THE NUTRITIONAL EFFECTS OF THE ELDERLY NUTRITION PROGRAM: TITLE III-C FOR THE MENOMONIE CONGREGATE-SITE MEAL PROGRAM PARTICIPANTS

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ABSTRACT

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The Elderly Nutrition Program (ENP) has been providing meals to American elderly since 1973. One aim of the program is to foster and maintain the participants' nutritional health. The congregate-setting of the elderly nutrition program is an important aspect of the nutritional services providing an opportunity for the participants to socialize and receive nutritious meals. A limited number of studies (Neyman, et al 1998; LeClere and Thornbury 1983; Kohrs, O'Hanlon, and Eklund 1978) have shown that the nutrition meal program participants have higher nutrient intakes than the non-participants. The purpose of our study was to determine whether the nutritional intake of the meal participants was improved by the contribution of the nutrition meal program.

Seventeen Menomonie congregate-site meal program participants voluntarily enrolled in this study. The nutrient intakes of the participants from the meal participation day and the non-participation day were obtained by using 24-hour dietary recalls during two interviews. In addition, the food frequency questionnaire was administered verbally during one interview to obtain each subject's overall dietary intake. Interview questions were also administered verbally to investigate factors influencing the elder's food

consumption. During both interview sessions, food models, measuring cups and spoons were used to help subjects identify food portion size.

The nutrient composition of the 24-hour recalls and food frequency questionnaires were analyzed by Food Processor Plus. Pair-samples t tests were used to compare the nutrient intakes and percentages of the RDA for the elderly participants on the meal participation day to the non-participation day; on the participation day to the food frequency questionnaire; and on the non-participation day to the food frequency questionnaire. One-way ANOVA was also used to test the effects of both gender and age differences on nutrient intakes and percentages of the RDA on the meal participation day, on the non-participation day, and on the food frequency questionnaire.

The results showed that the percentage of the RDA and the mean intakes of energy and some macronutrients including protein, carbohydrate, total fat, and saturated fatty acid were significantly higher on the meal participation day than the non-participation day. The mean dietary fiber intake was significantly higher on the meal participation day compared to the non-participation day. However, there was only a tendency of significance when dietary fiber intake was expressed as a percentage of the recommended. The mean intakes of thiamin, vitamin B-6 and niacin were significantly greater on the meal participation day; similar results were found when these vitamins were expressed as a percentage of the RDA. In addition, the percentage of the RDA and the mean intakes of all minerals, except zinc, were significantly higher on the participation day compared to the non-participation day.

The male participants appeared to benefit more so than the females because of the contribution of the meal program to their overall energy and nutrient intakes especially, vitamin D, thiamin, riboflavin, niacin, vitamin B-12, phosphorus, and potassium. Age did not appear to affect nutrient intakes on either the participation or non-participation days.

Although many benefits of the meal program were documented, it should be noted that the mean intake of vitamin D, folate, calcium, and zinc of the elderly participants on the meal program participation day was found to be substantially below the RDA and DRI. The lower intakes of these nutrients illustrate the reliance of participants on the meal program for their total daily nutritional intake. Therefore, nutrition education to foster consumption of additional nutrient dense food at home could improve their nutritional status. Our results conclude that the Dunn County Elderly Nutrition Program is enhancing the nutritional intakes of the participants.

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1. INTRODUCTION

The elderly comprise a large proportion of the U.S.A population. Statistics show that in 1994, more than 33 million adults (13% of the American population) were aged 65 years and older; by 2030, this number will increase to 70 million (20% of the population) as baby boomers age (ADA reports 1996; Kerschner and Pegues 1998; Roe 1992). In addition, people older than 85 years now constitute the fasted growing segment of the US population (Kerschner and Pegues 1998). The demographic changes pertaining to the increased size of the very old population have led to projections that health care costs will expand in the United States because the very old have the greatest need for medical and nursing care (Roe 1992; Rubenstein 1990). As more people survive to very advanced chronological old age, the heterogeneity characteristics present in this group must be acknowledged; Roe (1992) indicated that the elderly vary in age, sex, marital status, education, job skills, work experience, social background, living situation, and health.

Blumberg (1997) and Munro (1989) also mentioned that aging is accompanied by a variety of financial, psychological, and social change that can influence nutritional status. In addition, physiologic changes of aging affect the need for several essential nutrients. For example, the incidence of osteoporosis, a bone disease, increases with age, particularly in Caucasian women after menopause. The interrelationship between calcium, vitamin D and hormones are considered important for this ailment (Rosenberg, Russell and Bowman 1989). The aged small intestine does not adapt to a low calcium intake with a higher fractional calcium absorption as does the younger intestine (Brickman 1990; Roe 1992), which may be caused by the decreased skin synthesis of vitamin D and decreased renal synthesis of 1-25 dihydrovitamin D in the elderly people (Brickman 1990). Yamaguchi, et al. (1998) stated that the majority of the elderly population lives independently, but one in five elderly individuals experiences some decline in functional ability. Impaired performance of activities, such as the ability to shop for groceries and prepare meals, may also result in poor nutritional status. Drugs also play a role that influence elders food intake and nutritional status. Marcus and Berry (1998) mentioned that use of drugs accounted for 20% of the cases of weight loss in short-term nursing home residents. Some drug usage in elderly can have additive effects in producing nutrient depletion (Roe 1992).

Adequate nutrition is essential for maintaining good health, mitigating existing health problems, and maintaining optimal functional independence (Coulston, Craig, Voss 1996). The Food and Nutrition Board of the National Academy of Sciences has established recommended dietary allowances (RDAs) for the maintenance of good nutrition of practically all healthy people in the United States. However, the 1989 edition of the Recommended Dietary Allowances (RDAs) does not provide separate recommendations for persons older than 51 years due to a lack of data on older adults (National Research Council 1989). Addressing the nutritional and health needs of the elderly is an ongoing process. Before the new scientific data established specific nutritional requirements for the elderly, the 1989 edition of the RDA had been used as a standard to evaluate elderly nutritional status. It is common practice to set cut-off points of two-thirds or three quarters of the RDA to identify inadequate intake. Consumption of less than the RDA for a nutrient does not prove a deficiency, but it suggests a higher probability for a deficiency. Likewise, meeting the RDA does not assure a nutrient-sufficient condition (Kerstetter, Holthausen, and Fitz 1993).

Developing service networks to provide elderly people with a continuum of home- and community-based long-term care has become especially important, to allow individuals to avoid unnecessary and costly institutionalization (Administration on Aging 1996). The Older American Act was established in 1965 and included Title III-C, a nutrition program for the elderly, which provides low-cost and nutritious meals containing one third of Recommended Dietary Allowances (RDAs) (Carlin and Rhodes 1991).

In spite of the fact that nutrition services represent the largest program supported by the Older American Act, most large-scale investigations of this program have evaluated administration aspects of nutrition services rather than dietary intake or nutritional status of the people served (Administration on Aging 1996). While several studies have shown that the diet of nutrition meal program participants has a higher nutrient content than the diet of non-participants (Neyman, et al. 1998; Roe 1992), there is limited information regarding whether the nutritional intake of meal participants is improved by the contribution of the nutrition meal program.

1.1 STATEMENT OF PROBLEM

The primary purpose of this study is to determine if nutritional intake is improved on a day individuals participate in the congregate-site meal program compared to a non-participation day. The second purpose is to determine the contribution of the nutrition meal to overall food consumption by administration of a food frequency questionnaire.

1.2 NULL HYPOTHESES

There is no statistically significant difference of the nutritional intake on a day individuals participate in the meal program compared to a non-participation day.

There is no statistically significant difference of the nutritional intake on a day individuals participate in the meal program compared to the overall food consumption as measured by a food frequency questionnaire.

There is no statistically significant difference between nutrient intakes and age of participants.

There is no statistically significant difference between nutrient intakes and gender of participants.

2. REVIEW OF LITERATURE

2.1 DEMOGRAPHICS OF THE ELDERLY POPULATION

The elderly population has increased rapidly during the past 50 years. Many statisticians have stressed that the 65 years or older age group is expected to become a proportionately larger group in the US population. In 1970, the 65 years or older age group had increased to 9.8% of the US population, today the figure is 12%, and by 2020, it will represent between 17% to 19% of the US population. Moreover, people older than 85 years will comprise 15% of the elderly population, which will continue to be the fastest growing age group in the United States (Kerschner and Pegues 1998; Rubenstein 1990; Roe 1992). Wisconsin's population has a slightly higher proportion of residents age 65 and older than the nation as whole (13.3% versus 12.6%). The Wisconsin population age 65 to 84 is expected to increase by 3% between 1990 and the year 2000. However, the 85 plus population is expected to increase 31% over the same time period (Wisconsin Age Profiles Research & Education Project of the WI Dept. of Health and Social Services, Division of Community Services, Bureau on Aging 1995).

Rubenstein (1990) pointed out that immigration patterns, reductions in infant mortality, and actual increases in life expectancy for adults are contributors for the increases in the 65 and older population. The average life expectancy for an individual has doubled from approximately 40 years to almost 80 years since the beginning of the

20th century. It has been projected that life expectancy will continue to rise, and by the end of next century it will be close to 100 years (ADA Reports 1996).

As more people survive to a very advanced chronological old age, the heterogeneous characteristics of this group are evident. Roe (1992) indicated that the elderly vary in age, sex, marital status, education, job skills, work experience, social background, living situation, and health. Safford and Krell (1992) presented that 22.4% of elderly people are living in poverty, or near poverty. Although many elderly people are poor and eligible for a broad range of social welfare entitlements, many do not receive them; for example only 4 percent of elderly people receive Supplementary Security Income (SSI), and only 7 percent receive Food Stamps. Approximately fifty percent of all elderly women are widowed, compared to 14 percent of elderly men. A higher percentage of the elderly women live alone compared to the elderly men. The statistic shows that 72% of Wisconsin's population age 85 and older are women. (Wisconsin Age Profiles Research & Education Project of the WI Dept. of Health and Social Services, Division of Community Services, Bureau on Aging 1995). Kerschner and Pegues (1998) stated that because of the consequences of the extensive social and personal losses, older persons, especially women, may have to deal with loneliness and isolation as a result of the death of a spouse and may also have to endure the fear of outliving their financial resources. Numerous terms are used to subgroup the elderly by age. "Young elderly" refers to the age between 65 to 74 years, age 75 to 84 years is defined as "older elderly", and age 85 or older is named as "old-old" (Bartlett et al 1998).

Whether the average quality of life has improved, stayed the same, or deteriorated as average life expectancy has increased, still remains to be determined. Kerschner and Pegues (1998) mentioned that one of the consequences of the demographic shift is that increasing numbers of older people will face the possibility of many years of chronic disability from health disorders such as arthritis, poor hearing or visual acuity, hip fracture, and osteoporosis. Roe (1992) also indicated that the increased size of the very old population have led to the projections that health care costs will escalate in the United States because the very old have the greatest need for medical and nursing care. Chernoff (1991) reported that approximately 40% of the acute care hospital bed days, 25% of all the prescription drugs brought, and 30% of the health care dollars spent were used by the population segment over age 65 years.

Aging is the most complex of processes, numerous factors that may affect individual aging include genetic inheritance, food supply, social circumstances, political events, exposure to disease, climate, and nature disasters, and other environmental events (Chernoff 1991). The major effects of aging that influence nutritional status will be discussed below.

2.2 FACTORS AFFECTING NUTRITIONAL STATUS OF ELDERLY

2.2.1 Physiological Changes of Aging

Musculoskeletal System

The musculoskeletal system comprises the skeleton, joints, and muscles, which pass through phases of growth, maturation, and decline (Timiras 1994). While aging of the skeleton usually occurs without conscious awareness of the changes on the part of the individual, aging of the joints induces considerable physical pain and causes severe disability. The functional impairment and pain resulting from normal or pathologic aging of the joints limit the movement of elderly individuals, thus hindering their ability to care for themselves, eroding their independence, and forcing them to varying degrees of immobility.

Timiras (1994) stated that with aging, the balance between rate of bone formation and bone resorption is altered, and the continuing changes lead to a decrease in bone mass. As a result, the bone strength declines with aging. It is known that adequate circulating calcium is vital in maintaining bone mass, which is regulated by three hormones; parathyroid hormone, calcitonin, and calcitriol. The increase in parathyroid hormone level with aging may represent a compensatory response to reduced intensive absorption of calcium. There seems to be some racial differences with black and Oriental postmenopausal women having lower levels of parathyroid hormone and higher levels of calcium into advanced age than white women. There seems to be a gender difference as well, with men maintaining lower levels of parathyroid hormone and experiencing a lower incidence of osteoporosis than women. The endocrine changes in aging also affects regulation of bone metabolism. Timiras (1994) indicated that in women, the decline of estrogen at menopause plays a key role in the induction of osteoporosis. Thus, increased calcium intake is necessary to maintain calcium balance.

Skeletal muscle strength also declines with increasing age. As muscles age they become smaller in size, the synthesis of contractile protein is decreased, and the number of mitochondria is reduced (Timiras, 1994). As muscle ages, the following changes occur at the neuromuscular junction:

- The capability to sustain transmission of the nerve impulse from the neuronal axon to the muscle fiber decreases, as muscle and nerve fibers show increased refractoriness.
- The amount of acetylcholine (Ach), the neurotransmitter at the neuromuscular junction, declines.
- Motor nerve conduction velocity is reduced.
- The balance between nerve terminal growth and degeneration becomes less stable.

Munro (1989), and Timiras (1994) mentioned that increased physical activity could benefit muscle strength, ambulatory ability, and endurance in the elderly.

Body Composition

Even when the body weight remains unchanged, the body compartments change with age (Schlenker 1993). A general characteristic of these age-related changes is a loss of fat free mass accompanied by a gain in body fat. The decline in total body water is to be expected when muscle tissue is replaced with adipose tissue. In the general population, mean body weight continues to increase throughout middle age because of an increase in fat, which replaces lost muscle. Body weight declines only in the oldest age group.

With the aged-associated changes in body composition, protein nutrition is a concern in elderly persons. Morais et al. (1997) tested the hypothesis that aging affects whole-body protein turnover through altered fat-free mass (FFM). Sixteen healthy elderly subjects (8 men and 8 women) with a mean age of 72.6 years were compared to 15 lean, young subjects (8 men and 7 women) with a mean age of 28.4 years. Age and sex effects of whole-body protein kinetics were estimated by the 60-h <15N> glycine method. The results showed that age and female sex contributed significantly to lower muscle protein catabolism (based on 3-methylhistidine excretion). A higher percentage of whole-body protein breakdown was found in the young subjects compared to the elderly subjects (39.8% vs.20.2%). However, the rate of protein breakdown in nonmuscle lean tissues was not significantly affected by age or sex differences. The study concluded that the lower rate of flux, synthesis, and breakdown of protein per kilogram body weight in elderly compared to the young subjects was due to changes in body composition with age, because rate is not different per kilogram FFM. Because there is a reduction in FFM and subsequent reduction in protein catabolism in elderly persons, the potential implications for the nutrition of both normal and sick elderly persons are vast.

Oral and Circumoral Structure

As mentioned earlier, there is a net loss of bone that is due to bone resorption which exceeds bone deposition in the elderly. Martin (1991) described that the alveolar bone which surround and support each tooth in the mouth is one of the first bones to be affected by the lose of bone mass. As a consequence of this, the periosteal and periodontal surfaces of alveolar bone become less resistant to harmful local oral trauma, inflammation, or diseases.

Martin (1991) also mentioned that with aging, the teeth themselves undergo changes. Brittleness of the teeth is increased, which predisposes each tooth to cracks, fractures, and shearing. The reduction of innervation also can explain the decreased tooth sensitivity and increased pain threshold in elderly people.

The oral musculature is consistently changed along with the aging muscle tissue in the body. The atrophy of the oral musculature is generated by replacement of the muscle mass by fat or fibrous connective tissue, which can lead to decreases in the biting forces and slows chewing performance. Further, the impact of decreasing oral muscle mass and muscle tone can lead to swallowing difficulty because the capacity of forming and preparing a bolus in the oral stage of swallowing is altered. However, the diminished salivary flow in the elderly is considered to be due to pathologic or pharmacological conditions rather than aging itself. When salivary flow is deficient, it leads to increased oral diseases and dysfunction of chewing, swallowing, and taste.

Taste and smell are necessary to determine the flavor of foods and beverages. Barber (1997) presented international data from the 1986 National Geographic smell survey. The data from respondents who were composed of 19,219 Americans and 3,024

Africans were analyzed. Olfactory acuity included odor detection, identification, intensity, and quality. The results indicated that some measures of olfactory acuity tended to decline across age groups but loss of olfaction is not consistent or uniform between geographic regions of America or Africa, or between male and female respondents. With aging, both the numbers of taste and olfactory nerve endings decrease. The loss of taste buds starts in the anterior part of the tongue, so that the ability to detect sweet and salty taste is affected initially (Rosenberg, Russell and Bowman 1989). Many experts mentioned that declines in gustation and olfaction whether with age, chronic diseases, or drug use, decreases the flavor and palatability of food, and as a result, reduces appetite for foods (Martin 1991; Rosenberg, Russell and Bowman 1989).

Digestive System

The digestive tract organs present some diminution of function with age; for example, changes in esophageal motility, gastric acid secretion, and intestinal microflora occurs (Rosenberg, Russell and Bowman 1989).

Some abnormalities of esophageal function have been frequently found in asymptomatic elderly people, particular in those older than age 70, and include disordered contractions, as well as spontaneous gastroesophageal reflux. In addition, age-related changes in gastric physiology include decreased secretion of hydrochloric acid, intrinsic factor, and pepsin. Roe (1992) and Koehler et al (1997) mentioned that pernicious anemia, an autoimmune disease common in elderly people, is caused by vitamin B-12 deficiency brought on as a result of ceasation of secretion of gastric intrinsic factor or as a result of achlorhydria (complete lack of gastric acid production). Vitamin B-12 from the diet cannot be absorbed in the absence of gastric intrinsic factor. The aging process increases the risk of autoimmune disease within the gut. The increase of atrophic gastritis with advancing age also leads to a decrease in the secretion of gastric acid (Rosenberg, Russell and Bowman 1989; Young and Urban 1986). Some physiological changes that occur with atrophic gastritis include more rapid emptying of liquids, slower emptying of mixed solid-liquid diets, a rise in the stomach and proximal small bowel pH, and increased numbers of bacteria growing in the stomach and proximal small intestine. The consequence of the changes in gastric secretion of acid and pepsin is impairment of the digestion and /or absorption of certain nutrients, including calcium, copper, zinc, folic acid, vitamin B-12, and protein (Rosenberg, Russell and Bowman 1989).

Russel (1990) discussed that the small intestinal transit time remains relatively stable with increasing age. However, shorter villi were found in elderly subjects compared to young adults. Reduction in mucosal surface area would be nutritionally important, especially in persons with marginal nutrient intake, or with malabsorption (Young and Urban 1986). A higher prevalence of lactose intolerance in elderly people versus young adults may be due to age related decreased production of the enzyme lactase in the small intestine. On the other hand, sucrase and maltase concentrations in the human small intestinal mucosa remain relatively stable with age (Russel 1990).

The incidence of the bone disease, osteoporosis, increases with age, particularly in Caucasian women after menopause. The interrelationship between calcium, vitamin D and hormones are considered important for this ailment (Rosenberg, Russell and Bowman 1989). The aged small intestine does not adapt to low calcium intakes with a higher fractional calcium absorption as does the younger intestine, which may be caused by a change in vitamin D status (Brickman 1990; Roe 1992). The decreased skin synthesis of vitamin D and renal synthesis of the active form, 1-25 dihydroxyvitamin D in the elderly people are considered to be the major problem for lower serum levels of vitamin D (Brickman 1990).

Constipation is common in the elderly (Abyad and Mourad 1996). General causes of constipation, are delayed transit of feces throughout the colon and prolonged retention of feces within the rectum (Roe 1992). Contributing factors are impaired general health, use of medications, and decreased mobility and physical activity (Abyad and Mourad 1996). Diet may also have an effect on the incidence of constipation. Increased insoluble dietary fiber and water intake are always advised for softening the stool and increasing the total fecal bulk weight (Young and Urban 1986).

The liver is the largest gland in the body. It is an important organ for numerous functions in the body, including: bile formation; carbohydrate storage and metabolism; ketone body formation; reduction and conjugation of steroid hormones; inactivation of polypeptide hormones; detoxification of many drugs and toxins; manufacture of plasma proteins; urea formation; and regulation of lipid metabolism. Atrophy and decreased weight of the liver are common in elderly people. The reduced weight is due to a decrease in cell number rather in cell size. With aging the slowed cell regeneration could be due to the absence of growth factors for cell replication or to the excess of growth inhibitory factors. As the result, cell hypertrophy acts as a compensatory reaction to the cell loss (Timiras 1994).

Bile production is a major function of the liver, which is essential for optimal digestion and absorption of lipids for all ages and is particularly crucial for the elderly whose diet may be deficient in essential elements (e.g., lipid-soluble vitamins). Bile formation is considered to remain quite stable in healthy individuals into old age. However, the function of detoxification in the liver is progressively limited with advancing age; therefore, the increased use of drugs in the elderly group, increases the potential risks for toxicity of excessive or incorrect medication (Timiras 1994).

Cardiovascular System

Statistically, elderly people contribute to 68% of all deaths annually in the United States; it is estimated that 78% of deaths are attributed to coronary heart disease (Goldberg 1991). Cardiovascular disease remains the leading cause of death in the elderly (Brodkin and Abrass 1996-1997 Winter). Cardiac function is affected by direct or indirect age-related changes. A slight reduction of cardiac muscular contractility is considered to be due to a decrease in catecholamine concentration or reduced response in the cardiac muscle. In addition, aging is associated with a progressive increase in the rigidity of the aorta and peripheral arteries. This condition results in the loss of elastic fiber and an increase in the collagen and calcium deposits (Lowenthal and Kirschner 1994). The loss of arterial compliance which leads to a higher systolic pressure and a wider pulse pressure is known as isolated systolic hypertension (ISH) and is especially prevalent in elderly people. Hypertension is a strong predictor for cardiovascular morbidity and mortality (Brodkin and Abrass 1996-1997 Winter). The systolic blood pressure is especially a better predictor for the complications of cardiovascular diseases, including stroke, congestive heart failure, and coronary artery disease than diastolic blood pressure (Brodkin and Abrass 1996-1997 winter).

Optimal management of hypertension should include controlling the blood pressure and modifying other risk factors, such as glucose intolerance or obesity at the same time (Brodkin and Abrass 1996-1997 winter). Dietary management is recommended in the first step of the management protocol, which includes:

- Reduce weight when indicated
- Restrict sodium intake to 2 g/d
- Supplemental potassium only in the presence of hypokalemia
- Supplemental magnesium and calcium only when deficiency exits

- Increase fiber and lower fiber saturated fat intake
- Restrict alcohol to 2 oz/d

Antihypertensive drug therapy should be initiated if diet is not effective (Goldberg 1991). Aerobic exercise is also recommended to reduce both systolic and diastolic blood pressure at rest in young and elderly hypertensive subjects (Lowenthal and Kirschner 1994).

Renal Function

Renal function progressively declines with age as a result of both the loss of nephrons and changes in blood flow (Schlenker 1993). The basement membrane of Bowman's capsule becomes thickened, which leads to a decrease of permeability contributing to the atrophy of the nephrons and the vascular changes (Shephard 1986). A decrease of kidney mass can begin in some individuals at age 40 and as much as 30% decrease can occur by age 90, with the primary losses occurring in the capillary bed where filtration occurs (Schlenker 1993). Any loss in kidney function has implications for both the conversation of nutrients and the excretion of potentially harmful waste products (Schlenker 1993). When the lower filtration rate and a decreased glomerular clearance occurs with aging (Timiras 1994), the capacity to excrete waste products is reduced. Other manifestations include a reduced daily urine flow, a rise of blood urea, and a diminished excretory and reabsorptive capacity in the renal tubules (Shephard 1986). These changes can become critical in older individuals who have low fluid intake and high protein and electrolyte consumption (Schlenker 1993). Limiting protein intake in older people with compromised kidney functions might restore some degree of renal reserve and slow the progression of renal deterioration (Schlenker 1993).

Lower Urinary Tract

Urinary incontinence often results from alternation in the function of some of the structure of the lower urinary tract. It occurs in 10 to 30% of community-dwelling elderly and in 50 to 60% of those living in institutions (Safford & Krell 1992; Timiras 1994). Women were significantly more likely than men to report experiencing the episode of urinary incontinence. Urinary incontinence often interrelates with both depression and limitation in ambulation in older persons (Kutner et al. 1994).

