997; Brattstrom et al. 1994; Malinow et al. 1997;Jacques et al. 1999). High plasma hcy concentrations are considered an independent risk factor for cardiovascular disease (Verhoef et al. 1997, 1996; VonEckardstein et al. 1994; Genest et al. 1990; Pancharuniti et al. 1994; Lussier-Cacan et al. 1996).

Using meta-analysis techniques, Boushey et al. (1995) found that approximately 10% of heart disease risk can be attributed to high plasma hcy concentrations, but increasing folate intake to about 400 μg/day reduces the risk of developing coronary heart disease without increasing the risk of masking vitamin B-12 deficiency. Prior to fortification, Americans consumed less folate than the 400 μg that is recommended to reduce the risk of heart disease (Selhub et al. 1993; Subar et al. 1989). Mean folate intakes for males over 60 in the 1994-1996 CSFII were 279 μg/day, and only 17.5% of men and women over 60 consumed at least the new recommendation of 400 μg folate per day (Holmes T et al. 1999). In 1998, the FDA began requiring that all producers of enriched fortified cereal grain add folic acid to their products (Food and Drug Administration 1996). This level of fortification (140 μg/100 g) was estimated to increase daily folic acid intake by 70 to 120 μg in adults over 50 (Malinow et al. 1998). As a result of these changes there is need to know if folate intake is adequate in this population and what influences consumption of folic acid fortified (grains) and naturally occurring sources of folate (fruits and vegetables).

To promote healthy dietary change, it is important to understand factors that influence men's food choices such as attitudes and perceptions of dietary behavior. With a clearer understanding of men's behaviors and of environmental factors that affect their food choices, nutrition educators can more effectively promote change and provide strategies that will lead to long-term compliance (Nestle et al. 1998; Contento 1995). The objectives of this research project were to determine how older men's folate intake compares to the recommended amounts, and to assess older men's attitudes about foods containing folate, determine factors that influence their food choices, and to obtain ideas on strategies for nutrition professionals to use in improving the intake of folate-containing foods.

Methods

In-depth structured interviews were conducted with 40 Oklahoma men $\geq$ 60 years of age who were free-living and able to complete a detailed food record. The Social Cognitive Theory (SCT) was used to generate the interview questioning sequence based on environmental, personal, and behavioral constructs (Appendix D). Because the men who were interviewed indicated such a strong reliance on their wives regarding their eating habits, structured telephone interviews with 20 of these men's wives were conducted at a later time. The wives chosen were a convenience sample based on those willing to be interviewed. The wives were asked similar questions regarding their husband's food intake and education level. The same trained interviewer conducted all interviews.

Upon completion of the interview the men were asked to fill out a food frequency questionnaire (FFQ) (Block et al. 1990) with assistance if necessary and then received detailed instructions on how to complete a 4-day food record. The first day of the food record was completed by the interviewer using a modification of the multiple-pass 24-hour recall (U.S. Department of Agriculture 1998) to train each subject to record both quality and quantity of foods and beverages for the next 3 days.

Responses to the FFQ were analyzed using a microcomputer version of a data entry and analysis software program designed specifically for the selected instrument (DIETSYS Program). The nutrient database was updated to reflect folic acid fortification of grain products. Food records and recalls were analyzed using the dietary software program Food Processor (version 7.4, ESHA Research, 1999).

Data Analysis

Transcripts from the audiotaped interviews were analyzed using content analysis (Achterberg & Shepherd 1992). Content analysis is a technique that provides an objective and systematic description of the presence, intensity, or frequency of a characteristic (e.g. word, concept, or phrase) in samples of text (Carney 1972). Inter-rater reliability was calculated by response agreement for 7 transcripts between the researcher and a trained student assistant, and intra-rater reliability was calculated for 6 transcripts. The number of agreements was divided into the sum of agreements and disagreements. Inter-rater reliability for the transcripts was .90, and intra-rater reliability was .80. Values greater than .75 are indicative of good reliability (Portney & Watkins 2000). Quotes were taken from the transcripts to illustrate themes. Crosstabs were used to compare responses of matched husband and wife pairs.

Differences in and relationships between mean total calories, folate, vitamins B-6, B-12, and lipid intake by characteristic were analyzed using SPSS for Windows 10.0 (SPSS 2000). Folate from dietary records was correlated with times per week each meal was eaten (e.g. times per week the subject ate breakfast), and times per week the subject ate in a fast food or sit down restaurant using Pearson correlation coefficients. T-tests compared folate intake by race, marital status, vitamin supplement usage, and folate containing supplement usage. Analysis of variance with Scheffe range tests compared folate intake by employment status and education. Folate from food intake was correlated with mean intake of vitamins B-6 and B-12 from food using Pearson correlation coefficients. Paired T-tests were used to compare mean calories, folate, total fat, saturated fat, vitamin B-6 and cholesterol estimated by food records and FFQ. One sample *t*-tests and frequencies were used to compare mean intakes to the Recommended Dietary Allowances and the Estimated Average Requirement (EAR) (Institute of Medicine 1998) for folate, vitamin B-6, and vitamin B-12. Values are expressed as mean $\pm$ standard deviation (SD). Where appropriate, logarithmic transformations were used to approximate normal distributions. Differences were considered statistically significant at the $p < 0.05$ level.

Results

Mean age for the men in this study was 65 ± 5 years (range: 59-80). The majority of the men (n=38) were white, and married (n=35). Over half (n=22) were still working full-time, and only 1 out of 20 had less than a high school education, and half (n=10) had at least a Bachelor's degree.

The wives mean age was 62 ± 7 years (range: 49-75). All of the women were white (n=20), and had been married on average 36.5 ± 13 years (range: 3-53). Most (75%) were at home at least part-time because they either worked only part-time (n=2), were retired (n=8), or were homemakers (n=5). Only one wife had less than a high school education, and almost half (n=9) had at least a Bachelor's degree.

Nutrient Intake by Characteristic

Dietary intake was measured using both a FFQ and a 4-day diet record (Table 4.1). Paired *t*-tests revealed no significant differences for estimated folate, total fat, saturated fat, or cholesterol intake between these two dietary collections methods. Estimated vitamin B-6 intake was significantly higher on the diet record (p=.014) but calorie intake was significantly higher using the FFQ (p=.022). Vitamin B-12 was not analyzed using the FFQ, so this value was not compared. Further reports of dietary data will be from the diet record unless otherwise indicated.

Many men in this study (n=16) did not consume the RDA of 400 μg folate/day, and 11 men consumed less than the Estimated Average Requirement (EAR) of 320 μg/ day from food sources. Mean folate intake was 421 ± 144 μg/day, and median intake was 429 μg/day (Figure 4.1). Mean folate intake was not significantly different than the RDA, however, it was significantly higher than the EAR for both the FFQ (p=.002) and diet record (p=.000).

We compared the dietary folate intakes of these men on a variety of characteristics (Table 4.2). Married men (n=35) were more likely to consume adequate folate compared to those who were either divorced or widowed (p=.014). There was no difference in mean folate intake by race, education, or employment status. There was no difference in mean folate intake for men who worked full-time and those who worked either part-time or were retired, however, there was a tendency for men who were retired to have a lower mean folate intake than those who worked part time (p=.055). Most (n=35) of the men reported taking a vitamin or mineral supplement, and 14 reported taking a supplement that contained folic acid. However, there were no mean differences in dietary folate between the supplement and non-supplement users.

There was a strong positive correlation between folate and vitamin B-6 intake (r^2=.703, P<.001), and a positive correlation between folate and vitamin B-12 (r^2=.356, P<.05), and vitamins B-6 and B-12 (r^2=.517, P<.001). Most of the men (n=30) met the RDA of 1.7 μg/d for vitamin B-6, and 34 met the RDA of 2.4 μg/d for vitamin B-12.

The majority (n=32) of the men ate breakfast at least 6 times per week. There was a positive correlation (r^2=.382, P<.05) between dietary folate intake and times per week breakfast was eaten. RTE cereal was listed as one of the primary grain foods for most of the men (n=35).

Interviews

Content analysis from 40 husbands and 20 of their wives revealed common themes that influence the purchase of fruits, vegetables, and grains. The influences most often mentioned by both were season, taste, habit, personal preference, price, and perceived health benefit (Table 4.3). When eating out only 25% (n=10) of the men said they always order fruits, vegetables, or grains from the menu however, 82% (n=33) said they would eat these foods if provided with the meal. According to the wives, half of the men (n=10) always order a fruit, vegetable, or grain when eating out, and 80% (n=16) will eat these foods if provided with the meal.

About half (n=22) of men and their wives (n=10) thought the husband was getting enough daily servings of grain. However, almost all men (n=36) and their wives (n=19) underestimated the correct number of grain servings recommended. For fruits, 70% (n=28) thought they were getting enough however, over half (n=22) of the men underestimated the correct number of servings. Sixty-five percent (n=13) of the wives underestimated the correct number of fruit servings and thought there husband was getting enough. Knowledge of vegetables was better. More than half (n=22) of the men and 15 of the women knew the correct number of servings. Over half (n=22) of the men and 40% (n=8) of their wives thought their husbands were getting enough vegetables daily.

The majority of the husbands (n=28) and the wives (n=15) knew nothing about or very little about folate. According to the wife, the perception of the food as healthy (n=14), and habit, convenience, and husbands likes/wants (each n=5) were the primary factors that influenced the preparation of foods at home.

Many of the men thought that the best way to reach older men about eating more folate-rich foods would be through their wives (n=21), a health crisis (n=18), a health professional (n=14), or teach them when they are young (n=12). According to their wives, the most influential ways to reach men about eating more fruits, vegetables and grains would be magazine articles or books about health (n=12), a health professional (n=8), or through the wife (n=7). The wives said they got most of their health information from magazine articles or books about health (n=16), newspapers (n=10), and television (n=8).

Comparison of matched husband/wife pairs (n=20) suggested that over half of the pairs agreed on the influence of the wife (12/20), a health crisis (13/20), and health professionals (10/20) on men's selection of fruits, vegetables and grains. Almost all (11/15) pairs agreed that the husband would eat a fruit, vegetable, or grain if served with a meal. Pairs (12/19) agreed on ways to increase folate, although half of the agreements were due to multiple responses by one of the spouses. When calculated separately, men more frequently chose supplements (n= 18) whereas the wives thought their husbands would choose cereal (n=11).

Discussion

Consumption of folate for men in our study (421 $\pm$ 144 μg) was greater than that seen in past research (Albertson & Marquart 1999). Dietary folate intake reported before fortification of grain products from the 1995 Continuing Survey of Food Intake of Individuals (CSFII) shows that males 20 years and older consumed 294 μg (U.S. Department of Agriculture 1995) and men in phase I of the third National Health and Nutrition Examination Survey 1988-1991 (NHANES III) consumed 343 $\pm$7.4 μg/day (Ford & Bowman 1999). Foote et al. (2000) found that more than 60% of a senior population of 1740 Southwestern U.S. adults reported dietary folate intakes (1985-1989) below the EAR. Our data indicate that fortification has had a positive effect on folate intake in this population, however more needs to be done to reach the 40% of older men who are not consuming adequate amounts of folate.

Married men in our study were more likely to consume adequate folate which is in agreement with social support research that shows that men who are married are more likely to have positive health behaviors (Padula 1996; Broman 1993; Umberson 1987, 1992).

Supplement users in our study had dietary folate intakes similar to those who did not take folate supplements. Those who did take the supplements were likely to already be meeting recommended levels of dietary folate without the supplement, whereas those who were not meeting the recommendation by diet were also not taking a supplement. An assumption may be made that those who eat healthier are more concerned about their health, therefore are more likely to take a supplement as well (Hartz et al. 1988).

The positive correlation between folate intake and vitamins B-6 and B-12 is expected because RTE cereal that is fortified with folic acid is also fortified with vitamins B-6 and B-12. Intake of vitamin B-12 is of special concern because of the potential for folic acid to mask the symptoms of B-12 deficiency (Institute of Medicine 1998).

The older men in this study who ate breakfast more frequently had higher folate intakes. RTE cereals were one of the primary grain foods for this group. RTE cereals are a good source of folic acid and are probably the reason those who ate breakfast consumed more dietary folate. Albertson & Marquart (1999) also found that adults who regularly included cereal in their diets had significantly higher mean daily folate intakes, and that older males (65+) who were cereal eaters reported the highest intakes.

Social Cognitive Theory Constructs

The use of Social Cognitive Theory in structuring and evaluating the interviews helped to identify and understand factors that influence dietary behavior. The following themes were found in relation to the influences of environment, reinforcements, expectations, observational learning, and behavioral capability constructs.

Environment

According to the SCT the environment is the interaction of external physical, social, and institutional factors affecting behavior (Baranowski et al. 1997). The environmental themes affecting selection of foods high in folate for men and their wives in this study were season, cost, and convenience.

A theme that dominated, especially for fruit and vegetable consumption was season of the year. Men felt the quality of the food suffered during the off-season indicating that they don't purchase certain fruits and vegetables because "some times of the year they're not so good." Other comments such as "in season, almost anything," and "especially when it's in season" were responses given when asked about purchasing specific fruits and vegetables.

The men and women also mentioned cost as a factor. However, cost was most often associated with season in relation to fruit and vegetable purchases. One man commented that "as season gets towards the beginning or the end taste and quality are not there so we really won't spend the money." Heimendinger and Van Duyn (1995) found that during off-seasons, expense was one perceived barrier to fruit intake. Other researchers have also found price to be a factor influencing food choices (LSRO 1995; Betts et al. 1995; Lennernas et al. 1997; Devine et al. 1998; Glanz et al. 1998). However, according to a national survey of family meal planners cost was indicated by only 9% (n=930) as the most important meal planning attribute (National Pork Producers Council 2000).

The men in this study indicated convenience as a factor in relation to eating fruits and vegetables. The men mentioned having to prepare these foods (e.g. vegetables) as a hindrance to getting adequate servings, especially for those who ate away from the home during the day. Some comments included "with vegetables unless it's celery or carrots, you have to cook them so you have to plan a meal," and "these foods are just not as handy." Some comments indicated that men chose certain fruits over others due to convenience, "you don't have to peel it," and fruits over vegetables because "you can pick it up, grab it, and peel it," and "it's easy to eat, easy to fix." Other studies have found ease of preparation to be an important factor when selecting food (LSRO 1995; Betts et al. 1995; Dittus et al. 1995; Heimendinger & VanDuyn 1995; Glanz et al. 1998). Convenience seemed to be less of a concern for the wives although they were the main people purchasing and preparing foods. This is likely due to the traditional ideal that women in this age group probably expect to perform these tasks for their husband (Umberson 1992; Depner & Verbrugger 1980; Depner & Ingersoll-Dayton 1985). In addition, women in this age group (> 54 years) do not work outside the home (Hayghe 1997) and are not constrained by the hectic schedule associated with working. However, a comment by one wife, "I rarely cook anything that takes a long time, with just the two of us there's no need to prepare a large meal" indicated that convenience may be a factor simply because of the amount of food that needed to be prepared. Primary meal planners from a national survey indicated only 15% thought convenience was the most important meal planning attribute (National Pork Producers Council 2000).

The perceived lack of availability of fruits and vegetables in restaurants was an additional effect of the environment. The men and their wives both indicated that men would eat fruit, vegetables, and grains if they were served with the meal, however comments such as "they're just not served...and if they are they're not always good and properly prepared" and "there's never that many on the menu" indicated that these men and women felt that this limited their intake.

Even when making a choice about increasing consumption of folate, convenience was a factor. When asked to choose between a vitamin supplement, increasing daily consumption of fruits and vegetables, or eating a serving of fortified cereal daily to increase their intake of folate, the men and their wives overall made different choices.

The men most often selected the supplement and their wives thought their husbands would choose the fortified cereal. The men's comments regarding the supplement were "you can just take the pill and not have to worry about what to eat," and "it would give me a guarantee every day that I would get it." Simplicity seemed to be a priority for the men, although cereal was a primary grain food for most of the men. On the other hand, their wives comments suggested cereal would be easier 'because he eats cereal anyway," "he likes it [cereal]." The women were more concerned about him getting folate from "natural foods" rather than a supplement. One women even suggested her husband would eat cereal because "that's what I'd give him."

Another powerful influence for these men is their social environment. Social support systems such as their spouse and/or a health professional were indicated frequently by both the husband and their wives as ways to influence these men to increase their consumption of folate rich foods.

The spouse was mentioned by over half of the men as the best way to get him to change something about his diet. Comments such as "women are in charge," "talk to our wives, girlfriends, fiancés" indicated that they felt like the health decisions were left up to their spouse or significant other. Other men depended on their wives to influence them by being willing to eat whatever was prepared; "I expect it [what I eat] would come back to one person, the cook, she pays more attention [than I do] she reads food articles, recipes," and "she has a lot to do with it [what I eat]-it's [I eat] whatever she puts in front of me.' Other men felt like it was their wives' responsibility to inform him about food related decisions, "if the spouse takes responsibility, she'd solely move things [decisions about what I eat] around," or "if she likes it [a certain food], I get used to it, I'll like it, and I'll keep doing it."

The wives seemed to agree that they were influential. When asked how to get their husbands to change their eating habits one women simply responded "me." Others responses "he'll eat whatever I give him," and "I'd have to prepare it for him" showed that they also feel responsible for influencing their husband's food choices. Other research has shown the spouse to be a primary social support in relation to health behavior decision-making (Padula 1996; Broman 1993; Umberson 1987; Umberson 1992).

The other frequently mentioned support member was the physician. One man indicated that "a stern lecture from the doctor" might influence him to change an eating behavior. Comparing other methods of increasing folate, comments such as "you'd feel better if you were given advice by somebody who really knows, that would have more affect than reading or hearing it,' and "probably the most impressive is if your doctor told you" indicated that they trust their doctors over other sources. Their wives also indicated that a health professional might be influential to their husband with comments such as "if the doctor told him, maybe he'd do it." Similarly, The Nutrition and You: Trends 2000 survey conducted by the American Dietetic Association revealed that Americans named doctors (92%) among their most valued sources of nutrition information (American Dietetic Association 2000). In a United Kingdom study of 1700 adults, 53% said that a conversation with their general practitioner was a source of advice they trusted for nutrition information (Buttriss 1997).

Another frequently mentioned influence of food intake was the media. The media can convey nutrition information through advertisements, articles, or program content. The wives suggested magazine articles and books about health as an influence on their husband, with comments such as "he always reads things on health all the time." However, these were not frequently mentioned by the husbands as convincing sources of information, except perhaps indirectly through their wives (e.g. the wife sees an advertisement on television and then buys a new product). When the wives were asked where they got most of their health information they most frequently mentioned magazine articles and books about health, the newspaper "health section", and television, and to a lesser extent pamphlets from the health food store. A national survey of primary family meal planners named magazines and newspapers (80%) as one of the most popular source of nutrition and health information followed by television (55%) (National Pork Producers Council 1999). Other research shows that 22% of consumers felt the media was the most believable information source (Pitman 2000). Most adults in the United Kingdom obtained health information from the television (57%), however only 15% described the information as useful (Buttriss 1997). A 1998 March of Dimes Gallup poll revealed that 19% of the respondents reported learning about folic acid from television (Centers for Disease Control 1999). Reed et al. (1998) found media outlets to be a source of nutrition information for Vietnamese women now living in the United States. Much like the women in our survey, The Nutrition and You: Trends 2000 survey done by the American Dietetic Association revealed that Americans' primary sources for nutrition information are television and magazines (American Dietetic Association 2000). A Federal Trade Commission report revealed that fat and cholesterol intake improved rapidly after firms began to place emphasis on the nutritional value of their food products in advertising (Ippolito & Mathios 1996).

<u>Reinforcements</u>

Reinforcements are the effects of behavior that decrease or increase the chances of reoccurrence (Baranowski et al. 1997). Personal preferences, which included taste, were a strong theme in relation to purchase of fruits, vegetables, and grains. Taste was more often mentioned as a positive reinforcement than a negative one. Men often stated "what tastes good" as a means of deciding what to purchase and eat. Remarks were made that season-related quality of fruits, especially during the summer months, influenced preferences for fruit. Published research has found the perception of taste to be significantly related to fruit and vegetable intake (Devine et al. 1998; Krebs-Smith et al. 1995; Betts et al. 1997; Keim et al. 1997; Glanz et al. 1998) and overall food choices (Betts et al. 1995; LSRO 1995; National Pork Producers Council 1999, 2000; Glanz et al. 1998).

For the wife, when asked what influenced preparation of foods at home, the husband's likes/wants was reinforcement for increasing the likelihood of preparing certain foods. The wives indicated that "a combination of his likes and mine," or "what he's in the mood for," or "a meal he just really likes" were strong indicators of what was prepared. Family preference was named by 38% of family meal planners in 1999 and 29% in 2000 as a major motivator in meal planning (National Pork Producers Council 1999; 2000).

Another reinforcement that increased the chance of purchasing and eating certain foods was habit. Men and women both mentioned habit as a reason they purchased certain fruits, vegetables, and grains each time they went to the store. The following is one statement by a wife that illustrated this, "I have a list, usually the same foods with just a few variations, we tend to buy the same things." Other studies have found the perception of habit of eating certain foods to be related to intake (Betts et al. 1997; Keim et al. 1997).

Expectations

According to the Social Cognitive Theory, each individual holds expectations or beliefs about likely outcomes of a particular behavior (Baranowski et al. 1997). Many of the participants expected certain foods to provide a health benefit and therefore chose to eat those particular foods. Health benefits of fruits, vegetables, and especially grains were positive factors mentioned when indicating which of these types of foods to purchase and prepare. Men indicated that they chose a variety of foods but health was a factor as indicated by this statement "most everything [we cook] is more for health than it is taste." Other comments "I need fiber in my diet," and "we think the whole wheat is more nutritious" indicated that men chose grain foods specifically for health reasons. Wives tended to associate healthy foods with particular nutrients. Women said they chose fruits and vegetables "because of the vitamin content," or didn't choose particular grain foods due to "the fat content," or "because he has high cholesterol…so I keep it [fat] pretty low."

Other research has identified health benefits to be an important factor that influences food choices (Betts et al. 1995; Lennernas et al. 1997; LSRO 1995; Cheadle et al. 1995; Glanz et al. 1998). Healthy eating is more important to family meal planners than it was five years ago for 59% of family cooks and as a result, almost all (93%) of those cooks say they have changed the way they prepare meals because of concerns about healthy eating (National Pork Producers Council 1999). Consumers believe a way to improve or maintain their health is by eating more fruits and vegetables (Pitman 2000). Eighty-three percent of family meal planners from a national survey who say they are eating healthier these days say they are eating more fruits and vegetables (National Pork Producers Council 1999). However, Betts and colleagues (1997) failed to find healthy perceptions to be related to the frequency of intake and Keim et al. (1997) found actual selection of fruits and vegetables to be influenced less by healthy and fattening perceptions than by other factors.