Age-related changes could contribute to this etiologic condition. Estrogen deficiency in postmenopausal women weaken the tissues around the pelvic floor and bladder outlet, decreasing the tone of urethral smooth muscle, and causing atrophic vaginitis, all of which contribute to the decrease in urethral contractility and pressure with aging. In elderly men, the increased prostrate size is considered one of the major causes of incontinence as it leads to decline in urinary out-flow rate, increase risk of urine retention, and increased instability of the detrusor muscle (Timiras 1994). Urinary continence in the elderly can be treated individually according to each case and type of incontinence (Safford & Krell 1992; Timiras 1994).

2.2.2 Psychological Factors Affect Nutritional Status in the Elderly

A variety of medical and psychosocial stressors have the potential to negatively impact nutritional status. Depressive symptoms occur in approximately 15% of adults over 65 years of age. The prevalence of major depression among older adults living in the community is estimated at least 3%. The essential features of depression include either a depressed mood or loss of interest /pleasure in all or almost all activities for a period of 2 weeks or longer. Major risk factors for depression in older adults include:

- Female gender
- Unmarried
- Widowed

- Stressful life events
- Lack of social support
- Co-occurrences of physical conditions (i.e., stroke, cancer, dementia)

Nutrition status is in jeopardy since symptoms of depression are related to changes of appetite, weight and lack of interest in food (Niedert et al. 1998). Morley (1997) also indicated that depression has been shown to be the major cause of weight loss in older persons. Numerous depressive symptoms can lead to weight loss, and other concurrent conditions including weakness, stomach pains, nausea, anorexia, and diarrhea.

Besides depression, dementia is also commonly associated with weight loss. Morley (1997) explained that some demented patients increase their energy utilization by continuous pacing (wandering). However, most weight loss in demented patients is due to the failure to eat. Swallowing inability is also seen and may further decrease food intake.

In older persons with weight loss, oral control increases with age and is strongly associated with symptoms of depression. Several other psychological conditions have been related with weight loss in older persons. Theses include alcoholism, late-life paranoia, late life mania, sociopathy (lack of food ingestion used as a manipulative behavior), cholesterol phobia, globus hysterics, and choking phobia.

Moreover, Willis et al (1997) suggested that a cluster of psychosocial factors has been associated with increased morbidity and mortality. Individual personality structure remains relatively stable during adult years, indicating that personality factors provide stable and valid predictors of long-term health. One hundred and thirty-five men and women older than 65 years of age were studied prospectively to identify factors associated with health outcomes. At study onset, measures of personality, social interaction, and health locus of control were obtained from participants. A reliable health outcome measure was developed. The results suggested that a significant association between a less independent personality trait and poor health outcomes in the aged. Anxiety and low levels of social interaction were associated with poor health (Willis et al. 1997).

2.2.3 Socioeconomic Status Affect Nutritional Status in the Elderly

Socioeconomic status has a close relationship with the quality of nutritional intake of older adults; with the lower income groups having fewer choices. Poverty is a common cause of poor nutrition (Ryan and Bower 1989).

The relationship of socioeconomic status and living arrangements to nutritional intake of persons who were 55 years of age or older living in South Carolina was studied (Ryan and Bower 1989). Two hundred sixty-eight older subjects were selected in this study by using a multistage probability random sample that represented the adult population of the state. The results showed that the majority (89%) of the subjects studied had an inadequate nutrient intake on the basis of a 24-hour recall. The study also found a significant, positive relationship between low socioeconomic status and inadequate nutritional intake, which was based on a combination of four index nutrients: iron, vitamin B-6, calcium, and vitamin A.

Social interaction renders a positive influence on morale, life satisfaction, well-being and nutritional intake. When one is lonely, decreased appetite and lack of interest in food often appear and result in poor nutritional intake. Older adults who live alone may also need to deal with their physical activity problems that affect their food preparation. Living arrangement may also affect the quality of nutritional intake

(Bianchetti et al. 1990). However, the study by Ryan and Bower 1989, did not find a significant relationship between nutritional intake and living arrangement.

Bianchetti et al. (1990) indicated that poor nutritional intake was correlated strongly with socioeconomic conditions, function level, and affective status. This study was carried out in a restricted area of a northern Italian city. People aged 70 to 75 were subjects in the study. Information was collected on the demographic variables, financial status, educational levels, functional status, affective status, physical health status, and dietary intake. The study concluded that the following subgroups are particularly prone to poor nutritional intake: men who live alone, women with a low level of education, and men and women who are poor, depressed, or dependent as evaluated by the Instrumental Activity of Daily Living Scale (IADL) functions.

2.2.4 Drugs Affect Nutritional Status in the Elderly

Smith (1990) pointed out that about 30% of persons 65 years of age and over use prescribed and over-the counter (OTC) medications. The drug usage of these elderly is related to the frequency of chronic illnesses and disabilities. Drugs often influence nutrient disposition through effects of the medications on nutrient absorption, metabolism, and excretion. Nutrient and drug interaction are likely to occur in elderly patients not only because of drug or food induced alterations in nutrient and drug disposition, but also because of non-uniform organ deterioration, underlying chronic diseases, dietary regimes, an already compromised nutritional state, and other factors related to aging.

A variety of commonly prescribed mediations and nonprescription drug deserve special consideration because of their influence on nutritional status or the dietary effects on drug response.

Digitalis Glycosides

Digoxin is a frequently prescribed drug in the United States. This drug is known to produce a number of adverse effects in older adults. Loss of appetite, gastrointestinal (GI) disturbances, or diuretic-induced changes in plasma electrolytes can influence the likelihood of digitalis toxicity, which occurs frequently and can be life threatening. In addition, side effects of the drug are nausea, vomiting or diarrhea, and other disturbances, which can further compromise food intake and result in nutrient depletion (Smith 1990).

Diuretics

These drugs are commonly prescribed to treat a number of cardiovascular disorders, including hypertension, edema associated congestive heart failure, and other conditions. Potassium-depleting diuretics such as furosemide and thiazide enhance the renal excretion of potassium, as well as magnesium. For the person who has taken either of those drugs, sodium-restricted diets and foods rich in potassium are usually prescribed (Smith 1990).

Cholesterol-Lowering Agents

Although intensive dietary treatment is the primary therapy for treating patients with elevated cholesterol, drug therapy may be added after strict adherence to dietary changes. Cholestyramine, a bile acid sequestrant, has been shown to be effective to reduce elevated cholesterol levels when combined with fat-modified diets. The drug may inhibit the absorption of fat-soluble nutrients because of decreased availability of bile acids (Smith 1990).

Laxatives

Laxative use increases with age. Roe (1992) described several reasons for laxative use and abuse, including:

- Simple constipation caused by low-fiber diet
- Physical distress or medical disorders mitigating against easy defecation

- Long-term use of laxatives
- Intake of drugs which are constipating
- Bowel obstruction

The six groups of laxatives are bulk-forming agents, osmotic agents, agents that alter electrolyte transport, agents that alter intestinal motility, agents that alter both electrolyte transport and intestinal motility, and stool softeners.

In the elderly, bulk-forming agents taken before food consumption can reduce appetite because of the fullness sensation. Types of laxatives most commonly associated with potassium deficiency are the agents which affect electrolyte transport. Malabsorption with steatorrhea can occur in laxative abusers when the laxative taken has a primary effect on the small as well as on the large intestine. In addition, decreased calcium absorption is a contributory cause of ostomalacia, which may develop in elderly laxative abusers. Mineral oil, another laxative abused by elderly, can reduce absorption of beta carotene and other fat-soluble vitamins when it was taken at meal time or in the postprandial absorptive period (Roe 1992).

Analgesics

Elderly people commonly have arthritis or other painful musculoskeletal disorders. Aspirin or other non-steroidal anti-inflammatory drugs are often taken for relieving pain. Long-term use of high doses of aspirin cause erosion of the GI mucosa, leading to multiple small hemorrhages and chronic blood loss via the GI tract. Iron deficiency anemia may occur when the elderly overuse this drug for a long period of time. Another non-narcotic analgesic such as acetaminophen, which is the active ingredient of Tylenol can cause hepatic and renal damage with prolonged intake by the individual (Roe 1992).

Antacids

The most commonly used of antacid are forms of mixtures of aluminum and magnesium hydroxide, with or without magnesium carbonate, and others in which the chief acid ingredient is sodium bicarbonate. Antacids may be taken by older people whenever unpleasant symptoms occur after eating, regardless of the cause. Causes of these symptoms may be related to the gastrointestinal tract, including hiatus hernia, esophageal or peptic ulcers, systemic sclerosis involving the esophagus, and alcoholic gastritis. Antacids may also be taken for relief of epigastric discomfort related to angina and congestive heart failure, or dyspnea related to emphysema (Roe 1992).

A phosphate depletion symptom is known to occur in elderly people when excessive antacids which contain aluminum and magnesium hydroxide have been used along with a low-phosphate diet. The symptom of hypophosphatemia includes muscle weakness, malaise, paresthesias (pins and needles), anorexia, and convulsions. Low-phosphate osteomalacia and hemolytic anemia may also occur in some patients taking aluminum and magnesium hydroxide for a long period of time. Sodium overload with development of congestive heart failure can result from intake of antacids containing sodium bicarbonate ((Roe 1984).

2.3 NUTRITIONAL REQUIREMENTS FOR THE ELDERLY

Adequate nutritional intake is essential for optimal physical and mental activity. Healthy People 2000: National Health Promotion and Diseases Prevention Objectives for Americans has a vision of improved health for all of its citizens, a rising proportion of whom are age 65 and older (Fishman 1996). Even though life expectancy continues to rise, health-related quality of life is not parallel with living longer. Malnutrition continues to be a problem for the aged. Cid-Ruzafa, et al. (1999), assessed usual dietary intake of participants in the Salisbury Eye Evaluation (SEE) project in Maryland and estimated the prevalence of inadequate nutrient intakes using the probability approach. Two thousand six hundred and fifty-five participants were interviewed for their usual food intake from the previous year by a Health Habits and History Questionnaire (HHHQ). The results indicated that zinc had the highest estimated prevalence of inadequacy (> 43%) across all gender and race categories, followed by calcium, vitamin E, and vitamin B-6, with estimated prevalence greater than 30%. Vitamin C and folate were the nutrients likely to be deficient in the diets of this group, with estimated prevalence below 13% for vitamin C and below 17 % for folate across all gender, race, and age categories. Women had a higher estimated prevalence of inadequacy than men for all nutrients, except for vitamin E. Racial differences also affected nutrient intakes in this study. On the average, white participants of both genders reported higher mean energy and most nutrient intakes than black participants. However, cholesterol, vitamin A, and carotenoid intakes were reported higher in black participants than white participants.

The Food and Nutrition Board of the National Academy of Sciences has established recommended dietary allowances (RDAs) for the maintenance of good nutrition of practically all healthy people in the United States. The 1989 edition of the Recommended Dietary Allowances (RDAs) does not provide separate recommendations for persons older than 51 years due to a lack of data on older adults (National Research Council 1989). In the 1989 RDAs, only the recommendations for four nutrients; thiamin, riboflavin, niacin and iron were different for men and women aged 25 to 50 years and 51 + years. Since thiamin, riboflavin, and niacin are tied to protein and energy metabolism, reductions in these nutrient recommendations for the group (51 + years) were made because of the lower energy and /or protein intakes and lower energy expenditures in these older persons. The lower iron recommendation for women age 51+ years was due to the lack of menstrual periods (Russell 1997).

Nutritional and dietary knowledge of elderly people has expanded in the last decade to justify the RDAs for 50-70 and ≥ 70 years old categories. Scientific evidence indicates a need for changes in seniors' nutritional intake in order to prevent the risk of nutritional deficiencies and to improve their health (Jensen 1999). A major revision of 14 nutrient recommendations is currently established. The revised recommendations are called Dietary References Intake (DRI). The first in a series of reports was published in 1997, the five nutrients that play key roles in bone health-calcium, phosphorus, magnesium, vitamin D, and fluoride were revised. A second report came out in 1998 and featured revised recommendations for the eight B vitamins including thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, pantothenic acid and biotin and a related compound choline. The 1989 10^{th} edition of Recommended Dietary Allowances (RDA) and 1997-1998 Dietary Reference Intake (DRI) for the elderly are summarized in Appendix A.

Age-related changes that influence nutrient requirements summarized by Jensen (1999) are shown below:

Table 1. - - Examples of Age-Related Changes in Body Composition and Physiologic Function That Influence Nutrients Requirement

Change in Body Composition or Physiologic Function	Impact on Nutrient Requirement

Decreased muscle mass (sarcopenia)	Decreased need for calories
Decreased bone density (osteopenia)	Increased need for calcium, vitamin D
Decreased immune function	Increased need for vitamin B6, vitamin E, zinc
Increased gastric pH (atrophic gastritis)	Increased need for Vitamin B12, folic acid, calcium, iron, zinc
Decreased skin capacity for cholecalciferol synthesis	Increased need for Vitamin D
Increased winter-time parathyroid hormone Production	Increased need for vitamin D
Decreased calcium bioavailability	Increased need for calcium, vitamin D
Increased hepatic uptake of retinol	Decreased need for vitamin A
Decreased efficiency in metabolic Utilization of pyridoxal	Increased need for vitamin B6
Increased oxidative stress status	Increased need for beta-carotene, vitamin C, vitamin E
Increased levels of homocysteine	Increased need for folate, vitamin B6, vitamin B12.

Jensen, G. (1999). Nutritional needs of seniors. *Nutrition & M.D.* 25:6.

2.3.1 Energy

In the Baltimore Longitudinal Study of Aging, energy intakes of a sample of males decreased from 2700 kcal per day at age 30 years to 2100 kcal per day for those approximately age 80 years. The decreased basal metabolism, decreased physical activity associated with decreased lean body mass (LBM) and an increase in body fat are the primary contributors for the energy reduction with aging (Kerstetter, Holthausen, and Fitz 1993; Ausman and Russell 1999). The progressive decline in energy intake with advancing age suggests that intake of nutrients contained in the sources of energy will also decline. According to Ahmed (1992), older men in the Baltimore Longitudinal Study tended to consume less protein, iron, thiamin, riboflavin, and nicotinic acid after age 55. Calcium, vitamin A, vitamin C, and zinc intake also decreased concurrently when less energy was consumed.

Kerstetter, Holthausen, and Fitz (1993) mentioned that those individuals who successfully decrease caloric intake by 20% to 25% are most likely to maintain ideal body weight. Bidlack and Smith (1988) stressed that being overweight is only a problem for the elderly when their body weight exceeds their ideal body weight by more than 20%. However, if the individual has heart diseases, hyperlipidemia, hypertension, diabetes, arthritis, or gout, the maintenance of desirable body weight is recommended as the first line of therapy. Obesity makes these conditions more severe and actually increases morbidity and mortality. However, weight loss and low body weight are also undeniable predictors of geriatric mortality and morbidity (Willett 1997).

Determining a person's energy requirement is essential for energy balance. Daily energy requirement is determined by measuring a person's basal metabolic rate (BMR), which normally constitutes 60% to 75 % of daily energy expenditure, and multiplying this figure by a factor that encompasses, other daily energy needs, including the thermal effect of food, and physical activity. Taaffe et al. (1995) who assessed the accuracy of several published equations for predicting basal metabolic rate (BMR) in older women, suggested that the most appropriate equations for use in a heterogeneous population of healthy older women are those of Owen et al., Fredrix et al., and Harris-Benedic. These equations were compared to the measured BMR by indirect calorimetry from 116 healthy, older white women and were found to predict BMR within 116 Kcal/day. Predictive equations from Owen et al, Fredrix et al, and Harris-Benedict to estimate energy expenditure (Kilocalories per day) are displayed below (Taaffe et al. 1995):

Table 2. - - Predictive Equations to Measure Energy Expenditure in Elderly

Reference	**Equation**
Owen et al.	795 + 7.18 (W)
Fredrix et al.	1641 +10.7 (W) – 9 (A) –203 (G)
Harris-Benedict	655.0955 +9.5643 (W) +1.8496 (H) –4.6756 (A)

* W= weight (Kg; H= height (cm); A= age (y); G= gender: 1=male, 2=female.

The recommended energy intake from the 1989 Recommended Dietary Allowances (RADs) is **2300 Kcal** for the reference 77 kg elderly male and **1900 Kcal** for the reference 65 kg female, 51 years of age and older (Ausman and Russell 1999).

2.3.2 Protein

Protein intake and protein status are not usually problems in healthy, noninstitutionalized older persons, but this is not true in older institutionalized older persons. The controversial debates regarding protein requirements for the healthy older persons still exist. The decrease in muscle mass with age, which affects energy intake as well as protein intake, suggests requirements may be lower. However, decreased efficiency of digestion and absorption associated with aging suggests that an increase in dietary protein is necessary (Kerstetter, Holthausen, and Fitz 1993).

Millward et al. (1997) evaluated published nitrogen balance studies on the elderly and evaluated published reports on the extent of age-related changes on whole-body protein turnover. The authors concluded that although concern has been expressed that protein requirements for the elderly may be greater, none of the nitrogen balance studies have shown convincing evidence for any revision of the safe allowance of the 1985 FAO/WHO/UNU recommendation, which is 0.75 g/kg. In addition, the new [1-^{13}C] leucine balance studies have allowed measurement of the metabolic demand from postabsorptive leucine oxidation and efficiency of protein utilization from the change in leucine balance with feeding. These data indicate that in healthy elderly individuals there is a lower metabolic demand for dietary protein and a lower apparent protein requirement than in younger subjects. The exception is the decrease with age in protein turnover in skeletal muscle, which can be assumed to contribute to sarcopenia, loss of muscle strength, and metabolic reserve capacity in times of stress. However, life-style factors such as physical activity, especially resistance activities, seem to be strongly related. Millward et al. also mentioned that exercise improves the efficiency of protein utilization in young adults so that in the immobile elderly the efficiency of protein utilization may be decreased. Thus, a range of 0.69 $\pm$ 0.22 g/kg to 0.98 $\pm$ 0.17 body weight of protein requirement is apparently a safe level for improving restraint of proteolysis in the postabsorptive state, with little change with age in whole-body protein synthesis. However, Kerstetter, Holthausen, and Fitz (1993) suggested a range of 0.8 to 1.0 g protein per kg body weight or 12% to 14% of daily caloric intake for healthy older persons.

The 1989 RDA for protein (**0.8 g /kg /day)** is considered adequate for the elderly when adequate energy intake is observed (Ausman and Russell 1999). However, 0.92 – 1.0 g / kg of protein is recommended to maintain nitrogen balance and tissue protein stores in sedentary elderly people (Shoaf and Michell 1996).

2.3.3 Carbohydrate:

Since the body can efficiently convert amino acids and glycerol to glucose via gluconeogeneisis, no individual sugar has been considered an essential nutrient. Thus, there is no RDA for dietary carbohydrate (Bidlack and Smith 1988). However, the United States Department of Agriculture (USDA), American Heart Association, and American Cancer Society recommends **55-60%** of total calories be comprised of dietary carbohydrate, with an increased proportion of complex carbohydrate to simple sugar (Ausman and Russell 1999).

2.3.4 Fat

Bidlack and Smith (1988) stated that dietary fat has increased in the diet, proportionately displacing complex carbohydrate since the turn of the century. The increase in fat calories suggests a decrease in nutrient density of the diet. Schlenker (1993) mentioned that older men are consuming a higher level of fat than older women, and fat intakes decrease with age to a greater extent in older women than older men.

A great deal of attention has been focused on the potential relationship between plasma cholesterol and coronary heart disease. It was thought that plasma cholesterol levels could be lowered by shifting from a saturated fat diet to a polyunsaturated fat intake; a P to S ratio of 1 has produced a variable effect on plasma cholesterol levels (Bidlack and Smith 1988).

It is widely felt that a prudent diet with **30% or less** of calories of fat with a component of less than 10% for saturated fatty acids, 10-15% for monounsaturated acids and no more than 10% for polyunsaturated fatty acids is best (Ausman and Russell 1999). Polyunsaturated fatty acids contain essential fatty acids- linoleic acid and linolenic acid. The body uses essential fatty acids to maintain the structural parts of cell membranes and form eicosanoids which help regulate blood pressure, blood clot formation, blood lipids, and immune response to injury and infection (Whitney and Sharon 1999). In 1993 Schlenker suggested that it would seem pertinent to consider the establishment of RDAs for these polyunsaturated fatty acids.

2.3.5 Fiber

Fiber is a heterogeneous group of compounds composed of plant polysaccharides and lignins that are resistant to digestive hydrolysis in the human gastrointestinal tract. Water-insoluble fibers (e.g., wheat, rye, corn, legume hulls) are fermented by colonic bacteria and increase fecal bulk by their water-holding capacity. The major function of water-insoluble fiber is to reduce intraluminal clonic pressure and transit time. Water-soluble fibers (e.g., guar, pectin, legumes, oats, and barley) have little effect on fecal bulk, but reduce absorption of cholesterol and bile acids and lower postprandial serum glucose (Kerstetter, Holthausen, and Fitz 1993).

In population studies, increased consumption of dietary fiber is correlated with decreased rate of heart disease and cancer. Fiber is also included in a treatment regimen for a variety of diseases that particularly affect the elderly including constipation, hemorrhoids, diverticulosis, hiatal hernia, varicose veins, diabetes mellitus, hyperlipidemia, and obesity. The recommendation for fiber consumption for the elderly would be the same as for the adult, about 25 g/day (Ausman and Russell 1999).

2.3.6 Fluid

Total body fluid declines with age. A human embryo is 90% water, a newborn infant 80%, a mature adult 70%, and older person is 60% water (Kerstetter, Holthausen, and Fitz 1993).

Thirst and urine concentration are two normal defense mechanisms that work to protect against dehydration during conditions of water depletion (Welch 1998). Fluid balance is as important in the elderly as in other age groups. Many older adults demonstrate diminished thirst and impaired renal water conservation, and have decreased water intake even in circumstances of fluid deprivation (Shoaf and Michell 1996). As a result, dehydration often occurs among the elderly without being recognized.

Poor fluid balance may be due to both inadequate intake and excessive losses. Drug therapy such as diuretics and laxatives or hypertonic intravenous solution can also contribute to the problem (Ausman and Russell 1999**.** Welch (1998) suggested several formulas for calculating fluid needs under different circumstances. a) 30 mL/kg body weight; b) 1 mL/Kcal energy consumed; c) 100 mL/kg for first 10 kg, 50 mL/kg for next 10 kg and 15 mL for remaining kg. Ausman and Russell (1999) also stated that in the absence of severe clinical problems, consumption of 30 mL/kg/day is probably sufficient for the elderly.

2.3.7 Thiamin (Vitamin B1)

At physiological concentrations, thiamin is absorbed by an energy-requiring carrier-mediated process. There is little evidence that thiamin absorption is impaired in healthy older people unless associated with use of alcohol. However, thiamin intake prevalently decreases with age, which more likely results from the observed decrease in caloric intake rather than a change in the type of food consumed (Schlenker 1993).

Russell and Suter (1993) indicated that low thiamin intakes are correlated with institutionalization and poverty in elderly people. Juguan, Lukito, and Schultink (1999) conducted a cross-sectional study involved 204 elderly individuals who live in a poor urban area of Jakarta in Indonesia. The usual food intake was estimated by a semiquantitative food frequency questionnaire. Thiamin status was determined by measuring the erythrocyte transketolase (ETK) activity. Biochemical assessments demonstrated that 36.6% of the subjects had low thiamin level (ETK stimulation > 25%). In addition, the elderly men tended to have lower thiamin levels than elderly women.

The 1989 RDA for thiamin for elderly men is 1.2 mg/day and for elderly women is 1.0 mg/day (National Research Council 1989). This is considered sufficient for most healthy elderly persons. The 1998 DRI for thiamin for males is 1.2 mg/day and for females is 1.1 mg/day (Whitney and Rolfes 1999). However, thiamin deficiency in the elderly may be a problem due to alcoholism that lowers the absorption of thiamin (Ausman and Russell 1999).

2.3.8 Riboflavin (Vitamin B2):

Riboflavin deficiency in the elderly is quite common, 20% to 27% of older persons in America and European countries do not meet the 1989 RDA. Low intakes of riboflavin are even more frequent in developing countries where dairy products are not commonly consumed (Russell 1997). However, Madigan et al. (1998) concluded that a high proportion of healthy elderly people may have suboptimal status for riboflavin and vitamin B-6 measured by erythrocyte glutathione reductase activity coefficient (EGRAC) and plasma pyridoxal phosphate (PLP), even when they apparently consumed an adequate dietary intake. Furthermore, the study showed that a riboflavin and vitamin B-6 supplement at physiologic doses corrects biochemical abnormalities of EGRAC and plasma PLP, suggesting current UK and US dietary recommendations for riboflavin and vitamin B-6 are likely to be insufficient for elderly people.

The relationship of carbohydrate ratio to riboflavin was investigated by Boisvert et al. (1993) in a study conducted in Guatemala. Elderly people who were riboflavin–deficient, but otherwise healthy were involved in the study, which varied the fat: carbohydrate ratio of the diet. Riboflavin status was measured by erythrocyte glutathione reductase activity coefficient (EGRAC) and urinary riboflavin excretion. Boisvert et al. (1993) concluded that the riboflavin requirement was 1.1-1.3 mg/d when a Western-type diet (30% of energy from fat and 57% of energy from carbohydrate) was consumed, and that the requirement for older adults is the same as younger people. It appears that riboflavin requirements are influenced by the macronutrient composition of the diet; higher carbohydrate levels lower the dietary requirement of the vitamin.

The 1989 RDA for riboflavin for the elderly is 1.4 mg and 1.2 mg /day for males and females, respectively (National Research Council 1989). The 1998 DRI for elderly men is 1.3 mg/day and for elderly women is 1.1 mg/day (Whitney and Rolfes 1999). Ausman and Russell (1999) mentioned that little evidence exists for altered absorption of riboflavin with aging thus the requirement of the elderly does not differ from younger adults as confirmed by the Boisvert et al. study. Current DRIs of riboflavin is considered adequate for the elderly.

2.3.9 Ascorbic Acid (Vitamin C)

The 1989 RDA for vitamin C which is 60 mg /day for both sexes (National Research Council 1989), is insufficient for elderly (Rusell and Suter 1993). Garry et al. (1982) suggested that a different recommended dietary allowance for ascorbic acid should be considered for elderly men and women. Based on their data, it was estimated that intake of vitamin C would be 75 mg/day for elderly women and 150 mg/day for elderly men to maintain a plasma ascorbic acid level of 1.0 mg/dl (56.7 μmol/L).

Although this vitamin is widely abundant in many foods, intake of this vitamin among the elderly varies. Vitamin C status can be affected by certain conditions such as smoking, medication, and emotional as well as environmental stress (Ahmed 1992). In addition, Rusell and Suter (1993) pointed out that a high prevalence of senile cataract has been seen in elderly subjects with plasma concentration of vitamin C < 40 μmol/L. To prevent cataract formation in the elderly, consumption of vitamin C is suggested above the current RDA of 60 mg (Ausman and Russell 1999).

2.3.10 Niacin

Niacin, the collective term for nicotinic acid and nicotinamide, is a component of the coenzymes nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP). Niacin requirements are expressed as niacin equivalents (NE), since the amino acid tryptophan can be converted to niacin (Russell and Suter 1989). Erythrocyte nicotinamide adenine dinucleotide, plasma tryptophan, and urinary metabolites N-methylnicotinamide (NMN) and N-methyl-2 pryidone-5-carboxamide are sensitive indicators of niacin status (Rusell and Suter 1993).

The 1989 RDA for niacin is the same as for young adults, 15 mg NE/day for males and 13 mg NE/ day for females. Up to 53% of the elderly black with income below the poverty level have a niacin intake below two thirds of the RDAs (Ahmed 1992; Russell and Suter 1989). The DRI for niacin for elderly men is 16 mg-NE/day and for females is 14 mg-NE/day (Whitney and Rolfes 1999).

The decreased renal function in the elderly may call for attention concerning niacin intake. Otherwise, little evidence indicates that niacin requirements change with age (Ausman and Russell 1999).

2.3.11 Pyridoxal (Vitamin B6):

The 1989 RDA for vitamin B-6 in the elderly is 2.0 mg/day for men and 1.6 mg/day for women (National Research Council 1989). The 1998 DRI for vitamin B-6 for the elderly male is 1.7 mg/day and for the elderly female is 1.5 mg/day (Whitney and Rolfes 1999). Age-related declines in plasma pyridoxal phosphate have been reported, and evidence consistently reveals standard parameters of vitamin B-6 status to be quite low in older populations (Blumberg 1997). In addition, studies show that homocysteine levels rise when dietary vitamin B-6 is below 2.0 mg/day. So there is a need for considering increases to the recommended vitamin B-6 in the elderly (Ausman and Russell 1999).

2.3.12 Folate

The 1989 RDA for folate for elderly is 200 μg/day for men and 180 μg/day for women. However, studies have showed that homocysteine levels rise when dietary folate intake drops below 400 μg/day. Increased folate intake could be a potential benefit for the elderly because of its inverse association with metabolite homocysteine as a marker for coronary artery and cerebral vascular disease. The 1989 RDA for folate is considered too low for elderly people (Ausman and Russell 1999). The current 1998 DRI for folate has increased to 400 μg/day for elderly males and females (Whitney and Rolfes 1999).

Koehler et al. (1997) stated that folate fortification of bread and grains has been directed to prevent neural tube birth defect and reduce the risk of vascular disease. Although the new folate fortification rules provide the benefit of increasing folate in the food supply, they could be a risk for the elderly because excess folate intake can mask vitamin B-12 deficiency, delaying diagnosis and making possible the irreversible neurologic damage.

2.3.13 Vitamin B12

Low serum vitamin B-12 levels have been found in elderly people. Aging is accompanied by an increased risk of vitamin B-12 deficiency. In pernicious anemia, for example, the stomach fails to secret the intrinsic factor which is a requirement for vitamin B-12 absorption. Decreased digestion of vitamin B-12 from food and bacterial overgrowth in the small bowel are also important contributors that reduce vitamin B-12 absorption (Koehler et al. 1997). Elevated levels of methylmalonic acid is a sensitive and specific indicator of vitamin B-12 deficiency (Stabler, Lindenbaum and Allen 1996).

The 1989 RDA for vitamin B-12 for the elderly is 2.0 μg/day (National Research Council 1989), which has been raised to 2.4 μg/day for all elderly people by the 1998 DRI (Whitney and Rolfes 1999).

2.3.14 Vitamin A

The current DRI for vitamin A for elderly men and women are 1,000 μg and 800 μg, respectively, which remains unchanged compared to the 1989 RDA. Ausman and Russell (1999) suggested that the 1989 RDA for vitamin A for the elderly may be too high. Several studies have determined that plasma retinyl ester levels in the elderly remain higher than in young adults after a dose of vitamin A is taken.

The reduced clearance of the lipid-rich lipoproteins carrying the retinyl ester is a reason for this aspect. In addition, a change in the unstirred water layer may lead to an increase in vitamin A absorption in the elderly. Even though the role of vitamin A in preventing cancer and cardiovascular disease is still unclear, it may be beneficial for the elderly to continue obtaining sufficient vitamin A from carotene–containing fruits and vegetables because of the antioxidant effects of the carotinoids.

2.3.15 Vitamin D

Omdahl et al. (1982) determined vitamin D status from a group of healthy, free-living elderly people. Single blood samples were obtained from the study participants to analyze plasma 25-hydroxyvitamin D (25-OHD). In addition, dietary intakes were assessed from 3-day food records. The results showed that approximately one-third of the elderly group consumed less than 100 IU of vitamin D and 600 mg of calcium. Plasma 25-OHD was significantly lower in the elderly (15.5 ng/mL) compared to a younger control (29.1 ng/mL) population.

It has been suggested that the dietary need for vitamin D may be greater in the elderly than in younger individuals. Several aspects support this theory. First, vitamin D is found in only a few foods, including, seafood and fortified milk products, and over three-quarters of elderly persons have reported intakes of less than two-thirds of the RDA for this vitamin. In addition, the contribution of sunlight to the vitamin D status of the elderly is also reduced. Moreover, the number of vitamin D receptors decreases with advancing age, so absorption of vitamin D from the gastrointestinal tract is reduced in elderly people. Therefore, the 1989 RDA for vitamin D of 5 μg of cholecalciferol has been modified. The current adequate intake reference values is 10 μg for ages 51 through 70 and to 15 μg for individuals older than 70 (Ausman and Russell 1999).

2.3.16 Vitamin E

The 1989 RDA for vitamin E for the elderly is considered adequate; 10 mg/day for males and 8 mg/day for females. Therefore, the current DRI for vitamin E for the elderly is the same as the1989 RDA. The antioxidative properties that vitamin E provides may help to retard the aging process. The supplementation of this vitamin has also been reported to benefit the immune system and help prevent coronary artery diseases due to inhibition of LDL oxidation (Ausman and Russell 1999).

2.3.17 Calcium

In both men and women, absorption of calcium decreases with age. Calcium carbonate absorption may also decrease with the achlorhydria observed in some elderly persons, although this may be overcome by taking the calcium with a meal. In the NHANES I and II studies, average calcium intakes for women were about 500 mg/day, substantially below the 1989 RDA of 800 mg/day. NHANES III preliminary data showed a slight improvement in calcium intake in the older age group, but median intakes are still below the 1989 RDA of 800 mg/day. Ahmed (1992) mentioned that the bone loss of osteoporosis begins between the ages of 20 and 40 years. In women, this loss accelerates during the two decades after menopause and accounts for the high incidence of fractures to wrist, hip and spine. Bone density is thought to be a useful parameter for determining RDAs for calcium for the elderly population. The 1997 adequate intake reference value for calcium of the Food and Nutrition Board is 1200 mg/day for those 51 years and above. This is an increase of 400 mg/day above the 1989 RDA (Ausman and Russell 1999).

2.3.18 Phosphorus

Phosphorus has an important role in energy metabolism as a component of high-energy molecules such as *adenosine triphosphate*. About 85% of body phosphate is found in bone mineral in the ratio of 1 phosphorus to 2 calcium ions. Phosphorus is found abundantly in dairy products, meat, poultry, and fish, and grain products. Dairy products contain more calcium than phosphorus, whereas meat, poultry, and fish (without bone) contain 15 to 20 times more phosphorus than calcium (Schlenker 1993). In the elderly, the high use of antacids, such as aluminum hydroxide, used in the treatment of peptic ulcer, can cause a greater risk for decreased phosphorus absorption (Bidlack and Smith 1988). The 1989 RDA for phosphorus for older adults is 800 mg. However, the current DRI recommends lowering the intake for phosphorus to 700 mg for older adults. The Total Diet Study conducted between 1982-1989 illustrated that phosphorus intakes were adequate for older adults (1,243 mg for men and 880 mg for women) as well as other groups (Pennington and Young 1991). These results were similar to the NHANES II study, where the men age 60 to 69 consumed 1,290 mg of phosphorus daily, and women, 894 mg daily (Schlenker 1993).

2.3.19 Iron

The iron deficiency seen in the elderly is due to inadequate iron intake, blood loss due to chronic disease, and/or reduced nonheme iron absorption secondary to the hypohydria or achlorhydria of atrophic gastritis. Chronic use of antacids or other acid-lowering medication can also impair intestinal iron absorption. Iron absorption per se does not appear to decline significantly with age. The RDA of 10 mg/day for elderly persons with no concurrent disease conditions seems adequate and appropriate (Ausman and Russell 1999).

2.3.20 Zinc

Zinc intake seems to decline with advancing age. A study was conducted to evaluate the title VII congregate feeding program in Indianapolis. The results concluded that the nutrient intake of participants for an average weekday, except for zinc, approximately met the Recommended Dietary Allowances. Fifty-nine percent of the subjects consumed less than two-thirds of the allowance for zinc. Even, taste acuity by these elderly participants was generally less than that reported for young adults; however, there was no correlation between taste acuity and dietary zinc intake (Greger and Sciscoe 1977).

Since zinc nutriture may affect immune competence (Groff, Gropper, and Hunt 1995), the question arises whether poor zinc status may partially explain decreased immune function in the elderly. The present DRI for zinc for elderly men (15 mg) and women (12 mg) appears to be justified (Ausman and Russell 1999).

2.3.21 Copper

It is generally believed that copper deficiency does not occur in persons consuming mixed Western diets, who are free of diseases. This opinion is based on the fact that mixed Western diets provide 2 to 5 mg of copper daily, which is sufficient to meet requirements established from balance studies. However, analysis of the copper content of diets suggests that many provide less than 2 mg of copper daily and that intakes of less than 1 mg of copper / day are not rare (Sandstead 1982). The human gastrointestinal system can absorb 30-40% of ingested copper from the typical diets consumed in industrialized countries. Aging probably decreases the efficiency of copper homeostasis, resulting in higher plasma copper concentrations in the elderly (Wapnir 1998). Copper absorption is also influenced by the other trace minerals and other factors in the diet that inhibit or enhance cation absorption (e.g., phytates, zinc, oxalates) (Ausman and Russell 1999). Wapnir (1998) stated that manipulation of the fiber content of the diet might have an indirect effect on copper availability by altering the bioavailability of mineral antagonists. Protein and soluble carbohydrate (i.e. glucose polymers), however, tend to improve copper absorption and bioavailability by enhancing its solubility and intestinal bulk flow. Organic acids, other than ascorbic acid, are also likely to have a positive effect on overall copper absorption. No RDA for copper has been set because of uncertainties about its requirement in human. The Estimated Safe and adequate Daily Dietary Intake (ESADDI) for copper ranges from 1.5 to 3.0 mg/day in the adult (National Research Council 1989). With a dietary copper density of approximately 0.6 mg/ 1000 kcal, a minimum of 2500 kcal are needed to furnish the RDAs (Kerstetter, Holthausen and Fitz 1993).

2.3.22 Magnesium

The 1989 RDA for magnesium for adults of both sexes is 4.5 mg/kg body weight, which translates into 350 mg/day for a reference 76 kg male and 280 mg/day for a 62 kg female. Magnesium is found in unrefined grains and vegetables. In the FDA Total Diet Study, magnesium intake varies little with age between 15 and 65 years of age. Females aged 14-16, 25-30, and 60-65 years consumed self-selected diets containing 194 mg/day, 189 mg/day, and 187 mg/day, respectively; males in the same age categories consumed 297 mg/day, 194 mg/day, and 250 mg/day, respectively. Older women and men like younger adults consume a magnesium intake of about two-thirds of the RDA (J-Wood, Sutet, and Russell 1995). It is unknown whether aging affects the efficiency of the renal magnesium conservation mechanism during low dietary magnesium intake. However, elderly patients receiving diuretic therapy may be at increased risk of magnesium deficiency because of increased urinary magnesium loss (J-Wood, Sutet, and Russell 1995). As noted in Appendix I, the current DRIs for magnesium for those 51 years and older have been increased by 70 mg/day and 40 mg/day for men and women, respectively, above the 1989 RDA.

2.3.23 Manganese

Manganese deficiency has never been observed in noninstitutionalized human population because of the abundant supply of manganese in edible plant materials. There is no tendency for either a decrease or an increase in manganese accumulation throughout most of the life cycle. The Total Diet Study conducted in the United States between 1982 and 1989 indicated that the mean daily dietary manganese intake for men and women, 60-65 years of age was, 2.64 mg and 2.23 mg, respectively, which was within the ESADDI range (2.0-5.0 mg for adults) (Pennington and Young 1991).

2.3.14 Selenium

Selenium is a cofactor for glutathione peroxidase, an enzyme that, in cooperation with vitamin E, plays an important role in antioxidant function. The major sources of selenium are fish and grain products although the content of selenium of grains depends on the selenium content of the soil in which the grains were grown (Schlenker 1993). According to Schlenker (1993) the average adult consumes approximately 108 μg selenium per day from a typical American diet, which is based on the food composition tables. The 1989 RDA for selenium is 70 μg for older adult men and 55 μg for older adult women (National Research Council 1989). The Total Diet Study conducted between 1982-1989 also showed that selenium intake for each age-sex group for each year was above the RDA requirements. Average selenium intakes ranged from 109% to 250% of the RDA (Pennington and Young 1991). J-Wood, Suter and Russell (1995) indicated that serum selenium concentrations decrease with aging, especially between the ages of 65 and 90. Many authors mentioned that although selenium is part of the body defense mechanism, it is uncertain whether selenium intakes higher than the current RDA would provide an additional beneficial effect in the prevention of chronic disease, such as cancer or cardiovascular disease.

2.3.25 Potassium

Potassium is the principal intracellular cation. The small percentage of potassium found in plasma and interstitial fluid, plays a great physiological importance in the transmission of nerve impulses, the control of skeletal contractility, and the maintenance of normal blood pressure. More than 90% of potassium consumed is absorbed from the gastrointestinal tract, and its balance is regulated by the kidney (National Research Council 1989).

The minimum requirement for potassium for the adult is approximately 1,600 to 2,000 mg per day, which is needed to maintain normal body stores and a normal concentration in plasma and interstitial fluid (National Research Council 1989). The Total Diet Study 1982-1989 indicated that the potassium intake of older men and women met or exceeded the estimated minimum requirement (2,644 mg for men and 2,058 mg for women) (Pennington and Young 1991). Potassium intake tends to decrease with aging. In the NHANES II study, the potassium intakes of men and women ages 59 to 69 were 2,560 and 1,998 mg per day, respectively. Intakes decreased to 2,291 and 1,973 mg in men and women ages 70-74 (Schlenker 1993).

2.3.26 Sodium

Sodium is the principal cation in the extracellular fluid and is important in the regulation of extracellular fluid volume, osmolarity, acid-base balance, and the membrane potential of cells. Sodium is also involved in active-transport across the cell membrane. Sodium homeostasis is primarily regulated by the renin-angiotensin-aldosterone system in the renal tubules of the kidney (National Research Council 1989). In older people, both circulating renin and aldosterone levels decrease, which may influence both the time sequence and the degree of response to a change in sodium level. Decreased sodium regulation is frequently observed in older individuals (Schlenker 1993).

Obligatory sodium losses have been estimated to be 5 mmol (115 mg) of sodium a day. The safe minimum daily intake established by the Food and Nutrition Board is 500 mg. The Committee on Diet and Health recommends that all people limit their sodium intake to 2,400 mg of salt (Schlenker 1993). The Total Diet Study showed sodium intakes (which did not include discretionary salt) exceeded the estimated minimum requirement. Older men and women consumed respectively, 2,592 mg and 1,875 mg of sodium daily (Pennington and Young 1991).

2.4 THE ELDERLY NUTRITION PROGRAM:TITLE III-C

Splett (1994) emphasized that the federal food assistance programs are an important means for assuring that all Americans, especially for these who do not have sufficient food on a regular basis, can have access to an adequate, safe, nutritional and reliable food supply at a reasonable cost.

The elderly are vulnerable to the risk of poor nutritional status (Fahm & Seaborn, 1998) because of physiologic changes (Lowenthal and Kirschner 1994; Morais et al 1997; Morley 1997), psychological (Willis et al 1997), and sociological factors (Marcus and Berry 1998), and chronic disease that accompany aging. There is a great interest in identifying effective community-based services that enable elderly persons to maintain their health status and stay active in their communities (Splett, 1994).

2.4.1 History of the Elderly Nutrition Program

The Elderly Nutrition Program (ENP) has been providing meals to America's elderly since 1973. The program was authorized by Congress on March 1972, as Title VII of the Older American Act of 1965. This Act established a network of nutrition projects to provide meals primarily in congregate settings to eligible elderly persons. In 1978, all nutrition services including home-delivered meals (HDMs) were compiled under Title III-C of the Act (Carlin and Rhodes 1991).

2.4.2 Administration

The Older American Act led to the creation of the "aging network," (Appendix B) a system of local, state, and federal organizations for helping the elderly, and for helping the elderly represent themselves. The Director of the Commission on Aging of the Administration on Aging (AoA) within the Department of Health and Human Services was empowered to administer the Title III-C program through AoA consultation with other departments of the federal government. AoA is divided into ten regional offices, each containing three to eight states. The regional offices must review and approve the annual operating plan of states and provide assistance to state offices on aging for development of their Title III plans (Wisconsin Two-Year State Plan on Aging 1997).

Bureau of Aging and Long Term Care Resources is the single State Agency on Aging, designed by the Governor of Wisconsin to provide leadership and guidance to the agencies and organizations serving the elderly within the state of Wisconsin. The State Agency on Aging divides the state into planning and service areas (PSAs) and designates an Area Agency on Aging (AAA) for each PSA (Appendix C). The Area Agency on Aging has the responsibility for administration and oversight of state and federal aging funds granted from the Bureau of Aging and Long Term Care resources through the AAAs to county and tribal governments in Wisconsin. County and tribal aging units are authorized by Wisconsin statue, are responsible for the local planning, administration, and oversight of the state and federally funded aging program. In addition, aging units further act to represent the interests of the elderly in local communities and to assist elders to continue to act as vital participants in their communities (Wisconsin Two-Year State Plan on Aging 1997). Wisconsin Dunn County Office on Aging supervises fourteen congregate meal sites, which are located in cities of Boycevile, Colfax, Eau Galle, Knapp, Menominie, Ridgeland, Rock Falls, Sand Creek, and Wheeler. The city of Menomonie contains three congregate-meal sites which are located in Menomonie Leisure Center, Hosford/Rich Building, and Galloway Homes.

2.4.3 Aging Unit Staff

Each aging unit employs a nutrition program director to manage and administer functions of the program. Each nutrition project is established and administered with the advice of dietitians, persons competent in the field, elderly participants, and of persons who are knowledgeable with regard to the needs of older individuals. The program nutritionist has the responsibility of approving all menus served. In addition, a nutritionist assists the program director to provide staff training in proper sanitation, to develop sanitation policies and procedures, to select food service equipment, and to develop food contracts and implement a nutrition education plan. All congregate meal sites are supervised by a designated site manger who is responsible for organizing and supervising the serving of meals and all other related nutrition program activities carried out at the site. In addition, to the maximum extent feasible, the nutrition program provides opportunities for voluntary participation of individuals in all aspects of program operation (Bureau on Aging 1996).

2.4.4 Funding Sources

The funding sources for the Elderly Nutrition Program are contributed by a combination of federal and state funds, local public and private funds and participant donations. In general, participant contributions make up approximately one third of the program income (Bureau on Aging 1996). The report from Dunn County Office on Aging shows that a fiscal funding stream is primary contributed by federal tax funds, county tax fund, and participants donations, with composition of 44%, 21% and 35%, respectively. The suggested donations from Dunn County Office on Aging is $2.50 for each meal. Meal program participants are encouraged to voluntarily contribute for meals and supportive services directly related to nutrition services.

2.4.5 Nutrition Education

Nutrition education is one of components of the elderly nutrition program. In Wisconsin, nutrition education is required on at lease a semi-annual basis to participants in the Elderly Nutrition Program. The strategies used include pamphlets, brochures, posters, speakers, slide shows, video programs, newsletters, and newspaper articles, etc. Programs are encouraged to use other local resources to provide nutrition education services besides the program staff (including the dietitian or nutritionist), volunteers, and participants. In addition, dietary counseling has to be provided by a registered dietitian when a specific health related nutrition problem occurs among participants (Bureau on Aging 1996).

2.4.6 Food Service Requirements

A purpose of Title III-C is to provide nutritionally adequate and appetizing meals for individuals 60 years of age or older who may not eat properly either due to their unaffordability, their limited skills of preparing and purchasing nourishing meals, or lack of motivation to prepare the meals (Carlin and Rhodes 1991; Roe 1992). Congregate and home-delivered nutrition projects offer at least one meal per day, five or more days per week (except in rural areas). On the average, each meal must provide a minimum of one-third of the daily RDAs established by the Food and Nutrition Board of the National Academy of Sciences National Research Council (Carlin and Rhodes 1991). In addition, in order to comply with the requirements of the Older American Act, the Wisconsin Bureau on Aging recommends that all nutrition programs incorporate recommendations from the United States Surgeon General's Report on Nutrition and Health published in 1988. The Report emphasizes that high fat consumption may negatively affect health while consuming food high in complex carbohydrate and fiber may positively affect health (Bureau on aging 1996). In addition, special attention is required for meeting the caloric and nutrient needs of older clients (Carlin and Rhodes 1991). The meal pattern used as a guide for menu planning in the state of Wisconsin follows:

Table 3. - - Regular Meal Pattern in the State of Wisconsin

Food Groups	Amounts
Meat or alternate	- No less than 3 oz. cooked, edible portion - 2 oz. protein may be served in casserole type entrees
Vegetables/Fruits	- Two ½ cup (4oz.) servings

Bread or bread alternate	- One serving
Butter or fortified margarine	- One teaspoon
Dessert	- ½ cup serving
Milk	- ½ fluid pint (8 oz.)

The nutrition project also provides special menus to meet the particular dietary needs for health requirements, religious requirements or ethnic background of eligible individuals. The five special menu types are modified meals, therapeutic meals, liquid nutritional supplements, ethnic or religious meals and emergency meals. Modified meals meet the regular meal pattern, but contain modifications to one or more menu items; i.e. ground meat, thickened liquids or all pureed foods for an individual with chewing or swallowing problems. A therapeutic meal changes the meal pattern significantly by either limiting or eliminating one or more menu items. Therapeutic meals must be prescribed by a physician and the nutrition program must retain the written diet order. Each written diet order must be reviewed at least every six months to one year by the physician and updated according to physician instructions. Liquid nutritional supplements are high calorie dietary supplement products. They are intended to be used under the guidance of a health professional as part of a treatment or care plan for a medical and /or nutritional problem. Examples of supplements include regular, high fiber, high protein, glucose controlled, renal, or cardiac liquid products. The nutrition program may need to establish policies under feasible, appropriate and cost effective conditions that allow for the provision of menus to meet the particular dietary needs for religious requirements or ethnic background of eligible individuals. Emergency meals are prepared and supplied in disaster conditions for continuing meal services for congregate and home-delivered meal participants (Bureau on Aging 1996).