Fears from a health crisis were expectations that motivated dietary change. In our study, persons who experienced diet-related health problems themselves or had a family member with health problems related to diet seemed to be more aware of and concerned with food selection. They appeared to be more motivated to make and maintain dietary improvements than individuals who had not had a personal experience with diet related illness. When asked for the best way to influence men about health related dietary changes, health crisis was a common theme. Comments reflecting this included "I think after you get sick, it's going to have a lot more influence like when your blood pressure gets high…then you'll listen," and "when you get hit upside the head and have a heart attack or something." Devine et al. (1998) found that health status of participants influenced their food choices. Dittus et al. (1995) found that perceptions of a susceptibility to cancer were positively correlated with healthy nutrition behavior, indicating that a fear of disease may encourage intake of healthier foods. Data from the 1989-91 CSFII/DHKS indicated that those who were aware of diet and health relationships were more likely to consume a diet following recommendations (Guthrie & Derby 1999).

Observational learning

The observational learning construct of the SCT refers to learning by observation of other's actions (Baranowski et al. 1997). The men were not asked about specific influences on their actions as an adult, however when answering the question about the best way to influence men about eating habits "teach them when they're young" was a common response given by the men. Comments in support of this were "they have to be encouraged by their mothers, when they're growing up," and "as a child you get used to them (healthy foods), you like them, you keep eating them." Other men suggested that their current food intake is influenced by what they were fed as a child with statements such as "we were raised eating this way." These statements indicate that the participants felt like food habits from childhood might carry over into adulthood, similar results have been found by other researchers (Russell 1999). Devine et al. (1998) and Krebs-Smith et al. (1995) found early childhood food exposure influenced food choices.

Behavioral capability

Behavioral capability construct identifies the knowledge and skill to carry out a particular action (Baranowski et al. 1997). While some of the men and their wives had heard of folate, we found a general lack of knowledge about its role in preventing cardiovascular disease. A few of the respondents had heard of folate's relationship with birth. In general, when asked if they had heard of or knew anything about folate or folic acid the responses were "I have heard of it but I don't know that much about it," or "I don't know what I've heard, I just know about it," or "I know you need it, but I've never given it much thought." Other research has found a lack of knowledge about folate to be typical of many women (Kloeben & Batish 1999; Perez-Escamilla 1995; Centers for Disease Control 1999).

In addition, behavioral capacity regarding about the amounts of foods high in folate to include in their diet was unclear to these men. Men in our study perceived their diets to already be adequate in fruits, vegetables and grains, which may further limit increased consumption. Statements included "I get enough," and "I eat some every day." Our study found that most of the men and women did not know the correct number of servings recommended for fruits and grains, and almost half of the men and a quarter of their wives did not know the number of daily servings recommended for vegetables. Other researchers have found that many individuals do not know the correct number of grain servings to consume (Guthrie & Derby 1999; Morton & Guthrie 1997), and fewer than 10% of older adults consume the recommended daily grain servings, 40% of males consume recommended vegetable servings, and 48% consume recommended fruit servings (Foote et al. 2000).

There were limitations to our study. The subjects in our study were a convenience sample that limits the generalizability of our results to the overall U.S. population. These results may only apply to older men of similar backgrounds. In addition, the inductive analysis used in this study opens the door for researcher bias. However, great effort was made to be honest and accurate when analyzing and reporting the data. Finally, reported influences do not necessarily correlate with "true" influences on food choice.

Despite limitations, this research provides important insights into individual perceptions of influences on food choices and the many personal and environmental factors that were important to this group of older men. From this research we can see that being married and eating cereal are two important indicators for getting adequate folate intake. In addition, we saw that supplementation was not necessarily being used by those who need it. Including the spouse in nutrition education efforts for those who are married and further emphasis on including cereal as a part of healthy breakfast may be used to enhance efforts to promote adequate folate intake.

Secondly, nutrition education materials and programs should not only include the importance of food choices to diet-health relationships but also address recommendations and the need for changing the diet. The men in our study were aware of the general need to consume fruits, vegetable, and grains in the diet; however, many of them underestimated the need for these foods and felt there was no need to eat any more. Education about recommended intake, and promoting the need for folate and the reasons it affects older men may better serve this age group.

In addition, nutrition educators should address the issues related to what men felt were barriers to consumption of fruits, vegetables, and grains. Nutrition education programs should promote nutritious diets as being tasty and inexpensive. By highlighting the health benefits of fruits and vegetables, promoting the added benefits of grain foods and discussing alternate choices of fruits and vegetables during off-seasons, these men would likely be willing to choose a wider variety of these foods. One way to get older men to eat more fruits, vegetables and grains is to suggest convenient ways to include them in the diet. Including the wife in discussions about fast and practical means of incorporating fruits, vegetables and grains into busy lifestyles would most likely result in these foods being more accessible to the husband.

More research is needed to determine what could motivate men to change their diet for health prevention before they experience a health crisis. The identification of motivators will help create more effective interventions for promoting and sustaining dietary behavior changes for older men and their wives.

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Table 4.1 Dietary intake of older men (n=40) as estimated by 4-day diet record and FFQ

Nutrient	4-day diet record*	FFQ*
Total energy (kcal)	1935 ± 449[a]	1628 ± 644[b]
Total fat (grams)	66 ± 28	60 ± 29
Saturated fat (grams)	23 ± 12	21 ± 10
Cholesterol (mg)	245 ± 127	256 ± 168
Folate (μg)	421 ± 144	404 ± 160
Vitamin B-6 (mg)	2.2 ± 0.7[a]	1.9 ± 0.8[b]
Vitamin B-12 (mg)	5 ± 3	NA

*Plus-minus values are means ± SD
[a,b] Different superscripts indicate significant differences between columns using paired *t*-test ($p < .05$).

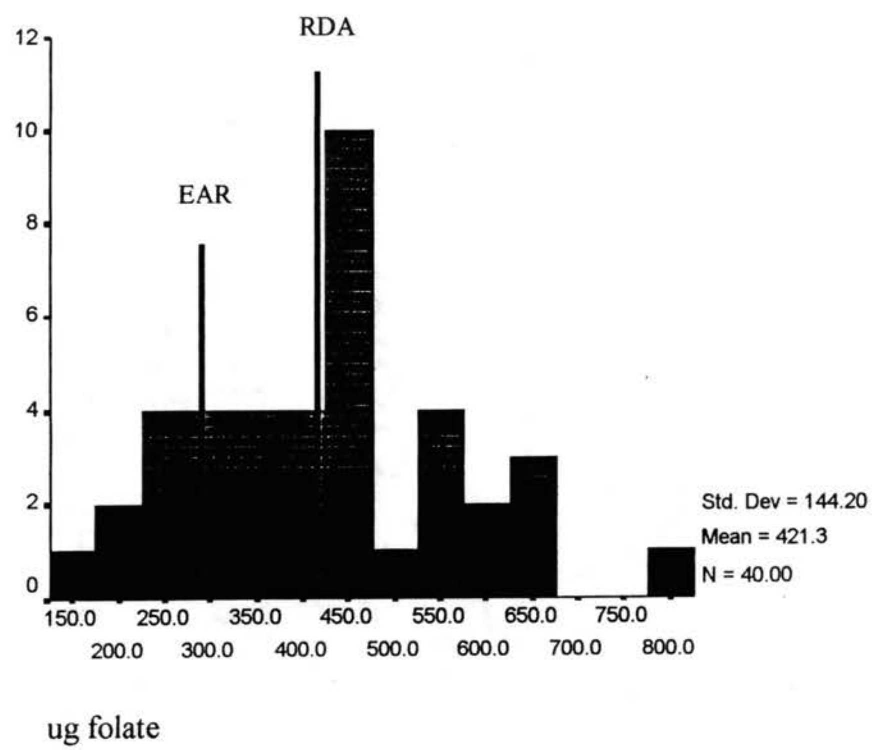

Figure 4.1 Distribution of dietary folate intake by older men (n=40). The Estimated Average Requirement (EAR) and Recommended Dietary Allowance (RDA) for folate are indicated.

Table 4.2 Differences in dietary intake of folate of older men by characteristic

Demographics	no.(%)	Dietary folate*	p
Race			
White	38 (95)	422 ± 143	NS
Other	2 (5)	407 ± 218	
Marital Status			
Married	35 (88)	442 ± 137[a]	.014
Other	5 (12)	276 ± 110[b]	
Employment			
Full-time	22 (55)	427 ± 146[ab]	.055
Part-time	2 (5)	642 ± 24[a]	
Retired	16 (40)	385 ± 127[b]	
Education			
High school	5 (12)	414 ± 215	
College	6 (15)	341 ± 112	NS
Graduate	6 (15)	524 ± 80	
Take vitamin supplement			
Yes	35 (88)	433 ± 143	NS
No	5 (12)	345 ± 144	
Take folate containing supplement			
Yes	14 (35)	475 ± 162	NS
No	26 (65)	392 ± 128	

*Plus-minus values are means ± SD

a,bMeans with different superscripts indicate significant differences in columns ($p<.05$).

Table 4.3 Themes that influence purchase the of fruits, vegetables, and grains for older men+

Influences	Fruits		Vegetables		Grains	
	Men*	Wives*	Men*	Wives*	Men*	Wives*
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Season	27(68)	5(25)	9(23)	1(5)	4(10)	1(5)
Taste	7(18)	5(25)	13(33)	4(20)	11(28)	3(15)
Habit	10(25)	4(20)	11(28)	4(20)	15(38)	2(10)
Personal preference	17(43)	12(60)	15(38)	11(55)	8(20)	6(30)
Price	12(30)	3(15)	1(2.5)	1(5)	3(7.5)	--
Perceived health benefit	16(40)	5(25)	9(23)	3(15)	16(40)	10(50)

+Column totals may be higher than 100% because participants could give more than one response
*n=40 men; n=20 wives

CHAPTER V

THE EFFECT OF FOLIC ACID FORTIFIED BREAKFAST CEREAL ON PLASMA HOMOCYST(E)INE LEVELS IN OLDER MEN

Department of Nutritional Sciences, College of Human Environmental Sciences

Oklahoma State University

Stillwater, Oklahoma 74078

Abstract

Considerable research has shown that a high plasma homocysteine (hcy) level in the blood is an independent risk factor for cardiovascular disease. Folic acid supplementation reduces levels of plasma hcy. The effects of nutrition education and a high folate diet on plasma hcy were studied in 41 men $\geq$ 58 years old. Subjects were randomized into either an experimental (n=21) or control (n=20) group. Subjects randomized into the experimental group were provided with super-fortified ready-to-eat cereal (400 μg) daily for 8 weeks, and given targeted nutrition education. Subjects in the control group were given general nutrition education only. All subjects completed a food frequency questionnaire at baseline, provided unannounced 24-hr dietary recalls by telephone during weeks 3, 7 and 19, and five-day food records at baseline and weeks 8 and 20. Blood samples were collected from all participants at baseline, 4 weeks, the end of the intervention period (8 weeks) and 3 months post intervention (20 weeks). Folate intake of participants at baseline was similar to recommended levels (436 $\pm$ 204 μg/day). Once the

experimental group was given the fortified cereal their intake of folic acid increased above recommended amounts, however immediately after the intervention period ended it dropped back to baseline levels. Serum folate in the experimental group was significantly higher at week 20 than at baseline. Plasma hcy did not differ significantly over time between groups. Lower hcy and normal serum folate concentrations in the experimental group at baseline may have reduced the hcy lowering potential of the dietary treatment. It is possible that fortification of grain products in the food supply had already had an effect in this group of men. We conclude that subjects with lower hcy levels who are already eating cereal regularly may not benefit from consuming folate above recommended levels.

Introduction

Considerable research has shown that a high homocysteine (hcy) level in the blood is an independent risk factor for coronary artery disease (CAD) (Verhoef et al. 1997; Verhoef et al. 1996; VonEckardstein et al. 1994; Genest et al. 1990; Pancharuniti et al. 1994; Lussier-Cacan et al. 1996). A study involving the elderly Framingham Study population demonstrated a twofold increase in all-cause cardiovascular disease mortality among those in the highest quartile of hcy compared with those in the lowest hcy quartile (Bostom et al. 1999). Homocysteine appears to be similar to cholesterol in that there is, as yet, no known threshold for the atherogenicity of this amino acid, so that the higher the plasma hcy the greater the risk, even within the normal reference range (Boushey et al. 1995; Nygard et al. 1995). Folic acid supplementation has been shown to reduce levels of plasma hcy (Brattstrom et al. 1994; Landgren et al. 1995; Malinow et al. 1997; Ubbink et al. 1994).

In 1998, the FDA began requiring that all producers of enriched fortified cereal grain products add folic acid to their products (Food and Drug Administration 1996). The FDA allows up to 400 μg (100% of the daily value) to be added to ready to eat (RTE) cereals. Most cereals provide 25% or 100 μg of the RDA; however, highly fortified cereals provide 400 μg of folic acid per serving (Albertson & Marquart 1999). The level of fortification recommended by the FDA (140 μg/ 100 g) was estimated to increase folic acid intake by 70 to 120 μg in adults over 50 (Malinow et al. 1998). Prior to fortification most Americans consumed less folate than 400 μg/day, the current RDA (Institute of Medicine 1998) and the amount that is recommended to reduce the risk of heart disease (Selhub et al. 1993; Subar et al. 1989). Since fortification, intake of grain products enriched with folic acid has been associated with an improvement in folate status (Jacques et al. 1999; Cuskelly et al. 1999; Schorah et al. 1998; Malinow et al. 1998). Three studies demonstrated that folic acid fortified breakfast cereals produced a modest reduction in hcy over a relatively short time (Malinow et al. 1998; Schorah et al. 1998; Riddell et al. 2000).

The objective for this research was to investigate the effects of nutrition education and a high folate diet on homocysteine in older men. Men in the intervention group participated in nutrition education built upon the social cognitive (social learning) theory (Bandura 1986) and an anthropological theory of food patterning, (Bennett 1942; Jerome 1976) and consumed highly fortified RTE cereals.

Methods

Subjects

Participants in this study were 41 men ($\geq$ 58 years of age) with no known serious medical condition who were not taking supplements that contained folic acid or medications known to affect hcy (e.g. methotrexate, anticonvulsant agents, bile acid sequestrants). In order to participate, potential subjects who were taking a folic acid containing supplement completed a 12 week washout phase in which they discontinued taking any folic acid containing supplements. Men with a variety of socioeconomic backgrounds were recruited locally. All subjects gave informed consent and the study was approved by the Institutional Review Boards at Oklahoma State University and Oklahoma Medical Research Foundation. Subjects were enrolled starting in October 1999 and data collection ended in June 2000.

Study Design

At recruitment, all subjects provided demographic, medication and supplement data, completed a 24 hr diet recall, and started four 1-day food records. All subjects were given complete instructions and food record supplies (measuring cups, spoons, and beanbag standard measures) to increase the accuracy of their record (Chambers et al. 2000). All subjects then completed a semiquantitative food frequency questionnaire (FFQ) (Block et al. 1990). At baseline, approximately 1 week after the first visit, subjects returned the food record and were randomized into either the experimental (n=21) or control (n=20) group. Blood samples were taken at baseline, on weeks 4 and 8, and three months post-intervention (week 20). A trained interviewer obtained unannounced 24-hour dietary recalls by telephone during weeks 3, 7, and 19, and subjects completed 5-day food records after completion of the study (about week 8), and 3 months post intervention (week 20). Food records and recalls were analyzed using the dietary software program Food Processor (version 7.4, ESHA Research, 1999).

Nutrition Education

Subjects in the experimental group were instructed on ways to increase folate in their diet using behavioral constructs from the social cognitive theory including how to choose high folate foods from a restaurant menu and how to interpret the amount of folate from a food label. Subjects were also given a self-monitoring folder that contained an individualized "folate in foods" counter and a more extensive general list of folate containing foods. The counter consisted of a list of the amount of folate provided by each subject's core and secondary core foods (Jerome 1976) that was developed from their initial food frequency questionnaire. They also received a self-monitoring log to record the amount and type of folate-containing food consumed. The dietary information was reinforced at the 4 week visit, and additional encouragement and information was provided at the 8 and 20 week visits using the 4 week and 8 week 5-day diet record analyses.

Participants in the control group were instructed on a healthy diet using the Food Guide Pyramid (National Live Stock and Meat Board 1993). A handout regarding increasing fruit, vegetable, and grain consumption was also provided (Nutrition Update

2000). They were not provided with cereal or a self monitoring folder. The dietary information for both groups at each of the visits was provided by a Registered Dietitian (TSH).

Fortified cereal

The fortified RTE cereals provided for participants in the experimental group contained 400 μg of folic acid plus 100% Daily Value (DV) (Lee & Nieman 1996) for other vitamins and minerals including vitamins B-6 (2 mg) and B-12 (6 mg). Subjects were asked to consume the cereal daily for 8 weeks in addition to their usual diet. Subjects were given approximately 30 packets of pre-measured cereal at both the baseline and 4 week visits. Each packet contained one serving by weight as indicated on the Nutrition Facts label of either: General Mills Total Raisin Bran™; General Mills Whole Grain Total™; General Mills Multigrain Cheerios Plus™; or Kellogg's Smart Start™. To increase compliance, subjects were allowed to choose their cereal. At both the 4 and 8 week visits, the empty and remaining packets of cereal were returned and counted for an assessment of compliance.

As an alternative to eating the cereal, the subjects were taught how to choose an equivalent amount of folate using a point system. Subjects could choose foods that equaled 10 points (each point was equivalent to 40 μg folic acid) from the individualized list of folate-containing foods developed from their initial FFQ. If the subjects chose to eat foods with naturally occurring folate (i.e. legumes, fruits, vegetables) instead of the fortified cereal they were required to consume 40% more folate due to the difference in bioavailability of naturally occurring vs. synthetic folic acid in the fortified cereal (Bailey

1998). Foods chosen and corresponding point values were recorded using their self-monitoring logs. The logs were reviewed to evaluate compliance at the week 4 and 8 visits.

Biochemical Analyses

At each visit, blood samples (after 10-12 h fast) were collected in Vacutainer tubes; one containing EDTA for plasma collection and one untreated for serum samples. The plasma was processed immediately at 3000 rpm in a refrigerated centrifuge at 4° C, and frozen in aliquots at –20° C. The processed plasma was used for analysis of plasma total homocysteine by high performance liquid chromatography and fluorescence detection using minor modifications of the methods of Vester and Rasmussen (1991) and Ubbink et al. (1991). The intra assay CV of the internal standards was 1.96%. Additional plasma aliquots were used to analyze the ferric reducing ability of plasma (FRAP) and creatinine using Roche reagents in a COBAS Roche FARA II chemistry system. FRAP provides an estimate of "antioxidant power" (Benzie & Strain 1996). Creatinine was measured because it has a positive relationship with hcy (Tonstad 1997). The intra assay CVs of the internal controls were 1.7% and 1.1%, respectively.

Serum tubes were stored on ice for 30 minutes to allow clot formation before being centrifuged and frozen at –20° C. Serum was analyzed for serum folate, vitamin B-12, and erythrocyte (RBC) folate by radioimmunoassay (Cobra II, Auto-Gamma Counter; Packard Instrument Co.) using the Dualcount Solid Phase No Boil Assay (Diagnostic Products Corporation 1999). The inter assay CVs for anemia controls were 6.4% for folate, and 9.6% for B-12. All samples were thawed only once for analysis.

Data Analysis

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) 10.0 for Windows (SPSS Data 2000). Sample size was estimated using data from O'Keefe et al. (1995) in Hall's (1983) method. One sample *t*-tests were used to determine if subjects met the estimated average requirement (EAR) and RDA (Institute of Medicine 1998) for folate, vitamins B-12 and B-6. Analysis of variance (ANOVA) was used to compare the groups on dietary folate intake. Repeated measures analyses of variance were used to determine if there were changes in dietary folate, hcy, serum folate, serum vitamin B-12, erythrocyte (RBC) folate, and FRAP over time and/or by group. Least Significant Difference (LSD) or Bonferroni post hocs were performed to adjust for multiple comparisons. The baseline measure was used as a covariant if there was a significant difference in baseline measures between the groups. Linear regression was used to determine if there were associations between hcy concentration and biochemical and dietary variables. The selection of variables for correlation was based on those shown in previous studies to be significant determinants of hcy concentration. Variables chosen were folate intake, coffee consumption, smoking status (Nygard et al. 1998), total cholesterol, HDL cholesterol, serum vitamin B-12, serum folate (Lussier-Cacan et al. 1996), vitamin B-6 intake(Verhoef, et al. 1996), RBC folate (Zittoun et al. 1998) and serum creatinine (Tonstad 1997; Brattstrom et al. 1994; Lussier-Cacan et al. 1996). Independent sample *t*-tests were used to compare biochemical measures for differences between groups at the follow-up visit (3 months post-intervention). Logarithmic transformations of the variables were performed as needed to improve normality. Data are reported as mean $\pm$ standard deviation. Differences were considered statistically significant at the $p \leq 0.05$ level (Steel & Torrie 1980).

Results

Characteristics for the two groups of subjects at entry were similar. There were no significant differences between groups for any of the demographic characteristics (Table 5.1). Reported dietary intakes are shown in Table 5.2. Men's estimated intake of energy ranged from approximately 1850 to 2200 kcal/day throughout the study period, and total fat intake resembled that of the "typical" American diet (approx. 33-35% of calories). There were no significant differences in energy or fat intake between groups or over time.

Analysis of the diet records for both groups indicated that estimated mean intake of folate at baseline was 436 $\pm$ 204 µg/day which was not significantly different from the RDA of 400 µg daily at any of the measured times. However, folate intake estimated by the diet record was significantly higher than the EAR at baseline, 8 weeks, and 20 weeks (p=.001, .008, .002, respectively). Even so, 35.5% of the men did not meet the estimated average requirement (EAR) of 320 µg/day and an additional 16% did not meet the RDA. Analysis of 24-hr. recalls revealed than folate intake at week 3 was significantly higher than the RDA (p<.001), and folate intake at weeks 3, 7, and 19 was significantly higher than the EAR (p<.001, .001, .024, respectively).

Repeated measures analyses revealed a significant (p=.001) time by group interaction for dietary folate. Folate intake in the experimental group was significantly higher than controls at week 3. Intake at week 3 in the experimental group was significantly higher than at baseline, weeks 8, 19, and 20, and intake at week 7 was higher than at baseline and week 8 ($p < .05$). Folate intake in the control group did not change significantly over time (Table 5.2 or Figure 5.1).

Mean intake for vitamins B-12 and B-6 exceeded the RDA (2.4 μg and 1.7 mg, respectively) (Institute of Medicine 1998) for this age group throughout the study. There was a significant time by group interaction ($p=.013$) for intake of vitamin B-12. Week 3 intake was significantly higher than at baseline for the experimental group ($p < .05$). There was a significant interaction ($p=.000$) for dietary intake of vitamin B-6. (Table 2). Vitamin B-6 intake in the experimental group was significantly higher than controls at week 3. Intake at week 3 in the experimental group was significantly higher than at baseline, weeks 8, 19, and 20, and intake at week 7 was higher than at baseline and week 8 ($p < .05$). Compliance with cereal-consumption instructions, estimated from returned breakfast cereal packets plus logs of consumption of other folate-containing foods, ranged from 79 to 100% the first month, and 80 to 100% the second month.