2.4.7. Food Preparation

Dunn County Office on Aging has a contract with the Food Service Department, in Menomonie High School, as a food provider. Food is prepared in the Menomonie High School kitchen and delivered to the Menomonie Leisure Center congregate site and Hosford/Rich congregate-site five days a week. The monthly cycle menu is planned by a registered dietitian, according to the Wisconsin regular menu pattern and approved by the nutrition program director of Dunn County Office on Aging to provide most elderly nutrition needs for the meal program participants. Safe food practices by the nutrition program cannot be compromised. Food temperature at the time of service and at the time of delivery is required to be no less than 150° F for hot food and no more than 40° F for cold food. If hot food arrives at a site at less than 150° F or hazardous cold foods arrive at the site higher than 40° F, food should not be served (Bureau on Aging 1996).

2.4.8. USDA Commodity Foods

USDA funds are a resource to the nutrition program that allows the program to increase the number and the quality of the meals. Based upon preferences of the nutrition program directors, Wisconsin has opted for cash payments in instead of donated foods.

2.4.9 Nutrition Screening Initiative

The Nutrition Screening Initiative established in 1990 as a collaborative effort between the American Dietetic Association, the American Academy of Family Physicians, and the National Council on Aging, promotes nutrition screening in the United States for people 65 years or older. The Nutrition Screening Initiative, "Determine Your Nutritional Health Checklist" (Determine Checklist) is widely used and includes items that relate to nutritional status in older adults and fall within important domains of quality of life (Barrocas et al. 1996). Several modifications to the original checklist had been made by the Wisconsin Office on Aging to evaluate the older meal program participants statewide.

The Nutrition Screening Initiative version consists of 10 statements, each describing a risk indicator of malnutrition. Each statement is assigned points ranging from 1 through 4, which depends on the contribution to nutrition risk. Respondents circle the points corresponding to the item if they agree with the statement. The total possible score is 21; high scores indicate greater nutritional risk. Wisconsin modifications to the Determine Checklist retain the maximum score of 21. Both "yes" and "no" response options are available in the modified Determine Checklist (Vailas et al 1998). An example of the modified Determine Checklist is shown in Appendix D.

2.4.10 <u>Money Spent and Number of Participants:</u>

The Federal Elderly Nutrition Program (ENP) provided 127 million meals to 23 million congregated-site participants and 113 million meals to 877,000 meal-on wheel participants in 1994 (Voe 1997). Moyer and Balsam (1996) stated that participation in the program has changed over the last ten years. From 1985 to 1994 congregate meals served decreased 15% (from 149.9 million meals served in 1985 to 126.7 million meals served in 1994); however, home delivered meals increased 9.8 % (from 75.5 million meals served in 1985 to 113.1 million meals served in 1994). The number of participants in the congregate meal program decreased from 2.94 million in 1985 to 2.29 million in 1994, however, an increase in home-delivered participation levels from 690,000 to 880,000 occurred in the same ten year period. The funding for the program also has showed differences. The Older Americans Act funding for the congregate meal program in 1985 was $336 million, but in 1994 the funding was only $245.1 million (a 27 % decrease). Whereas, home delivered funding increased from $67.9 million to $128.2 million (an 89% increase). Voe (1997) addressed that "ENP doesn't reach all who need its services. Forty one percent of local ENP sites have waiting lists of people for home delivered meals, they can't serve because of inadequate resources."

2.5 STUDIES OF THE ELDERLY NUTRITION PROGRAM

Older adults are at higher risk for malnutrition compared with the general population. Several studies have indicated that meal program participants, especially meals-on wheels applicants are a population at risk for poor nutritional status (Coulston, Craig, and Voss 1996; Stevens, Grivetti, and McDonald 1992; Neyman et al. 1998; Gilbride et al. 1998). Coulston, Craig and Voss (1996) identified older adults with poor nutritional status among 230 independent-living elderly applying for meals-on-wheels by determining their anthropometric, dietary, and laboratory data along with a Nutrition Screening Initiative (NSI) self-assessment tool-the "Determine Your Nutritional Health" Checklist. Seventy-four percent of the study participants were found to be at risk for poor nutritional status according to the study criteria (i.e., BMI < 24, energy intake was less than the estimate energy requirement), and 83% were at risk for poor nutritional status based on the NSI-self-assessment tool. The authors suggested that the NSI self-assessment checklist identified a greater percentage as "at risk" for poor nutritional status than study criteria, which is appropriate because the NSI tool was designed to identify elderly adults who would then be further screened with objective data. In this study, men had a higher incidence of risk for poor nutritional status (90%) than women (60%).

A pilot study also indicated that congregate-meal participants had a higher percentage of nutritional risk compared to non-participants. The study assessed nutritional health in a metropolitan area. Forty older New Yorkers, which included 13 congregate-site meal program participants were involved in the study. The nutritional status was assessed using two 24-hour recalls, 5 -day food records, a food frequency, and anthropometric measurement along with mental and functional measurements. Congregate meal participants consumed less energy and selective nutrients (protein, carbohydrate, fat dietary fiber, cholesterol, magnesium, iron, zinc, vitamin A, vitamin D, vitamin C, calcium, phosphorus and folate) except for vitamin E than those not receiving congregate meals. The mean energy intakes for congregate meal participants and non-congregate meal program participants were 1,338 kcal and 1,754 kcal, respectively. The average percentage of carbohydrate, protein, and fat were similar for both groups with 53%, 16% and 30%, respectively. The mean vitamin and mineral intakes for all study subjects met the RDAs expect for calcium (660 mg), vitamin D (178 IU), zinc (7.6 mg), and magnesium (264 mg). The mean dietary fiber was also lower than the recommended; 13.0 g and 18.9 g for congregate-site meal program participants and non-meal program participants, respectively (Gilbride et al. 1998).

Several studies with varying methods have been designed to determine the effectiveness of the meal programs on nutritional status for the elderly participants. A comparison study recruited 135 senior subjects (70 congregate-meal participants and 65 nonparticipants) from senior centers of two northern California counties to evaluate whether participation in a congregate-site meal program influenced the nutritional status of a group of healthy people. Nutrient intakes were obtained by a 3-day food record, which were assessed relative to current recommendations, and selected biochemical indexes of nutritional status were also evaluated. The study concluded that nutritional status of the Title-III-C congregate-site meal participants does not differ significantly from the status of nonparticipants of a similar age. The mean intake of 17 vitamins and minerals met or exceeded 100% of the RDA or Estimated Safe and Adequate Daily Dietary Intake (ESADDIs) for both groups except for calcium, zinc, and copper. Mean levels of all 13 biochemical indexes of nutritional status were within the normal range for both groups, except for iron. The authors pointed out that the important aspect of the meal program was to provide an opportunity to socialize with others, which was considered a primary reason for most meal program participants for attending the congregate-site program in this study (Neyman, Zidenberg, and McDonald 1996).

The nutritional benefits of participating in the congregate meal program were also determined in a Hispanic seniors study (Neyman et al. 1998). Dietary intakes were obtained by using multiple 24-hour recalls from free-living Hispanic seniors who were participating or not participating in the congregate-site meal program. Age-adjusted analysis of variance was used to compare the mean energy and nutrient intakes of the two groups. Male congregate-site participants consumed significantly higher total energy and carbohydrate than nonparticipants. No significant differences in percentage of total energy contributed by macronutrients were noted between groups. Mean intake of cholesterol for all groups met or was below the 300 mg/day recommendation of the American Heart Association. Mean dietary fiber intakes were below current recommendations, with the exception of intakes of male congregate-meal participants (27.9 g). Mean intakes of vitamin B-6 were lower than the RDA for all groups and were less than two-thirds of the RDA in male non-participants. The mean vitamin A intakes were above the RDA only for male and female congregate-meal participants; 1,438 RE and 1,196 RE, respectively. Calcium was consumed at less than the RDA by female participants and female and male non-participants. Magnesium was consumed at less than the RDA by female participants and non-participants and less than two-thirds of the RDA by male non-participants. Zinc was consumed at less than the RDA by female and male participants and less than two-thirds of the RDA by females and male non-participants. The study suggested that male participants benefit from the effectiveness of congregate-site meal program by enhancing their overall energy and nutrient intakes, especially on vitamin A, vitamin C, Vitamin E, folate, calcium, iron, and magnesium (Neyman et al. 1998).

The effectiveness of the nutritional elderly program has been documented before Title VII of the Older American Act was amended to Title III-C. One-day food records kept by 466 individuals participating in the Nutrition Program for the Elderly from Central Missouri showed that nutrient intakes, especially energy, protein, and calcium were greater for those who ate at the meal site on the day of the food record than those who did not. Even the mean iron intake was above the RDA for all groups; however, non-participants consumed more iron than participants. Participants who consumed the one-day meal from the meal-site also had better overall diet consumption by dietary rating than non-participants. The daily intake of all selective nutrients, except calcium, of those eating at the meal site reflected what was offered. Approximately 40 to 50% of the total daily intake was consumed from the meal center. The benefit the nutrition meal program to women was recognized. The results showed that women consumed a significantly greater proportion of their daily intake of most nutrients from the meal provided by program than the men (Kohrs, O'Hanlon, and Eklund 1978).

The relationship of the nutritional status of the 247 Title VII nutritional meal program participants with the frequency of participation in the meal program was investigated by Kohrs et al (1980) who used dietary intake, biochemical, clinical and anthropometric data. The overall quality of the diet was associated with frequency of participation in the program. The nutriture for vitamin A and C was positively associated with frequency of participation in the program. However, a significantly smaller percentage of persons who participated in the program on a regular basis had inadequate intakes of riboflavin and thiamin. Frequency of participation in the program was also not associated with anemia or serum-iron association. In addition, participation in the program was not significantly related to the dietary intake of energy, saturated fat, and cholesterol or to the incidence of obesity when triceps skinfold thickness, ponderal index, body mass index, and percentage of desirable weight. The authors concluded that the nutrition meal program for the elderly is associated with improvement in the nutritional status of the participants (Kohrs et al. 1980).

Nutrient intakes, dietary habits, and the nutritional knowledge and attitudes of 53 elderly recipients and nonrecipients of a Title III meal program from central Maine were examined. Mean intakes of recipients and nonrecipients from a three-day diet record showed no significant differences for many of the nutrients studied. However, mean intakes of energy and all nutrients except niacin and vitamin C were higher for recipients. Average dietary intakes were above 90% of the RDAs for protein, iron, vitamin, vitamin C, riboflavin and niacin for all groups. Men consumed less energy than women, which was less than 66% of the RDA. However, men had a significantly higher intake of riboflavin than women due to higher consumption of milk and other dairy products. Thiamin intake was generally low for all groups, ranging from 71% for nonrecipient men and 89% of the RDA for recipient women. Calcium intakes were less than the RDA for both groups, recipient women had the lowest intake (66% of the RDA). Even though there was no a significant difference between iron intakes of recipients and nonrecipients, iron intakes for both groups were above RDA recommendations, with mean intakes which ranged from 100-123% of the RDA. Age was a factor for consuming certain nutrients. As age increased, intake of fat, protein, iron, thiamin, and niacin decreased. The number of meals eaten from the nutrition meal program and living arrangement had no effect on the patterns of intake of the nutrients studied. In addition, significant differences were found in nutrition knowledge and attitudes between recipients and nonrecipients (LeClere and Thornbury 1983).

The quality of life and nutritional status of participants in the congregate-site meal program and home-delivered meal program were investigated in Pepin County, Wisconsin (Vailas et al. 1998). The questionnaire was designed and modified from the Nutrition Screening Initiative, "Determine Your Nutritional Health Checklist" (Determine checklist) to assess the nutrition risk for participants. In addition, quality of life, quality of health, depression, social satisfaction, functional status, food security, and food enjoyment were also administered. The results of this study indicated that food enjoyment was associated with quality of life. A significant correlation between the Determine Checklist score and global quality of life was observed, which suggested nutritional risk was negatively associated with quality of life. Some characteristics associated with poor health are inversely associated with quality of life, including unintentional weight loss or weight gain, and oral health problems. In addition, depression, food insecurity, and functional impairment were negatively correlated with quality of life. The authors concluded, "reducing nutritional risk and incorporating social-psychological components into intervention programs have the potential to increase quality of life" (Vailas et al. 1998).

3. METHODOLOGY

3.1 SUBJECT SELECTION

The purpose of this study is to determine if nutritional intake is improved on a day

individuals participated in the Title III-C Menomonie congregate-site meal program compared to a non-participation day. The Human Subjects Protection procedures were approved by the Human Subjects Committee of the University of Wisconsin-Stout. Study subjects were recruited privately and voluntarily from individuals participating in the Dunn County Elderly Nutrition Program, in Menomonie. An invitation/informed consent from (Appendix E) with the description of the study was given to individuals who were 60 years or older age, free of mental illness, and attending the congregate-site meal program. This sheet indicated that if the participants did agree to be interviewed, they were giving their informed consent. Elderly participants were allowed to have at least seven days to decide whether they would like to participate in this study. After that, the student researcher confirmed with them individually. All volunteer study subjects were identified by code numbers. The code number was matched to name on a sheet, which was only available to the researcher. After data collection, the sheet identifying participants was destroyed and code numbers were utilized for data analysis.

3.2 PROCEDURES

In consideration of visual limitation associated with the aging process, 14-font size and a black-on white format were used for the invitation and the interview questionnaire. The interview questions (Appendix F) were adapted from the *Diet History Form for Older Adults* (Schlenker 1993) and included questions regarding demographics, reasons for program participation or nonparticipation, living arrangement, and eating habits. The 24-Hour Recall Form (Appendix G) and the Food Frequency Questionnaire (Appendix H) were also implemented in this study. One hundred and two food items were selected from commonly consumed seasonal food and the cycle menu for the elderly nutrition program to enhance data collecting and analysis of food consumption.

The student researcher was trained to be an effective interviewer by learning interview techniques from the educational videotape, entitled “The 24 Hour Food Recall” (1998). A pilot study was conducted with two older adults using the interview process. Food models, measuring cups and spoons were used to facilitate the identification of food portion sizes by the subjects.

Two interviews were set up with each of the individual study subjects. One interview was conducted the day after the subjects had participated in the meal program, and the other interview was set-up following a non-meal program participation day. All interviews were conducted in the congregate meal program sites; each interview was approximately 30 minutes long. A 24-hour recall was implemented in each interview to obtain the subject’s dietary consumption during the pervious 24 hours. In addition, the food frequency questionnaire and interview questions were administered verbally to obtain subject’s overall dietary intake and to identify factors influencing the elder’s food consumption. Unclear responses were followed up by phone calls.

3.2 DATA ANALYSIS

The data were collected from the 17 elderly nutrition program participants who were involved in this study. The nutrient composition of the 24-hour recalls and the food frequency questionnaire were analyzed using Food Processor Plus (version 6.0, 1987-1994, ESHA Research, Salem, OR). Paired-Samples t tests were used to compare the nutrient intake and percentage of the RDA for the 17 congregate meal program subjects on a participation day to the non-participation day; on a participation day to the food frequency questionnaire; and on a non-participation day to the food frequency questionnaire. One-way ANOVA was used to test the effects of both gender and age differences on nutrient intakes and percentage of the RDA on a meal program participation day, on a non-meal program participation day, and on the food frequency questionnaire. All the data were analyzed by SPSS Base 9.0.

4. RESULTS

Study subjects were recruited privately and voluntarily from those participating in Dunn County Elderly Nutrition Program, in Menomonie. A sheet with the description of the study was given to individuals attending the congregate-site meal program. This sheet indicated that if the participants did agree to be interviewed, they were giving their informed consent. Elderly participants were allowed to have at least seven days to decide whether they would like to participate in this study. After that, the student researcher confirmed with them individually. All volunteer study subjects were identified by code numbers. The data were collected during two interviews; each interview was approximately 30 minutes long. Dietary recalls were implemented on each interview day to obtain subjects' dietary consumption during the previous 24 hours. One interview was conducted for a day when the subject had eaten the meal from the congregate-site meal program and the other interview was conducted for a day when the subject had not participated in the meal program. In addition, the food frequency questionnaire was administered verbally during one interview to obtain each subject's overall dietary intake. Interview questions were also administered verbally to investigate factors influencing the elders' food consumption. During both interview sessions, food models, measuring cups and spoons were used to help subjects identify food portion size.

4.1 DEMOGRAPHICS

A total of seventeen elders participating in Dunn County Elderly Nutrition Program, in Menomonie, voluntarily enrolled in this study. Thirty–five percent of study subjects were male and sixty-five percent were female (Figure 1). The average weight of the seventeen study subjects was 155.7 lb. The weight range was from 102 lb. to 210 lb. (Figure 2). The mean height of the seventeen study subjects was 62 in. The height range was from 59 in. to 71 in. (Figure 3). Table 4 presents age information of study subjects. Five of subjects were in the category of 65 to 75 years old. Nine subjects were in the category of 76 to 86 years old, and three subjects were in the category of 87 years old or older. The oldest subject was 90 years old and the mean age for the seventeen study subjects was 80 years.

4.2 FACTORS INFLUENCING NUTRIENT INTAKE

Questions were asked during the interview session to ascertain factors influencing the elder's food intake. The results appear in Table 5. Fourteen subjects stated that their weights had not changed in the last year. Only three subjects stated that their weights had changed in the last year. Ten subjects considered that their physical activities were not restricted in any way, but seven of study subjects stated they dealt with physical restriction problems. Fourteen subjects in this study live alone and only three subjects live with somebody else. Ten subjects stated they didn't follow any special diet; seven subjects followed a special diet. When the question "Do you regularly skip meals?" was asked, fifteen subjects stated "no" and two subjects stated "yes". Fourteen out of the seventeen study subjects said if they have a chance they would like to recommend this nutrition meal program to their friends.

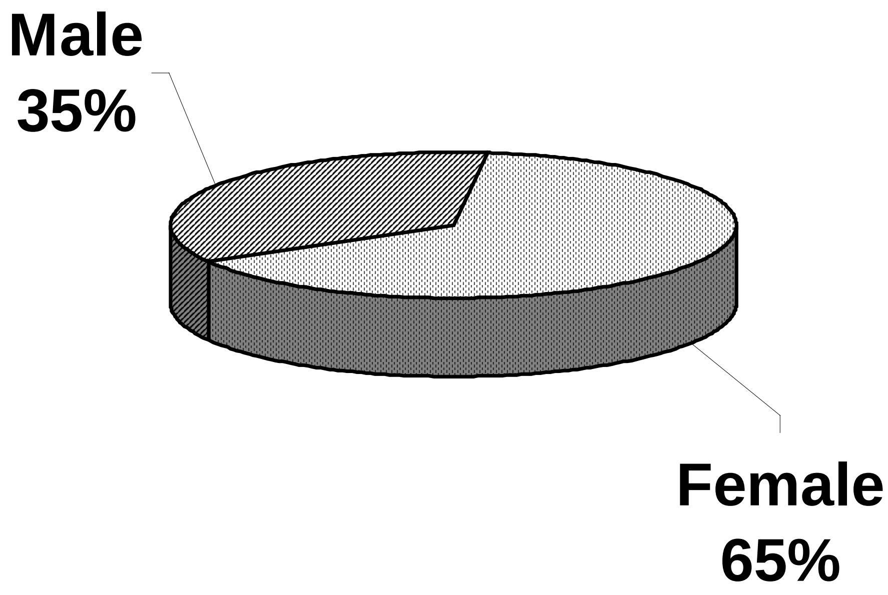


Figure 1.- - Frequencies of Demographic Data (Gender) of the 17 Study Participants

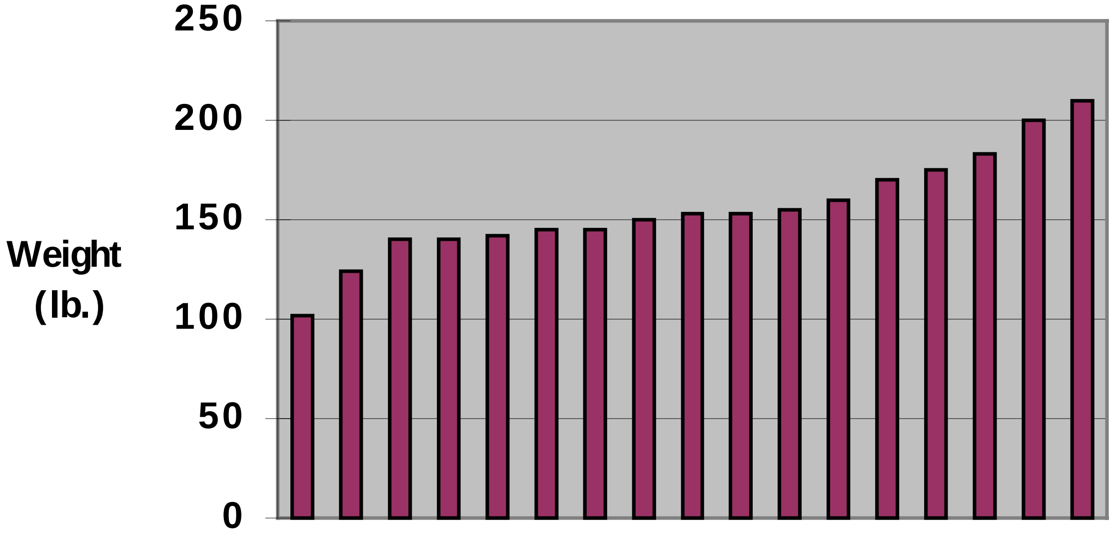


Figure 2.- - Frequencies of Demographic Data (Weight) of the 17 Study Participants

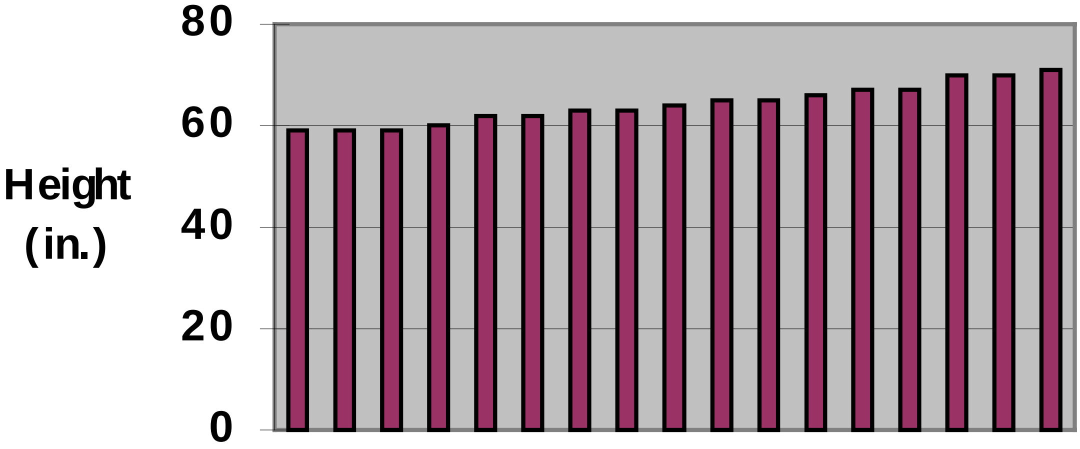


Figure 3.- - Frequencies of Demographic Data (Height) of the 17 Study Participants

Table 4. - - Frequencies of Demographic Data (Age) of the 17 Study Participants

	Frequency	Valid Percent
65-75 Years Old	5	29.4
76-86 Years Old	9	52.9
87 Years Old or Older	3	17.6
Total	17	100.0

Table 5. - -Frequencies of Factors That May Influence Nutrient Intake of Participants in the Congregate-Site Meal Program

	Frequency (n=17)	
	Yes	**No**
Has your weight changed in the last	3	14

year?		
Is your physical activity restricted in any way?	7	10
Do you live alone?	1 4	3
Do you follow any special diet?	7	10
Do you regularly skip meals?	2	15
If you have a chance would you like to recommend this nutrition meal program to your friends?	14	3

4.3 COMPARING MACRONUTRIEENT INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE PARTICIPATION DAY TO THE NON-PARTICIPATION DAY

The t test results of macronutrient intake and percentage of the Recommended Dietary Allowances for the 17 congregate meal program subjects on a participation day compared to the non-participation day are illustrated in Table 6-A. Calories

were significantly greater, 1543.9 versus 1132.6 ($p \leq 0.001$) for the participation and the non-participation day, respectively. Similarly caloric intake expressed as a percentage of the RDA was also significantly higher, 74.7% and 55.5% ($p \leq 0.001$). Protein, carbohydrate, and total fat on the participation day were significantly greater than the non-participation day expressed as grams as well as a percentage of the RDA. The percent RDA for the participation day versus the non-participation day for protein was (123.9% and 92.5%), for carbohydrate (64.1% and 48.6%), and for total fat (84.9% and 61.2 %), respectively. Saturated fatty acid intake was significantly higher, 21.6 g and 12.5 g, respectively, for the participation day versus the non-participation day ($p \leq 0.028$). When saturated fatty acid intake was expressed as a percentage of the RDA, there was a strong tendency for a significant difference ($p \leq 0.057$), 98.5% and 55.5%, respectively, for the participation day to be higher than the non-participation day. Monounsaturated fatty acid, polyunsaturated fatty acid as well as cholesterol were not significantly different when the participation day was compared to the non-participation day. Dietary fiber intake on the participation day was significantly higher ($p \leq 0.045$) compared to the non-participation day, 14.6 g and 10.4 g, respectively. However, there was only a tendency of significance ($p \leq 0.063$) between the two days when dietary fiber intake was expressed as a percentage of the recommended.

Table 6-A. - -t Test Results of Macronutrient Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Participation Day Compared to the Non-Participation Day

Nutrient	Mean	SD	T Valu e	Sig. (2-tailed)	% RD A	SD	T Valu e	Sig. (2-tailed)
Calories	*1543. 9 112.6	396. 7 302.	4.26 9	.001	74.7 55.5	22. 9 20.	3.960	.001

		5				5		
Protein (g)	68.8 50.7	23.5 16.3	3.39 7	.004	123. 9 92.5	44. 2 35. 0	3.461	.003
Carbohydrate (g)	194.4 145.2	66.9 56.5	2.68 4	.016	64.1 48.6	23. 0 22. 0	2.422	.028
Total Fat (g)	57.3 40.9	26.0 17.2	2.62 7	.018	84.9 61.2	49. 9 33. 6	2.236	.040
Saturated Fat (g)	21.6 12.5	15.8 6.2	2.41 4	.028	98.5 55.5	92. 4 33. 1	2.054	.057
Monounsatura Fat (g)	20.4 16.5	8.1 8.4	1.80 0	.091	90.4 74.4	46. 8 45. 8	1.536	.144
Polyunsaturat Fat (g)	10.8 8.1	4.9 4.4	1.68 1	.112	46.4 37.1	21. 1 25. 9	1.177	.256
Cholesterol (mg)	204.5 145.4	113. 6 74.3	1.98 8	.064	68.1 48.4	38. 0 24. 8	1.981	.065
Dietary Fiber (g)	14.6 10.4	6.8 5.7	2.17 8	.045	69.4 50.6	31. 9 33. 3	1.999	.063

* 1st row = participation day
2nd row = non-participation day

4.4 COMPARING VITAMIN INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE PARTICIPATION DAY TO THE NON-PARTICIPATION DAY

The t test results of vitamin intake and percentage of the RDA of the 17 congregate meal program subjects on a participation day compared to the non-participation day are presented in Table 6-B. Vitamin A, vitamin D, vitamin E, vitamin C, riboflavin, vitamin B-12 as well as folate showed no significant differences when the participation day was compared to the non-participation day. Thiamin intake was significantly higher, 1.5 mg and 1.1 mg, respectively, for the participation day versus the non-participation day ($p \leq 0.002$). Similarly, thiamin intake expressed as a percentage of the RDA was also significantly greater ($p \leq 0.002$), 136.7% and 97.5%, respectively. A significantly higher intake ($p \leq 0.021$) was also found for niacin on the participation day versus on a non-participation day (16.9 mg versus 13.0 mg, respectively). Niacin intake was also significantly higher ($p \leq 0.027$) when expressed as a percentage of the RDA, 118.0% and 91.5%, for the participation day and the non-participation day, respectively. Moreover, vitamin B-6 was significantly greater ($p \leq 0.017$) for the participation day versus the non-participation day (1.6 mg and 1.2 mg, respectively). Similarly, vitamin B-6 expressed as a percentage of the RDA, 92.1% and 65.9%, was also significantly higher ($p \leq 0.018$) on the participation day compared to the non-participation day. Pantothenic acid was not significantly different, 3.9 mg and 3.2 mg ($p \leq 0.381$), respectively, on the participation day versus the non-participation day. However, when pantothenic acid intake was expressed as a percentage of the RDA, intake was significantly higher ($p \leq 0.008$) on a participation day (55.5%) than on the non-participation day (38.1%).

Table 6-B. - - t Test Results of Vitamin Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Participation Day Compared to the Non-Participation Day

Nutrient	Mean	SD	T Value	Sig. (2tailed)	% RDA	SD	T Value	Sig. (2tailed)
Vitamin A (RE)	*1257.4 903.4	1399.2 1016.7	.819	.425	149.2 102.0	174.3 103.8	.948	.357
Vitamin D (mcg)	3.8 3.2	2.3 2.0	.982	.341	76.2 65.2	45.1 40.8	.998	.333
Vitamin E (mg)	5.5 3.9	5.5 2.3	1.433	.171	64.6 45.0	69.4 26.2	1.361	.192
Vitamin C (mg)	74.9 54.9	42.3 49.1	1.559	.139	125.0 91.4	70.8 81.9	1.564	.137
Thiamin-B1 (mg)	1.5 1.1	.6 .5	3.714	.002	136.7 97.5	50.5 43.5	3.637	.002
Riboflavin-B2 (mg)	1.6 1.3	.5 .5	2.09	.053	117.5 96.4	34.6 39.1	1.957	.068
Niacin (mg)	16.9 13.0	5.4 4.2	2.563	.021	118.0 91.5	35.6 30.0	2.441	.027
Vitamin B6 (mg)	1.6 1.2	.6 .6	2.651	.017	92.1 65.9	32.7 30.9	2.641	.018
Vitamin B12 (mcg)	2.7 2.8	1.4 1.6	-.133	.896	137.1 140.0	69.0 80.1	-.135	.894
Folate (mcg)	168.0 138.4	81.0 83.7	1.094	.290	89.4 73.6	40.5 42.1	1.129	.276
Pantothenic acid (mg)	3.9 3.2	1.3 2.5	.900	.381	55.5 38.1	19.1 15.7	3.041	.008

* 1st row = participation day

2nd row = non-participation day

4.5 COMPARING MINERAL INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE PARTICIPATION DAY TO THE NON-PARTICIPATION DAY

The t test results of mineral intake and percentage of the RDA for the 17 congregate meal program subjects on a participation day compared to the non-participation day are shown in Table 6-C. All minerals, except for zinc, showed significant differences in the mean intakes as well as percentages of the RDA when the participation day was compared to the non-participation day. For these minerals, the mean intake on the participation day was higher than the non-participation day. The mean calcium intake for the participation day was significantly higher ($p \leq 0.005$) than the non-participation day, 713.4 mg and 520.2 mg, respectively. Similarly, calcium intake expressed as a percentage of the RDA, 89.2% and 65.1%, was significantly greater ($p \leq 0.005$) on the participation day. Copper intake was significantly higher ($p \leq 0.008$), 1.1 mg and 0.8 mg, respectively, for the participation day versus the non-participation day. There was also a significant difference ($p \leq 0.007$) when copper intake was expressed as a percentage of the RDA, 43.4 % and 32.6 %, respectively. The mean iron intake for a participation day (10.3 mg) was significantly higher ($p \leq 0.023$) than the non-participation day (8.3 mg). When iron was expressed as a percentage of the RDA, 103.4% and 82.9%, respectively, there was also a similar significant difference ($p \leq 0.023$). Magnesium intake was also significantly greater ($p \leq 0.003$) when the participation day was compared to the non-participation day (245.4 mg and 181.5 mg, respectively). Similarly, magnesium intake expressed as a percentage of the RDA, 80.5% and 60.3%, was also significantly higher ($p \leq 0.004$) on the participation day. The mean intake of manganese for the participation day was significantly greater than the non-participation day ($p \leq 0.002$) with a mean intake of 2.6 mg and 1.7 mg, respectively. Manganese expressed as a percentage of the RDA (73.1% and 49.5%) was also significantly higher ($p \leq 0.002$) on the meal participation day than the non-participation day. The mean intakes of phosphorus for the participation day and the non-participation day were 1069.2 mg and 797.2 mg, respectively. The mean phosphorus intake for a participation day was significantly higher ($p \leq 0.001$). Similarly, phosphorus expressed as a percentage of the RDA, 133.7% and 99.7%, respectively, was also significantly greater ($p \leq 0.001$) for the participation day. The mean intakes of potassium (2576.4 mg, 1831.8 mg), selenium (79.3 mcg, 46.8 mcg) as well as sodium (2606.2 mg, 1768.0 mg) were significantly greater ($p \leq 0.003$, $p \leq 0.000$, $p \leq 0.002$, respectively) on the participation day compared to the non-participation day. When intake was expressed as a percentage of the RDA, potassium (68.6%, 48.9%), selenium (130.9%, 77.6%) and sodium (108.6%, 73.7%) were also significantly higher ($p \leq 0.003$, $p \leq 0.000$, $p \leq 0.002$) on the participation day. Zinc intake (8.9 mg and 6.8 mg) showed a strong tendency to be significantly higher ($p \leq 0.052$) when the participation day was compared to the non-participation day. When zinc intake was expressed as a percentage of the RDA (68.7% and 52.0%), a strong tendency for significance ($p \leq 0.064$) for higher intake on the participation day was also found.

Table 6-C. - - t Test Results of Mineral Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Participation Day Compared to the Non-Participation Day

Nutrient	Mean	SD	Value	Sig. (2tailed)	% RDA	SD	T Value	Sig. (2-tailed)
Calcium (mg)	*713.4 520.2	365.2 199.6	3.221	.005	89.2 65.1	45.7 24.8	3.213	.005
Copper (mg)	1.1 .8	.4 .4	3.050	.008	43.4 32.6	14.8 15.9	3.096	.007
Iron (mg)	10.3 8.3	3.2 2.4	2.512	.023	103.4 82.9	31.9 24.2	2.521	.023
Magnesium (mg)	245.4 181.5	85.3 62.8	3.514	.003	80.5 60.3	26.1 20.9	3.383	.004
Manganese (mg)	2.6 1.7	1.1 1.1	3.666	.002	73.1 49.5	32.2 30.3	3.653	.002
Phosphorus (mg)	1069.2 797.2	385.2 212.6	3.975	.001	133.7 99.7	48.2 26.5	3.953	.001
Potassium (mg)	2576.4 1831.8	870.3 725.7	3.549	.003	68.6 48.9	23.4 19.4	3.529	.003
Selenium (mcg)	79.3 46.8	30.9 23.4	4.574	.000	130.9 77.6	45.9 38.2	4.530	.000
Sodium (mg)	2606.2 1768.0	1085.8 634.7	3.724	.002	108.6 73.7	45.4 26.5	3.714	.002

Zinc (mg)	8.9 6.8	3.7 2.9	2.101	.052	68.7 52.0	28.4 21.9	1.989	.064

* 1st row = participation day
2nd row = non-participation day

4.6 .... COMPARING NUTRIENT INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE PARTICIPATION DAY TO THE FOOD FREQUENCY QUESTIONNAIRE

The t test results of nutrient intake and percentage of the RDA for the 17 congregate meal program subjects on a participation day compared to the food frequency questionnaire are presented in Table 7-A, 7-B and 7-C. Data showed no significant differences for calories, protein, carbohydrate, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated acids, cholesterol and dietary fiber when the intake on the participation day was compared to the intake calculated from the food frequency questionnaire. However, when protein was expressed as a percentage of the RDA, the intake on a participation day was significantly higher ($p \leq 0.045$) as compared to the calculated intake from the food frequency questionnaire (123.9% and 103.9 %, respectively) (Table 7-A).

The vitamins, which showed no significant differences when a participation day was compared to the calculated intake from the food frequency questionnaire include vitamin A, vitamin E, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, folate as well as pantothenic acid. However, vitamin D intake was significantly lower ($p \leq 0.016$) when the participation day was compared to the calculated intake form the food frequency questionnaire (3.8 mcg vs. 4.9 mcg). Similarly, vitamin D intake expressed as a percentage of the RDA was significantly lower ($p \leq 0.016$), 76.2% and 98.6%, respectively, for the participation day compared to the intake derived from the food frequency questionnaire. Intake of vitamin C was also significantly lower ($p \leq 0.007$) on the participation day versus the intake calculated from the food frequency questionnaire (74.9 mg vs.114.3 mg). A similar finding was found when vitamin C intake was expressed as a percentage of the RDA, 125.1% and 190.4%; the intake on the participation day was significantly lower ($p \leq 0.008$) than the intake from the food frequency questionnaire (Table 7-B).

Table 7-C showed that all minerals including calcium, copper, iron, magnesium, manganese, phosphorus, potassium, selenium, sodium, and zinc were not significantly different when the participation day was compared to the calculated intake from the food frequency questionnaire.

Table 7-A. - - t Test Results of Macronutrient Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Participation Day Compared to the Food Frequency Questionnaire

Nutrient	Mean	SD	T Value	Sig. (2-tailed)	%	SD	T Value	Sig. (2-tailed)
Calories	*1543.9 1422.5	396.8 283.5	1.203	.247	74.7 68.4	22.9 15.1	1.264	.225
Protein (g)	68.8 58.0	23.5 12.4	2.086	.053	123.9 103.9	44.2 22.5	2.179	.045
Carbohydrate (g)	194.4 202.4	66.9 45.1	-.548	.591	64.1 67.2	23.0 15.7	-.607	.552
Total Fat (g)	57.3 46.0	26.0 15.6	1.632	.122	84.9 66.7	49.9 24.7	1.535	.144
Saturated Fat (g)	21.6 16.9	15.8 6.8	1.26	.224	98.5 73.8	92.4	1.171	.259

			6			33. 9		
Monounsaturated Fat (g)	20.4 16.7	8.1 5.6	1.73 3	.102	90.4 72.5	46. 8 27. 0	1.664	.116
Polyunsaturated Fat (g)	10.8 8.8	4.9 4.0	1.20 7	.245	46.4 37.7	21. 1 15. 2	1.192	.251
Cholesterol (mg)	204.5 171.5	113. 6 66.0	1.21 8	.241	68.1 57.2	38. 0 22. 0	1.207	.245
Dietary Fiber (g)	14.6 15.4	6.8 4.5	- .507	.619	69.4 73.6	31. 9 19. 9	-.54	.592

* 1st row =participation day
2nd row =food frequency questionnaire

Table 7-B. - - t Test Results of Vitamin Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Participation Day Compared to the Food Frequency Questionnaire

Nutrient	**Mean**	**SD**	**T Value**	**Sig. (2-tailed)**	**% RDA**	**SD**	**T Value**	**Sig. (2-tailed)**
Vitamin A (RE)	*1257. 4 1284.9	1399. 2 398.9	-.074	.942	149. 2 149.	174. 3 50.7	-.006	.995

					5			
Vitamin D (mcg)	3.8 4.9	2.3 2.1	-2.702	.016	76.2 98.6	45.1 41.5	-2.688	.016
Vitamin E (mg)	5.5 4.7	5.5 1.4	.565	.580	65.2 54.5	69.3 18.4	.566	.579
Vitamin C (mg)	74.9 114.3	42.3 45.0	-3.063	.007	125.1 190.5	70.8 75.0	-3.043	.008
Thiamin-B1 (mg)	1.5 1.2	.6 .3	1.778	.094	137.1 114.5	50.2 28.9	1.716	.105
Riboflavin-B2 (mg)	1.6 1.6	.5 .4	-.380	.709	117.5 120.8	34.6 28.5	-.425	.677
Niacin (mg)	16.9 15.6	5.4 4.1	.766	.455	118.0 109.5	35.6 29.8	.674	.510
Vitamin B6 (mg)	1.6 1.8	.6 .7	-1.265	.224	92.1 103.6	32.7 40.0	-1.407	.179
Vitamin B12 (mcg)	2.7 3.2	1.4 .9	-1.678	.113	137.1 160.9	69.0 46.5	-1.675	.113
Folate (mcg)	168.0 194.4	81.0 63.9	-1.085	.294	89.4 103.8	40.5 32.7	-1.123	.278
Pantothenic acid (mg)	3.9 4.0	1.3 1.1	-.353	.729	55.5 57.5	19.1 16.0	-.356	.727

* 1st row =participation day
2nd row =food frequency questionnaire

Table 7-C. - - t Test Results of Mineral Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Participation Day Compared to the Food Frequency Questionnaire

Nutrient	Mean	SD	T Value	Sig. (2-tailed)	% RDA	SD	T Value	Sig. (2-tailed)
Calcium (mg)	*713.4 760.9	365.2 290.0	-.615	.547	89.2 95.1	45.7 36.3	-.610	.550
Copper (mg)	1.1 1.0	.4 .2	.366	.719	43.4 41.5	14.8 9.0	.381	.708
Iron (mg)	10.3 10.0	3.2 2.5	.363	.721	103.4 100.5	31.9 24.8	.356	.726
Magnesium (mg)	245.4 262.8	85.3 68.2	-.825	.422	80.5 86.8	26.1 23.4	-.915	.374
Manganese (mg)	2.6 2.1	1.1 .6	1.612	.127	73.1 60.2	32.2 15.8	1.589	.132
Phosphorus (mg)	1069.2 991.0	385.2 280.6	.962	.350	133.7 123.9	48.2 35.0	.961	.351
Potassium (mg)	2576.4 2751.8	870.3 798.7	-.795	.438	68.6 73.4	23.4 21.4	-.797	.437
Selenium (mcg)	79.3 65.7	30.9 14.9	1.755	.098	130.9 110.0	45.9 28.0	1.615	.126
Sodium (mg)	2606.2 2141.8	1085.8 560.2	1.813	.089	108.6 89.2	45.4 23.3	1.816	.088
Zinc (mg)	8.9 8.5	3.7 2.5	.518	.611	68.7 65.0	28.5 17.8	.532	.602

* 1st row =participation day
2nd row =food frequency questionnaire

4.7 COMPARING MACRONUTRIENT INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE NON-PARTICIPATION DAY TO THE FOOD FREQUENCY QUESTIONNAIRE

The t test results of macronutrient intake and percentage of the RDA for the 17 congregate meal program subjects on the non-participation day compared to the food frequency questionnaire are presented in the Table 8-A. Calories were significantly lower ($p \leq 0.005$), 1132.6 and 1422.5, respectively, for the non-participation day versus the calculated intake from the food frequency questionnaire. Similarly, caloric intake expressed as a percentage of the RDA was also significantly lower ($p \leq 0.004$), 55.5% and 68.4%, respectively, for the non-participation day compared to the food frequency data. Carbohydrate, saturated fatty acids and dietary fiber intakes were also significantly different when the non-participation day was compared to the food frequency questionnaire data. The mean intakes of carbohydrate for the non-participation day was significantly lower ($p \leq 0.001$) than that of the food frequency questionnaire, (145.2 g and 202.4 g, respectively). Carbohydrate expressed as a percentage of the RDA was also similarly lower ($p \leq 0.001$) on the non-participation day. Saturated fatty acid intake was significantly lower ($p \leq 0.007$) on the non-participation day compared to the calculated intake from the food frequency questionnaire, 12.5 g and 16.9 g, respectively. Dietary fiber was also significantly lower ($p \leq 0.007$) when the non-participation day was compared to the food frequency questionnaire data (10.4 g and 15.4 g, respectively). Dietary fiber intake expressed as a percentage of the recommended (50.6% vs.73.6%) was significantly lower ($p \leq 0.009$) on the non-participation day than the intake calculated from the food frequency questionnaire. However, protein, total fat, monounsaturated fatty acids, polyunsaturated fatty acids, and cholesterol showed no significant differences when the intake on the non-participation day was compared to the food frequency questionnaire data.

Table 8-A. - - t Test Results of Macronutrient Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Non-Participation Day Compared to the Food Frequency Questionnaire

Nutrient	Mean	SD	T Value	Sig. (2-ailed)	% RDA	SD	T Value	Sig. (2-ailed)
Calories	*1132.6 1422.5	302.5 283.5	-3.219	.005	55.5 68.4	20.5 15.1	-3.309	.004
Protein (g)	50.7 58.0	16.3 12.4	-1.535	.144	92.5 103.9	35.0 22.5	-1.448	.167
Carbohydrate (g)	145.2 202.4	56.5 45.1	-4.126	.001	48.6 67.2	22.0 15.7	-4.151	.001
Total Fat (g)	40.9 46.0	17.2 15.6	-.933	.365	61.2 66.7	33.6 24.7	-.722	.481
Saturated Fat (g)	12.5 16.9	6.2 6.8	-3.069	.007	55.5 73.8	33.2 33.9	-3.041	.008
Monounsaturated	16.5 16.7	8.4 5.6	-.077	.939	74.4 72.5	45.8	.165	.871

Fat (g)						27.0		
Polyunsaturated Fat (g)	8.1 8.8	4.4 4.0	-.381	.708	37.1 37.7	25.9 15.2	-.086	.933
Cholesterol (mg)	145.4 171.5	74.3 66.0	-1.270	.222	48.4 57.2	24.8 22.0	-1.272	.222
Dietary Fiber (g)	10.4 15.4	5.7 4.5	-3.113	.007	50.6 73.6	33.3 19.9	-2.953	.009

* 1st row =non-participation day
2nd row =food frequency questionnaire

4.8 COMPARING VITAMIN INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE NON-PARTICIPATION DAY TO THE FOOD FREQUENCY QUESTIONNAIRE

The t test results of vitamin intakes and percentages of the RDA for the 17 congregate meal program subjects on the non-participation day compared to the food frequency questionnaire are illustrated in Table 8-B. Vitamin D intake was significantly lower ($p \leq 0.014$), 3.3 mcg and 4.9 mcg, respectively, when the intake on the non-participation day was compared to the calculated intake from the food frequency questionnaire. Vitamin D intake expressed as a percentage of the RDA also was significantly lower ($p \leq 0.014$) when the non-participation day was compared to the food frequency questionnaire (65.5% vs. 98.6%). The mean intakes of vitamin C for the non-participation day and the calculated intake from the food frequency questionnaire were 54.8 mg and 114.3 mg, respectively, which made the non-participation day vitamin C intake significantly lower ($p \leq 0.000$) than the calculated intake from the food frequency questionnaire. Similarly, when vitamin C intake was expressed as a percentage of the

RDA, 91.4% and 190.5%, respectively, the percentage intake of vitamin C on the non-participation day was also significantly lower ($p \leq 0.000$). Riboflavin intake was significantly lower ($p \leq 0.031$) when the non-participation day was compared to the calculated intake from the food frequency questionnaire (1.3 mg and 1.6 mg, respectively). The mean intake of niacin on the non-participation day (13.0 mg) compared to the calculated intake from the food frequency questionnaire (15.6 mg) was significantly lower as well as niacin expressed as a percentage of the RDA (91.5% and 109.5 %, respectively). The mean intake of vitamin B-6 was significantly lower ($p \leq 0.006$) for the non-participation day compared to the calculated intake from the food frequency questionnaire (1.2 mg and 1.8 mg, respectively). Similarly, vitamin B-6 expressed as a percentage of the RDA was significantly lower ($p \leq 0.005$), 65.9% and 103%, respectively. The mean intakes of folate for the non-participation day and the calculated intake from the food frequency questionnaire were 138.2 mcg and 194.4 mcg, respectively, which also made the intake of folate on a non-participation day significantly lower ($p \leq 0.004$) than the food frequency questionnaire data.

However, vitamin A, vitamin E, thiamin as well as vitamin B-12 showed no significant differences in the means or percentages of the RDA when the non-participation day was compared to the calculated intake from the food frequency questionnaire. Pantothenic acid intake was not significantly different on the non-participation day compared to the food frequency questionnaire. Nevertheless, the non-participation day was significantly lower ($p \leq 0.000$) when this nutrient was expressed as a percentage of the RDA, 38.1% (the non-participation day) and 57.2 % (the food frequency questionnaire data).