The mean hcy concentration of the entire study group was 14.5 $\pm$ 4.6 μmol/L (range: 8.3-28.5 μmol/L) at baseline. All participants had concentrations of serum and RBC folate and serum vitamin B-12 that were within or above their respective reference ranges (3-17 ng/mL, 175-700 ng/mL, 200-950 pg/mL) (Diagnostic Products Corporation 1999) (Lagua & Claudio 1996). Mean creatinine was within the reference range (0.6-1.5 mg/dL), however 6 subjects in the control group and 6 subjects in the experimental group had creatinine values slightly above the reference range (Diagnostic Products Corporation 1999) (Lagua & Claudio 1996).

Plasma hcy was significantly different between the groups at baseline (p=.008) therefore, baseline hcy was used as a covariant in repeated measures analysis of variance. There was no significant difference in hcy between groups over time (Figure 5.2).

Creatinine and serum vitamin B-12 were significantly correlated with hcy, 23% of the variance in hcy was explained by these variables at baseline (p=.009) (Beta=.393 p=.019, Beta=-.300 p=.048, respectively) and 39% was explained at the end of the intervention period (p<.001) (Beta=.452 p=.001, Beta=-.430 p=.002, respectively). Creatinine was positively correlated, whereas serum vitamin B-12 was negatively correlated. The other variables in the model that were not significantly related to hcy were age, smoking status, cups of coffee per day, total cholesterol, HDL, LDL, FRAP, dietary and serum folate, and dietary vitamin B-12.

Serum folate levels showed a significant time by group interaction (p=.040). Serum folate in the experimental group was significantly higher at week 20 than at baseline (p<.05) (Figure 5.3). However, serum folate was not significantly different over time in the control group. There was no significant difference in RBC folate between groups over time, although RBC folate for both groups was significantly lower at baseline, weeks 4 and 8 than at week 20 (p=.046) (Figure 5.4). Time by group interaction was significant for serum vitamin B-12 (p=.024) due to differences in pattern of intake, however no significant differences between groups or time were found (Figure 5.5). Neither FRAP (Figure 5.6) nor creatinine (Appendix S, Table 3) levels were significantly different over time or between groups. A table with data for all of the above biochemical measures can be found in Appendix S, Table 3.

Discussion

It has been known for some time that daily supplementation with 400 μg folic acid reduces hcy concentrations in healthy individuals (Malinow et al. 1997; Brattstrom 1996; Ubbink et al. 1994; Landgren et al. 1995; Homocysteine Lowering Trialists' Collaboration 1998; Riddell et al. 2000). Recently, during a relatively short (5 wk) study, Malinow et al. (1998) observed reductions in hcy of 11% and 14%, respectively, in male and female CHD patients consuming cereals fortified with 499 and 665 μg folic acid/serving. Schorah et al. (1998) observed a 10% reduction in hcy concentrations after 24 weeks, in healthy individuals whose intake of fortified or supplemental folic acid was low, when they added cereals fortified with 200 μg folic acid. Riddell et al. (2000) observed a 24% reduction in hcy concentrations in healthy subjects with hcy $\geq$ 9 μmol/L consuming an additional 298 μg/d of folic acid in fortified breakfast cereals for 12 weeks (mean intake 518 $\pm$ 136 μg folate). In the present study, the hcy lowering efficacy of folic acid fortified cereals at 400 μg/d was tested in healthy older men for 8 weeks.

For this group of men the change in hcy between groups over time was not significant. At baseline the control group had more subjects with elevated ($\geq$ 14 μmol/L) hcy levels (n=13, 65%) than the experimental group (n=7, 33.3%). Schorah et al. (1998) found that folic acid did not decrease hcy for those already in the lowest tertile for hcy, and the higher the initial hcy, the greater the folate effect. Similarly, a meta-analysis of hcy lowering trials showed that a proportionate and absolute reduction in blood hcy produced by folic acid supplements was greatest at higher pretreatment blood hcy concentrations and at low pretreatment blood folate concentrations (Homocysteine

Lowering Trialists' Collaboration 1998). Pretreatment levels of serum folate in our study were not low (range: 5.29-19.95 ng/mL). It is conceivable that the lower baseline concentrations of hcy and the normal pretreatment serum folate levels in the experimental group in our study may have reduced the hcy-lowering potential of the dietary treatment.

Schorah et al. (1998) saw an increase in serum folate at weeks 4, 8 and 24 in subjects eating fortified cereal. Similarly, Malinow et al. (1998) saw an increase in plasma folate proportionately with folic acid content of cereal. In our study, the experimental group's serum folate increased between baseline and week 4 and remained higher during the second half of the intervention (week 8) and the post intervention period (week 20). Red blood cell folate in this study, which typically takes approximately 3-4 months to respond to dietary change (Schorah et al. 1998), was significantly lower at baseline, week 4 and week 8 than at week 20 for both groups. Red blood cell folate did not change until 24 weeks in a similar study (Schorah et al. 1998). The observed increase for vitamin B-12 in this study's experimental group occurred during weeks 4 and 8 and remained higher at week 20. Schorah et al. (1998) found no significant change in vitamin B-12 over a 24-week period, even though one of the groups was eating cereal fortified with vitamin B-12 in addition to folic acid and other vitamins.

Mean dietary folate intake at baseline (before cereal consumption) for those in the experimental group was already 393 $\pm$ 140 and did not significantly increase after the intervention ended. However, mean folate intake in the experimental group increased at weeks 3 (684 $\pm$ 195 μg) and 7 (576 $\pm$ 198 μg), while the control group's intake did not change (341 $\pm$ 156 μg, 388 $\pm$ 196 μg, respectively). The high rate of compliance with daily cereal consumption suggested that most subjects in the experimental group were eating the provided cereal throughout the study, however prior to the study 76% (n=16) of those subjects were already regular cereal eaters. The cereal that was provided may have been a replacement of the cereals they were already eating, or for some the provided cereal was eaten in addition to other cereals. According to diet records, 70% (n=14) of the control group ate cereal prior to the study, 65% (n=13) ate cereal on at least 2 of 4 measured occasions, although only 3 of the cereal eaters were eating super-fortified cereals.

Most participants in the control group already ate recommended amounts of folate (404 $\pm$ 157) at baseline and continued to meet at least the EAR of 320 µg/d (361$\pm$ 165) at the end of the study period (20 weeks). The high intake of folate from food in the control group may explain why there were no differences in RBC folate and hcy between the groups over the study period. Perhaps subjects from both groups in this study had already reached a plateau of folate intake prior to the study. Fortification of grain products prior to the start of this study may have already had some effect (Keast et al. 2000; Jacques et al. 1999) Several groups have suggested a near maximal hcy lowering effect of supplemental folic acid at intakes of approximately 400 µg/d (Malinow et al. 1998, 1997; Boushey et al. 1995; O'Keefe et al. 1995; Hcy Lowering Trialists 1998).

The homocysteine-lowering ability of folic acid fortified cereals in subjects who were already consuming 400 µg folate per day was not apparent in this study. The subjects in this study were highly educated older men and the consistently high levels of folate intake throughout the study period indicated that this group was already paying attention to their diets, and may have already been aware of the health benefits of consuming adequate folate. Many of these men were already regular cereal eaters who apparently replaced their regular cereal with the super-fortified cereal only during the 8 week period. After the intervention stopped, the targeted education did not seem to increase these men's folate intake above the current recommendation of 400 μg/day. It is possible that subjects with milder elevated hcy levels who are already eating cereal regularly may require only simple dietary advice to continue to maintain plasma hcy levels in the normal range.

Future research to test the effects of folic acid fortified cereals should be conducted in a group of men who are not typical cereal eaters. In addition, blinding the subjects by using a placebo cereal may also prove to have an effect by discouraging those not asked to change their diet (non cereal eaters) from doing so. In similar studies using folic acid fortified cereals the subjects were receiving either a placebo cereal or a cereal with a different amount of fortification; so all subjects were receiving something (Schorah et al. 1998; Malinow et al. 1998; Riddell et al. 2000). Malinow et al. (1998) asked participants to replace previously eaten breakfast cereals with the placebo and experimental cereals that were provided. In this study, participants in the control group did not receive a placebo cereal, and some were aware that subjects in the other group were receiving cereal. Therefore, participants in the control group not already eating cereal may have decided to eat similar foods on their own causing a similar increase in biochemical measures of folate.

Including the spouse in the visits may have increased the effectiveness of the targeted nutrition education. Spouses, especially wives, monitor and attempt to control their partner's health behaviors (Umberson 1992), and having them present might have influenced the continued intake of high folate containing foods beyond the intervention period. Finally, recruiting subjects who would benefit the most, those who have elevated hcy levels and/or low serum folate levels, would likely show the most improvement.

Breakfast cereals are an important source of dietary folic acid (Albertson et al. 1997), and their intake is an important predictor of hcy levels (Shimakawa et al. 1997). Our investigation has expanded those findings by indicating that fortification of grain products may have already had an effect on this group of men even before intake of super-fortified breakfast cereals. Further intervention trials to find the lowest effective dose and best combination of B vitamins that lowers hcy levels is needed. More importantly, whether breakfast cereals fortified with folic acid will modify the incidence and outcome of atherosclerotic disease still needs to be established.

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Table 5.1 Characteristics of subjects at entry, according to study groups*

Characteristics	Control Group (n=20)	Experimental Group (n=21)
Age-yr	66 $\pm$ 6	65 $\pm$ 5
BMI[a]	28 $\pm$ 4	28 $\pm$ 4
Race-white (%)	100	100
Marital Status-no.(%)		
Married	14 (70)	20 (95)
Divorced	4 (20)	--
Widowed	2 (10)	1 (5)
Employment status-no. (%)		
Full time	8 (40)	9 (43)
Part time	5 (25)	3 (14)
Retired	7 (35)	9 (43)
Education level-no. (%)		
High school	4 (20)	3 (14)
Other training-no college	4 (20)	--
Some college	3 (15)	--
Bachelors degree	2 (10)	7 (33)
Masters degree	4 (20)	4 (19)
Doctorate degree	3 (15)	7 (33)
Following a special diet- no.(%)		
No	17 (85)	17 (81)
Smoke –no. (%)[b]		
No	16 (80)	17 (81)
Cups of coffee/day- no. (%)		
0-2	9 (45)	13 (62)
>2	11 (55)	8 (38)

*Plus-minus values are means $\pm$ SD

[a]The body mass index is the weight in kilograms divided by the square of the height in meters.

[b]Data on this variable was available for 40 subjects only

Table 5.2 Dietary intake of subjects at six time points based on 5-day diet records and 24-hr recalls by treatment group[++]

	Energy (kcal)	Folate (μg)	Vitamin B-12 (μg)	Vitamin B-6 (mg)	Total Fat (% energy)
Control Group:					
Baseline[a]	2079 ± 428	404 ± 157	8.05 + 6.31	2.23 ± 0.85	33 ± 8
week 3[b]	1899 ± 530	341 ± 156[+]	5.28 ± 2.55	1.77 ± 0.87[+]	34 ± 12
week 7[b]	2150 ± 470	388 ± 196	33.1 ± 83.2	2.19 ± 1.18	36 ± 9
Post 8-week*[a]	1944 ± 427	393 ± 48	6.22 ± 4.02	2.16 ± 1.10	33 ± 9
week 19[b]	1991 ± 423	341 ± 166	5.82 ± 3.90	2.05 ± 0.98	33 ± 10
week 20[a]	1924 ± 401	361 ± 165	5.91 ± 3.13	1.99 ± 0.96	33 ± 10
Intervention Group:					
Baseline[a]	1979 ± 478	393 ± 140[z]	4.98 ± 1.95[x]	2.04 ± 0.67[z]	33 ± 9
week 3[b]	1922 ± 600	684 ± 195[+,x]	11.3 ± 7.90[y]	3.44 ± 1.02[+,x]	32 ± 10
week 7[b]	1879 ± 606	576 ± 198[xy]	8.29 ± 3.04	4.24 ± 4.64[xy]	33 ± 9
Post 8-week*[a]	1855 ± 399	397 ± 112[z]	5.41 ± 2.32	2.06 ± 0.53[z]	32 ± 8
week 19[b]	1868 ± 446	456 ± 251[yz]	7.42 ± 4.64	2.44 ± 1.05[yz]	36 ± 11
week 20[a]	1919 ± 434	483 ± 194[yz]	7.22 ± 3.31	2.49 ± 0.84[yz]	35 ± 7

*8-week records were collected after the intervention ended
[++] Plus-minus values are means ± SD
[a,b] Superscript a indicates diet record, b indicates 24-hr. recall
[+]Different superscripts in a column indicate significant differences between groups (p< .05)
[xyz]Different superscripts in a column indicate significant differences between times (p< .05)

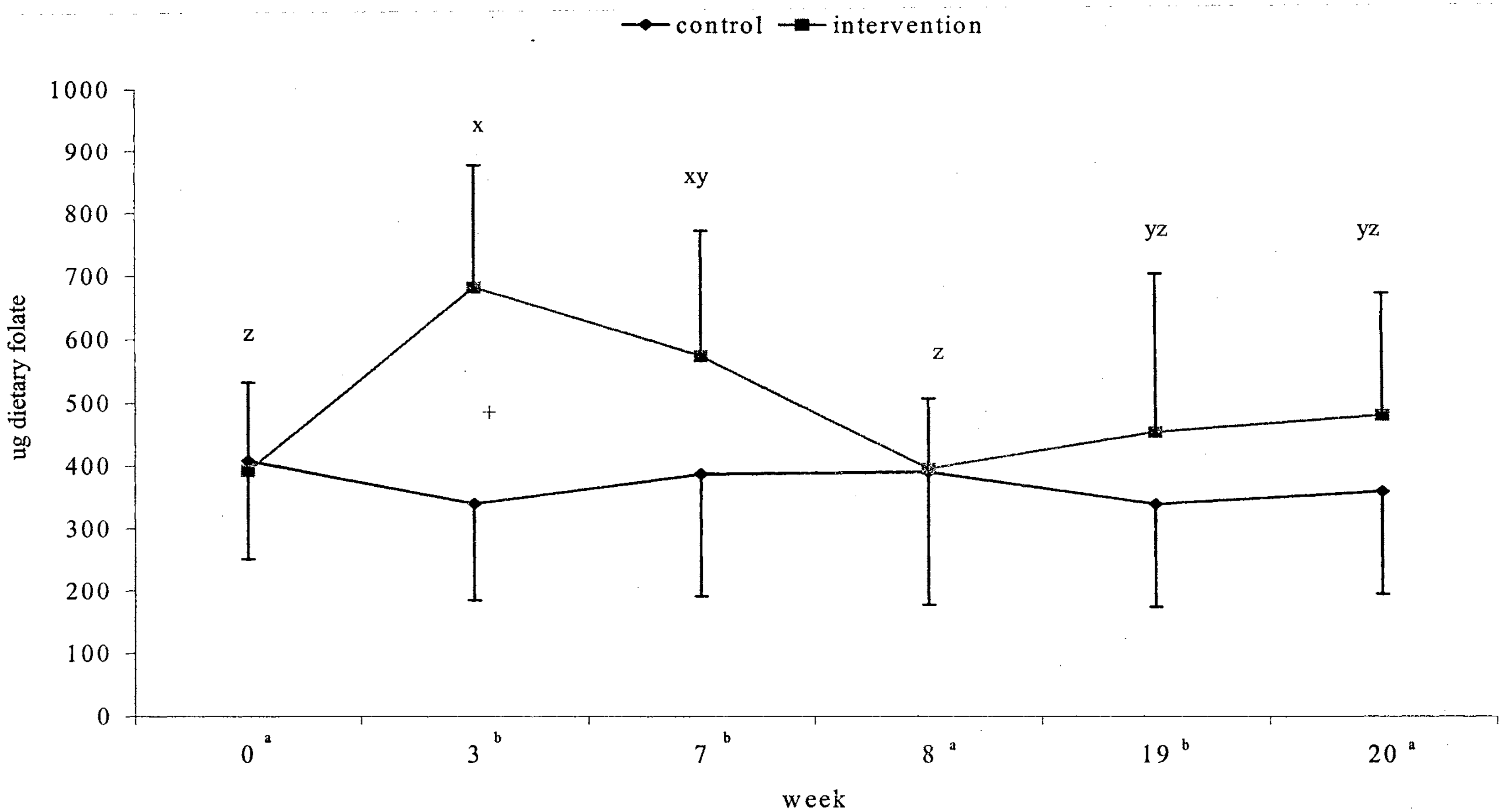

Figure 5.1 Mean (±SD) folate intake from food estimated by diet records[a] and 24-hr recalls[b]. Points with a superscript indicate means that are different between groups (+) or over time (x,y,z) for the interaction using repeated measures ANOVA.

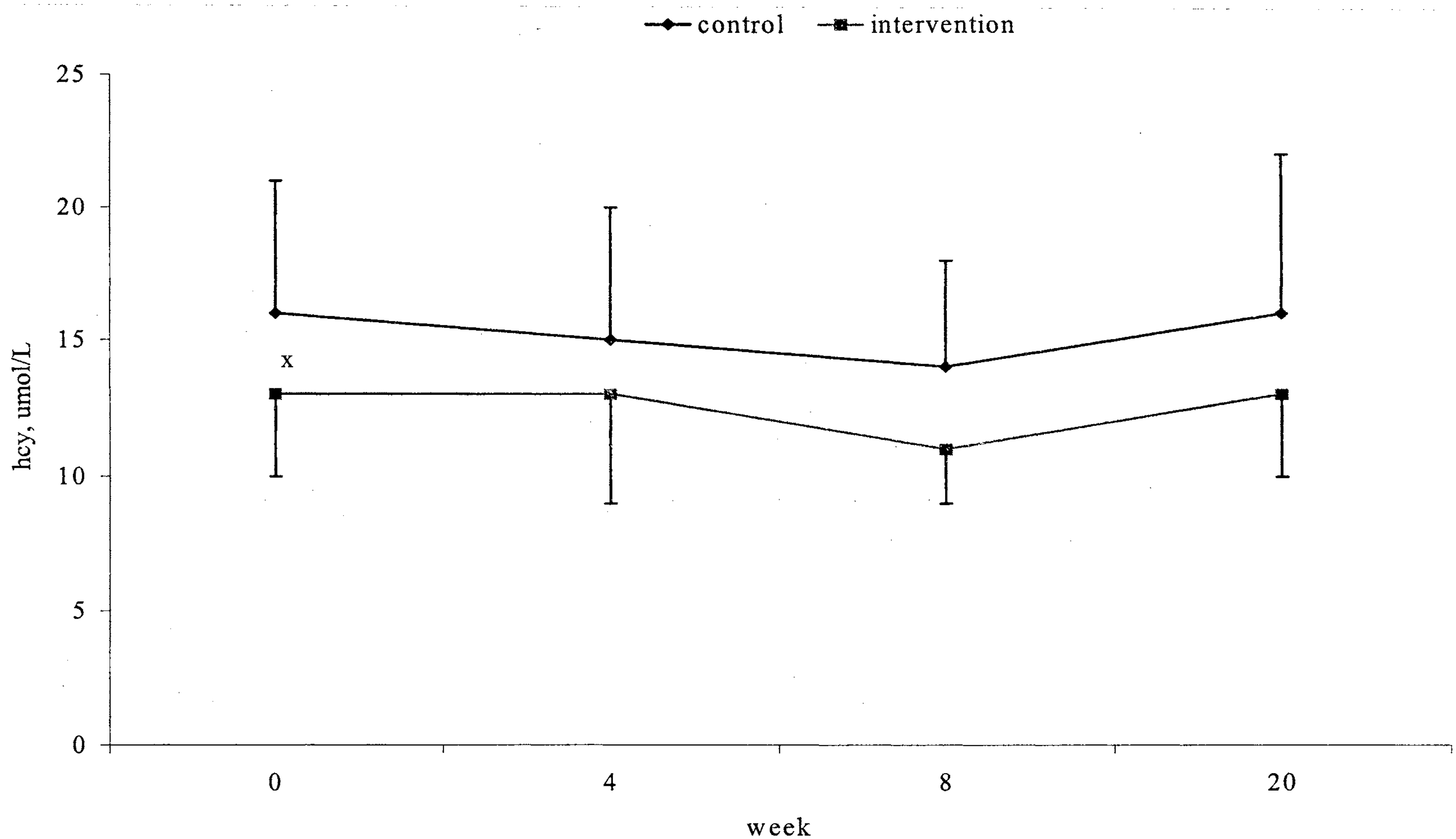

Figure 5.2 Mean (±SD) plasma homocysteine (hcy) over 4 time periods and between groups. Points with superscripts (x) indicate means that are different between the groups using *t*-test.

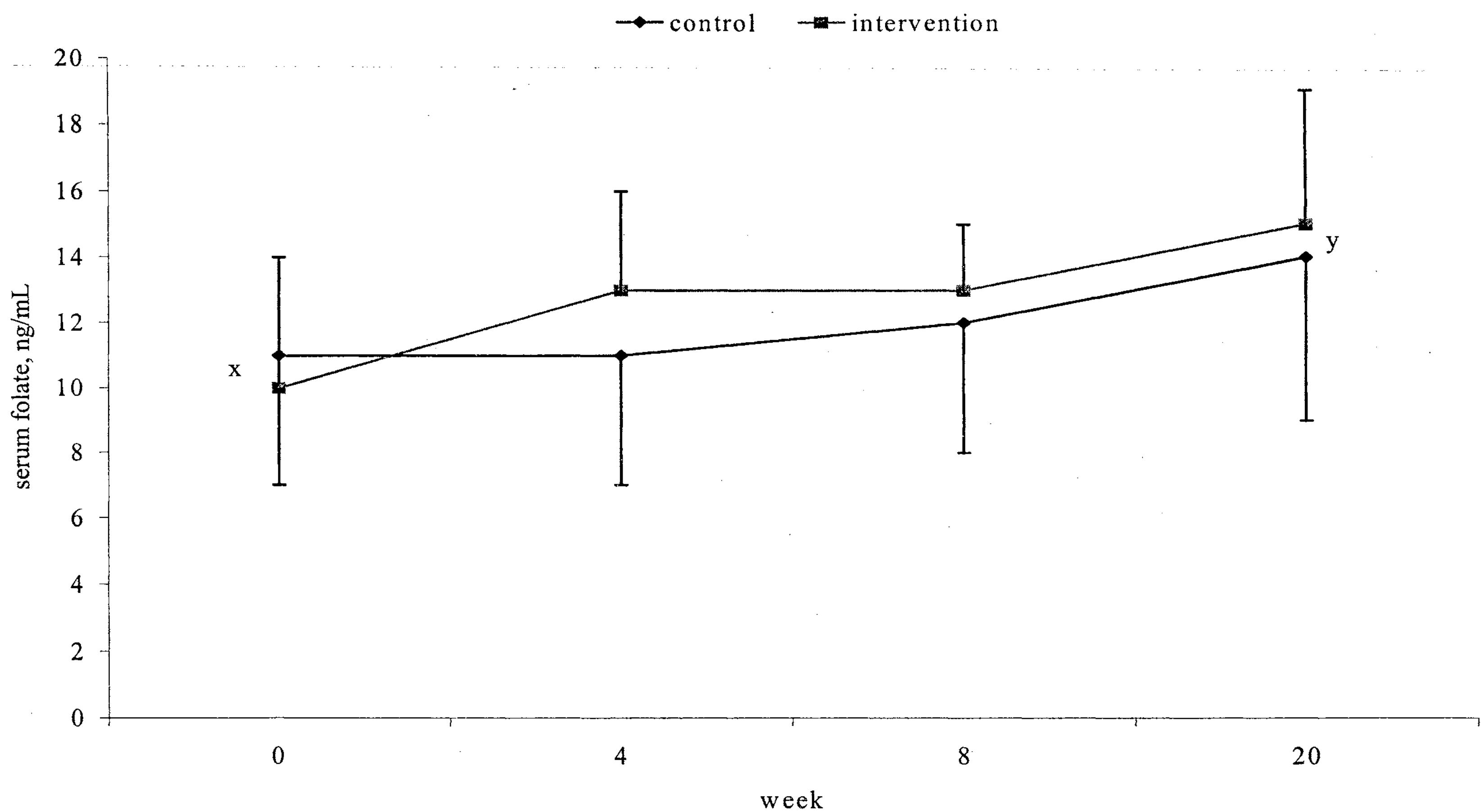

Figure 5.3 Mean (±SD) serum folate over 4 time periods and between groups. Points with different superscripts (x, y) indicate means that are different across time for the interaction using repeated measures ANOVA.

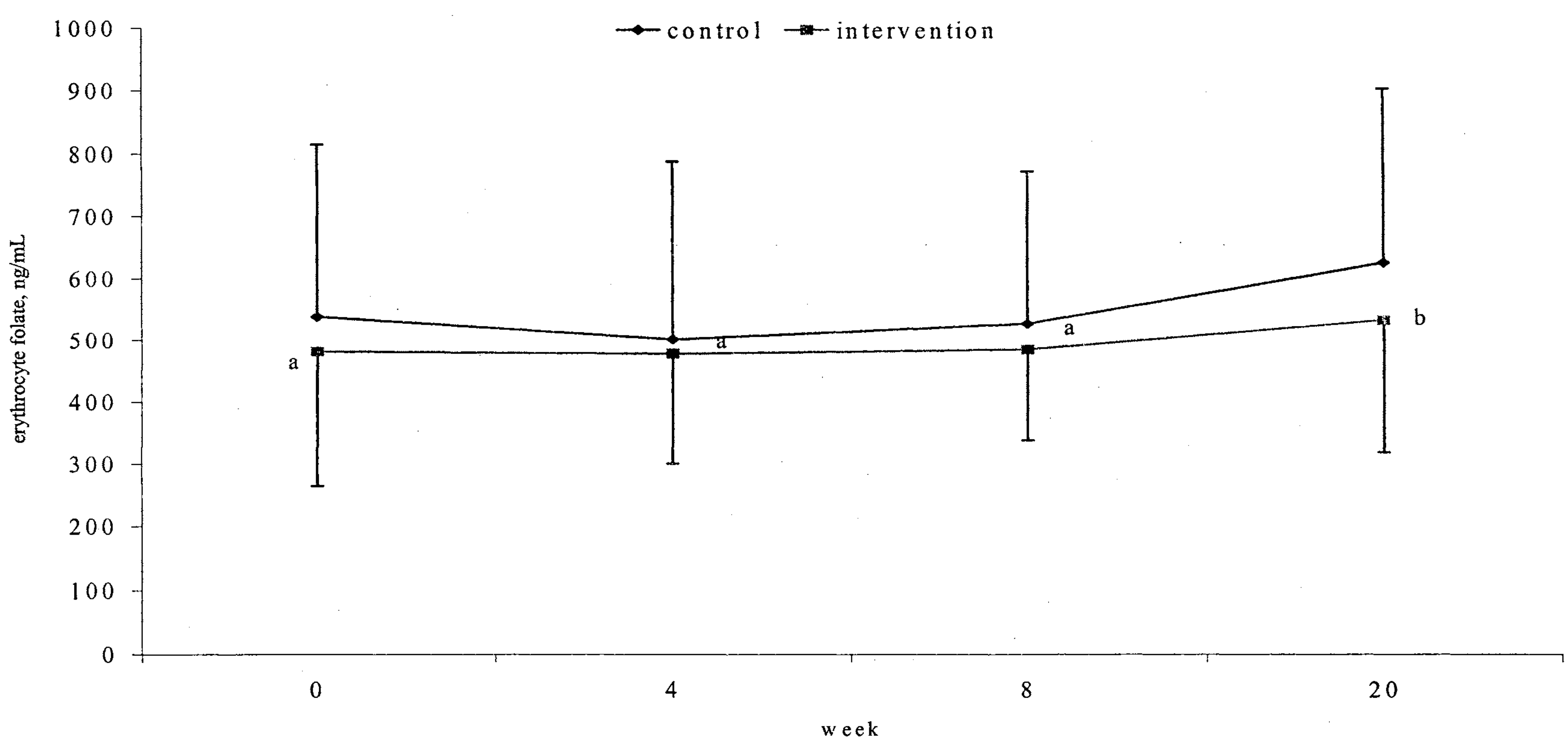

Figure 5.4 Mean (+SD) erythrocyte folate for experimental and control groups. Points with different superscripts (a,b) indicate means that are different across time using repeated measures ANOVA.

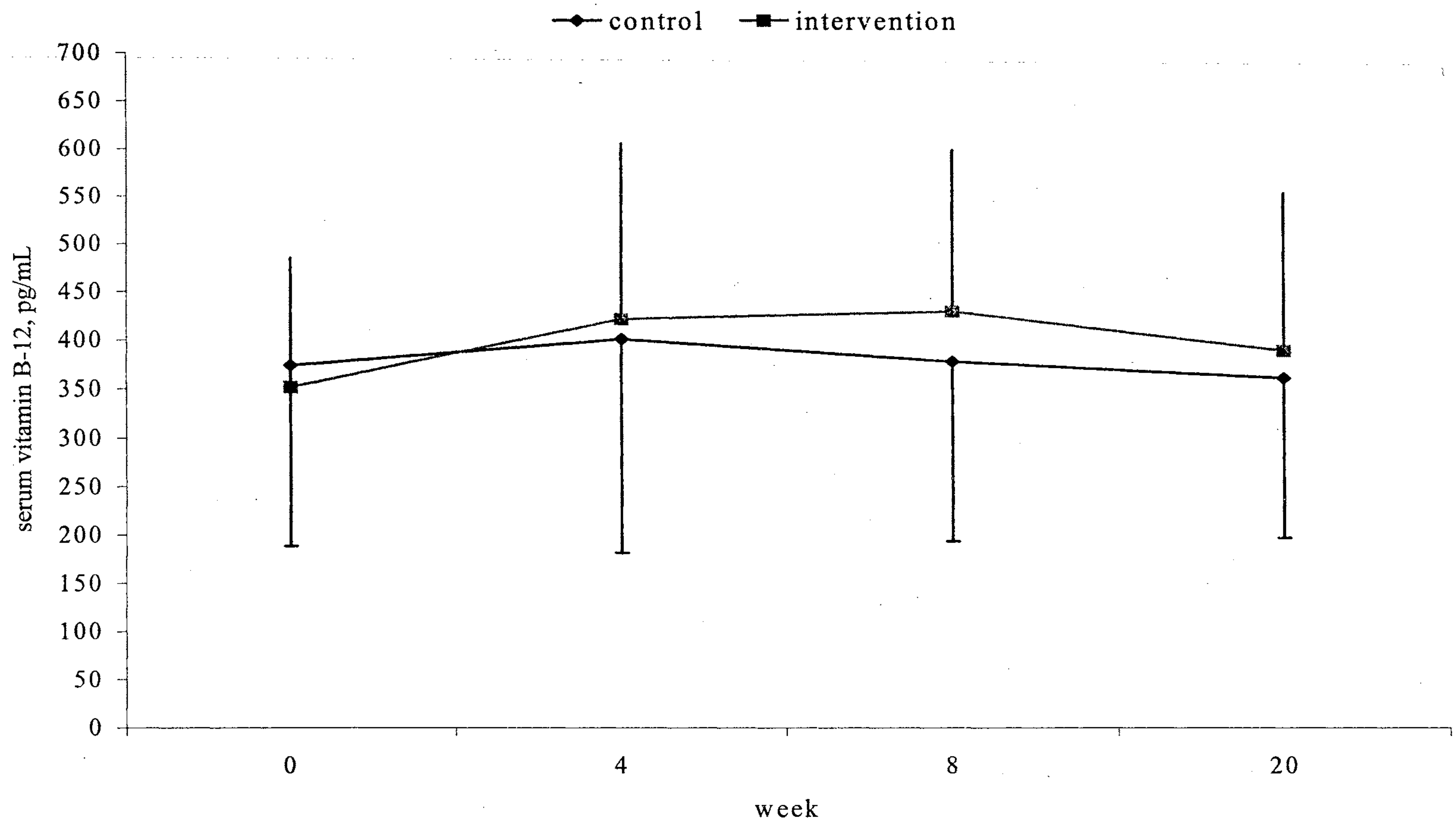

Figure 5.5 Mean (±SD) serum vitamin B-12 for experimental and control groups.

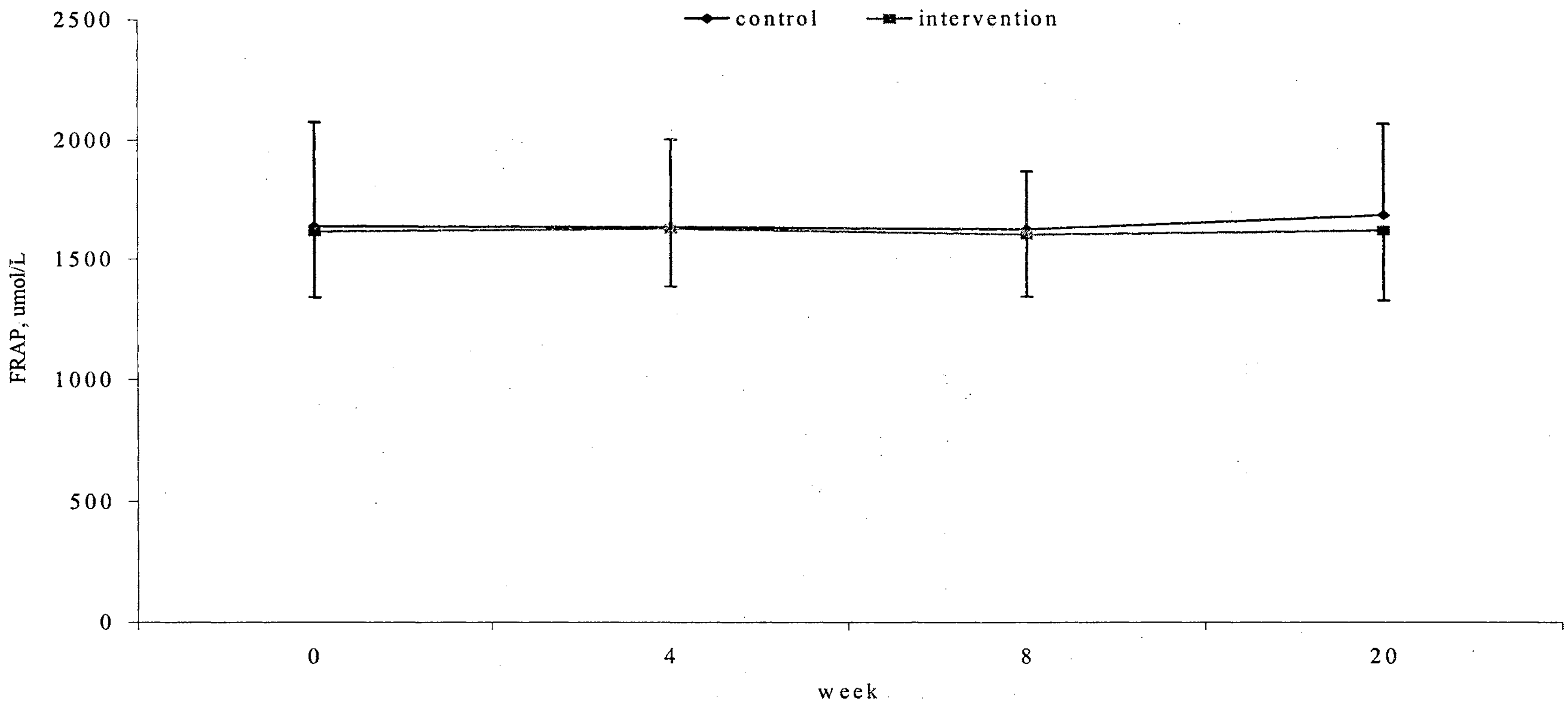

Figure 5.6 Mean (±SD) ferric reducing ability of plasma (FRAP) in experimental and control groups.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary and Conclusions

Study One

During the initial study we examined factors that influence food consumption, acceptable educational strategies, and perceptions and beliefs about folate rich foods in 40 Oklahoma men $\geq$ 60 years using in-depth structured interviews. Four-day food records and a food frequency questionnaire were also collected to determine adequacy of selected nutrients for the participants. Wives (n=20) were interviewed by telephone at a later time.

We found that many men in our first study were not consuming recommended amounts of folate. Men who were married and ate cereal more often were more likely to consume adequate folate. Intake of folate for those taking a dietary supplement was no different than for those not taking one.

Similarities were found between older men and their wives in overall perceptions and beliefs about folate rich foods. Themes such as season, preference, habit, price, and health benefit emerged as important characteristics for food selection. A wide range of personal and environmental factors determined these men's food choices. Factors mentioned most often by both were the strong influence of the wife, a health crisis and the physician. When multiple responses were considered, husband/wife pairs agreed on ways to increase the intake of folate in older men; although wives more often thought cereal would be the best way, and their husbands thought supplement would be easiest.

Men and their wives knew very little or nothing about folate. There was a general awareness about the need to consume foods high in folate (fruits, vegetables, and grains), although there was a lack of awareness about amounts of these foods that are recommended and the reasons why their intake was important. Both agreed that if provided or served with a meal, men would eat these foods.

Overall, men's perceptions and attitudes about including folate rich foods was positive, however they either perceived barriers to their intake, or lacked the knowledge of amounts of these foods to choose and why. Men were influenced the most by their wives when it came to health-related behaviors, and the media was the primary source of health information for their wives. Nutrition educators can use this information to design more effective interventions in order to reach the 40% of older men not getting adequate amounts of folate.

Study Two

Using a separate group of 41 men $\geq$ 58 years old the effects of nutrition education and a high folate diet on plasma homocysteine were studied. Subjects were randomized into either an experimental (n=21) or control (n=20) group. At baseline both groups completed a food frequency questionnaire, and a 5-day food record. Subjects randomized into the experimental group were provided with super-fortified ready-to-eat cereals (400 μg) daily for 8 weeks, and given targeted nutrition education based on the results of the first study. Subjects in the control group were given general nutrition education only. All subjects provided unannounced 24-hr dietary recalls by telephone during weeks 3, 7 and 19, and five-day food records again at weeks 8 and 20. Blood samples were collected from all participants at baseline, 4 weeks, the end of the intervention period (8 weeks) and 3 months post intervention (20 weeks).

In the second study, folate intake of participants at baseline was similar to recommended levels (436 $\pm$ 204 μg/day). Once the experimental group was given the fortified cereal their intake of folic acid increased above recommended amounts, however immediately after the intervention period ended it had dropped back to baseline levels. Plasma hcy was higher in the control group at baseline, however there were no changes in hcy between groups or over time when these values were adjusted for baseline hcy concentrations. Serum folate levels in the experimental group were significantly higher at week 20 than at baseline. There was a significant time by group interaction for serum vitamin B-12. Erythrocyte (RBC) folate increased for both groups by week 20, although there were no differences between the groups. There were no differences observed in lipids, hematology, creatinine, or FRAP.

The homocysteine-lowering ability of folic acid fortified cereal in subjects who were already consuming recommended amounts of folate was not apparent. Several explanations can be given for these results.

First, the high intake of folate from food in both the control and experimental groups prior to and during the study may explain why there were no differences in RBC folate and hcy between the groups over the study period. We suggest that subjects from both groups in this study had already reached a plateau of folate intake prior to the study indicating that fortification of grain products may have already had an effect on this group of men even before intake of super-fortified breakfast cereals. Several groups have suggested a near maximal hcy lowering effect of supplemental folic acid at intakes of approximately 400 μg/d (Malinow et al. 1998, 1997; Boushey et al. 1995; O'Keefe et al. 1995; Homocysteine Lowering Trialists 1998).

Second, the control group had more subjects with elevated homocysteine levels at baseline. Research supports the idea that folic acid has the greatest effect in subjects with the highest levels of hcy (Homocysteine Lowering Trialists 1998). We suggest that the lower baseline concentrations of hcy in the experimental group may have reduced the hcy lowering potential of the dietary treatment.

Finally, the targeted nutrition education in the experimental group did not have an effect for those who were already consuming adequate amounts of dietary folate. The men in this study were highly educated and paying attention to their diets, therefore may have already been aware of the health benefits of consuming adequate folate. We conclude that subjects with milder hcy levels who are already eating cereal regularly may require only simple dietary advice for maintenance of acceptable hcy levels.

Results from both of these studies suggest a need to design more effective nutrition education strategies based on the needs of the target group. At baseline a similar percentage of men from both of our studies, about 45%, were not meeting the minimum recommendation for folate. In addition, from both studies we can conclude that those who were regular cereal eaters were most likely to be consuming adequate amounts of folate. However, it is not clear from this study whether amounts above the RDA have an additional plasma hcy lowering effect. Further intervention trials to find the lowest effective dose and best combination of B vitamins that lowers hcy levels is needed. More importantly, whether breakfast cereals fortified with folic acid will modify the incidence and outcome of atherosclerotic disease still needs to be established.

Recommendations

The following recommendations were developed from these studies:

1. In nutrition education efforts aimed at older men, the spouse should be included.
2. Nutrition education efforts to increase folate intake in this age group should address amounts of fruits, vegetables, and grains that are recommended, barriers to their intake, the importance of these foods to the older population, and the connection with health-related conditions.
3. Nutrition education efforts aimed at older men should stress the importance of including fortified ready-to-eat cereal as a part of the daily diet.
4. Future research efforts to test the effects of folic acid fortified cereals should be conducted in a group of men who are not already regular cereal eaters.
5. Future research to test the effects of folic acid in lowering homocysteine should be conducted with men who have elevated levels of homocysteine, and/or low baseline levels of serum folate.
6. Future research should include the use of placebo cereal to discourage "over compliance" by the control group.

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APPENDIX A

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 04-03-98 **IRB #: HE-98-080**

Proposal Title: INFLUENCES OF FOLATE INTAKE ON ELDERLY OKLAHOMA MEN

Principal Investigator(s): Gail Gates, Kathryn Keim

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:
REVIEWER #1:
This reviewer approves the study with the condition that the tapes will be destroyed after they are transcribed and no longer needed.

REVIEWER #2:
This is a well thought-out study which appears to represent minimal or no known risks to the subjects. The participants (adult males) will be recruited through a variety of means, including newspaper advertisements, and their participation in the study is entirely voluntary. They are apprised of what they are expected to do and their rights as research subjects are protected. The principal investigators have taken the necessary precautionary measures to assure confidentiality of the written as well as audio-taped data collected. Permission should be granted to this study to proceed as planned.

Signature: [signature]
Chair of Institutional Review Board

Date: April 3, 1998

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date: July 19, 1999 IRB #: HE-99-104

Proposal Title: "INFLUENCES OF FOLATE INTAKE ON ELDERLY OKLAHOMA MEN"

Principal Investigator(s): Gail Gates
Kathryn Keim

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

Signature:

Carol Olson

Carol Olson, Director of University Research Compliance

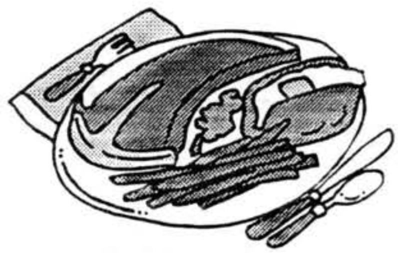
July 19, 1999
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX B

men 60 and over needed

for research related to heart disease risk



If you are a man age 60 or older, we need you to participate in a research study being conducted at Oklahoma State University. We want to interview you about your eating habits and what influences your food choices. The interview is expected to last approximately 1 hour and you will need to record your food intake for 3 days.

If you participate, you will be eligible to win a free dinner, and will receive an analysis of your diet.

All information you provide will be kept confidential. This study has been approved by the Institutional Review Board for Protection of Human Subjects.

Your opinion is valuable and we **need** your participation. If you are at least 60 years of age, and would like to help –please call **744-5032** for more information or to volunteer for the project.

Gail E. Gates, Ph.D., RD
Principal Investigator

Tawni Holmes MS, RD
Research Associate

Department of Nutritional Sciences
Oklahoma State University
(405) 744-5032.

To encourage you to complete the study and to allow us to collect accurate data, you will receive:

- **$100**
- **diet analysis**
- **blood cholesterol analysis**

at the end of the study.

2611

Gail E. Gates, Ph.D., RD
College of Human Environmental Sciences
Department of Nutritional Sciences
HES 425
Stillwater, OK 74078-6141

Male participants needed

for OSU research project on the prevention of heart disease in men

Would you like the opportunity to learn about how food choices can improve men's intake of recommended vitamins and reduce the risk of heart disease?

If you are a ***man 60 years of age or older***, you can participate in research to assess the effectiveness of nutrition education to increase folate intake, that is being conducted at Oklahoma State University.

To be part of this study, you will need to:

- ♥ come for a total of 5 visits over a 5 month period
- ♥ keep three 5-day food records
- ♥ provide fasting blood samples 4 times
- ♥ and may get a free 8 week supply of fortified cereal.

Data will be collected at two sites:

- ♥ Stillwater, OK

OSU

- ♥ Oklahoma City, OK

OMRF

In order to participate, you may not take any folic acid supplements or any multivitamin containing folic acid for three months prior to and until the end of the study.

By participating, you may benefit by improving your food choices and ultimately decreasing your risk of heart disease.

Thank you for your interest.

For more information or to volunteer for the project, please contact one of the following individuals:

Gail E. Gates, Ph.D., RD
Principal Investigator
Dept. of Nutritional Sciences
Oklahoma State University
(405) 744-5032

Tawni Holmes, M.S., RD
Research Associate
(405) 417-3744

APPENDIX C

Consent to Participate in Research

Influences of Folate Intake on Men

I, ______________________________, voluntarily agree to participate in the above titled research. The Oklahoma Agricultural Experiment Station and the College of Human Environmental Sciences at Oklahoma State University sponsor this research.

I understand that:

(1) the purposes of the study are to find out what influences the food intake of older men, how men wish to receive information about healthy eating, and how food choices influence risk of heart disease in older men.

(2) I will participate in an interview about influences on my food preferences and choices.
(a) The interview will take about 1 to 1 1/2 hours.
(b) I will allow the researcher to audiotape my interview.
(c) The tape of the interview may be transcribed.

(3) I will complete a food frequency questionnaire that will ask me to recall my typical food choices;

(4) I will record my daily food intake for four days;

(5) All records are confidential. My name will not be used in any reports or data records at the end of the study. All information obtained about me as an individual will be considered privileged and held in confidence.
(a) Audiotapes of the interviews will be reviewed by the project director or her authorized representatives. Tapes will be filed in the project director's office until completion of the study when they will be destroyed.