Table 8-B. - - t Test Results of Vitamin Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Non-participation Day Compared to the Food Frequency Questionnaire

Nutrient	Mean	SD	T Value	Sig. (2tailed)	% RDA	SD	T Value	Sig. (2-tailed)
Vitamin A (RE)	*903.4 1284.9	1016.7 398.9	-1.505	.152	102.0 149.5	103.8 50.7	-1.706	.107
Vitamin D (mcg)	3.3 4.9	2.0 2.1	-2.749	.014	65.5 98.6	40.8 41.5	-2.747	.014

Vitamin E (mg)	3.9 4.7	2.3 1.4	- 1.182	.254	45.0 54.5	26.1 18.4	- 1.212	.243
Vitamin C (mg)	54.8 114.3	49.1 45.0	- 4.928	.000	91.4 190.5	81.9 75.0	- 4.924	.000
Thiamin-B1 (mg)	1.1 1.2	.5 .3	- 1.776	.095	97.5 114.5	43.5 28.9	- 1.763	.097
Riboflavin-B2 (mg)	1.3 1.6	.5 .4	- 2.362	.031	96.4 120.7	39.1 28.5	- 2.218	.041
Niacin (mg)	13.0 15.6	4.2 4.0	- 2.273	.037	91.5 109.5	30.0 29.8	- 2.286	.036
Vitamin B6 (mg)	1.2 1.8	.6 .7	- 3.138	.006	65.9 103.6	30.9 40.0	- 3.212	.005
Vitamin B12 (mcg)	2.8 3.2	1.6 .9	- 1.001	.322	140.0 160.9	80.1 46.5	- 1.002	.331
Folate (mcg)	138.2 194.4	83.7 63.9	- 3.386	.004	73.6 103.8	42.1 32.7	- 3.323	.004
Pantothenic acid (mg)	3.2 4.0	2.5 1.1	- 1.229	.237	38.1 57.2	15.7 16.0	- 4.379	.000

***** 1st row =non-participation day
2nd row =food frequency questionnaire

4.9 COMPARING MINERAL INTAKES AND PERCENTAGES OF THE RDA OF THE 17 CONGREGATE MEAL PROGRAM SUBJECTS ON THE NON-PARTICIPATION DAY TO THE FOOD FREQUENCY QUESTIONNAIRE

The t test results of mineral intakes and percentages of the RDA for the 17 congregate meal program subjects on a non-participation day compared to the food frequency questionnaire are shown in Table 8-C. The mean intake of calcium was significantly lower ($p \leq 0.004$) when the non-participation day was compared to the food frequency questionnaire data, 520.2 mg and 760.9 mg, respectively. Similarly, calcium expressed as a percentage of the RDA was also significantly lower ($p \leq 0.004$) on the non-participation day, 65.5% versus 95.1%. The mean intake of iron was significantly lower ($p \leq 0.036$) when the non-participation day and the calculated intake from the food frequency questionnaire were compared (8.3 mg and 10.0 mg, respectively). Iron expressed as a percentage of the RDA was also similarly lower ($p \leq 0.035$) on the non-participation day than the food frequency questionnaire data (82.9% versus 100.5%). The mean magnesium intake was significantly lower ($p \leq 0.002$) on the non-participation day versus the calculated intake from the food frequency questionnaire (181.5 mg vs. 262.8 mg). Magnesium expressed as a percentage of the RDA was also significantly lower ($p \leq 0.002$) on the non-participation day compared to the food frequency data, 60.3% and 86.8%, respectively. The mean intake of phosphorus for the non-participation day was significantly lower ($p \leq 0.01$) than the calculated intake from the food frequency questionnaire (797.2 mg and 991.0 mg, respectively). The mean potassium intakes (1831.8 mg and 2751.8 mg) and the percentage of the RDA (48.9% and 73.4%) were also significantly lower on the non-participation day compared to the calculated intake from the food frequency questionnaire ($p \leq 0.003$ and $p \leq 0.003$, respectively). Moreover, the mean intake of selenium was significantly lower, 46.8 mcg and 65.7 mcg, respectively, for the non-participation day compared to the food frequency questionnaire data ($p \leq 0.000$). Similarly, selenium intake expressed as a percentage of the RDA was also significantly lower ($p \leq 0.000$), 77.6% on the non-participation day versus 110.0% for the calculated intake from the food frequency questionnaire. However, the mean intakes of copper, manganese, sodium and zinc were not significantly different when the non-participation day was compared to the calculated intake from the food frequency questionnaire.

Table 8-C. - - t Test Results of Mineral Intake and Percentage of RDA of the 17 Congregate Meal Program Subjects on the Non-participation Day Compared to the Food Frequency Questionnaire

Nutrient	ean	SD	T Value	Sig. (2-tailed)	% RDA	SD	T Value	Sig. (2-tailed)
Calcium (mg)	*520.2 760.9	199.6 290.0	-3.419	.004	65.1 95.1	24.8 36.3	-3.413	.004

Copper (mg)	.8 1.0	.4 .2	-1.582	.133	32.6 41.5	15.9 9.0	-1.590	.132
Iron (mg)	8.3 10.0	2.4 2.5	-2.284	.036	82.9 100.5	24.2 24.8	-2.298	.035
Magnesium (mg)	181.5 262.8	62.8 68.2	-3.641	.002	60.3 86.8	20.9 23.4	-3.645	.002
Manganese (mg)	1.7 2.1	1.1 .6	-1.918	.073	49.5 60.2	30.3 15.8	-1.929	.072
Phosphorus (mg)	797.2 991.0	212.6 280.6	-2.906	.010	99.7 123.4	26.5 35.0	-2.918	.010
Potassium (mg)	1831.8 2751.8	725.7 798.7	-3.504	.003	48.9 73.4	19.4 21.4	-3.494	.003
Selenium (mcg)	46.8 65.7	23.4 14.9	-4.479	.000	77.6 110.0	38.2 28.0	-4.380	.000
Sodium (mg)	1768.0 2141.8	634.7 560.2	-1.891	.077	73.7 89.2	26.5 23.3	-1.887	.077
Zinc (mg)	6.8 8.5	2.9 2.5	-1.911	.074	52.0 65.0	21.9 17.8	-1.859	.082

* 1st row = non-participation day
2nd row =food frequency questionnaire

4.10 THE EFFECT OF GENDER DIFFERENCES ON NUTRIENT INTAKES AND PERCENTAGES OF THE RDA ON THE MEAL PROGRAM PARTICIPATION DAY

Analysis of variance of the effect of gender differences on nutrient intakes and percentages of the RDA on the meal program participation day are illustrated in Table 9-A, 9-B, and 9-C. Caloric intake and other macronutrients including protein, carbohydrate, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, and dietary fiber expressed by intake and by percentage of the RDA showed no significant differences by gender on the meal program participation day (Table 9-A).

However, males had significantly higher consumption of several vitamins compared to females on the meal program participation day (Table 9-B). The vitamins include vitamin D, thiamin, riboflavin, niacin, and vitamin B-12. The mean vitamin D intake for males was significantly higher ($p \leq 0.007$) than females; mean intakes were 5.7 mcg and 2.8 mcg, respectively. Similarly, vitamin D intake expressed as a percentage of the RDA was also significantly higher ($p \leq 0.007$), for males (113.5 %) than females (55.9 %). The mean thiamin intake was significantly higher ($p \leq 0.046$) for males than females with a mean intake of 1.9 mg and 1.3 mg, respectively. However, thiamin expressed as a percentage of the RDA was not significantly different by gender. Riboflavin intake was significantly higher ($p \leq 0.014$) for males, 2.0 mg versus 1.3 mg for females. On the other hand, when riboflavin intake was expressed as a percentage of the RDA, there was no significant difference by gender. Niacin intake for males was significantly higher than females, 20.3 mg and 15.0 mg, respectively, on the meal program participation day ($p \leq 0.048$). There was no significant difference when niacin was expressed as a percentage of the RDA. Vitamin B-12 intake showed a significant difference ($p \leq 0.010$) by gender on the meal program participation day. The mean intakes of vitamin B-12 for males and females were 3.8 mcg and 2.1 mcg, respectively. Similarly, vitamin B-12 intake expressed as a percentage of the RDA was also significantly higher for males than females with, 191.7% and 107.3% of the RDA, respectively ($p \leq 0.010$). Vitamin intakes, which didn't show significant differences by gender on the meal program participation day were vitamin A, vitamin E, vitamin C, vitamin B-6, folate and pantothenic acid (Table 9-B).

The results of analysis of variance of the effect of gender differences on mineral intake as well as mineral intake expressed as a percentage of the RDA on the meal program participation day are presented in Table 9-C. The mean calcium intake showed a strong tendency for significant difference ($p \leq 0.059$), 937.2 mg and 591.3 mg, respectively, when males and females were compared. Similarly, there was a strong tendency for a significant difference ($p \leq 0.06$) when calcium intake was expressed as a percentage of the RDA, 117.2% and 74.0%, respectively, for males and females. The mean phosphorus intake was significantly higher for males than females, 1323.5 mg and 930.5 mg, respectively ($p \leq 0.040$). Phosphorous intake for males and females expressed as a percentage of the RDA (165.5% and 116.4%) showed a significantly higher ($p \leq 0.04$) intake for the males. The mean intakes of potassium for males and females were 3174.0 mg and 2250.5 mg, respectively, which was significantly different by gender ($p \leq 0.031$). Similarly, potassium intake expressed as a percentage of the RDA, 84.7% and 59.9%, respectively, was significantly higher ($p \leq 0.032$) for males than females. However, several minerals including copper, iron, magnesium, manganese, selenium, sodium, and zinc didn't show any significant differences between males and females on a meal program participation day.

Table 9-A. - - Analysis of Variance of the Effect of Gender Differences on Macronutrient Intakes and Percentages of RDA on the Meal Program Participation Day

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.
Calories	Male Female	1677.2 1471.3	333.8 423.9	1.049	.322	69.1 77.6	15.1 26.4	.515	.484
Protein (g)	Male Female	83.4 60.8	29.1 16.3	4.315	.055	140.2 115.0	62.9 30.1	1.280	.276
Carbohydrate (g)	Male Female	207.0 187.5	51.1 75.6	.314	.584	58.3 67.2	13.8 26.8	.559	.466
Total Fat (g)	Male Female	59.2 56.2	22.4 28.8	.047	.831	73.2 91.4	28.8 58.6	.501	.490
Saturated Fat (g)	Male Female	21.2	9.9 18.7	.005	.945	79.2 109.0	39.2 112.0	.389	.542

		21.8							
Monounsaturated Fat (g)	Male Female	21.4 19.8	8.0 8.5	.151	.703	79.7 96.2	30.8 54.1	.467	.505
Polyunsaturated Fat (g)	Male Female	11.7 10.3	3.8 5.5	.310	.586	43.3 48.0	13.7 24.7	.181	.677
Cholesterol (mg)	Male Female	236.6 187.0	122.1 110.5	.728	.407	78.8 62.3	40.9 36.9	.726	.408
Dietary Fiber (g)	Male Female	16.2 13.7	6.4 7.2	.513	.485	66.7 70.9	25.9 35.9	.065	.803

Table 9-B. - - Analysis of Variance of the Effect of Gender Differences on Vitamin Intakes and Percentages of the RDA on the Meal Program Participation Day

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.
Vitamin A (RE)	Male Female	907.5 1448.3	772.5 1649.3	.564	.464	90.8 181.1	77.2 206.1	1.044	.323
Vitamin D (mcg)	Male Female	5.7 2.8	2.1 1.7	9.702	.007	113.5 55.9	41.3 33.4	9.824	.007
Vitamin E (mg)	Male Female	4.7 6.0	2.0 6.8	.187	.672	47.5 74.8	19.9 84.8	.588	.455
Vitamin C (mg)	Male Female	78.9	61.0 31.5	.078	.784	131.7	101.9	.076	.786

		72.7				121.5	52.9		
Thiamin – B1 (mg)	Male Female	1.9 1.3	.6 .4	4.752	.046	155.8 126.9	62.7 41.8	1.313	.270
Riboflavin-B2 (mg)	Male Female	2.0 1.3	.5 .4	7.649	.014	135.3 107.7	40.6 28.3	2.732	.119
Niacin (mg)	Male Female	20.3 15.0	4.5 5.0	4.618	.048	127.5 112.8	32.2 37.8	.644	.435
Vitamin B6 (mg)	Male Female	2.0 1.4	.8 .5	4.187	.059	100.8 87.4	38.1 30.3	.642	.435
Vitamin B12 (mcg)	Male Female	3.8 2.1	1.2 1.1	8.605	.010	191.7 107.3	62.3 53.9	8.566	.010
Folate (mcg)	Male Female	207.0 146.8	112.2 52.8	2.325	.148	103.5 81.7	56.0 29.4	1.133	.304
Pantothenic acid (mg)	Male Female	4.5 3.6	1.2 1.3	1.835	.196	63.8 51.0	17.1 19.3	1.848	.194

Table 9 C. - - Analysis of Variance of the Effect of Gender Differences on Mineral Intakes and Percentages of the RDA on the Meal Program Participation Day

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.
Calcium (mg)	Male Female	937.2	440.2 264.7	4.174	.059	117.2 74.0	54.9 33.	4.156	.060

		591.3					2		
Copper (mg)	Male Female	1.2 1.0	.3 .4	1.086	.31 4	48.3 40.6	13. 9 15. 1	1.05 9	.320
Iron (mg)	Male Female	12.1 9.4	2.7 3.1	3.151	.09 6	120.8 93.9	26. 7 31. 5	3.13 0	.097
Magnesium (mg)	Male Female	288.8 221.7	88.8 77.1	2.650	.12 4	82.7 79.3	25. 5 27. 6	.062	.807
Manganese (mg)	Male Female	2.8 2.4	1.4 1.0	.452	.51 2	80.5 69.1	39. 4 28. 8	.472	.502
Phosphorus (mg)	Male Female	1323. 5 930.5	435.4 287.6	5.066	.04 0	165.5 116.4	54. 6 36. 0	5.05 5	.040
Potassium (mg)	Male Female	3174. 0 2250. 4	974.9 636.8	5.640	.03 1	84.7 59.9	26. 0 17. 3	5.62 6	.032
Selenium (mcg)	Male Female	97.8 69.2	33.8 25.4	3.889	.06 7	139.8 126.1	48. 4 46. 1	.334	.572
Sodium (mg)	Male Female	3005. 5 2388. 5	795.3 1192. 6	1.275	.27 7	125.3 99.5	33. 1 49. 8	1.28 6	.275
Zinc (mg)	Male Female	9.6 8.4	4.0 3.7	.546	.47 1	65.7 70.4	26. 8 30. 6	.099	.757

4.11 THE EFFECT OF GENDER DIFFERNECES ON NUTRIENT INTAKES AND PERCENTAGES OF THE RDA ON THE NON-MEAL PROGRAM PARTICIPATION DAY

Analysis of variance of the effect of gender differences on nutrient intakes and percentages of the RDA on the non-meal program participation day are presented in Table 10-A, 10-B and 10-C. Caloric intake and other macronutrients including protein, carbohydrate, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, and dietary fiber expressed by intakes and percentages of the RDA showed no significant differences by gender on the non-meal program participation day (Table 10-A). Similarly, there were no significant gender differences for the vitamins analyzed which included vitamin A, vitamin D, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, folate, and pantothenic acid (Table 10-B). The mean intakes of calcium and sodium were the only two minerals, which showed significant differences in consumption pattern between males and females on the non-meal program participation day (Table 10-C). The mean intakes of calcium for males and females were 676.5 mg and 435.0 mg, respectively, thus there was a significantly higher calcium intake for males than females on the non-meal program participation day ($p \leq 0.031$). Similarly, calcium intake expressed as a percentage of the RDA was also significantly higher ($p \leq 0.012$) for males 84.5%, than females, 54.5%, on the non-meal program participation day. Sodium intake was significantly higher ($p \leq 0.027$) for males than females (2213.0 mg and 1525.3 mg respectively) on the non-meal program participation day. When sodium was expressed as a percentage of the RDA, there was also a significant difference ($p \leq 0.027$) with the males consuming more sodium (92.3%) than the females (63.5%).

Table 10-A. - - Analysis of Variance of the Effect of Gender Differences on Macronutrient Intakes and Percentages of the RDA on the Non-Meal Program Participation Day

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.
Calories	Male Female	1095.8 1152.7	257.5 334.7	.130	.724	45.0 61.2	8.9 23.1	2.664	.123
Protein (g)	Male Female	57.5 47.1	22.4 11.6	1.630	.221	94.5 91.5	39.3 34.4	.028	.870
Carbohydrate (g)	Male Female	139.7 148.2	41.2 65.0	.084	.776	39.2 53.7	10.3 25.3	1.782	.202
Total Fat (g)	Male Female	35.8	12.1 19.3	.801	.385	44.2 70.5	14.3 37.	2.632	.126

		43.6					9		
Saturated Fat (g)	Male	12.9	4.4	.038	.848	48.0	17.9	.454	.510
	Female	12.3	7.2			59.5	39.3		
Monounsaturated Fat (g)	Male	13.2	5.3	1.495	.240	48.7	17.4	3.348	.087
	Female	18.3	9.4			88.4	50.9		
Polyunsaturated Fat (g)	Male	6.8	3.4	.809	.383	25.2	11.8	2.114	.167
	Female	8.9	4.9			43.6	29.5		
Cholesterol (mg)	Male	142.0	81.6	.018	.895	47.2	27.1	.022	.884
	Female	147.2	74.1			49.1	24.8		
Dietary Fiber (g)	Male	9.2	4.4	.371	.552	36.8	14.6	1.647	.219
	Female	11.0	6.4			58.1	38.6		

Table 10-B. - - Analysis of Variance of the Effect of Gender Differences on Vitamin Intakes and Percentages of the RDA on the Non-Meal Program Participation Day

Nutrient	**Gender**	**Mean**	SD	**F Value**	**Sig.**	**%** RDA	SD	**F Value**	**Sig.**

Vitamin A (RE)	Male Female	1244.2 717.5	1619.2 485.2	1.044	.323	124.5 89.7	161.8 60.6	.420	.527
Vitamin D (mcg)	Male Female	4.1 2.8	1.2 2.3	1.735	.208	82.7 56.2	24.5 45.8	.380	.547
Vitamin E (mg)	Male Female	3.9 3.8	2.9 2.1	.009	.927	39.7 47.9	28.5 25.7	.124	.730
Vitamin C (mg)	Male Female	41.3 62.2	32.7 56.2	.690	.419	68.8 103.6	54.4 93.7	.167	.686
Thiamin – B1 (mg)	Male Female	1.3 .9	.3 .5	2.275	.152	106.5 92.6	29.2 50.2	.164	.691
Riboflavin-B2 (mg)	Male Female	1.5 1.2	.3 .6	1.727	.209	101.0 93.8	17.5 47.7	1.787	.201
Niacin (mg)	Male Female	14.2 12.4	3.7 4.5	.726	.408	87.3 93.7	17.3 35.7	.534	.476
Vitamin B6 (mg)	Male Female	1.4 1.0	.8 .4	1.725	.209	70.2 63.6	41.5 25.6	.058	.813
Vitamin B12 (mcg)	Male Female	3.5 2.4	1.9 1.4	1.770	.203	174.3 121.3	95.1 68.2	.687	.420
Folate (mcg)	Male Female	167.6 122.3	126.8 48.7	1.148	.301	83.8 68.0	63.4 26.9	1.706	.211
Pantothenic acid (mg)	Male Female	2.7 3.5	.7 3.1	.365	.555	39.3 37.4	9.2 18.7	.370	.552

Table 10-C. - - Analysis of Variance of the Effect of Gender Differences on Mineral Intakes and Percentages of the RDA on the Non-Meal Program Participation Day

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.
Calcium (mg)	Male Female	676.5 435.0	199.1 145.9	8.261	.012	84.5 54.5	24.8 18.2	8.185	.012
Copper (mg)	Male Female	.8 .8	.3 .4	.212	.652	30.2 33.9	13.3 17.7	.204	.658
Iron (mg)	Male Female	8.4 8.2	3.4 1.9	.025	.877	84.2 82.2	34.0 18.4	.025	.878
Magnesium (mg)	Male Female	186.3 178.9	81.1 54.8	.050	.827	53.3 64.1	23.3 19.6	1.029	.327
Manganese (mg)	Male Female	1.9 1.7	1.3 1.0	.116	.738	53.0 47.6	38.0 27.2	.115	.740
Phosphorus (mg)	Male Female	891.3 745.9	258.0 175.5	1.922	.186	111.5 93.3	32.3 21.8	1.942	.184
Potassium (mg)	Male Female	2056.8 1709.1	1067.3 475.6	.885	.362	55.0 45.5	28.5 12.7	.917	.353
Selenium	Male	54.7	24.6	1.055	.321	78.2	35.3	.002	.965

(mcg)	Female	42.5	22.7			77.3	41.2		
Sodium (mg)	Male Female	2213.0 1525.3	496.2 581.2	5.976	.027	92.3 63.5	20.7 24.2	.603 3	.027
Zinc (mg)	Male Female	7.8 6.2	2.8 2.9	1.092	.313	52 52	19.0 24.2	.000	1.000

4.12 THE EFFECT OF GENDER DIFFERENCES ON NUTRIENT INTAKES AND PERCENTAGES OF THE RDA AS MEASURED BY THE FOOD FREQUENCY QUESTIONNAIRE

Analysis of variance of the effect of gender differences on nutrient intakes as measured by the food frequency are shown in Table 11-A, 11-B and 11-C. Caloric intake and other macronutrients including protein, carbohydrate, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, and dietary fiber expressed by calculated intakes and percentages of the RDA from the food frequency questionnaire showed no significant differences by gender (Table 11-A). Similarly, there were no significant gender differences for minerals analyzed which included calcium, copper, iron, magnesium, manganese, phosphorus, potassium, selenium, sodium, and zinc (Table 11-C). Riboflavin and vitamin B-12 were the only two vitamins that showed significantly higher intakes for males (Table 11-B). The mean riboflavin intakes as measured by the food frequency questionnaire was significantly higher ($p \leq 0.048$) for males than females (1.9 mg and 1.4 mg, respectively). However, there was no significant difference between males and females when riboflavin intake was expressed as a percentage of the RDA. Males had a significantly higher ($p \leq 0.045$) vitamin B-12 intake than females (3.8 mcg and 2.0 mcg, respectively) when comparisons were made using a food frequency questionnaire. Similarly, there was a significant difference ($p \leq 0.045$) between gender when vitamin B-12 intake was expressed as a percentage of the RDA, 191.0% and 144.5%, respectively. Males had a greater calculated intake of vitamin B-12 than females based on the food frequency questionnaire.

Table 11-A. - -Analysis of Variance of the Effect of Gender Differences on Macronutrient Intakes and Percentages of the RDA as Measured by the Food Frequency Questionnaire

Nutrient	**Gender**	**Mean**	**SD**	**F Value**	**Sig.**	**% RDA**	**SD**	**F Value**	**Sig.**
Calories	Male Female	1515.8 1371.6	255.8 296.4	1.005	.332	62.7 71.5	12.5 16.0	1.341	.265
Protein (g)	Male Female	65.3 54.0	6.9 13.1	3.847	.069	108.5 101.4	21.4 23.7	.375	.549
Carbohydrate (g)	Male Female	204.0 2015	43.8 47.9	.011	.919	57.8 72.3	12.7 15.3	3.848	.069
Total Fat (g)	Male Female	52.4 42.5	18.1 13.6	1.621	.222	65.5 67.4	24.5 26.0	.021	.888
Saturated Fat (g)	Male Female	19.6 15.4	7.3 6.4	1.506	.239	73.8 73.8	31.8 36.5	.000	.999
Monounsaturated Fat (g)	Male Female	18.9 15.5	6.5 5.0	1.468	.244	70.7 73.5	26.4 28.5	.039	.846
Polyunsaturated Fat (g)	Male Female	9.9 8.1	6.0 2.4	.787	.389	36.8 38.2	21.2 11.9	.029	.867
Cholesterol (mg)	Male Female	193.3 159.7	88.9 50.8	1.011	.331	64.5 53.2	29.7 16.8	1.031	.326
Dietary Fiber	Male		6.0		.74	65.0	22.	1.844	.19

(g)	Female	15.9 15.1	3.8	.114	1	78.4	6 17.6		5

Table 11-B. - -Analysis of Variance of the Effect of Gender Differences on Vitamin Intakes and Percentages of the RDA as Measured by the Food Frequency Questionnaire

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.
Vitamin A (RE)	Male Female	1443.0 1198.6	209.5 457.6	1.503	.239	144.3 152.4	21.1 62.1	.092	.766
Vitamin D (mcg)	Male Female	6.2 4.3	1.2 2.2	3.731	.073	123.0 85.4	23.5 43.9	3.748	.072
Vitamin E (mg)	Male Female	4.5 4.8	1.1 1.6	.097	.760	45.3 59.5	11.3 19.9	2.515	.134
Vitamin C (mg)	Male Female	107.4 118.0	44.6 46.9	.205	.657	179.2 196.6	74.5 78.0	.200	.661

Thiamin –B1 (mg)	Male Female	1.3 1.2	.3 .3	.209	.654	105.8 119.2	19.7 32.8	.818	.380
Riboflavin-B2 (mg)	Male Female	1.9 1.4	.3 .4	4.613	.048	127.3 117.2	15.7 33.6	.478	.500
Niacin (mg)	Male Female	15.9 15.4	3.9 4.4	.070	.795	98.7 115.4	21.5 32.9	1.235	.284
Vitamin B6 (mg)	Male Female	2.0 1.7	.8 .7	.506	.488	98.2 106.6	39.4 42.0	.165	.691
Vitamin B12 (mcg)	Male Female	3.8 2.9	.6 .9	4.803	.045	191.0 144.5	32.2 45.8	4.798	.045
Folate (mcg)	Male Female	215.7 182.8	81.1 53.1	1.031	.326	107.7 101.6	40.7 29.5	.125	.729
Pantothenic (mg)	Male Female	4.4 3.8	.8 1.2	1.109	.309	63.0 54.5	11.8 17.6	1.095	.312

Table 11-C. - -Analysis of Variance of the Effect of Gender Differences on Mineral Intakes and Percentages of the RDA as Measured by the Food Frequency Questionnaire

Nutrient	Gender	Mean	SD	F Value	Sig.	% RDA	SD	F Value	Sig.