(6) I volunteer to take part in this study.
(a) I have the right to withdraw from this study at any time by contacting the researchers.
(b) I may stop participating in the study at any time without penalty or loss of benefits that I am otherwise entitled to receive.

(7) this research is beneficial in that it provides information about the effects of nutrition education on food habits of older men; and
(a) the information gained from this study may provide information useful in helping older men choose nutritionally adequate diets;

(8) I will be receiving an analysis of my dietary intake;

(9) if I need more facts about the study I may contact Dr. Gail Gates at (405) 744-5032. I may also contact Gay Clarkson at the office of University Research Services, 305 Whitehurst, Oklahoma State University, Stillwater, OK 74078 at (405) 744-5700.

I have read and fully understand the consent form. I sign freely and voluntarily. A copy has been given to me.

Date ______________________ Time ____________

Subject Name (please print) ____

Signed____

Permanent Address ____

____

____

I certify that I have personally explained all parts of this form to the subject before requesting the subject to sign it.

Signed ____
(project director or her authorized representative)

Printed name ____
(project director or her authorized representative)

Consent to Participate in Research

Influences of Folate Intake on Older Oklahoma Men

I, ________________________, voluntarily agree to participate in the above titled research. The Agricultural Experiment Station and the College of Human Environmental Sciences at Oklahoma State University sponsor this research.

I understand that:

(1) the purpose of the study is to assess the effectiveness of nutrition education for increasing folate intake in older men.

(2) I will be asked to stop taking any B vitamins or multivitamins containing folic acid for three months prior to beginning the study and for the entire study period (a 5 month period).

(3) I will complete a food frequency questionnaire that will ask me to recall my typical food choices. It will take me about 30 minutes to complete this questionnaire.

(4) I will be asked to recall my food intake for a 24-hour period at four times during the study. The first time will be during my initial visit and the next three I will be telephoned at times unknown to me. Each recall will take about 20 minutes.

(5) I will keep a food record for five days at three different times during the study. It will take me about 15 minutes each day to record my intake. I will be given measuring cups, spoons, ruler, and beanbag measures to assist me. I will receive $15 each for completing and returning the first two records and $25 for completing and returning the final food record.

(6) I will be asked to give a blood sample four times during the study. I will receive $10 each for the first three blood samples and $15 for the final blood sample.

(7) trained medical staff will draw fasting blood samples of 21 mL (about 4 teaspoons) from my arm, and minimal risk (slight discoloration or discomfort) may result from the venipuncture.

(8) my blood will be used only for analyses which assess nutritional status including, but not limited to, folate, homocysteine, vitamin B_{12}, hemoglobin, mean corpuscular volume, LDL/HDL cholesterol.

(9) should sufficient sample remain other tests that may be performed including plasma and erythrocyte mineral concentrations and erythrocyte enzyme activities;
   (a) after these tests are performed the remaining blood will be incinerated; and
   (b) in no circumstances will perpetual cell lines be developed or maintained.

(10) I may be asked to consume fortified ready-to-eat cereal provided by the researcher or other folate containing foods everyday for an 8-week period.

(11) all records are confidential. My name will not be used in any reports or data records at the end of the study. All information obtained about me as an individual will be considered privileged and held in confidence.
   (a) food records will be reviewed and analyzed by the project director or her authorized representatives. Food records will be filed in the project director'' office until the completion of the study when they will be destroyed.

(12) I volunteer to take part in this study.
   (a) I have the right to withdraw from this study at any time by contacting the researchers.

(b) I may stop participating in the study at any time without penalty or loss of benefits that I am otherwise entitled to receive.

(c) I am authorized to receive all necessary medical care for injury or disease which is the proximate result of my participation in this research:
   (a) other than medical care that may be provided and the specific remuneration listed above (items 4 and 5) there is no compensation for my participating in this study; and
   (b) this consent is not a waiver or release of my legal rights;

(13) this research is beneficial in that it provides information about the effects of nutrition education on food habits of older men
   (a) the information gained from this study may provide information useful in helping older men choose nutritionally adequate diets:

(14) I will be receiving an analysis of my dietary intake and a report of the results of my blood tests

(15) if I need more facts about the study I may contact Dr. Gail Gates at (405) 744-5032. I may also contact Sharon Bacher at the office of University Research Services, 203 Whitehurst, Oklahoma State University, Stillwater, OK 74078 at (405) 744-5700.

I have read and fully understand the consent form. I sign freely and voluntarily. A copy has been given to me.

Date ____________________ Time __________

Subject Name (please print) ______________________________

Signed ______________________________

Permanent Address ______________________________

____

____

I certify that I have personally explained all parts of this form to the subject before requesting the subject to sign it.

Signed______________________________
(project director or her authorized representative)

Printed name______________________________
(project director or her authorized representative)

Oklahoma State University
Oklahoma Medical Research Foundation

Individual's Consent to Voluntary Participation in a Research Project

I, ______________________ voluntarily consent to participate in the study entitled: Influences of Folate Intake on Older Oklahoma Men, sponsored by The Agricultural Experiment Station and the College of Human Environmental Sciences at Oklahoma State University.

1. **PURPOSE:** The purpose of this study is to assess the effectiveness of nutrition education for increasing folate intake in older men.

2. **PROCEDURE(S) AND DURATION:** I will be asked to not consume any folic acid supplement or any multivitamins containing folic acid for 3 months prior and until the completion of the study.

   I will complete a food frequency questionnaire that will ask me to recall my typical food choices. I will be asked to recall my food intake for a 24-hour period at four times during the study. The first time will be during my initial visit, and the next three contacts will be by telephone, at times unknown to me.

   I will keep a food record for five days at three different times during the study. I will be given measuring cups, spoons, ruler, and beanbag measures to assist me.

   I will be asked to give a blood sample four times during the study. Trained medical staff will draw fasting blood samples of 21ml (about 4 teaspoons) from my arm. My blood will be used only for analyses which assess nutritional status including, but not limited to folate, homocysteine, vitamin B12, hemoglobin, mean corpuscular volume, LDL/HDL. Should a sufficient sample remain, other tests that may be performed include plasma and erythrocyte mineral concentrations and erythrocyte enzyme activities. After these tests are performed the remaining blood will be incinerated; and in no circumstances will perpetual cell lines be developed or maintained.

   I may be asked to consume fortified ready-to-eat cereal provided by the researcher or other folate containing foods every day for an 8-week period.

3. **POSSIBLE RISKS:** I understand the possible risks, inconveniences, and side effects may include occasional slight discomfort associated with blood drawing, bruising, dizziness or fainting. Rarely, I may experience infection at the blood drawing site.

4. **BENEFITS:** I will receive $15.00 each for completing and returning the first two food records and $25.00 for completing and returning the final food record. I will

also receive $10.00 for the first three blood samples and $15.00 for the final blood sample. I will receive an analysis of my dietary intake and a report of the results of my blood test. This research is beneficial in that it provides information about the effects of nutrition education in food habits of older men. The information Influences of Folate Intake on Older Oklahoma Men gained from this study may provide information useful in helping older men choose nutritionally adequate diets.

5. ALTERNATE TO PARTICIPATION: I have the right to withdraw from this study at any time by contacting the researchers. I may stop participating in the study at any time without penalty or loss of benefits that I am otherwise entitled to receive.

6. SUBJECT'S ASSURANCES: I understand that in the event of physical injury as an immediate complication of this study, appropriate medical care will be provided to me, not to include hospital charges. I further understand that no compensation will be available to me from the Oklahoma Medical Research Foundation or Oklahoma State University Center unless I otherwise qualify for employee benefits such as insurance. If I have questions about the availability of care, I may contact the Office of University Research at (405) 744-5700.

I understand that by signing this consent form I have not waived any of my legal rights or released this institution for liability or negligence.

I understand that records from this study will be held confidential and that I will not be identified by name in any report or publication resulting from this study. My food records will be reviewed and analyzed by the project director or her authorized representatives. Food records will be filed in the project director's office until completion of the study when they will be destroyed.

I understand that if I have questions about this study, or need to report adverse effects, I may contact Dr. Gail Gates at (405) 744-5032. If I have any question about my rights as a research subject, I may contact Sharon Bacher at the Office of University Research Services, 305 Whitehurst, Oklahoma State University, Stillwater, OK 74078 at (405) 744-5700 or the office of the President, OMRF (405) 271-7210

7. SIGNATURES: I have read this consent form and understand its contents. I freely consent to participate in this study as described herein. I will receive a copy of this consent form.

Date Time

Subject's Name (Please Print)

Subject's Signature

Permanent Address

City State Zip Code

I certify that I have personally explained all parts of this form to the subject before requesting the subject to sign it.

Signature – Project Director or Authorized Representative

Printed Name – Project Director or Authorized Representative

APPENDIX D

Interview questions (men over 60):

1. Think back to the last time you ate a meal that you enjoyed. What did you eat? (E)

2. What influenced your choice? (E, SE, P, BC), How much does taste, ease of preparation, appearance, habit, preparation time, fattening or not, availability, family, price, variety influence your choice?

3. Who shops for your groceries **? If shopper** :When you go to the grocery store, what fruits, veg, & grains do you most often buy? (BC, E, SE) Is this decision influenced by anything (family members, cost…)? **If you are not the one who typically goes to the store** – does that person tend to buy the same (split) f, v, grains each time –what are the ones you eat most often? Why these ? How much influence do you have on what is purchased ?

   Ask following questions separately for fruits, vegetables, grains.

4. How many servings of fruits, veg. & grains is it recommended a person your age should eat per day? How do you know this information? (ED, E)

5. What prevents you from eating enough fruit…vegetables…grains (healthy foods)? (P, E, SE, BC)

6. What do you think are some reasons men don't eat fruits, vegetables, and grains ?(P

7. What is the best way to get information to men about eating fruit, vegetables and grains? (P, ED) What way would convince you to eat these foods ?

8. When eating out or ordering take-out, how do you figure out where to eat and what to get? (BC, E, SE) (who you're with, price, convenience…) Do you ever order f, v, & grains ? If they come with a meal do you typically eat them ?

9. What are some things you would like to change about the types of food you eat? (P, SE) (If they say "eat healthier, probe -How do you define "healthy eating"?)

10.)The latest studies show that you should increase your consumption of fruits, vegetables, and grains to increase the vitamin folate in your diet. What do you know about folate? What disease can it help prevent? (ED, P)

11. How do you feel about taking vitamin supplements, such as folate? (P)

12. What would be the easiest way for you to increase your intake of folate - if you could choose between eating a serving of fortified cereal every day, increasing the amounts

of fruits and vegetables you eat daily, or taking a supplement that contains folate– which would you most likely do ? Why?

13. In making the choice between two cereals that you liked equally well, if one made the health claim that it was fortified with folic acid and therefore could reduce the incidence of heart disease, and the other did not make this claim, would this influence which cereal you buy that day ?

14. What about seeing an ad ?

15. What further comments do you have?

Interview questions (wives of men over 60):

16. Think back to the last time you prepared a special meal for you and your husband. What did you prepare? (E)

17. What influenced your choice of what was prepared? (E, SE, P, BC), How much does taste, ease of preparation, appearance, habit, preparation time, fattening or not, availability, family, price, variety influence your choice?

18. How many meals per day do you prepare for your husband – which meals are they?

19. Who shops for your groceries **? If shopper** : How much influence does your husband have over what you buy? —what are the f, v, g your husband eats most often? Why these ? How does he make his preferences known to you ?

Ask questions 5-6 separately for fruits, vegetables, grains.

20. How many servings of fruits, veg. & grains are recommended for a person your husbands age to eat each day? How do you know this information? (ED, E) (Give recommendation) Does you husband eat this many servings in a day?

21. IF NOT, What prevents him from eating enough servings of fruit…vegetables…grains each day? (P, E, SE, BC)

22. What is the best way to convince your husband to eat more of these foods ?

23. What would encourage you to provide/prepare more of these foods for you and your husband?

24. Where do you get most of your "health" information ? What are the best ways to reach you?

25. Who else (besides you) influences your husband's eating habits ?

26. When eating out or ordering take-out with your husband, how do you and your husband decide where to eat and what to order? (BC, E, SE) (who you're with, price, convenience…) Does your husband ever order f, v, & grains ? If they come with a meal does he typically eat them ?

27. What are some things you would like to change about the types of food your husband eats? (P, SE) (If they say "eat healthier, probe -How do you define "healthy eating"?)

28.)The latest studies show that we should increase our consumption of fruits, vegetables, and grains to increase the vitamin folate in our diet. What do you know about folate? What disease can it help prevent? (ED, P)

29. What would be the easiest way for your husband to increase his intake of folate - if he could choose between eating a serving of fortified cereal every day, increasing the amounts of fruits and vegetables he eats daily, or taking a supplement that contains folate– which would he most likely do ? Why?

30. In making the choice between two cereals that he liked equally well, if one made the health claim that it was fortified with folic acid and therefore could reduce the risk of heart disease, and the other did not make this claim, would this influence which cereal you buy that day ?

31. What about seeing an ad (show ad), would this convince you to serve more of these foods?

32. What further comments do you have?

APPENDIX E

Content Analysis– TRIP

1. last time you ate a meal enjoyed…
- enjoy all (most) meals
- an occasion where they ate "out"
- a meal at home they don't typically eat
- last meal they had
- a favorite meal

1. what influences enjoyment and choice…
- who they're with
- habit
- convenience
- "mood"
- where they are
- cost
- appearance of food
- cleanliness of restaurant
- whether food is perceived to be healthy
- variety of food choices
- it's what's prepared for them
- what they grew up eating
- taste
- a cuisine they can't usually get

1. who shops for groceries
- wife
- me
- both

if not shopper, how much influence do you have over what is purchases
- a lot
- some
- very little
- none

4. FRUITS

What fruits are most often bought?
-apples
-bananas
-grapes
-oranges
-peaches
-grapefruit
-orange juice
-cranberry juice
-grape juice
-grapefruit juice
-mixed juices
-strawberries
-pears
-watermelon
-cantaloupe
-nectarines
-plums
-other_______________

Do you typically buy the same fruits….
-yes
-no

What influences what is purchased
- season
- other family members preferences
- my preference
- taste
- price
- habit
- ease of preparation
- how I was raised
- convenience
- what looks good
- what we're out of
- provide a specific nutrient (i.e. bananas for potassium)
- -perceived healthy

VEGETABLES

What vegetables?
-lettuce
-mixed salad in bag
-tomatoes
-onions
-green beans
-broccoli
-carrots
-corn
-potatoes
-spinach
-squash
-cauliflower
-green/red peppers
-cabbage
-celery
-peas
-(beans)
-other_______

Do you typically buy the same vegetables….
-yes
-no

What influences what is purchased
- season
- other family members preferences
- my preference
- taste
- price

- habit
- ease of preparation
- how I was raised
- convenience
- what looks good
- what we're out of
- provide a specific nutrient (i.e. bananas for
  potassium)
- -perceived healthy

GRAINS

What grain foods?
-bread
-whole wheat bread
-cereals
-oatmeal
-pasta
-rice
-waffles/bagels/english muffins
-(legumes/beans)
-crackers
-other__________

Do you typically buy the same grains
-yes
-no

What influences what is purchased
- season
- other family members preferences
- my preference
- taste
- price
- habit
- ease of preparation
- how I was raised
- convenience
- what looks good
- what we're out of
- provide a specific nutrient (i.e. bananas for
  potassium)
- -perceived healthy

FRUIT

1. How many servings are recommended?(2-4)

-correct answer
-not correct answer

How do you know this information ?
-don't know
-read it somewhere
-have seen the pyramid
-medical professional told me
-guess
-other

What prevents you from getting enough servings from this food group ?
-nothing / I think I get enough
-not available to me (convenient)
-habit
-forgot to buy or bring with
-don't like
-too lazy to fix
-prefer other foods
-too busy

Reasons other men don't get enough?
–way they were brought up
-habit
-convenience
-don't like
-not prepared or given to them
-not readily available where they eat (at restaurants)
-not a concern in their life
-influenced to eat other foods
-they have to be prepared

VEGETABLES

2. How many servings are recommended?(3-5)

-correct answer
-not correct answer

How do you know this information ?
-don't know
-read it somewhere
-have seen the pyramid
-medical professional told me
-guess
-other

What prevents you from getting enough servings from this food group ?
-nothing / I think I get enough
-not available to me (convenient)
-habit
-forgot to buy or bring with
-don't like
-too lazy to fix
-prefer other foods
-too busy

Reasons other men don't get enough?
–way they were brought up
-habit

-convenience
-don't like
-not prepared or given to them
-not readily available where they eat (at restaurants)
-not a concern in their life
-influenced to eat other foods
-they have to be prepared

GRAINS

3. How many servings are recommended?(6-11)

-correct answer
-not correct answer

How do you know this information ?
-don't know
-read it somewhere
-have seen the pyramid
-medical professional told me
-guess
-other

What prevents you from getting enough servings from this food group ?
-nothing / I think I get enough
-not available to me (convenient)
-habit
-forgot to buy or bring with
-don't like
-too lazy to fix
-prefer other foods
-too busy

Reasons other men don't get enough?
–way they were brought up
-habit
-convenience
-don't like
-not prepared or given to them
-not readily available where they eat (at restaurants)
-not a concern in their life
-influenced to eat other foods
-they have to be prepared

4. Best ways to get info to men about eating more of these foods (f, v, g)

-newspaper
-TV shows
-TV news
-TV ads
-radio (NPR, KOSU)
-magazines (health article)
-reading published literature
-health professional
-nothing will work (at this age)
-wife
-other family members
-seminars/classes (like WC)
-only in a health crisis
-use scare tactics
-teach them when they're young
-word of mouth
-public education
-through a health club (target audience)
-sex sells
-other authority figure

5. When eat out or ordering take-out what influences where and what?

- who they're with
- habit
- convenience
- "mood"
- cost
- availability of restaurant choices
- appearance of food
- cleanliness of restaurant
- atmosphere
- quality of food
- whether food is perceived to be healthy
- variety of food choices

Do you ever order f, v, g?
-yes
-no
-if available
-sometimes

what?
-potatoes
-other vegetables
-fruit juices
-fruit salads
-piece of fruit
-pasta
-rice
-salads
-rolls or bread with a meal
-cereal

If a f, v, or g comes with a meal will you eat it?
-yes
-no
-usually

1. what changes would you like to make?
-none
-smaller portions
-eat more of what they like/want
-eat healthier (less fat)
-other__________

2. What do you know about folate?
-nothing
-it's a vitamin
-heard of it but don't know what it is
-something to do with women and birth defects
-related to heart disease or Hcy in men

what disease can it help prevent?
-don't know
-heart
-cancer
-NTD
-pallegra

3. How do you feel about supplements?
-I take them
-don't need
-too expensive
-if someone tells me to, I'll take it
-don't need, but would take if I needed

4. easiest way to increase folate (3 choices)
-supplement
-increase fruits and vegetables
-eat cereal every day
why?
-make sure I get the right amount
-easier than other choices
-already doing
-I like them

5. choice between 2 cereals with and without health claim?
-would influence
-wound not influence
-might influence
-would, but only since I've talked to you

6. what about ad?
-no
-yes
-maybe

if no, why?
-don't read ads
-don't believe ads
-turn off because cereal company
-didn't like picture
-already eat a variety of foods
-no specific info about folic acid

Content Analysis– TRIP-Wives

DEMOGRAPHICS:

1. age____
2. employment status
-homemaker
-retired
-part-time
-full-time
3. education (self)___________
(husband)_______________
4. years married_______
5. meals/week eat together______

INTERVIEW

7. last time you prepared a special meal...
-grain
-meat
-vegetable
-fruit
-milk
-dessert

8. what influences choice of preparation...
- who they're with
- habit
- convenience
- "mood"
- where they are
- cost
- whether food is perceived to be healthy
- what they grew up eating
- taste
- its what their husband likes/wants
- other

1. who shops for groceries
- husband
- me
- both

how much influence does your husband have over what is purchased
- a lot
- some
- very little
- none

how does he make his preferences known
-he just tells me
-he just picks out what he wants
-I just know through experience
-he doesn't

4. FRUITS

What fruits does he eat most often?
-apples
-bananas
-grapes
-oranges
-peaches
-grapefruit
-orange juice
-cranberry juice
-grape juice
-grapefruit juice
-mixed juices
-strawberries
-pears
-watermelon
-cantaloupe
-nectarines
-plums
-other_______________

What influences why he chooses those
- season
- other family members preferences
- his preference
- taste
- price
- habit
- ease of preparation
- how I was raised
- convenience
- what looks good
- what we're out of
- provide a specific nutrient (i.e. bananas for potassium)
- perceived healthy

VEGETABLES

What vegetables?
-lettuce
-mixed salad in bag
-tomatoes
-onions
-green beans
-broccoli
-carrots
-corn
-potatoes
-spinach
-squash
-cauliflower
-green/red peppers
-cabbage
-celery
-peas
-(beans)

-other_______

What influences why he chooses those?
- season
- other family members preferences
- his preference
- taste
- price
- habit
- ease of preparation
- how I was raised
- convenience
- what looks good
- what we're out of
- provide a specific nutrient (i.e. bananas for
  potassium)
- -perceived healthy

GRAINS
What grain foods?
-bread
-whole wheat bread
-cereals
-oatmeal
-pasta
-rice
-waffles/bagels/english muffins
-(legumes/beans)
-crackers
-other__________

Why those?
- season
- other family members preferences
- his preference
- taste
- price
- habit
- ease of preparation
- how I was raised
- convenience
- what looks good
- what we're out of
- provide a specific nutrient (i.e. bananas for
  potassium)
- -perceived healthy

FRUIT
1. How many servings are recommended for him?(2-4)

-correct answer
-not correct answer

If correct -how do you know this information ?
-don't know
-read it somewhere
-have seen the pyramid
-medical professional told me
-guess
-other

What prevents him from getting enough servings from this food group ?
-nothing / I think he gets enough
-not available to him (convenient)
-habit
-forgot to buy or bring with
-don't like
-too lazy to fix
-prefer other foods
-too busy
-we just don't eat that much

VEGETABLES
2. How many servings are recommended for him?(3-5)

-correct answer
-not correct answer

How do you know this information ?
-don't know
-read it somewhere
-have seen the pyramid
-medical professional told me
-guess
-other

What prevents him from getting enough servings from this food group ?
-nothing / I think he gets enough
-not available to him (convenient)
-habit
-forgot to buy or bring with
-don't like
-too lazy to fix
-prefer other foods
-too busy
-we just don't eat that much

GRAINS
3. How many servings are recommended for him?(6-11)

-correct answer
-not correct answer

How do you know this information ?

-don't know
-read it somewhere
-have seen the pyramid
-medical professional told me
-guess
-other

What prevents him from getting enough servings from this food group ?
-nothing / I think he gets enough
-not available to him (convenient)
-habit
-forgot to buy or bring with
-don't like
-too lazy to fix
-prefer other foods
-too busy
-we just don't eat that much

4. Best ways to get info to men about eating more of these foods (f, v, g)
-newspaper
-TV shows
-TV news
-TV ads
-radio (NPR, KOSU)
-magazines (health article)
-reading published literature
-health professional
-nothing will work (at this age)
-wife
-other family members
-seminars/classes (like WC)
-only in a health crisis
-use scare tactics
-teach them when they're young
-word of mouth
-public education
-through a health club (target audience)
-sex sells
-other authority figure

5. What encourages you to provide/prepare more of these foods?
- general concern about health
- our Dr.
- things I read
- a specific health concern_______
- other____________

1. Where do you get your health information?
-newspaper
-TV shows
-TV news
-TV ads
-radio (NPR, KOSU)
-magazines (health article)
-reading published literature
-health professional
-other family members
-seminars/classes (like WC)
-word of mouth
-public education
-through a health club (target audience)
-other authority figure

2. Who else influences husbands eating habits?
-no one
-friends
-other family member
-doctor

3. When eat out or ordering take-out what influences where and what?
- who they're with
- habit
- convenience
- "mood"
- cost
- availability of restaurant choices
- appearance of food
- cleanliness of restaurant
- atmosphere
- quality of food
- whether food is perceived to be healthy
- variety of food choices

Does he ever order f, v, g?
-yes
-no
-if available
-sometimes

what?
-potatoes
-other vegetables
-fruit juices
-fruit salads
-piece of fruit
-pasta
-rice
-salads
-rolls or bread with a meal
-cereal

If a f, v, or g comes with a meal will he eat it?
-yes

-no
-usually

1. what changes would you like to make?
-none
-smaller portions
-eat more of what they like/want
-eat healthier (less fat)
-other__________

2. What do you know about folate?
-nothing
-it's a vitamin
-heard of it but don't know what it is
-something to do with women and birth defects
-related to heart disease or Hcy in men

what disease can it help prevent?
-don't know
-heart
-cancer
-NTD
-pallegra

3. easiest way to increase folate (3 choices)
-supplement
-increase fruits and vegetables
-eat cereal every day
why?
-make sure he gets the right amount
-easier than other choices
-already doing
-he likes them

4. choice between 2 cereals with and without health claim?
-would influence
-wound not influence
-might influence
-would, but only since I've talked to you

5. what about ad?
-no
-yes
-maybe

if no, why?
-don't read ads
-don't believe ads
-turn off because cereal company
-didn't like picture
-already eat a variety of foods
-no specific info about folic acid

other comments:

APPENDIX F

Name:__________________

Date__________________ Subject Number______________

Age_________ Height________ Weight________

Race 1 white
2 black
3 asian/pacific islander
4 american indian
5 other, specify_______

Marital status 1 married
2 divorced
3 widowed
4 never married

Employment status: 1 full-time
2 part-time
3 retired

Do you live in a facility such as a retirement center where you typically eat in a cafeteria setting. 1 no
2 yes

_____times per week you eat breakfast ?

_____times per week you eat lunch?

_____times per week you eat dinner/supper?

_____times per week you typically eat food from a fast food/deli restaurant ?

_____times per week you typically eat at a sit-down restaurant?

_____number of other adults that live with you?

Do you take any kind of vitamin supplements ?_____ If yes, what kind ?___________

Are you taking a folic acid supplement ?_________

MEDICATION RECORD:

Please list any medications you take, and how often. We need this information because some medications interfere with folate status.

MEDICATIONS	HOW OFTEN
Example:	
Pravachol	daily

BASELINE VISIT (WEEK 2)

Name:____________________________ Subject No.________________________

Age__________ Height______ Weight_______BMI_________

Race 1 white
2 black
3 asian/pacific islander
4 american indian
5 other, specify_________

Marital status
1 married
2 divorced
3 widowed
4 never married

Employment status:
1 full-time
2 part-time
3 retired

Education Level
1 high school
2 Bachelors degree
3 Masters degree
4 Doctorate degree
5 some college, no degree
6 other_____________

Are you following a special diet ?_________If yes, what for?_______________

Please list the medications and vitamins/minerals you are currently taking and how often:

APPENDIX G

Department of Nutritional Sciences
425 Human Environmental Sciences
Stillwater, Oklahoma 74078-6141
405-744-5040, Fax 405-744-7113
Email: ggates@okstate.edu

Dear ________________________

Thank you for participating in this very important study. Everything that goes into your body is important to your health. For this reason, we would like for you to write down everything that you eat and drink for the next three days. We hope this study will help us make recommendations for improving your health based on what you eat. If you have any questions at any time, feel free to ask. Do not change your eating habits during the time that you keep this diary. This is very important since we must know exactly what you usually eat.

Thank you!

Gail E. Gates, Ph.D., RD
Principal Investigator

Directions for Using the Food Diary

1. Write down **everything** that you put into your mouth for the next three days. This includes foods, candies, drinks (including alcohol beverages), and anything that you swallow. Everything that goes into your body is important.

2. On the pages given to you, please list the food immediately after each meal or snack. Also list the time and amount that you ate. Use these codes to indicate the time of day:

M=	**Morning**	**AN=**	**Afternoon**
MM=	**Midmorning**	**E=**	**Evening**
N=	**Noon**	**LE=**	**Late evening**

3. Describe every item that you record, include specific details such as how it was prepared, size or amount and condiments that you use. For example:
   a). Write "fried chicken wing" if it is fried, not just chicken
   e.) Write whole milk, 2% milk, or skim milk. Do not just write milk.
   f.) Write white bread, wheat bread, and do not just write bread.
   g.) Record the name brand when you know it. For example "Kellogg's Frosted Flakes", "Campbell's chicken soup", or "Ramen noodles".
   h.) Include everything that you add to your food or drinks (jellies, sugar, salad dressings, mustard, ketchup, mayonnaise, butter, sauces, etc.).

   For example:

Time of day	Food Item and Method of Preparation	Amount Eaten
E	Canned green beans with	½ cup
	Margarine	2 tsp.
E	French fries (Burger King) with	1 small order
	Ketchup	2 TB
E	Iced tea with	16 oz
	Sugar	2 tsp.
E	Fried chicken thigh	1 whole

4. Estimate what you ate in household measures (tablespoons, cups, slices, etc.). Your nutrition educator will show you some examples. List the amount that you ate in the column marked amount eaten.

5. Please write as neatly as possible. Use as many pages as you need to record what you ate.

6. If anything is not clear to you, be sure to ask the nutrition educator any questions that you have before you leave today.

Use the following measurements when recording these items:

You may need some help in trying to decide how much you ate. Use this guide to help you.

Drinks: cups or fluid ounces. For example: pepsi 20 oz.

Grains: slices, cups. For example: white bread 1 slice.

1. An average size bagel is the size of a hockey puck.
2. A medium size pancake is the size of a CD.
3. 1 cup of rice or pasta would be about the size of a Walkman.
4. 1/2 cup of rice or pasta would fill a cupcake wrapper.
5. 1 cup of dried breakfast cereal would be a large handful.

Fruits: pieces, portions of pieces, or cups. For example: red apple 1 medium.

1. A fruit that is considered to be medium sized if is the size of a tennis ball.
2. 1 cup of chopped fruit is about the size of a baseball.
3. 1/2 cup of fruit looks like a pile of 15 marbles.

Vegetables: cups. For example: french fries 10 units.

1. 1 cup of lettuce is 4 large leaves.
2. 1 cup of chopped vegetables is the size of a fist.
3. 1/2 cup of chopped vegetables is the size of a light bulb.

Meat: ounces or cups. For example: fried chicken legs 2, refried beans 11/2 cup.

1. 3 ounces of cooked meat is the size of a deck of cards or a cassette tape.
2. 1 ounce of meat is the size of a matchbook or 1 domino.

Milk Items: cups or ounces. For example: whole milk 1 cup or 8 oz.

1. 1 1/2 ounces of cheese looks like 3 dominoes or a 9-volt battery.
2. 1 ounce of cheese is the size of 4 dice.

Fats, oils, sweets/others:
1. 1/2 cup of ice cream is the size of a tennis ball.
2. 2 tablespoons of butter, salad dressing, peanut butter, or mayonnaise is the size of 1 dice.
3. 1 ounce of small snack foods like hard candy or nuts is a handful.
4. 1 ounce of larger snack foods like pretzels, corn chips, or potato chips is a large handful.

For your information:

1. 1 cup is the size of a baseball
2. 1 tablespoon is 3 teaspoons.

Remember to write down these items

- Crackers, breads, rolls, tortillas.
- Hot or cold cereals.
- Cheese added as topping on vegetables or on a sandwich.
- Chips candy, nuts, seeds.
- Fruit eaten with meals or as a snack.
- Coffee, tea, soft drinks, juices.
- Beer, wine cocktails, brandies, any other drinks made with liquor.

Use the cups that we have left with you to figure out how many ounces you drink and eat.

Directions for Keeping a Food Diary

Write down **everything** you put in your mouth and swallow for the next five days. This includes all meals, snacks, nibbling, condiments, candies, drinks (including alcoholic beverages) etc. Always record in your diary immediately after having a meal, snack, or drink. Everything that goes into your body is important.

1. In the **first column (Time/Where)** list the time of day you ate the meal or snack and where the food was prepared; at home (h), restaraunt (r), other (o). See example below.

2. In the **middle column (Food Item and How Prepared)**, describe every item and how it was prepared.
   - Record one item per line
   - Be specific about how it was prepared
- Write fried, baked, broiled, etc…-not just chicken
   - Be as descriptive as possible using specific details
- Write whole, 2%, skim etc…-not just milk
     - Write white, whole wheat, rye etc…-not just bread
- Record the brand name if you know it (i.e. Snickers candy bar)
- Include everything that you add to your foods such as dressings, sugar, mustard, mayo, butter, sauces, jellies, etc.
   - See example below

3. In the **last column (Amount),** please record the amount of each of the listed foods you ate

Estimate what you ate in common household measures (cups, tablespoons, teaspoons, slices)
   - Use measuring spoon sizes for jelly, sugar, syrup, gravy, salad dressing, butter, margarine, and condiments – 3 teaspoons (tsp) = 1 tablespoon (tbsp)
   - Use measuring cup sizes for vegetables, rice, noodles, cereals, soups, stews, casseroles, ice cream, jello and canned fruits. - 1 cup, ½ cup, ¼ cup, 1/8 cup
   - Use ounces for meats, fish, poultry, cheese
   - Use number and size (small, med., large) for breads, rolls, raw fruits, crackers, chips, candy, and french fries.

Example :

Time / Where	**Food Item and How Prepared**	**Amount Eaten**
7 am h	Grape-nuts cereal	1 cup
	Skim milk	½ cup
11 am h	Ham sandwich	
	Whole wheat bread	2 slices
	95% fat free ham lunch meat	2 oz.

	American cheese	1 slice (3/4 oz.)
	Mustard	1 tsp.
	Diet coke	12 oz.
7 pm r	Breaded, fried chicken breast (Grandys)	4 oz.
	French fries (Grandys)	20 fries
	Ketchup	1 tbsp.
	Diet coke	16 oz.

Tips for Estimating Amounts

Use this guide to help you decide how much you ate. The measuring cups and spoons that were provided to you can help you with these estimates. Also, remember that the red bean bag equals 1 cup, the yellow bean bag represents ½ cup and the blue bean bag represents ¼ cup of dry measure.

DRINKS: use cups or fluid ounces. Example: coffee 2 cups, or iced tea 16 oz.

GRAINS: cups, sizes (sm., med., large) or slices. Example: cheerios ½ cup, 1 small bagel, white bread 2 slices.

- a medium size bagel is the size of a hockey puck
- a medium size pancake the size of a CD
- 1 cup of rice, pasta, or dry cereal would be the size of the red bean bag
- ½ cup would fill a cupcake wrapper (green bean bag)

FRUITS: size and number of pieces, or cups. Example: red apple 1 med, pineapple chunks ¼ cup (blue)

- a medium fruit is the size of a tennis ball
- 1 cup of chopped fruit is the size of a baseball (red bean bag)
- ½ cup of fruit looks like a pile of 15 marbles (green bean bag)

VEGETABLES: cups, number of pieces. Example: french fries 20 pieces, broccoli ½ cup

- 1 cup of lettuce is 4 large leaves
- 1 cup of chopped vegetables is the size of a fist (red bean bag)
- ½ cup of chopped vegetables is the size of a light bulb (green bean bag)

MEAT: ounces, number of items, cups. Example: chicken breast 4 oz., eggs 2 large, refried beans ½ cup (green bean bag)

- 3 ounces of cooked meat is the size of a deck of cards or a cassette tape
- 1 ounce of meat is the size of a matchbook or domino

MILK ITEMS: cups or ounces. Example: whole milk 1 cup or 8 oz.

- 1 slice of cheese is ¾ oz.
- 1 ounce of block cheese is the size of 4 dice.

FATS, OILS, SWEETS pieces, cups, ounces (see package)

- 1 pat of butter is 1 tsp.
- ½ cup of ice cream is the size of a tennis ball
- ¼ cup small snack foods like hard candy or nuts looks like the black bean bag (or you can count number of pieces)
- larger snack foods like pretzels, corn chips, or potato chips can be measured in pieces, or cups

Food Frequency Questionnaire

Subject Number ______________________________ Date ____________

The following section is about your usual eating habits. Think back over the **past year**. How often do you usually eat the foods listed?

First: Mark (√) the column to show how often, on the average, you ate the food during the past year.
Please BE CAREFUL which column you put your answer in. It will make a big difference if you say "Hamburger once a day" when you mean "Hamburger once a week"!
For example, if you eat bananas twice a week put a √ in the "2 per week" column.

Second: Mark (√) whether your usual serving size is small, medium, or large.
Please DO NOT OMIT serving size.

Additional comments:

A small serving is about one-half the medium serving size shown, or less.
A large serving is about one-an-a-half times as much, or more.
Please DO NOT SKIP any foods. If you never eat a food, mark "Never or less than once a month."

FOOD FREQUENCY

EXAMPLE: This person ate a medium serving of rice about twice per month and never ate squash.

TYPE OF FOOD	HOW OFTEN									HOW MUCH			
	Never or less than once per month	1 per mon	2-3 per mon	1 per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Medium Serving	Your Serving Size		
											S	M	L
Rice			√							3/4 cup		√	
Winter squash, baked squash	√									1/2 cup			
FRUITS AND JUICES													
Example: Apples, etc.				√						1 medium or 1/2 cup		√	
Apples, applesauce, pears										1 medium or 1/2 cup			
Bananas										1 medium			
Peaches, apricots, (fresh or canned)										1 medium or 1/2 cup			
Cantaloupe (in season)										1/4 medium			
Cantaloupe (rest of year)										1/4 medium			
Watermelon (in season)										1 slice			
Strawberries (in season)										1/2 cup			
Oranges										1 medium			
Grapefruit										1/2 medium			
Orange juice or grapefruit juice										6 ounce glass			
Fruit drinks with added vitamin C, such as Hi-C										6 ounce glass			
Any other fruit, including berries, fruit cocktail, grapes										1/2 cup			

TYPE OF FOOD	HOW OFTEN									HOW MUCH			
	Never or less than once per month	1 per mon	2-3 per mon	1 per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Medium Serving	Your Serving Size		
											S	M	L
BREAKFAST FOODS													
High fiber, bran or granola cereals, shredded wheat										1 medium bowl			
Highly fortified cereals, such as Total, Just Right or Product 19										1 medium bowl			
Other cold cereals, such as corn flakes, Rice Krispies										1 medium bowl			
Cooked cereal, or grits										1 medium bowl			
Milk on cereal										1/2 cup			
Sugar added to cereal										2 teasp.			
Eggs										1 egg=sml 2 eggs=med			
Bacon										2 slices			
Sausage										2 patties or links			
VEGETABLES													
String beans, green beans										½ cup			
Peas										½ cup			
Chili with beans										¾ cup			
Other beans such as baked beans, pintos, kidney, limas, and lentils										¾ cup			
Corn										½ cup			
Winter squash/baked squash										½ cup			
Tomatoes, tomato juice										1 medium or 6 oz. glass			
Red chili sauce, taco sauce, salsa picante										2 tablesp.			
Broccoli										½ cup			
Califlower or brussels sprouts										½ cup			

TYPE OF FOOD	HOW OFTEN									HOW MUCH			
	Never or less than once per month	1 per mon	2-3 per mon	1 per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Medium Serving	Your Serving Size		
											S	M	L
Spinach (raw)										¾ cup			
Spinach (cooked)										½ cup			
Mustard greens, turnip greens, collards										½ cup			
Cole slaw, cabbage, sauerkraut										½ cup			
Carrots, or mixed vegetables containing carrots										½ cup			
Green salad										1 medium bowl			
Regular salad dressing & mayonnaise, including on sandwiches or on potato salad, etc.										2 tablesp.			
French fries and fried potatoes										¾ cup			
Sweet potatoes, yams										½ cup			
Other potatoes, including boiled, baked, mashed & potato salad										1 medium or ½ cup			
Rice										¾ cup			
Any other vegetable, including cooked onions, summer squash										½ cup			
Butter, margarine or other fat added to veg., potatoes, etc.										2 pats			

MEAT, FISH, POULTRY, LUNCH ITEMS													
TYPE OF FOOD	**HOW OFTEN**									**HOW MUCH**			
	Never or less than once per month	**1 per mon**	**2-3 per mon**	**1 per week**	**2 per week**	**3-4 per week**	**5-6 per week**	**1 per day**	**2+ per day**	**Medium Serving**	**Your Serving Size**		
											S	**M**	**L**
Hamburgers, cheeseburgers, meatloaf, beef burritos, tacos										**1 med. or 4 ounces**			
Beef, (steaks, roasts, etc., including sandwiches)										**4 ounces**			
Beef stew or pot pie with carrots or other vegetables										**1 cup**			
Liver, including chicken livers										**4 ounces**			
Pork, including chops, roasts										**2 chops or 4 ounces**			
Fried chicken										**2 small or 1 large pce**			
Chicken or turkey (roasted, stewed or broiled, including on sandwiches)										**2 small or 1 large pce**			
Fried fish or fish sandwich										**4 oz. or 1 sandwich**			
Tuna, tuna salad, tuna casserole										**½ cup**			
Oysters										**5 pieces, ¼ cup, or 3 oz.**			
Shell fish, (shrimp, crab, lobster, etc.)										**5 pieces, ¼ cup, or 3 oz.**			
Other fish (broiled or baked)										**2 pieces or 4 ounces**			
Spaghetti, lasagna, other pasta with tomato sauce										**1 cup**			
Pizza										**2 slices**			
Mixed dishes with cheese (such as macaroni and cheese)										**1 cup**			
Liverwurst										**2 slices**			

TYPE OF FOOD	HOW OFTEN									HOW MUCH			
	Never or less than once per month	1 per mon	2-3 per mon	1 per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Medium Serving	Your Serving size		
											S	M	L
Hot dogs										2 hot dogs			
Ham, bologna, salami, and other lunch meats										2 slices or 2 ounces			
Vegetable and tomato soups, including vegetable beef, minestrone										1 medium bowl			
Other soups										1 medium bowl			
BREADS, SNACKS, SPREADS													
Biscuits, muffins, (including fast foods)										1 medium piece			
White bread (including sandwiches, bagels, burger rolls, French or Italian bread)										2 slices			
Dark bread, such as wheat, rye, pumpernickel, (including sandwiches)										2 slices			
Corn bread, corn muffins, corn tortillas										1 medium piece			
Salty snacks, such as potato chips, corn chips, popcorn										2 handfuls or 1 cup			
Peanuts, peanut butter										2 tablesp			
Margarine on bread or rolls										2 pats			
Butter on bread or rolls										2 pats			
Gravies made with meat drippings, or white sauce										2 tablesp			

TYPE OF FOOD	HOW OFTEN									HOW MUCH			
	Never or less than once per month	1 per mon	2-3 per mon	1 per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Medium Serving	Your Serving size		
											S	M	L
DAIRY PRODUCTS													
Cottage cheese										½ cup			
Other cheeses and cheese spreads										2 slices or 2 ounces			
Flavored yogurt, frozen yogurt										1 cup			
SWEETS													
Ice cream										1 scoop or ½ cup			
Doughnuts, cookies, cake, pastry										1 piece or 3 cookies			
Pumpkin pie, sweet potato pie										1 medium slice			
Other pies										1 medium slice			
Chocolate candy										1 small bar or 1 oz.			
Other candy, jelly, honey, brown sugar										3 pieces or 1 tblsp.			

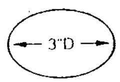
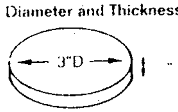
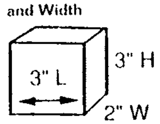
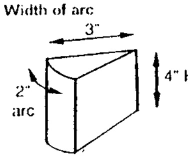
BEVERAGES (Please note that the categories for these columns are different.)													
	Never or less than once per month	1-3 per mon	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day	Medium Serving	Your Serving Size		
											S	M	L
Whole milk and beverages with whole milk (not incl. on cereal)										8 oz. glass			
2% milk and beverages with 2% milk (not incl. on cereal)										8 oz. glass			
Skim milk, 1% milk or buttermilk (not incl. on cereal)										8 oz. glass			

TYPE OF FOOD	HOW OFTEN									HOW MUCH			
	Never or less than once per month	1-3 per mon	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day	Medium Serving	Your Serving Size		
											S	M	L
Regular soft drinks (not diet soda)										12 oz. can or bottle			
Beer										12 oz. can or bottle			
Wine or wine coolers										1 medium glass			
Liquor										1 shot			
Coffee, regular or decaf										1 medium cup			
Tea (hot or iced)										1 medium cup			
Lemon in tea										1 teasp.			
Non-dairy creamer in coffee or tea										1 tablesp.			
Cream (real) or Half-and-Half in coffee or tea										1 tablesp.			
Milk in coffee or tea										1 tablesp.			
Sugar in coffee or tea										2 teaspoon s			
Glasses of water										8 oz. glass			

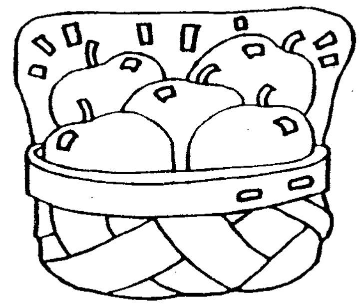
SUMMARY QUESTIONS	AVERAGE USE LAST YEAR								
	Less than once per week	1-2 per week	3-4 per week	5-6 per week	1 per day	1 ½ per day	2 per day	3 per day	4+ per day
a. How often do you use fat or oil in cooking?									
b. About how many servings of vegetables do you eat, not counting salad or potatoes?									
c. About how many servings of fruit do you eat, not counting juices?									
d. About how many servings of cold cereal do you eat?									

APPENDIX I

MEASURING DESCRIPTION

DESCRIPTION	EXAMPLES
Measuring cups (c) Teaspoons (t or tsp) Tablespoons (tbsp)	Vegetables, canned or frozen fruits, pasta casseroles, all liquids, such as, beverages, soups, gravies, sauces, salad dressing, ice-cream or shakes.
Weight in grams (gm) or ounces (oz)	Any solid food such as meat, cheese, or frozen entree.
Fraction of the whole	1/8 of 9" pie or 1/4 of 6" cantaloupe.
Diameter (D)  	Any sphere, such as a 3" D apple, roll or muffin.
Diameter and Thickness  	Any cylinder or disk, such as salmon patty, slice of bologna or hamburger (ie: a 3" D hamburger patty 1/2" thick).
Length and Height and Width  	Any rectangle or square such as a 3" long 3" high 2" wide piece of chocolate cake.
Length and Height and Width of arc  	Any wedge, such as a slice of angel food cake, pizza or pie.