Calcium (mg)	Male Female	906.3 681.6	220.7 301.1	2.557	.131	113.3 85.2	27.7 37.6	2.565	.130
Copper (mg)	Male Female	1.0 1.0	.3 .2	.028	.869	42.2 41.1	10.8 8.5	.052	.823
Iron (mg)	Male Female	10.2 9.9	1.5 3.0	.047	.832	102.3 99.5	14.6 29.6	.046	.833
Magnesium (mg)	Male Female	277.7 254.6	65.7 71.3	.426	.524	79.3 90.9	18.8 25.4	.949	.345
Manganese (mg)	Male Female	2.0 2.2	.5 .6	.497	.492	56.5 62.3	14.9 16.7	.499	.491
Phosphorus (mg)	Male Female	1148.3 905.2	179.7 294.7	3.343	.087	143.5 113.3	22.5 36.7	3.325	.088
Potassium (mg)	Male Female	2813.3 2718.2	727.4 867.5	.052	.823	75.2 72.4	19.5 23.2	.063	.805
Selenium (mcg)	Male Female	67.8 64.6	10.2 17.3	.170	.686	96.7 117.3	14.7 31.4	2.260	.153
Sodium (mg)	Male Female	2427.5 1986.0	641.0 470.1	2.662	.124	101.2 82.6	26.5 19.5	2.731	.119
Zinc (mg)	Male Female	9.7 7.8	2.5 2.3	2.398	.142	64.8 65.1	16.8 19.2	.001	.978

4.13 THE EFFECT OF AGE DIFFERENCES ON NUTRIENT INTAKES AND PERCENTAGES OF THE RDA FOR THE MEAL PROGRAM PARTICIPATION DAY, THE NON-MEAL PROGRM PARTICIPATION DAY, AND THE FOOD FREQUENCY QUEATIONNAIRE

The results of the analysis of the meal program participation day, the non-meal program participation day, and the food frequency questionnaire showed no significant differences by age for calories and other nutrient intakes including: protein, carbohydrate, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated acids, cholesterol, dietary fiber, vitamin A, vitamin D, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, folate, pantothenic acid.

5. DISCUSSION AND CONCLUSION

A goal of the Elderly Nutrition Program is to ameliorate the participants' nutritional health (Carlin and Rhodes 1991). An important aspect of the program is to provide a nutritious meal in a congregate setting. The results from this study illustrated that nutrient intakes were better on the day individuals participated in the congregate-site meal program compared to the non-participation day. This data is contrary to the study by Neyman, Zidenberg-Cherr and McDonald (1996). They found that dietary intakes of participants did not differ significantly from those of nonparticipants, nor did the meal provided at the site significantly affect the overall dietary intake of participants. The present study showed that the percentage of the RDA and the mean intakes of energy and some macronutrients including protein, carbohydrate, total fat and saturated fatty acid were significantly higher on the meal program participation day compared to the non-participation day. The mean intake of saturated fat for males and females was over the recommended of 10% or less of total calories by 1% and 3%, respectively. The mean dietary fiber intake was significantly higher on the participation day compared to the non-participation day. However, there was only a tendency of significance when dietary fiber intake was expressed as a percentage of the recommended. The mean thiamin, vitamin B-6 and niacin intakes were significantly greater on a meal participation day compared to the non-participation day; similar results were found when these three vitamins were expressed as a percentage of the RDA. In addition, the percentage of the RDA and mean intakes of all minerals, except for zinc, were significantly higher when a participation day was compared to the non-participation day.

In contrast to the study of nutritional intake by Kohrs, O'Hanlon, and Eklund (1978), with 466 participants, our study included 17 participants. In the Kohrs et al study, food records were analyzed from a group who had participated in the congregate meal, from a group who sometimes participated, but not on the food record day and a group who seldom participated, who also consumed a meal elsewhere on the food record day. Nutrient intakes were compared according to meal participation or non-participation on the food record day. However, in our study the 24-hour food records were made for each subject on both the meal program participation day and the non-meal program participation day. Energy and 29 selective nutrients were evaluated in our study, whereas only energy and eight selective nutrients were analyzed in the Kohrs, O'Hanlon, and Eklund's study. Both studies came to the same conclusion that individuals eating at the meal site consumed more energy, protein, and calcium than non-meal program participants. Lower mean intakes of vitamin A and vitamin C were found for the meal participants compared to the non-meal participants on the food record day by Kohrs et al. In our study, the mean intakes of vitamin A and vitamin C were not significantly higher on the meal program participation day compared to the non-participation day; however, the mean intakes of vitamin A and vitamin C exceeded 100% of the RDA and DRI for the meal program participation day. Our study found a significantly higher intake of iron, which exceeded 100% of the RDA, when individuals consumed meals at the congregate sites. In contrast, in the Kohrs et al study, the meal program participants had a lower mean iron intake compared to the non-meal program participants.

A limited number of studies have shown that the nutrition meal program participants have higher nutrient intakes than the non-participants (Neyman, et al 1998; LeClere and Thornbury 1983; Kohrs, O'Hanlon, and Eklund 1978). Our study further illustrated that the nutritional intake of the meal participants was improved by the contribution of the nutrition meal program. Low energy intake associated with aging was widely reported in several studies (Kerstetter, Holthausen, and Fitz 1993; Ausman and Russell 1999). However, our results determined that aging was not a factor for reduced energy or nutrient intakes.

In the present study, the mean intake of energy for the congregate meal program participants was less than 100% of the recommended for both the meal program participation day (74.7% of RDA) and the non-participation day (55.5% of RDA). In spite of the low caloric intake, energy intake expressed as a percentage of the RDA was significantly improved by 19.2% when the subjects ate meals at the congregate site.

Protein intake is usually not a problem in healthy noninstitutionalized older people. The results from this study showed that protein intake was not only significantly greater on the meal program participation day than the non-participation day, but also was well above 100% of the RDA on the participation day. These results suggest that the elderly nutrition program provides a sufficient amount of protein for their participants.

Carbohydrate intake, on the other hand, was generally low (64.1% and 48.6% of the recommended, respectively) for both the meal program participation day and the non-participation day. However, there was a significant improvement of carbohydrate intake on the meal program participation day (194.4 g versus 145.2 g, respectively).

The mean intake of total fat was higher on a program participation day than the non-participation day, and exceeded the recommendation of 30% of calories from fat by

3%. The mean cholesterol intake was also greater on a meal participation day; however, the mean intake of dietary cholesterol, 204.5 mg, was below the recommended 300 mg/day (National Research Council 1992).

The mean dietary fiber intake of the elderly participants was improved on the meal program participation day, but the mean intake of dietary fiber (14.6 g) was still below the recommendation of 25 g/day (Marlett and Slavin 1997). This finding was similar to Gilbride's (1998) study, which found that the mean dietary fiber (13.0 g) for the congregate-site meal program participants was also lower than the current recommendation.

The mean intake of vitamin D was not significantly higher on the meal program participation day compared to the non-participation day. However, the mean intake of vitamin D for the meal program participation day was below the 1989 RDA of 5 μg by 24% (National Research Council 1989) and lower than the DRI of 10 μg by 62% (Whitney and Rolfes 1999). The insufficient vitamin D intake by the elderly subjects has also been reported by Kinyamu et al (1997). The elderly population is at risk of vitamin D deficiency because of the low dietary vitamin D intake, insufficient exposure to sunlight, a reduced ability of the skin to synthesize cholecalciferol, and decreased calcitriol synthesis by the aging kidney (Kinyamu et al 1997). Vitamin D is important in calcium balance, and plays an essential role in bone health (Bartlett et al 1998); therefore, vitamin D intake in the elderly deserves special attention in meal planning for congregate sites.

The mean vitamin E intake was higher on the meal program participation day compared to the non-participation day, although there was no statistical difference. The mean vitamin E intake of elderly participants (5.5 mg) was lower than the RDA and the DRI of 10 mg α-TE for males and 8 mg α-TE for females on the meal program participation day. The lower vitamin E intake has also been reported in the Ahmed (1992) study, which found that 40% of the elderly surveyed obtained below three fourths of the RDA. The antioxidant property of vitamin E protects lipids from peroxidation and may prevent cardiovascular diseases and cancer. Vegetable oils, such as soybean, corn, cottonseed, sunflower, and wheat germ oil, are high in vitamin E.

The prevalence of low thiamin intakes has been found in the elderly population (Russell and Suter 1993). Ahmed (1992) reported that up to 47% of the US elderly have thiamin intakes below two thirds of the RDA, which might be secondary to social factors or chronic illness. However, our study found that the mean thiamin intake of the congregate meal program participants (1.5 mg) exceeded the RDA and DRI of 1.2 mg for males and 1.0 mg for females on the meal program participation day. In contrast, the mean thiamin intake of men on the non-participation day did not meet the DRI, although the mean intake of thiamin met the DRI for females. Also, the mean thiamin intake was significantly higher on the meal program participation day (1.5 mg) compared to the non-participation day (1.1 mg).

Riboflavin status in the elderly is a controversial issue. Russell (1997) reported that 20% to 27% of older persons in America and European countries do not meet the 1989 RDA. A deficit of this vitamin may be correlated with income status (Ahmed 1992). Because the estimated dietary intake of riboflavin appears to vary widely from study to study, Madigan et al (1998) concluded that, with the exception of a few studies reporting low dietary intakes, intake of riboflavin appears to be satisfactory for free-living elderly people, which was confirmed by our findings. The present study showed that the mean intake of riboflavin by the elderly participants was above the DRI (1.3 mg for males and 1.1 mg for females). This finding was true of the daily nutrient intake when one meal was consumed at the congregate-site (1.6 mg on the meal participation day) as well as the nutrient intake on a non-participation day (1.3 mg). However, there was no significant difference in the mean riboflavin intake between the two days.

The mean niacin intake was significantly higher for the elderly participants on the meal program participation day (16.9 mg) compared to the non-participation day (13.0 mg). The mean intake of niacin on a meal program participation day exceeded the 1989 RDA of 15 mg and met the new DRI recommendation of 16 mg.

Similarly, the mean vitamin B-6 intake of the elderly participants was significantly higher on the meal program participation day compared to the non-participation day. When this vitamin was analyzed by gender, the mean intake of vitamin B-6 of the male participants (2.0 mg) adequately met the 1989 RDA of 2.0 mg and exceeded the 1998 DRI of 1.7 mg on the meal program participation day. However, the mean intake of this vitamin (1.4 mg) for the female participants was slightly below the RDA of 1.6 mg and DRI of 1.5 mg. Several studies have also reported that vitamin B-6 intakes of elderly subjects have been generally below the RDA (Neyman et al. 1998; Hoogenboom, Spangler, and Crose 1998). In a survey conducted in Boston, 56% of free-living males and females had a dietary intake of vitamin B-6 below two-thirds of the RDA; however, only 5.0% had abnormally high aspartate aminotransferase activity coefficients (ASTAC) (Russell and Suter 1993). Foods that are good sources of vitamin B-6 include organ meats, dairy products, oysters, green leafy vegetables, especially spinach and beet greens, and mushrooms. In the average American diet, about 50% of vitamin B-6 is obtained from dairy products, 25% from meat, and 25% from vegetables (Whitney, Cataldo, and Rolfes 1994).

The mean vitamin B-12 intakes for the elderly participants from both the meal program participation day (2.7 mcg) and the non-participation day (2.8 mcg) exceeded the 1989 RDA of 2.0 mcg and the new DRI of 2.4 mcg. Vitamin B-12 intake tended to be slightly lower, but not significantly so, on the meal program participation day when compared to the non-participation day. The male participants consumed a generally higher amount of vitamin B-12 than the female participants; however, males consumed significantly more vitamin B-12 than females only on the meal program participation day. Other research has shown that 10% to 30% of people aged 51 and older may have protein-bound vitamin B-12 malabsorption because of inadequate pepsin activity and gastric acid production, which suggests that supplementing synthetic vitamin B-12 may correct the protein-bound vitamin B-12 malabsorption. Dietetic and health care professionals should be aware of the prevalence of vitamin B-12 deficiency in the elderly population (Ho, Kauwell, and Bailey 1999).

Our study showed that the mean intake of folate was higher on the meal program participation day (168.0 mcg) than on the non-participation day (138.4 mcg), even though there was no significant difference. However, it should be noted that the mean intake of folate (168 mcg) for the meal program participants was 16% lower than the 1989 RDA of 200 μg and 58% lower than the DRI of 400 μg. Russell and Suter (1993) mentioned that poor folate status can result in higher plasma homocysteine concentrations which are consistently elevated among patients with all types of vascular diseases.

In the present study, the mean intake of calcium for the elderly participants was significantly greater on a meal program participation day than on a non-participation day. However, the mean calcium intake (713 mg) on the meal program participation day was below the 1989 RDA of 800 mg and the new DRI of 1,200 mg. In the NHANES I and II studies, average calcium intakes for women were about 500 mg/day. The NHANES III preliminary data showed a slight improvement in calcium in the older age group, but median intake of this mineral was still below the 1989 RDA of 800 mg/day. In humans, there is an age-related decrease in calcium absorption and an impaired ability to increase calcium absorption efficiency when a low-calcium diet is consumed. Milk and milk-based products supply about one-half of the dietary calcium intake of the elderly population. Adequate calcium intake is needed to prevent bone mass loss in elderly people (J-Wood, Suter, and Russell 1995).

The mean copper intake was significantly higher on the meal program participation day than on the non-participation day. However, the mean copper intake (1.1 mg) from the meal program participation day was lower than the ESADDI of 1.5 to 3.0 mg/day (National Research Council 1989). Food sources that are high in copper include beef liver, shrimp, peanuts, pecans and raisins. These foods can be used when the congregate meals and desserts are prepared.

Our study found that the mean magnesium intake of the elderly participants (245.4 mg) was lower than the RDA (350 mg for males and 280 mg for females) and DRI (420 mg for males and 320 mg for females). J-Wood, Suter, and Russell (1995) also indicated that elderly men and elderly women consume about two-thirds of the RDA for magnesium. Our study showed that the mean daily intake of magnesium of the elderly participants was improved on the meal program participation day (80.5% of the RDA) compared to the non-participation day (60.3% of the RDA).

Our study found that the mean manganese intake of the elderly on the meal program participation day was 2.6 mg. This result was similar to the mean of manganese consumed (2.64 mg) in the Total Diet Study, which was conducted in the United States between 1982 and 1989 (Pennington and Young 1991). Our results also showed that the mean manganese intake was significantly higher on the meal program participation day (2.6 mg) than on the non-participation day (1.7 mg).

In our study, the mean phosphorus intake (1069.2 mg) was above the 1989 RDA (800 mg for males and females) and the new DRI (700 mg for males and females). In the Total Diet Study (Pennington and Young 1991), the amount of phosphorus consumed (1,243 mg for men and 880 mg for women) was very similar to our findings; these phosphorus intakes were considered adequate for older adults.

Our study showed that the mean selenium intake (79.3 mcg) of the elderly participants on the meal program participation day was lower than that reported by Schlenker (1993). Schlenker maintained that the average adult consumes approximately 108 µg selenium per day from a typical American diet. The mean selenium intake from the meal participation day was not this high but did exceed the 1989 RDA and 1998 DRI of 70 µg for males and 55 µg for females.

The mean potassium intake found by our study was significantly greater on the meal program participation day compared to the non-participation day. The mean potassium intake from the meal program participation day was 2,576 mg, which was similar to the 2,560 mg intake per day reported for men ages 59 to 69 in the NHANES II study (Schlenker 1993).

The mean sodium intake of the elderly participants was higher on a meal program participation day than on a non-participation day. To compensate for wide variations in physical activity and sodium losses through sweating, the National Research Council (1989) has recommended an intake of 500 mg/day. The mean sodium intakes of the elderly subjects from both the meal program participation day (2606 mg) and the non-participation day (1768 mg) exceeded the estimated 500 mg minimum requirement.

Our study found that the mean zinc intake of the elderly participants was greater on the meal program participation day than on the non-participation day, although, there was no significant difference. However, the mean zinc intakes for both the meal program participation day (8.9 mg) and the non-participation day (6.8 mg) were considerably lower than the 1989 RDA and new DRI of 15 mg for males and of 12 mg for females. Since zinc intake is related to energy intake, the lower caloric consumption on both the meal participation and the non-meal participation days might be a contributing factor for the lower zinc intake of these elderly. Greger and Sciscoe (1977) indicated that low zinc intakes were prevalent among the elderly population, and 59 % of their elderly subjects consumed less than two-thirds of the recommended allowance for zinc. Marginal zinc deficiency occurs in older persons consuming less than 10 mg/day and can result in impaired wound healing and immunity, as well as loss of taste and smell acuity (Kerstetter, Holthausen, and Fitz 1993).

A comparison of the nutrient intakes and percentages of the RDA for the 17 congregate meal program subjects on a participation day to the calculated intake from the food frequency questionnaire indicated only mean protein, vitamin D, and vitamin C intakes were significantly different. Thus, the food intake calculated from the food frequency questionnaire and the food record of the participation day were very similar. However, when the non-participation day was compared to the calculated intake from the food frequency questionnaire, there were many significant differences which included calories, carbohydrate, saturated fat, dietary fiber, vitamin D, vitamin C, riboflavin, niacin, vitamin B-6, folate, pantothenic acid, calcium, iron, magnesium, phosphorus, potassium, and selenium. Thus, the intakes calculated from the food frequency questionnaire and that from the food record of a non-participation day were very dissimilar. Therefore, the food frequency data tends to mimic intake at the congregate-meal site more than the non-participation day. This suggests food served at the congregate site appeared to strongly influence the participants perceived intake across time. The similarity of the data may also indicate a bias of the food frequency questionnaire to foods served at the congregate-meal site. This is a methodology issue that may need to be addressed in future studies of elderly participation in meal programs.

The analysis of variance of the effect of gender differences on nutrient intakes on the meal program participation day showed that females consumed more vitamin A, vitamin E and saturated fatty acids than the male participants (13% versus 11% of total calories), although there were no significant differences. Male participants had a significantly higher consumption of vitamin D, thiamin, riboflavin, niacin, vitamin B-12, phosphorus, and potassium than the female participants on the meal program participation day. However, on the non-meal program participation day, the mean intakes of calcium and sodium were significantly higher for the males. The results suggest that the male meal program participants may benefit to some extent more so than females from the congregate-site meal program by enhancing their overall energy and nutrient intakes especially, vitamin D, thiamin, riboflavin, niacin, vitamin B-12, phosphorus, and potassium as well as decreasing their sodium intake.

Congregate meals served in the senior centers and other sites are an important source of nutrients for many older adults. In addition, these meals provide an opportunity for socialization (Moran and Reed 1993). Similarly, in our study, 82% of the study subjects considered that participation in the nutrition program adequately meets their foods needs; and they would recommend this nutrition meal program to their friends. Only a few study subjects commented on the food. One comment was that the B.B.Q ribs, were “too greasy”. Otherwise, the elderly generally stated that what they enjoyed most about this nutrition meal program was the vegetables served, balanced meals, choices of milk, delicious foods served, socialization with others, and the convenience for obtaining food.

In conclusion, the Dunn County Elderly Nutrition Program contributes significantly to the nutritional intake of the congregate meal program participants. Individuals participating in the meal program consumed more energy and some macronutrients which include protein, carbohydrate, total fat, saturated fat and dietary fiber. The mean vitamin intakes, which were significantly higher on the meal program participation day compared to the non-participation day were thiamin, niacin, vitamin B-6. With the exception of zinc, the mean intakes of all minerals which included calcium, copper, iron, magnesium, manganese, phosphorus, selenium, and sodium were significantly higher on the meal program participation day than the non-participation day. These results suggest that the Dunn County Elderly Nutrition Meal Program contributes to the mineral intakes of the elderly participants to a greater extent than to the mean vitamin intakes. Male participants may benefit more so than females because of the contribution of the meal program to their overall energy and nutrient intakes especially, vitamin D, thiamin, riboflavin, niacin, vitamin B-12, phosphorus, and potasium.

However, the mean intake of calcium, vitamin D and folate of the elderly participants on the meal program participation day was found to be substantially below the RDA and DRI. It may not be cost effective for the nutrition program to supply more than one-third of the RDA to their participants. If they chose to do so, food sources high in calcium such as calcium fortified juice, sardines, yogurt or low fat cheese could be provided to the elderly participants. To increase vitamin D intakes, some cereals fortified with vitamin D could be used as a topping in the dessert preparation. Also some fatty fishes such as herring and tuna, which are also good sources of vitamin D, could be served in the meal program. Food sources that might be utilized to increase folate intake include beef and chicken liver, asparagus, brussels sprouts, broccoli, cauliflower, and spinach. The lower intake of some nutrients such as vitamin D, folate, calcium, copper, and zinc illustrate the reliance of participants on the meal program for their nutritional intakes. Therefore, nutrition education to foster consumption of additional nutrient dense foods such as those listed above at home could improve their nutritional status. Our results indicated that the Dunn County Elderly Nutrition Program is definitely enhancing the nutritional intakes of the participants.

APPENDIX-A
1989 RECOMMENDED DIETARY ALLOWANCES AND 1989 DIETARY REFERENCE INTAKE FOR PERSONS AGED 51+

1989 Recommended Dietary Allowances and 1998 Dietary Reference Intake for the Person Aged 51+

	RDA	DRI	RDA	DRI
Energy (Kcal)	2300 *		1900 *	
Protein (g)	63		50	
Vitamin A(µg-RE)	1,000	1,000	800	800
Vitamin D (µg)	5	10[a]	5	10[a]
Vitamin E (mg-α-TE)	10	10	8	8
Vitamin C (mg)	60	60	60	60
Thiamin (mg)	1.2	1.2	1.0	1.1
Riboflavin (mg)	1.4	1.3	1.2	1.1
Niacin (mg-NE)	15	16	13	14
Vitamin B-6 (mg)	2.0	1.7	1.6	1.5
Folate (µg)	200	400	180	400
Vitamin B-12 (µg)	2.0	2.4	2.0	2.4
Calcium (mg)	800	1,200	800	1,200
Phosphorus (mg)	800	700	800	700
Magnesium **(mg)**	350	420	280	320
Iron (mg)	10	10	10	10
Zinc (mg)	15	15	12	12
Selenium (µg)	70	70	55	55

***** The recommended energy intake of 2300 Kcal is for the reference 77 kg elderly male and of 1900 Kcal is for the reference 65 kg elderly female

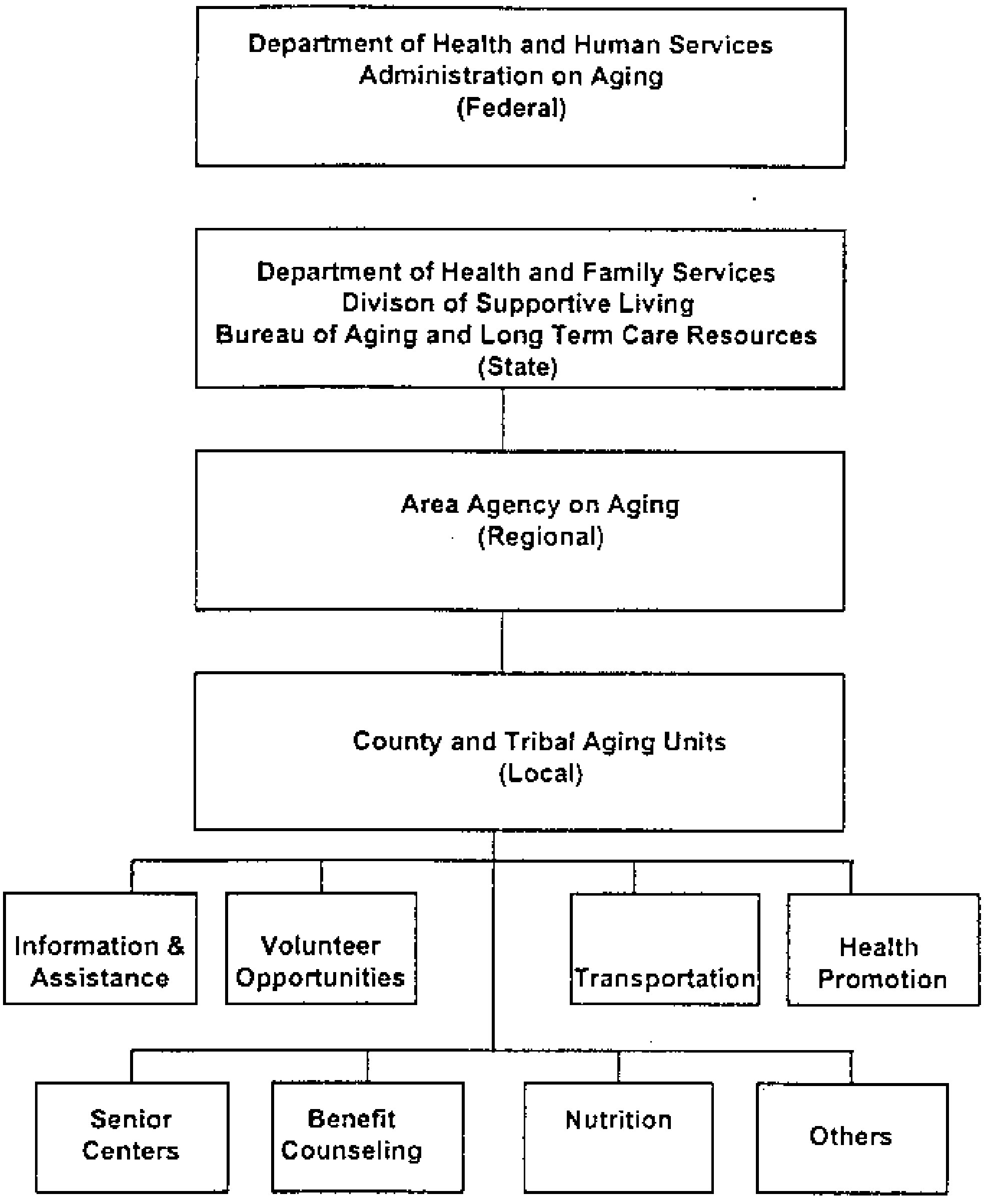
[a] Adequate intake

National Research Council. 1989. Recommended Dietary Allowances. Washington, D.C: National Academe Press.