Food Record



Please write down everything you eat and drink for the next five (5 days). Please refer to the *Directions for Keeping a Food Diary* for specific instructions on how to record your food intake.

Name________________________

ID Number________________________

Week ________________________

EXAMPLE Date 9/1/99 Day of week **wed.**

Time/Where	Food Item/ Preparation	Amount
8 am h	Total corn flakes	1 cup
	2 % milk	½ cup
	Grapefruit	½ large
	Sugar	1 tbsp.
	Coffee, decaf, black	2 cups
12 pm r	Cheese pizza (Pizza Hut)	2 slices (10" pie)
	Lettuce salad	2 cups
	Cherry tomatoes	2
	Ranch dressing, fat free	2 tbsp.
	Diet coke	16 oz.
7 pm h	Green beans, canned	½ cup
	Skinless chicken breast, grilled	4 oz.
	Mashed potatoes prepared with with 2 % milk	1 cup
	Margarine	1 ½ tsp.
	Whole wheat roll	1 small
	Iced tea, unsweetened	20 oz

Day 5 Date________ Day of week________

Time/Where	Food Item/ Preparation	Amount

Day 4 Date__________Day of week_________

Time/Where	Food Item/ Preparation	Amount

Day 1 Date__________Day of week________

Time/Where	Food Item/ Preparation	Amount

Day 2 Date__________Day of week_________

Time/Where	Food Item/ Preparation	Amount

Day 3 Date__________Day of week_________

Time/Where	Food Item/ Preparation	Amount

APPENDIX J

Intervention Mapping

	Internal Determinant	Strategy
Objective	1.) Evaluate food intake using individualized folate counter	
Knowledge/ Skill (K/S)	Recognize high folate sources in diet	1.) discuss foods high in folate 2.) give individual folate counter 3.) have guided practice filling out food record (group) 4.) guided practice filling out log
	Recognize portion sizes	1.) guided practice id portion sizes using flip chart (group)
	Decide if adequate	1.) pt. adds points from folate counter to reach standard (daily)
Self –Eval.	Completes daily monitoring log	1.) log provided to indicate whether provided cereal was eaten, or pt. will list what was eaten instead to meet standard 2.) reinforcement given at week4, and on telephone at week 3
Objective	2.) Ask wife to purchase and prepare foods high in folate	
K/S	Able to verbalize what foods needed	1.) guided practice listing foods he would request
Self –Eval.	Will eat the foods he requests to reinforce purchase/preparation	1.) review log 2.) aknowledge eating foods with verbal praise at week 4
Objective	3.) Select foods high in folate at home	
K/S	Identify foods that will meet standard	1.) guided practice id foods using folate counter 2.) guided practice planning a meal using these foods
Self-Eval.	Monitors progress	1.) completes food records 2.) completes daily monitoring log
Objective	4.) Select foods high in folate in other settings	
K/S	Identify foods that meet his needs	1.) reinforce high folate foods at week 4 2.) have guided practice choosing foods from a sample menu 3.) have guided practice id restaraunts where these foods might be available
Self Eval.	Monitors progress	1.) completes food records 2.) completes daily monitoring log

		3.) at week 4 discuss problems and ways to increase folate if needed

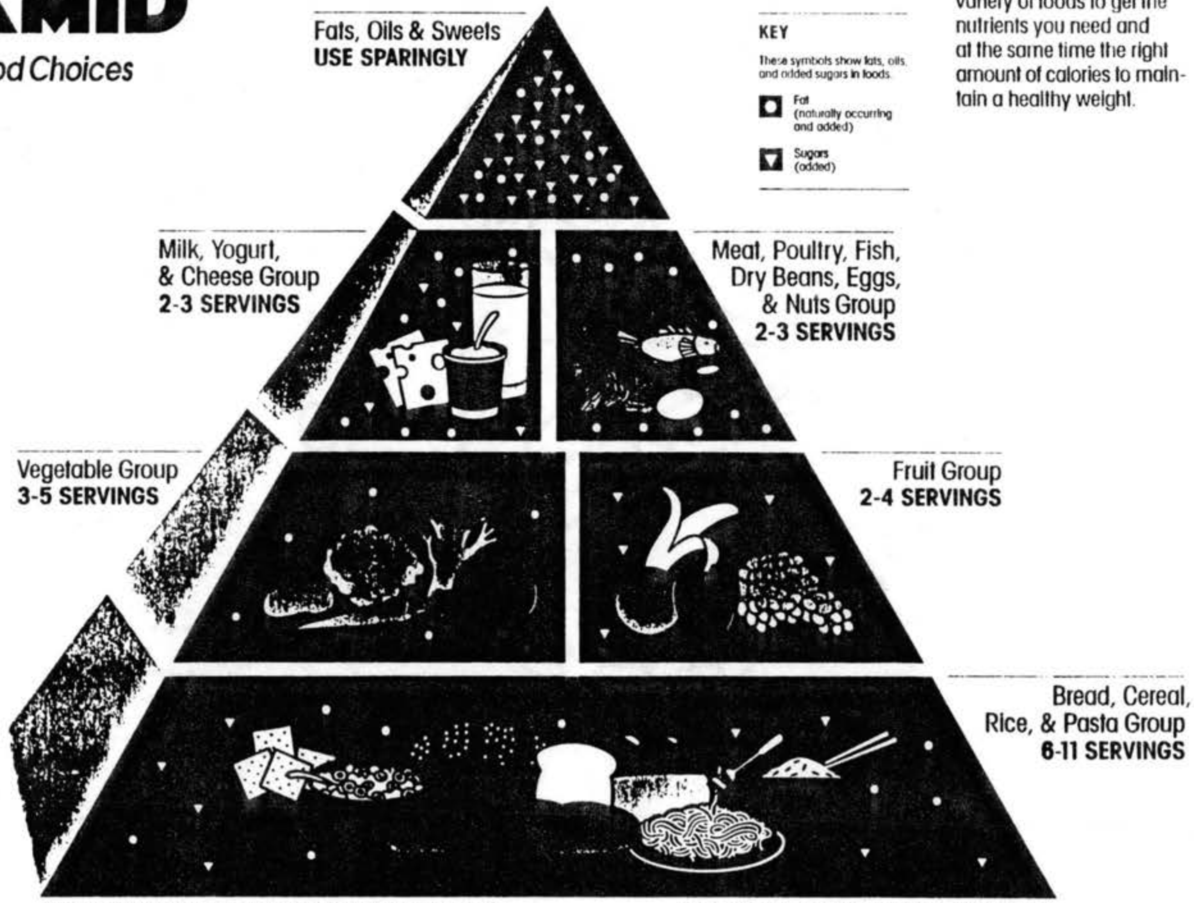
	External Determinant	Strategy
External Reinforcement	Objectives 1-4	
	Wife will assist in keeping food record and log, purchase and prepare what is asked, agree to eat at chosen places outside the home, includes these foods in lunches etc.	1.) handout tells wife to follow some suggested guidelines
	Wife will eat the high folate foods with husband daily	1.) ask question on log 2.) handout will request she eat the foods with husband
	Eats high folate cereal	1.) cereal provided 2.) recorded on log

APPENDIX K

FOOD GUIDE PYRAMID

A Guide to Daily Food Choices

The Pyramid is an outline of what to eat each day. It's not a rigid prescription, but a general guide that lets you choose a healthful diet that's right for you. The Pyramid calls for eating a variety of foods to get the nutrients you need and at the same time the right amount of calories to maintain a healthy weight.



The **Food Guide Pyramid** emphasizes foods from the five food groups shown in the three lower sections of the Pyramid.

Each of these food groups provides some, but not all, of the nutrients you need. Foods in one group can't replace those in another. No one food group is more important than another—for good health, you need them all.

17-114

Source: U.S. DEPARTMENT OF AGRICULTURE and the U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Provided by: the Education Department of the NATIONAL LIVE STOCK AND MEAT BOARD

How Many Servings Do You Need?

The **Food Guide Pyramid** shows a range of servings for each food group. The number of servings that are right for you depends on how many calories you need. Calories are a way to measure food energy. The energy your body needs depends on your age, sex and size. It also depends on how active you are.

In general, daily intake should be:

- ▲ 1,600 calories for most women and older adults;
- ▲ 2,200 calories for kids, teen girls, active women and most men; and
- ▲ 2,800 calories for teen boys and active men.

Those with lower calorie needs should select the lower number of servings from each food group. Their diet should include 2 servings of meat for a total of 5 ounces. Those with average calorie needs should select the middle number of servings from each food group. They should include 2 servings of meat for a total of 6 ounces. Those with higher calorie needs should select the higher number of servings from each food group. Their diet should include 3 servings of meat for a total of 7 ounces. Also, pregnant or breastfeeding women; teens; or young adults up to age 24 should select 3 servings of milk.

The amount of food that counts as one serving is listed below. If you eat a larger portion it is more than one serving. For example, a slice of bread is one serving, so a sandwich for lunch would equal two servings.

For mixed foods, estimate the food group servings of the main ingredients. For example, a large piece of sausage pizza would count in the bread group (crust), the milk group (cheese), the meat group (sausage) and the vegetable group (tomato sauce). Likewise, a helping of beef stew would count in the meat group and the vegetable group.

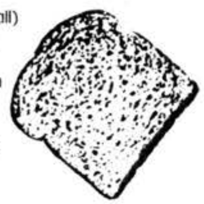
What Counts as a Serving?

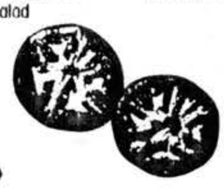
Bread, Cereal, Rice & Pasta Group

1 slice bread
1 tortilla
½ cup cooked rice, pasta or cereal
1 ounce ready-to-eat cereal
½ hamburger roll, bagel or English muffin
3-4 plain crackers (small)
1 pancake (4-inch)
½ croissant (large)
½ doughnut or danish (medium)
1/16 cake (average)
2 cookies (medium)
1/12 pie (2-crust, 8")

Vegetable Group

½ cup chopped raw or cooked vegetables
1 cup raw, leafy vegetables
¾ cup vegetable juice
½ cup scalloped potatoes
½ cup potato salad
10 French fries





Fruit Group

1 piece fruit or melon wedge
¾ cup fruit juice
½ cup chopped, cooked or canned fruit
¼ cup dried fruit

Milk, Yogurt & Cheese Group

1 cup milk or yogurt
1½ ounces natural cheese
2 ounces process cheese
2 cups cottage cheese
1½ cups ice cream or ice milk
1 cup frozen yogurt

Meat, Poultry, Fish, Dry Beans, Eggs & Nuts Group

2½ to 3 ounces cooked lean beef, pork, lamb, veal, poultry or fish

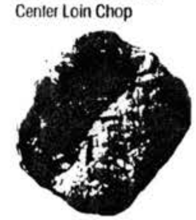
Count ½ cup cooked beans or 1 egg or 2 tablespoons peanut butter or ⅓ cup nuts as 1 ounce of meat

Fats, Oils & Sweets

use sparingly

Lean Meat Choices

BEEF	PORK	LAMB	VEAL
Round Tip	Tenderloin	Loin Chop	Cutlet
Top Round	Boneless Top Loin Chop	Leg	Loin Chop
Eye of Round	Boneless Ham, Cured		
Top Loin	Center Loin Chop		
Tenderloin			
Sirloin			



Adapted from the **Food Guide Pyramid** Home and Garden Bulletin Number 252
U.S. Department of Agriculture, Human Nutrition Information Service
FOOD MODELS courtesy of NATIONAL DAIRY COUNCIL®

Published by the Education Department
NATIONAL LIVE STOCK AND MEAT BOARD
444 NORTH MICHIGAN AVENUE
CHICAGO, ILLINOIS 60611

APPENDIX L

NUTRITION UPDATE

Upping Your Cereal, Grain, Vegetable, and Fruit Eating

The *Food Guide Pyramid* tells us that the basis of a healthful diet is to eat plenty of cereal, grains, vegetables, and fruit while consuming less fat, oil, and sweets. Few of us as children were given plates filled with plant foods and a side dish of meat. It was usually the other way around. But increasing your cereal, grain, fruit, and vegetable eating is important and is possible for everyone, with a little help.

The Foods Behind the Categories

The good news is that foods in the cereal, grain, vegetable, and fruit categories are probably ones you already like to eat. The trick is to include more of them in your food choices each day. Which foods are these?

Cereal*:

- all ready-to-eat cereals and hot cereals (aim for whole-grain varieties such as shredded wheat, raisin bran, high-bran, oatmeal)
- wheat germ

Grains*:

- sliced bread, pita bread, bagels, English muffins (aim for whole-grain varieties such as whole wheat, rye, pumpernickel, corn, oat, multi-grain); breadsticks; crackers
- pasta, including spaghetti and other noodles made without whole eggs
- brown rice, white rice, barley, couscous, polenta, kasha (buckwheat)
- popcorn (aim for unbuttered)

Vegetables:

- green, leafy such as Romaine lettuce, spinach, kale, Brussels sprouts
- red, orange, and yellow such as yams, carrots, peppers, squash, cabbage
- green beans, peas, broccoli, corn, potato, celery, cucumber, cauliflower, onion
- vegetable juice

Fruit:

- citrus fruit such as oranges, grapefruits
- berries such as strawberries, blueberries, raspberries

Creamy Potato Soup

- melons such as cantaloupe, honeydew, watermelon
- apple, pear, banana, peach, apricot, grapes, plum, nectarine, mango, kiwi
- dried fruit such as raisins, figs, prunes, apricots
- fruit juice

* The cereal and grain categories are part of the Bread Group in the Food Guide Pyramid

How Much Is Enough?

According to the *Food Guide Pyramid*, the number of daily servings of cereal, grains, vegetables, and fruit a person should eat depends on his or her calorie level for the day. For example:

if you eat...	choose...		
	Bread Group*	Vegetable Group	Fruit Group
Daily calories	(number of servings)		
1600	6	3	2
2200	9	4	3
2800	11	5	4

*Bread Group consists of foods in the cereals and grains categories

Your dietitian or nutritionist can help you work out which calorie level fits your needs. She/he can also make sure you get adequate servings from the remaining food groups (milk and meat groups).

Do these numbers of servings sound like an impossible goal for you to achieve? It's really quite possible when you know how big a serving size is in each food group. This chart can help.

Food Group Serving Size Chart

(For serving size information in the meat and milk groups, see the accompanying article entitled, "More About the Food Guide Pyramid.")

Bread, Cereal, Rice, Pasta Group

- 1 slice bread
- 1 oz of ready to eat cereal
- 1/2 cup of cooked cereal, rice, or pasta
- 3 to 4 small crackers

Vegetable Group

- 1 cup of raw leafy vegetables
- 1/2 cup of other vegetables, cooked or chopped raw
- 3/4 cup of vegetable juice

Fruit Group

- 1 medium apple, banana, orange
- 1/2 cup of chopped, cooked, or canned fruit
- 3/4 cup of fruit juice

Let's look at a day's worth of cereal, grains, vegetables, and fruit at the 2,200 calorie level (see chart on the following page). *At least* 9 servings from the Bread Group, 4 servings from the Vegetable Group, and 3 servings from the Fruit Group are recommended.

Remember to vary your choices from day to day to get more of the nutrients you need to stay healthy and fit. Your dietitian or nutritionist can help you with ideas on how to add food choices from the other food groups.

	Bread Group	Vegetable Group *(Number of Servings)*	Fruit Group
Breakfast			
2 oz shredded wheat	2		
1/2 cup sliced bananas			1
3/4 cup orange juice			1
Snack			
3-4 low-fat crackers	1		
Lunch			
sandwich on whole wheat bread	2		
small salad with leafy greens, celery, tomato, cucumber, red pepper		2	
Snack			
3/4 cup vegetable juice		1	
3 breadsticks	1		
Dinner			
vegetable and meat stir-fry on		2	
1 cup of rice	2		
Dessert			
1/2 cup canned fruit salad			1
2 medium lowfat cookies	1		
Total *(Number of Servings)*	9	5	3

Getting Creative

Here are some food preparation ideas to help you make the switch to high cereal, grain, vegetable, and fruit eating.

- Have two vegetable-and-grain main meals each week. Try rice and beans; vegetable stir-fry and rice; pasta primavera; kasha and bowtie noodles; tortellini salad; bean-filled tacos and tortillas; hearty vegetable-rice soup with low-fat crackers.
- Sprinkle cereal or wheat germ on ice milk or low-fat frozen yogurt. Or, add berries or chopped fruit to these frozen desserts.
- Add lots of celery, zucchini, green peppers, mushrooms, and onions to tomato-based pasta sauce.
- Eat fruit salad as an appetizer or with your low-fat cake or cookies at dessert.
- Prepare tuna and chicken salads with celery, grapes, chopped red peppers, or apple pieces. Enjoy these salads with low-fat crackers.
- Dip fish or skinless chicken first in low-fat milk, egg white, or cholesterol-free egg substitute and then in crushed cereal before baking.
- Use whole-grain bread or cracker crumbs, oatmeal, or crushed oat bran cereal in your meatloaf or hamburgers.
- Dip pretzel chips or baked tortilla chips in salsa or other low-fat dips.

Don't Forget Fluids

When you add plant products to your diet, be sure to drink a variety of fluids to keep your bowels regular. This is recommended whether you feel thirsty or not. Approximately eight glasses of water or other nonalcoholic beverages each day will do the trick.

Try these delicious recipes

Creamy Potato Soup

Makes 8 (3/4 cup) servings
(Pictured)

- 3 medium potatoes, cubed (about 2 1/2 cups)
- 2 (13 3/4-ounce) cans COLLEGE INN Lower Salt Chicken Broth
- 1/2 cup chopped onion
- 1/2 cup chopped green pepper
- 1 tablespoon FLEISCHMANN'S Margarine
- 1/4 cup all-purpose flour
- 2 cups skim milk
- Parsley, for garnish
- 48 HARVEST CRISPS 5-Grain Crackers

In large saucepan, over medium-high heat, heat potatoes and chicken broth to a boil; reduce heat. Cover; simmer 15 minutes or until potatoes are tender.

Meanwhile, in medium skillet, over medium heat, saute onion and green pepper in margarine until tender but not browned; stir in flour. Gradually whisk in milk; cook and stir until thickened. Stir in potato mixture; cool slightly.

Remove 1 cup potatoes and 1/2 cup liquid to food processor or blender container; blend until smooth. Stir potato puree into soup; cook and stir until heated through. Garnish each serving with parsley if desired. Serve hot with crackers.

NUTRITION INFORMATION per serving (3/4 cup soup, 6 crackers): 106 calories, 457 mg sodium, 4 mg cholesterol, 4 gm total fat, 1 gm saturated fat, 3 gm dietary fiber.

Black Bean Dip

Makes 1 1/2 cups

- 1 (16-ounce) can black beans, rinsed and drained
- 1/2 cup ORTEGA Medium Thick and Chunky Salsa
- 1 clove garlic
- 1/2 teaspoon ground cumin
- 1/2 cup shredded carrot
- Shredded carrot, for garnish
- 36 HARVEST CRISPS 5-Grain Crackers

In food processor or electric blender, combine beans, 1/4 cup salsa, garlic, and cumin; blend until smooth. Stir in remaining salsa and carrot. Cover; chill for at least 1 hour to blend flavors. Garnish with carrot if desired. Serve as a dip with crackers.

NUTRITION INFORMATION per serving (2 tablespoons dip, 3 crackers): 50 calories, 190 mg sodium, 0 mg cholesterol, 1 gm total fat, 0 gm saturated fat, 2 gm dietary fiber.

Dietitian Comments	
Today's Date:	Follow-up Date:

APPENDIX M

YOUR PERSONAL FOLATE CHOICES

These are the foods that contain folate that you eat most often. If you decide not to eat the cereal provided, you may use this list and the attached list of additional foods to meet your daily requirement of (400 µg) of folate. To do that, please choose a total of ten (10) points per day (each point equals approximately 40 µg). The corresponding serving size is listed.

FOODS	SERVING SIZE	FOLATE POINTS
GRAIN Foods		
Cereals		
Fortified cereal (i.e. Cheerios)	40% DV check box for serving size	4
Oatmeal, instant	1 pkt.	3
Muffin, blueberry from mix	1	1
Bagel	1 med. (grocery)	2
Cookies, animal crackers	2 oz. box	2
Pasta (spaghetti)	1 cup	4
FRUIT		
Cantaloupe	¼ med. melon (6”)	1
Orange	1 ea.	1
Orange juice	6 oz.	1
VEGETABLES		
Corn, cream style	½ cup	1
Corn, whole kernel	½ cup	1
Corn on the cob	1 ear	1
Broccoli, cooked	½ cup	1
Mustard greens	½ cup	1
Artichoke, cooked	1 med.	2
Avocado	1 ea.	3
Beets, canned	¾ cup slices	1
Okra, cooked	½ cup	3
Spaghetti sauce, canned	1 cup	1
MEAT, FISH, POULTRY		
Egg, hard cooked	2	1
BEANS, PEAS, LENTILS, NUTS		
Peas; green, or yellow	½ cup	1
Chili with beans, canned	¾ cup	1
Black, navy, white, kidney, or pinto beans,	¾ cup	5
Lentils, cooked	¾ cup	7
Three bean salad	½ cup	3
Baked beans, canned	¾ cup	2

Soybeans, dry roasted	½ cup	4
Chickpeas (garbonzo beans)	¾ cup	3
Split peas	½ cup	2
Black-eyed peas (cowpeas)	½ cup	2
Peanuts, dry roasted	2 Tbsp	1
MIXED DISHES		
Chow mein noodles	¾ cup	1
Corn pudding	¾ cup	1
Egg salad	¾ cup	1
Peanut butter	2 Tbsp.	1
Peanut butter and jelly on white	1	2
Trail mix	1 cup	3
FAST FOODS		
Hamburger or cheeseburger on bun	4 oz. meat	2
Baked potato with cheese sauce	1 ea.	2
Biscuit with egg	1 ea.	2
Submarine sandwich	6 inch	3

APPENDIX N

DAILY MONITORING LOG

Name____________________

Subject Number____________ Week______

Monday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

Tuesday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

Wednesday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

Thursday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

Friday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

Saturday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

Sunday

Date____________

I ate provided cereal today____yes

If not, I ate the following folate foods instead...

Food Points

____

____

____

____

____

____

TOTAL Points_______

How many of the above listed foods did your wife eat with you ?

All____ Some_____

None ______

APPENDIX O

GOOD SOURCES OF FOLATE

In order to meet your daily requirement (400 μg) of folate, please choose a total of ten (10) points per day (each point equals approximately 40 μg). The corresponding serving size is listed.

FOODS	SERVING SIZE		FOLATE POINTS
GRAIN Foods			
Cereals			
High fiber, shredded, granola cereal		check box for serving size	4
Super fortified cereal (i.e. Total)	100% DV	check box for serving size	10
Fortified cereal (i.e. Cheerios)	40% DV	check box for serving size	4
	50% DV	check box for serving size	5
Cream of wheat, instant	¾ cup		5
Oatmeal, instant	1 pkt.		3
Biscuit	1 small		1
Muffin, english	1		1
Muffin, blueberry from mix	1		1
Bagel	1 med. (grocery)		2
	1 large (bagel shop)		4
Bread; white, rolls, french, italian	2 slices		2
Pita bread	1 pocket		2
Tortilla, flour	10"		4
Corn bread, corn muffin	1 med.		2
Doughnuts, glazed	1 large		1
Cookies, animal crackers	2 oz. box		2
vanilla wafers	10 ea.		1
graham crackers	2 rectangles (8 crackers)		1
Pies, fruit, pecan	1/6 of pie (med. slice)		1
Pasta (spaghetti)	1 cup		4
Egg noodles	1 cup		4
Rice, instant, white	¾ cup		2
Rice, wild	¾ cup		1
Wheat germ	2 Tbsp.		1
Brewers yeast	1 Tbsp.		8
FRUIT			
Cantaloupe	¼ med. melon (6")		1
Strawberries	1 cup		1
Orange	1 ea.		1
Orange juice	6 oz.		1
Pineapple juice	6 oz.		1

Papaya	1 medium	3
Raspberries, frz., red, sweetened	½ cup	1
Plantains	1 cup	1
VEGETABLES		
Corn, cream style	½ cup	1
Corn, whole kernel	½ cup	1
Corn on the cob	1 ear	1
Tomato juice	6 oz.	1
Broccoli, cooked	½ cup	1
Cauliflower	½ cup	1
Brussel sprouts, cooked	½ cup	1
Spinach, canned, cooked	½ cup	2
Spinach, raw	¾ cup	1
Mustard greens	½ cup	1
Turnip greens, cooked	½ cup	2
Chinese cabbage	1 cup	2
Endive, romaine lettuce	1 cup	2
Chicory lettuce	1 cup	5
Artichoke, cooked	1 med.	2
Asparagus, boiled	4 spears	2
Avocado	1 ea.	3
Beets, canned	¾ cup slices	1
Okra, cooked	½ cup	3
Parsnips, cooked	½ cup	1
Spaghetti sauce, canned	1 cup	1
MEAT, FISH, POULTRY		
Egg, hard cooked	2	1
Beef or calf liver, braised	4 oz.	6
Pork liver, braised	4 oz.	5
Chicken or turkey liver, braised	4 oz.	13
Crabmeat	3 ounces	1
Clams, canned	1 cup	1
BEANS, PEAS, LENTILS, NUTS		
Peas, green, or yellow	½ cup	1
Chili with beans, canned	¾ cup	1
Black, navy, white, kidney, or pinto beans,	¾ cup	5
Lentils, cooked	¾ cup	7
Lima beans	¾ cup	2
Three bean salad	½ cup	3
Baked beans, canned	¾ cup	2
Soybeans, dry roasted	½ cup	4

Chickpeas (garbonzo beans)	¾ cup	3
Split peas	½ cup	2
Black-eyed peas (cowpeas)	½ cup	2
Peanuts, dry roasted	2 Tbsp	1
MIXED DISHES		
Beef stew with veg., homemade	1 cup	1
Chicken noodle soup, canned	1 cup	1
Chow mein noodles	¾ cup	1
Corn pudding	¾ cup	1
Egg salad	¾ cup	1
Hummus	¼ cup	1
Peanut butter	2 Tbsp.	1
Peanut butter and jelly on white	1	2
Trail mix	1 cup	3
Tiger or Sports Bar	1 ea.	10
FAST FOODS		
Beef and Bean burrito,	1 ea.	2
Hamburger or cheeseburger on bun	4 oz. meat	2
Ham and cheese on bun (Arbys)	1 ea.	3
Roast beef on bun	1 ea.	2
Chicken filet sandwich on bun	1 ea.	4
Fish sandwich, large	4 oz..	3
Hot dog with chili	2 ea.	4
Baked potato with cheese sauce	1 ea.	2
Pintos and cheese	1 ea.	2
Bean and cheese tostada	1 ea.	2
Enchilada, cheese	1 ea	2
Biscuit with egg	1 ea.	2
Submarine sandwich	6 inch	3
Taco salad	1 ½ cups	2

APPENDIX P

FAIT
Folic Acid Intervention Trial
Oklahoma State University
Department of Nutritional Sciences

Dear Mrs. _________;

Your husband has agreed to participate in a research study where he has been asked to eat a serving of fortified cereal every day for 8 weeks. If he chooses, he may select other foods high in folate from a list we have given him, instead of the cereal.

Preliminary research has shown that men depend on their wives a great deal when it comes to food selection and preparation. In order to help your husband increase his intake of folate, please do the following.

- At specified times during the study, your husband will be asked to keep a five day food record (3 different times; for a total of 15 days). He may need your help in recording foods and estimating portion sizes of foods you serve and prepare.
- He has been asked to keep a daily monitoring log, indicating whether he eats the provided cereal and/or other foods from his personal list of folate foods he has chosen. Please assist him in keeping this log if needed.
- If you are the primary shopper and food preparer, please purchase and prepare folate containing foods he may request, if he chooses not to eat the cereal.
- If possible, please eat the folate foods (other than the provided cereal) with him.
- When eating away from the home with your husband please eat at eating establishments where folate choices are available.
- If you prepare a lunch or other meal for your husband to be eaten away from the home, please include some of the foods from his personal list of folate foods.

By doing the above, you may be helping your husband lower his risk for heart disease. Thank you.

APPENDIX Q

Study Schedule
Folic Acid Intervention Trial

Visit 1

(approximately 1 hour)

- ♥ sign Informed Consent form
- ♥ education on filling out food record
- ♥ fill out Food Frequency Questionnaire (FFQ)
- ♥ 24 –hour dietary food recall
- ♥ take 5-day food record home to fill out for next 4 days

Visit 2 -

1 week later – fasting (approximately 1 hour)

- ♥ measure height and weight
- ♥ take a fasting blood draw
- ♥ return 5-day food record
- ♥ receive nutrition education according to group you are chosen to be in (intervention = I, or control = C)
- ♥ receive cereal (I)

Visit 3
(1 mo.)

4 weeks later – fasting (approximately 30 min.)

- ♥ take a fasting blood draw (I and C)
- ♥ return bags of unused cereal (I)
- ♥ receive cereal (I)
- ♥ review monitoring record (I)

Visit 4
(2 mo.)

4 weeks later – fasting (approximately 30 min.)

- ♥ measure height and weight
- ♥ take a fasting blood draw
- ♥ receive a five day food record (you will mail back to us 1 week later)
- ♥ return bags of unused cereal (I)
- ♥ review monitoring record (I)

Visit 5
(5 mo.)

12 weeks later – fasting (approximately 30 min.)

- ♥ measure height and weight
- ♥ take a fasting blood draw
- ♥ receive a five day food record (you will mail back to us 1 week later)

APPENDIX R

Whole Grain Total

Nutrition Facts

Serving Size ¾ cup (30g)
Servings Per Container About 17

Amount Per Serving	Whole Grain Total	with 1/2 cup skim milk
Calories	110	150
Calories from Fat	10	10
	% Daily Value**	
Total Fat 1g*	1%	1%
Saturated Fat 0.5g	0%	0%
Polyunsaturated Fat 0g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 200mg	8%	11%
Potassium 100mg	3%	9%
Total Carbohydrate 24g	8%	10%
Dietary Fiber 3g	11%	11%
Sugars 5g		
Other Carbohydrate 16g		
Protein 3g		
Vitamin A	10%	15%
Vitamin C	25%	25%
Calcium	25%	40%
Iron	100%	100%
Vitamin D	10%	25%
Vitamin E	100%	100%
Thiamin	100%	100%
Riboflavin	100%	110%
Niacin	100%	100%
Vitamin B_6	100%	100%
Folic Acid	100%	100%
Vitamin B_{12}	100%	110%
Pantothenic Acid	100%	100%
Phosphorus	8%	20%
Magnesium	6%	10%
Zinc	100%	100%
Copper	4%	4%

*Amount in Cereal. A serving of cereal plus skim milk provides 1g total fat, less than 5mg cholesterol, 260mg sodium, 310mg potassium, 30g total carbohydrate (11g sugars) and 7g protein.
**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

INGREDIENTS: WHOLE GRAIN WHEAT, SUGAR, WHOLE GRAIN BROWN RICE, CALCIUM CARBONATE, SALT, CORN SYRUP, MONOGLYCERIDES, ZINC AND IRON (MINERAL NUTRIENTS), VITAMIN E (TOCOPHERYL ACETATE), TRISODIUM PHOSPHATE, A B VITAMIN (NIACINAMIDE), VITAMIN C (SODIUM ASCORBATE), BEET JUICE CONCENTRATE AND ANNATTO EXTRACT COLOR, A B VITAMIN (CALCIUM PANTOTHENATE), VITAMIN B_6 (PYRIDOXINE HYDROCHLORIDE), VITAMIN B_2 (RIBOFLAVIN), VITAMIN B_1 (THIAMIN MONONITRATE), A B VITAMIN (FOLIC ACID), VITAMIN A (PALMITATE), VITAMIN B_{12}, VITAMIN D. FRESHNESS PRESERVED BY BHT.
CONTAINS WHEAT INGREDIENTS.

DISTRIBUTED BY **General Mills Sales, Inc.**
GENERAL OFFICES, MINNEAPOLIS, MINNESOTA 55440
Made in U.S.A. © 1999 General Mills, Inc.

Exchange: 1½ Starch [illegible]
Exchange calculations based on the *Exchange Lists for Meal Planning* ©1995 the American Dietetic Association, the American Diabetes Association.

Total Raisin Bran

Nutrition Facts

Serving Size 1 cup (55g)
Servings Per Container About 9

Amount Per Serving	Total Raisin Bran	with ½ cup skim milk
Calories	180	220
Calories from Fat	10	10
	% Daily Value**	
Total Fat 1g*	2%	2%
Saturated Fat 0g	0%	0%
Polyunsaturated Fat 0g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 240mg	10%	13%
Potassium 280mg	8%	14%
Total Carbohydrate 43g	14%	16%
Dietary Fiber 5g	20%	20%
Sugars 19g		
Other Carbohydrate 19g		
Protein 4g		
Vitamin A	10%	15%
Vitamin C	0%	0%
Calcium	25%	40%
Iron	100%	100%
Vitamin D	10%	25%
Vitamin E	100%	100%
Thiamin	100%	100%
Riboflavin	100%	110%
Niacin	100%	100%
Vitamin B_6	100%	100%
Folic Acid	100%	100%
Vitamin B_{12}	100%	110%
Pantothenic Acid	100%	100%
Phosphorus	10%	25%
Magnesium	10%	10%
Zinc	100%	100%
Copper	8%	8%

*Amount in Cereal. A serving of cereal plus skim milk provides 1g fat, less than 5mg cholesterol, 300mg sodium, 490mg potassium, 49g carbohydrate (25g sugars) and 8g protein.
**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

[illegible]

General Mills Sales, Inc.

Multi-Grain Cheerios

Nutrition Facts

Serving Size 1 cup (30g)
Servings Per Container About 15

Amount Per Serving	Multi-Grain Cheerios Plus	with ½ cup skim milk
Calories	110	150
Calories from Fat	10	10
	% Daily Value**	
Total Fat 1g*	2%	2%
Saturated Fat 0g	0%	0%
Polyunsaturated Fat 0g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 200mg	8%	11%
Potassium 85mg	2%	8%
Total Carbohydrate 24g	8%	10%
Dietary Fiber 3g	11%	11%
Sugars 6g		
Other Carbohydrate 15g		
Protein 3g		
Vitamin A	10%	15%
Vitamin C	25%	25%
Calcium	10%	25%
Iron	100%	100%
Vitamin D	10%	25%
Vitamin E	100%	100%
Thiamin	100%	100%
Riboflavin	100%	110%
Niacin	100%	100%
Vitamin B_6	100%	100%
Folic Acid	100%	100%
Vitamin B_{12}	100%	110%
Pantothenic Acid	100%	100%
Phosphorus	10%	25%
Magnesium	6%	10%
Zinc	100%	100%
Copper	2%	2%

*Amount in Cereal. A serving of cereal plus skim milk provides 1.5g total fat, less than 5mg cholesterol, 270mg sodium, 290mg potassium, 30g total carbohydrate (12g sugars) and 7g protein.

**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

INGREDIENTS: WHOLE GRAIN CORN (INCLUDES THE CORN BRAN), WHOLE GRAIN OATS (INCLUDES THE OAT BRAN), BROWN SUGAR, WHOLE GRAIN BARLEY (INCLUDES THE BARLEY BRAN), WHOLE GRAIN RICE (INCLUDES THE RICE BRAN), WHOLE GRAIN WHEAT (INCLUDES THE WHEAT BRAN), SUGAR, WHEAT STARCH, CORN BRAN, SALT, CALCIUM CARBONATE, PARTIALLY HYDROGENATED SOYBEAN OIL, TRISODIUM PHOSPHATE, ZINC AND IRON (MINERAL NUTRIENTS), CARAMEL AND ANNATTO EXTRACT COLOR, VITAMIN E (TOCOPHERYL ACETATE), A B VITAMIN (NIACINAMIDE), VITAMIN C (SODIUM ASCORBATE), A B VITAMIN (CALCIUM PANTOTHENATE), VITAMIN B_6 (PYRIDOXINE HYDROCHLORIDE), VITAMIN B_2 (RIBOFLAVIN), VITAMIN B_1 (THIAMIN MONONITRATE), A B VITAMIN (FOLIC ACID), VITAMIN A (PALMITATE), VITAMIN B_{12}, VITAMIN D, ALMOND MEAL. VITAMIN E (MIXED TOCOPHEROLS) ADDED TO PRESERVE FRESHNESS.
CONTAINS WHEAT AND ALMOND INGREDIENTS.

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Exchange: 1½ Starch
Exchange calculations based on the *Exchange Lists for Meal Planning*, ©1995 the American Dietetic Association, the American

98% FAT FREE SMART START®

Nutrition Facts

Serving Size 1 Cup (50g/1.8 oz.)
Servings per Container About 8

Amount Per Serving	Cereal	Cereal with ½ Cup Vitamins A & D Fat Free Milk
Calories	180	220
Calories from Fat	5	5
	% Daily Value**	
Total Fat 0.5g*	1 %	1 %
Saturated Fat 0g	0 %	0 %
Cholesterol 0mg	0 %	0 %
Sodium 330mg	14 %	16 %
Potassium 100mg	3 %	9 %
Total Carbohydrate 43g	14 %	16 %
Dietary Fiber 2g	9 %	9 %
Sugars 15g		
Other Carbohydrate 26g		
Protein 3g		
Vitamin A	15 %	20 %
Vitamin C	25 %	25 %
Calcium	0 %	15 %
Iron	100 %	100 %
Vitamin D	10 %	25 %
Vitamin E	100 %	100 %
Thiamin	100 %	100 %
Riboflavin	100 %	110 %
Niacin	100 %	100 %
Vitamin B_6	100 %	100 %
Folic Acid	100 %	100 %
Vitamin B_{12}	100 %	110 %
Pantothenate	100 %	100 %
Phosphorus	10 %	20 %
Magnesium	8 %	10 %
Zinc	100 %	100 %
Copper	4 %	6 %

*Amount in cereal. One half cup of fat free milk contributes an additional 65mg sodium, 6g total carbohydrate (6g sugars), and 4g protein.

**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4

Ingredients: Rice, whole grain wheat, sugar, oat clusters (sugar, toasted oats [rolled oats, honey, brown sugar, soy oil], rolled wheat, crisp rice [milled rice, sugar, malt, salt], corn syrup, honey, cinnamon, artificial vanilla flavor, BHT [preservative]), salt, high fructose corn syrup, honey, malt flavoring, reduced iron, alpha tocopherol acetate (vitamin E), natural and artificial vanilla flavor, niacinamide, zinc oxide, sodium ascorbate and ascorbic acid (vitamin C), calcium pantothenate, yellow #5, pyridoxine hydrochloride (vitamin B_6), riboflavin (vitamin B_2), thiamin hydrochloride (vitamin B_1), BHT (preservative), vitamin A palmitate, folic acid, vitamin B_{12} and vitamin D.

CONTAINS WHEAT AND SOYBEAN INGREDIENTS

MADE BY KELLOGG USA, INC.
BATTLE CREEK, MI 49016 U.S.A.

Exchange: 3 Carbohydrates
The dietary exchanges are based on the *Exchange Lists for Meal Planning*, ©1995 by The American Diabetes Association, Inc. and The American Dietetic Association.

APPENDIX S

SUPPLEMENTAL MATERIALS FOR CHAPTER V

Hematology

At the time of blood collection, an aliquot of heparinized whole blood was removed for hematology (ABX Vega, Montpellier, Cedex 04 or Coulter T890). Repeated measures analysis of variance showed no significant differences between groups over time for red blood cells or hemoglobin. Both hematocrit and mean corpuscular volume were significantly different by time ($p=.039$, $p<.001$, respectively), but not between groups. Hematocrit at baseline was significantly higher ($p=.046$) than at week 4. Mean corpuscular volume at baseline was significantly higher than at week 4 ($p<.001$). Results of these analyses are presented in Appendix S, Table S1.

Lipid Analyses

Aliquots of plasma sample were used for triglyceride, total cholesterol, and HDL cholesterol analysis. All lipid assays were performed using the clinical analyzer (FARA COBAS) and Roche reagents (Nutley, NJ). LDL cholesterol was calculated. Repeated measures analysis of variance showed no significant differences between groups over time for any of the lipid measures. Results of lipid analyses are presented in Appendix S, Table S2.

Dietary Intake Methods

One way analysis of variance was performed in order to determine if there was difference for dietary folate between the three methods of determining dietary intake; diet record, 24-h recall, and FFQ. Logarithmic transformation of folate was performed to improve normality. When mean intake of folate was adjusted for calories there was a significant difference between methods (p=.002). Scheffe post hoc tests revealed that there were no significant differences between the diet record (n= 121) (210 $\pm$ 79 µg; logfolate=1.38 $\pm$ .29) and 24 h recall (n=121) (255 $\pm$ 140 µg; logfolate=1.45 $\pm$ .44) however, both the diet record and 24h recall were different from the FFQ (n=41) (254 $\pm$ 105 µg; logfolate=1.6 $\pm$ .57) (p=.002 and p=.032, respectively).

Other Data Presented

Appendix S, Table S3 contains data on plasma homocysteine, erythrocyte (RBC) and serum folate, serum vitamin B-12, FRAP and creatinine. These results are reported in Chapter V.

Appendix S, Table S.1 Hematological data*

	Control Group (n=20)				Experimental Group (n=21)			
	Baseline	4 week	8 week	20 week	Baseline	4 week	8 week	20 week
Red Blood Cells	5 ± 0.4	5 ± 0.4	5 ± 0.4	5 ± 0.4	5 ± 0.3	5 ± 0.3	5 ± 0.3	5 ± 0.3
Hemoglobin	15 ± 1	15 ± 1	15 ± 1	15 ± 1	15 ± 1	14 ± 3	15 ± 1	15 ± 1
Hematocrit	45 ± 3^a	44 ± 3^b	44 ± 3^a	44 ± 3^a	44 ± 3^a	44 ± 3^b	43 ± 3^a	43 ± 3^a
Mean corpuscular volume	91 ± 4^a	89 ± 3^b	90 ± 4^a	90 ± 3^a	92 ± 4^a	90 ± 3^b	90 ± 4^a	91 ± 4^a

*plus-minus signs are means ± SD

[a,b]means with different superscripts are different between columns ($p<.05$)

Appendix S, Table S.2 Lipid data[a]

	Control Group (n=20)				Experimental Group (n=21)			
	Baseline	4 week	8 week	20 week	Baseline	4 week	8 week	20 week
Cholesterol	206 ± 44	207 ± 49	217 ± 50	206 ± 44	216 ± 33	218 ± 37	210 ± 28	207 ± 39
Triglycerides	147 ± 82	165 ± 92	161 ± 67	147 ± 81	151 ± 88	152 ± 78	154 ± 92	134 ± 58
HDL cholesterol	44 ± 13	44 ± 13	47 ± 15	46 ± 13	49 ± 12	47 ± 10	47 ± 9	50 ± 10
LDL cholesterol	133 ± 35	130 ± 37	137 ± 41	131 ± 33	137 ± 35	140 ± 37	132 ± 30	131 ± 37

[a]plus-minus values are means ± SD, no significant differences were found

Appendix S, Table S.3 Homocysteine, erythrocyte (RBC) and serum folate, serum vitamin B-12, FRAP and creatinine data*

	Control Group (n=20)				Experimental Group (n=21)			
	Baseline	4 week	8 week	20 week	Baseline	4 week	8 week	20 week
Homocyteine (umol/L)	16 ± 5^{a}	15 ± 5	14 ± 4	16 ± 6	13 ± 3^{b}	13 ± 4	11 ± 2	13 ± 3
RBC folate (ng/mL)	11 ± 6^{x}	10 ± 6^{x}	11 ± 5^{x}	12 ± 5^{y}	10 ± 4^{x}	10 ± 4^{x}	10 ± 3^{x}	11 ± 4^{y}
Serum folate (ng/mL)	11 ± 4	11 ± 4	12 ± 4	14 ± 5	10 ± 3^{x}	13 ± 3	13 ± 2	15 ± 3^{y}
Serum B-12 (pg/mL)	374 ± 186	400 ± 219	455 ± 413	368 ± 184	363 ± 134	422 ± 184	430 ± 169	389 ± 165
Creatinine (mg/dL)	1 ± 0.2	1 ± 0.2	1 ± 0.2	1 ± 0.3	1 ± 0.2	1 ± 0.2	1 ± 0.2	1 ± 0.2
FRAP (umol/L)	1640 ± 437	1639 ± 366	1630 ± 243	1690 ± 381	1619 ± 277	1631 ± 243	1607 ± 261	1624 ± 293

*plus-minus values are means ± SD

[a,b]means with different superscripts are significantly different between groups (p<.05)

[w,x,y,z]means with different superscripts are significantly different over time (p<.05)

VITA

Tawni Welk Holmes

Candidate for the Degree of

Doctor of Philosophy

Thesis: FOLATE INTAKE IN OLDER OKLAHOMA MEN: PERCEPTIONS AND THE EFFECTS OF AN INTERVENTION

Major Field: Human Environmental Sciences

Area of Specialization: Nutritional Sciences

Biographical:

Personal Data: Born in Oklahoma City, Oklahoma, On April 19, 1970, the daughter of Dick and Judy Segress.

Education: Graduated from Edmond Memorial High School, Edmond, Oklahoma in May 1988; received Bachelor of Science degree in Dietetics with a minor in Business Administration, and a Master of Science in Nutritional Sciences from Oklahoma State University, Stillwater, Oklahoma May 1992 and December 1993, respectively. Completed the requirements for the Doctor of Philosophy degree at Oklahoma State University in December, 2000.

Experience: Employed as a nutrition assistant at Oklahoma State University Wellness Center (8/93-6/94); employed as Dietitian/Study Coordinator at Oklahoma Medical Research Foundation full time for two years (8/94-10/96), currently part-time (11/98-present); employed by Oklahoma State University as a graduate research associate (1/97-present) and graduate teaching assistant (1/99-present) in the Department of Nutritional Sciences.

Professional Memberships: American Dietetic Association, Society for Nutrition Education, American Association of Lifestyle Counselors, Oklahoma Dietetic Association.