Whitney, E. and S. Rolfes. 1999. Understanding Nutrition. Belmont, CA: West/ Wadworth.

APPENDIX-B
THE AGING NETWORK

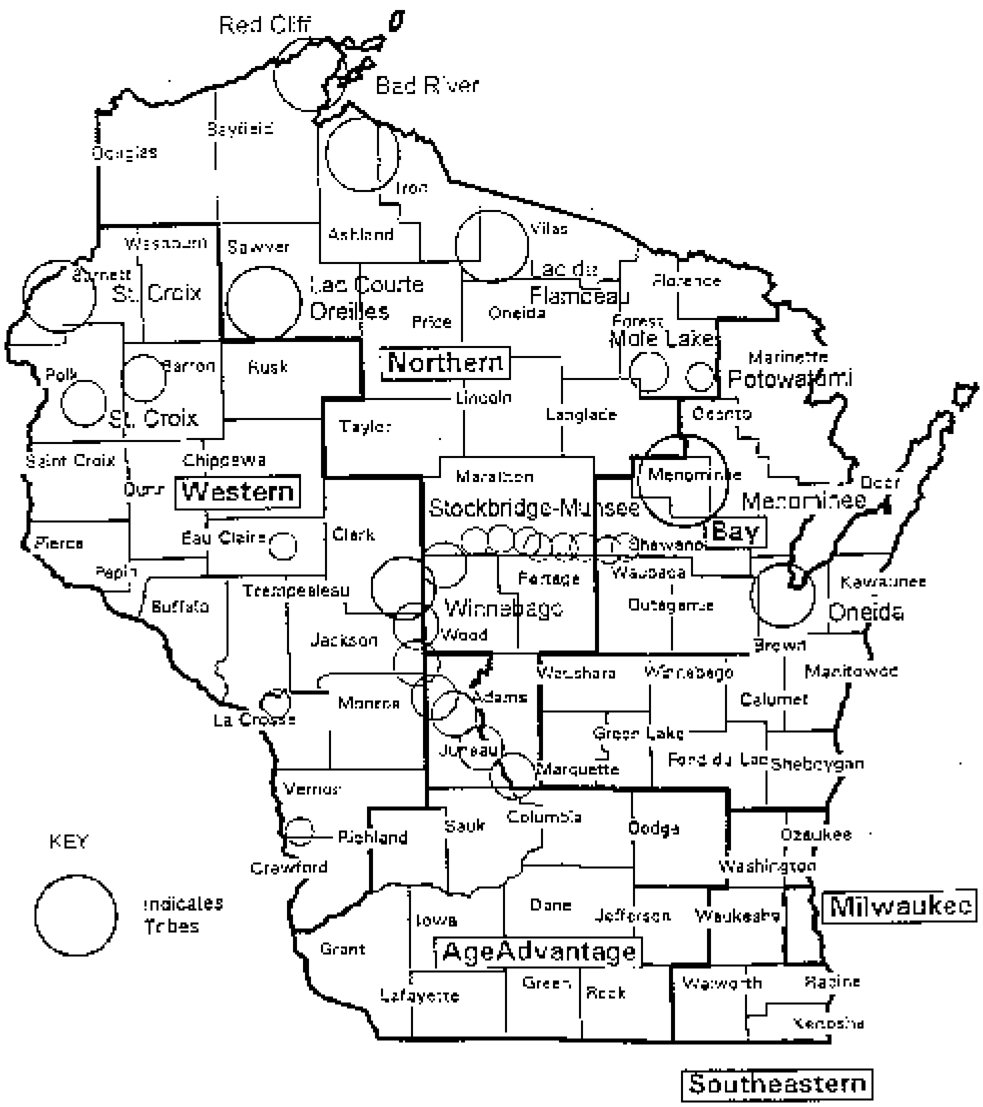
The Aging Network



Wisconsin Two-Year State Plan on Aging. 1997. Bureau of Aging and Long Term Care Resources division of Supportive Living Department of Health and Family Services.

APPENDIX-C
WISCONSIN AREA AGENCY ON AGING PLANNING AND SERVICE AREAS

Wisconsin Area Agency on Aging
Planning and Service Areas



Wisconsin Two-Year State Plan on Aging. 1997. Bureau of Aging and Long Term Care Resources division of Supportive Living Department of Health and Family Services.

APPENDIX-D

NUTRITION CHECK

✓ *Nutrition Check* *Take a moment to check your eating habits*

Your name______________________________ Date_______________

To find out your Nutrition Score, check (✓) YES or NO for the questions below.
Add up the numbers checked in the YES column for your total.

	✓ YES	✓ NO
Are you unable to eat the kinds and amount of food you would like, because of an illness or health condition?	2	0
Do you eat less than 2 meals a day?	3	0
Do you have less than 5 servings of fruits, vegetables or juice a day?	1	0
Do you eat or drink less than 2 servings of milk or dairy products a day?	1	0
Do you have more than 2 servings of beer, wine or liquor a day?	2	0
Do you have tooth, denture or mouth problems that make it hard to eat?	2	0
Do you ever run out of money for food?	4	0
Do you frequently eat alone?	1	0
Do you take more than 2 different prescribed or over-the-counter drugs a day?	1	0
Have you lost 10 or more pounds in the last 6 months without wanting to?	2	0
Have you gained 10 or more pounds in the last 6 months without wanting to?	2	0
Are you physically unable to shop for food, cook or feed yourself?	2	0
Total Your Nutrition Score:		

Your Nutrition Score suggests whether you may or may not be at nutritional risk.

Nutritional Risk means that you need to pay close attention to your eating habits.

If your Nutrition Score is:

0 - 2 — You are at **low nutritional risk**. Check your nutrition score again in 6 months.

3 - 5 — You may be at **moderate nutritional risk**. You may need to make some changes in your eating habits. For help, contact your county Office on Aging or Health Department. Check your nutrition score again in 4 months.

6 or more — You may be at **high nutritional risk**. Discuss your eating habits with your doctor, dietitian or other health professional. Check your nutrition score again in 2 months.

APPENDIX-E
INVITATION/ INFORMED CONSENT FORM

Invitation

Jou-Chia Lin, a graduate student in the Department of Food and Nutrition, College of Human Development, University of Wisconsin-Stout, under the advisement of Carol Seaborn, Ph.D., RD, is investigating the nutritional contribution of the elderly nutritional meal program. We would like to invite you to participate in our study.

The purpose of this study is to determine the nutritional intake of participants in the nutritional meal program. If you choose to participate in this study you will be interviewed about your food intake for two sessions and each will be approximately 30 minutes. We hope that you can arrive 30 minutes early or stay 30 minutes after the meal for this interview.

Your participation in this project is completely voluntary and you may discontinue at any time. You will not lose any rights. Confidentiality will be maintained by using a code number rather than your name on all forms.

You may direct any questions to and request the study results from Jou-Chia Jo Lin, Department of Food and Nutrition, UW-Stout, Menomonie, WI, 715-232-9664, Carol Seaborn, Ph.D., Department of Food and Nutrition, WI, 715-232-2216 or Ted Knous, Ph. D., Chair of the Committee for the Protection of Human Subjects, UW-Stout, Menomonie, WI 54751, 715-232-1126.

By agreeing to be interviewed, you are giving your informed consent to participate in this study and that you verify that you have read the above description. You understand the purpose and methods, and are aware of your right for confidentiality and voluntary participation.

Thank You For Your Participation

APPENDIX-F
INTERVIEW QUESTIONS

Interview Questions

Code # ________________________

1. Gender:
   ____ Male
   ____ Female

2. Age: ______Years Old

3. Current Weight: ____ lb.; Current Height: ____ in.

4. Has your weight changed in the last year? Yes ___ No ___
Approximate number of pounds gained ___
Approximate number of pounds lost ___
Explanation for weight change, if known ______________________________

5. Is your physical activity restricted in any way? Yes ___ No ___
If yes, type of restriction ____
Does this interfere with food preparation? Yes ___ No ___
Does this interfere with food shopping? Yes ___ No ___

6. What reasons you did not participate in the meal program yesterday?
___ Family or friends visiting
___ Doctor visit
___ Illness
___ Bad weather
___ Lack of transportation
___ No meal serviced during the weekend
___ Others (please specify) _______________________________________

7. Do you live alone?
___ Yes, skip to question # 9 ___ No

8. If you ***do not*** live alone, with whom do you live?

___ Spouse	___Children
___Grandchildren	___Parents
___Brother / Sister	___Friend

___Other (please specify)____

9. Who does usually prepare the meal?

___ Myself	___ Wife /Husband
___ Children /Grandchildren	___ Parents
___ Brother /Sister	___ Friend
___ Care Giver	Other (please specify) _________________

10. Please check all equipment that you have at home:

___ Refrigerator	___ Stove
___ Microwave	___ Oven
___ Easy Can Opener	

11. Who does grocery shopping?

___ Myself	___ Other family members
___ Paid worker	___ Neighbor

___ Others (please specify)____

12. Do you follow any special diet? Yes ___ No ___

13. What is your biggest problem regarding food and meal?
____

14. Do you regularly skip meals? Yes ___ No ___
If yes, about how many meals per week do you skip? ___________________
Why do you usually skip meals?
___ No appetite due to illness or tiredness
___ Don't feel hungry due to having a big previous meal
___ Too busy to cook
___ Lack of money to purchase foods.
___ Others (please specify)
____

15. Do you eat at regular times each day? Yes ___ No ___
Describe a typical daily pattern of when and where you eat _______________
____
What types of food do you usually eat at those times?
____

16. If you have a chance would you like to recommend this nutrition meal program to your friends? Yes ___ No ___

Why: ____
____

17. Does the nutrition program in which you now participate adequately meet your food needs?
Yes ___ No ___
If not, what are your unmet food needs?
____

Thank You For Your Time and Participation

APPENDIX –G
24-HOUR FOOD RECALL FORM

24-Hour Recall Form

Code #: __________ **Date of recall: _______________**

Is this your nutrition meal program participation day? Yes ___ No ___

Meal	Food Items	Amount	Description
Brea kfast			
Snac k			
Lunc h			
Snack			
Dinner / Supper			

Snack			

APPENDIX-H
FOOD FREQUENCY QUESTIONNAIRE

Food Frequency Questionnaire

Code #:______________________	**Date**

:____________________________

For each food below, please show how often you usually eat the food. Put only one (X) for each food. **MAKE SURE YOU FILL IN EVERY LINE.**

Food List	Serving Size	How Often?	
		Times/ Week	Times/ Day

Dairy foods									
Skim, low-fat	8 fl oz								
2 % milk	8 fl oz								
Whole milk	8 fl oz								
Chocolate milk or hot chocolate	8 fl oz								
Ice cream	1 cup								
Yogurt	1 cup								
Cottage, ricotta cheese	½ cup								
Cream cheese	1 Tb								
Other cheese	1 oz or 1 slice								
Pudding or custard	½ cup								
Fruits									
Bananas	1 medium								
Cantaloupe	¼ or ½ cup cubes								
Raisins, grapes	1 ½ oz , ½ cup								
Watermelon	1 slice								
Apples, raw	1 medium								
Apple juice, cider	4 fl oz								
Applesauce	½ cup								
Oranges, raw	1								
Orange juice	4 fl oz								
Grapefruit	½								
Grapefruit juice or cranberry juice	4 fl oz								
Strawberries rhubarb	½ cup								
Peach, raw	1 medium								
Peach , pineapple, and mixed fruits cnd, light syrup	½ cup								
Pear, raw	1 medium								
Pear, cnd, light syrup	½ cup								
What other kinds of fruit do you eat and how often?									
Vegetables									
Broccoli	½ cup								

Sauerkraut	½ cup								
Coleslaw uncooked cabbage	½ cup								
Cabbage, cooked	½ cup								
Cauliflower	½ cup								
Beets	½ cup								
Carrots	½ cup								

Food List	Serving Size	How Often?							
		Times/ Week				Times/ Day			
		0	1	2-4	5-6	1	2-3	4-5	6+
Vegetables									
Corn	1 ear or ½ cup								
Beans, such as baked beans, pintos, kidney beans or in chili	½ cup								
Celery	4-in stick								
Mushrooms	½ cup								
Winter squash	½ cup								
Zucchini, summer squash	½ cup								
Lettuce, romaine, or spinach, raw	1 cup								
Green pepper	½								
Tomatoes, tomato sauce, pasta sauce	1 or 1 cup								
Tomato juice	2/3 cup								
What other kinds of vegetable do you eat and how often?									
Eggs, meats, fish									
Eggs	1								
Chicken, turkey with skin	2-3 oz								
Chicken, turkey, without skin	2-3 oz.								
Luncheon meat	1 slice								
Bacon	2 slices								
Hot dogs	2								
Beef	2-3 oz								
Pork	2-3 oz								
Meatballs, Swedish	2-3 oz.								
Meatloaf	4 oz								
Ham	1 slice								
Cod fish	2-3 oz								
Tuna fish, can	½ cup								

Breads, cereals, starches									
Cold breakfast cereal	1 cup								
Cooked oatmeal	½ cup								
Other cooked breakfast cereal	½ cup								
White bread	1 slice								
Dark bread	1 slice								
English muffins, bagel rolls	½ medium								
Dinner rolls or buns	1								
Muffin, biscuits, or corn breads	1 small								
Brown-rice	½ cup								
White rice	½ cup								

Food List	Serving Size	How Often?							
		Times/ Week				Times/ Day			
		0	1	2-4	5-6	1	2-3	4-5	6 +
Breads, cereals, starches									
Pasta	½ cup								
Other grains, such as noodle or barley	½ cup								
Pancakes, waffles	1, 4” diameter								
French fries	1 small bag								
Potatoes, baked, boiled (mashed)	1 (1/2 cup)								
Potato or corn / chips	1 oz								
Crackers	6								
Pizza	1 medium slice								
Bread Dressing	½ cup								
Beverages									
Coffee	1 cup								
Coffee with creamer	1 cup								
Tea	1 cup								
Carbonated beverage with sugar	1 can (12 oz)								
Carbonated beverage (diet)	1 can (12oz)								
Beer	1 can (12 oz)								
Plain water	1 cup								

Sweets, baked goods									
Chocolate bar or other candy bar	1 small								
Candy	1.5 oz, ¼ cup								
Cookies	3 small (2”)								
Brownies or dessert bars	1								
Doughnuts	1								
Cake, cheese cake	1 slice								
Pie	1 slices								
Sweet roll, coffee cake, pasty	1								
Miscellaneous									
Gravy	¼ cup								
Butter	1 pat (1Tb)								
Margarine	1 pat (1Tb)								
Peanut butter	1 Tb								
Peanuts	1 oz (about 35 pieces)								
Other nuts	1 oz								
Popcorn (light or regular) (machine or microwave)	1 small bag (3 cups)								
Salad dressings, mayo (not diet)	1 Tb								
Chicken or turkey liver	1 oz								
Beef, calf, or pork liver	1 oz								
Soup	1 cup								

6. REFERENCE LIST

Abyad, A. and Mourad, F. (1996). Constipation: Common-sense care of the older patient. *Geriatrics*. 51:28-36.

ADA Reports. 1996. Position of the American Dietetic Association: Nutrition, aging, and the continuum of care. *J Am Diet Assoc.* 96:1048-1052.

Administration on Aging. 1996. Executive summary: serving elders at risk; the Older Americans Act Nutrition Programs-national evaluation of the elderly nutrition program, 1993-1995. *http://www.aoa.dhhs.gov/aoa/nutreval/execsum.html.*

Ahmed, F. 1992. Effect of nutrition on the health of the elderly. *J Am Diet Assoc.* 92:1102-8.

Ausman, L., and R. Russell. 1999. Nutrition in Elderly. In Modern Nutrition in Health Disease, ed. M. Shils, J. Olson, M. Shike, A. Ross, chapter 53:896-881. Baltimore, MD: Williams & Wilkins.

Barber, C. 1997. Olfactory acuity as a function of age and gender: A comparison of African and American samples. *Intl. J. Aging and Human Development.*

44:317-332.

Barrocas, A., J. White, C. Gomez, and L. Smithwick. 1996. Assessing health status in the elderly: The Nutrition Screening Initiative. *Journal of Health Care for the Poor & Undeserved.* 7:210-219.

Bartlett, S., M. Marian, D. Taren, and M. Muramoto. 1998. Geriatric Nutrition Handbook. New York: Chapman & Hall.

Bianchetti. A., R. Rozzini, C. Carabellese, O. Zanetti, and M. Trabucchi. !990. Nutrition intake, socioeconomic conditions, and health status in a large elderly population. *J Am Geriatr Soc.* 38:521-526.

Bidlack, W. and C. Smith. 1988. Nutritional requirements of the aged. *Crit Rev Food Sci Nutr.* 27:189-218.

Blumberg, J. 1997. Nutritional needs of seniors. *J Am Coll Nutr.* 16:517-523.

Boisvert, W., I. Mendoza, C. Castaneda, L. Portocarrero, N. Solomons, S. Gershoff, and R. Russell. 1993. Riboflavin requirement of healthy elderly humans and its relationship to macronutrient composition of the diet. *J. Nutr.* 123:915-925.

Brodkin, K. and I. Abrass 1996-1997. Hypertension in the elderly. *Generations.* Winter:28-32.

Brickman, A. 1990. Calcium, Vitamin D, and Osteopenia in the Elderly. In Geriatric Nutrition-A Comprehensive Review, ed. J. Morley, Z. Glick, L. Rubenstein, chapter 10:149-160. New York: Raven Press.

Bureau on Aging, Division of Supportive, Department of Health and Family Services. reprinted, 1996. The Wisconsin Elderly Nutrition Program - A Manual of Policies and Procedures for the Elderly Nutrition Program.

Carlin, J. and S. Rhodes. 1991. History of the Elderly Nutrition Program. In Effective Menu Planning for the Elderly Nutrition Program, ed. S. Rhodes, chapter 1: 1-7. Chicago, IL: The American Dietetic Association.

Chernoff, R. 1991. Demographics of Aging. In Geriatric Nutrition, ed. R. Chernoff, chapter 1:1-10. Gaithersburg; Maryland: An Aspen Publication.

Cid-Ruzafa, J., L. Caulfield, Y. Barron, and S. West. 1999. Nutrient intakes and adequacy among an older population on the eastern shore of Maryland: the Salisbury Eye Evaluation. *J Am Diet Assoc.* 99:564-571.

Coulston, A., L. Craig, and A. Voss. 1996. Meals-on wheels applicants are a population at risk for poor nutrition status. *J Am Diet Assoc.* 96:570-573.

Fahm, E. and C. Seaborn. 1998. Nutritional status of black elders: A review of the relevant literature. *Journal of Family and Consumer Sciences.* Spring:23-27.

Fishman, P. 1996. Healthy People 2000: What progress toward better nutrition? *Geriatrics*: 51:38-42.

Garry, P., J. Goodwin, W. Hunt, and B. Gilbert. 1982. Nutritional status in a health elderly population: vitamin C. *Am J Clin Nutr.* 36:332-339.

Gilbride, J., E. Amella, E. Breines, C. Mariano, and M. Mezey. 1998. Nutrition and health status assessment of community-residing elderly in New York city: a pilot study. *J Am Diet Assoc.* 98:554-558.

Goldberg, J. 1991. Aging and the Cardiovascular System. In Geriatric Nutrition, ed. R. Chernoff, chapter 8:229-251. Gaithersburg; Maryland: An Aspen Publication.

Greger, J. and B. Sciscoe. 1977. Zinc nutriture of elderly participants in an urban feeding program. *J Am Diet Assoc.* 70:37-41.

Groff, J., S. Gropper, and S. Hunt. 1995. Microminerals. In Advanced Nutrition and Human Metabolism, chapter 12:352-416. Minneapolis/St. Paul: West Publishing Company.

Hoogenboom, M., A. Spangler, and R. Crose. 1998. Functional status and nutrient intake from the council on aging meal and total daily intake of congregate, adult day care and homebound program participants. *Journal of Nutrition for the Elderly.* 17:1-19.

Ho, C., G. Kauwell, and L. Bailey. 1999. Practitioners' guide to meeting the vitamin B-12 Recommended Dietary Allowance for people aged 51 years and older. *J Am Diet Assoc*. 99:725-727.

J-Wood, R., P. Suter, and R. Russell. 1995. Mineral requirements of elderly people. *Am J Clin Nutr.* 62: 493-505.

Jensen, G. 1999. Nutritional needs of seniors. *Nutrition & M.D.* 25:6.

Juguan, J., W. Lukito, and W. Schultink. 1999. Thiamin deficiency is prevalent in a selected group of urban Indonesian elderly people. *J. Nutr.* 129:366-371.

Kerschner, H. and Pegues, J. 1998. Productive aging: A quality of life agenda. *J Am Diet Assoc.* 98:1445-1448.

Kerstetter, J., B. Holthausen, P. Fitz. 1993. Nutrition and nutritional requirements for the older adult. *Dysphagia.* 8:51-58.

Kinyamu, H., J. Gallagher, K. Balhorn, K. Petranick, and K. Rafferty. 1997. Serum vitamin D metabolites and calcium absorption in normal young and elderly free-living women and in women living in nursing homes. *Am J Clin Nutr.* 65:790-797.

Koehler, K., S. Pareo-Tubbeh, L. Romero, R. Baumgartner, and P. Garry. 1997. Folate nutrition and older adults: Challenges and opportunities. *J Am Diet Assoc.* 97:176-173.

Kohrs, M., J. Nordstrom, E. Plowman, P. O'Hanlon, C. Moore, C. Davis, O. Abrhams, and D. Eklund. 1980. Association of participation in a nutritional program for the elderly with nutritional status. *Am J Clin Nutr.* 33:2643-2656.

Kohrs, M., P. O'Hanlon, and D. Eklund. 1978. Title VII-Nutrition Program for the Elderly. I..Contribution to one day's dietary intake. *J Am Diet Assoc.* 72:487-492.

Kutner, N., K. Schechtman, M. Ory, D. Baker, and FICSIT Group. 1994. Older adults' perceptions of their health and functioning in relation to sleep disturbance, falling and urinary incontinence. *JAGS.* 42:757-762.

LeClere, H. and M. Thornbury. 1983. Dietary intakes of Title III meal program participants and nonparticipants. *J Am Diet Asooc.* 83:573-577.

Lowenthal, D. and D. Kirschner. 1994. Effects of exercise on age and disease. *Southern Medical Journal.* 87:S5-S12.

Madigan, S., F. Tracey, H. McNulty, J. Eaton-Evans, J. Coulter, H. McCartney, and J. Strain. 1998. Riboflavin and vitamin B-6 intakes and status and biochemical response to riboflavin supplementation in free-living elderly people. *Am J Clin Nutr*. 68:389-395.

Marcus, E. and E. Berry. 1998. Refusal to eat in the elderly. *Nutrition Reviews.* 1998:1445-1448.

Marlett, J. and J. Slavin. 1997. Position of the American Dietetic Association: Health implication of dietary fiber. *J Am Diet Assoc*. 97:1157.

Martin, W. 1991. Oral Health in the Elderly. In Geriatric Nutrition, ed. R. Chernoff, chapter 6: 107-181. Gaithersburg; Maryland: An Aspen Publication.

Millward, D., A. Fereday, N. Gibson, and P. Pacy. 1997. Aging, protein requirements, and protein turnover. *Am J Clin Nutr.* 66:774-786.

Morley J. 1997. Anorexia of aging: Physiologic and pathologic. *Am J Clin Nutr.* 66:760-73.

Morais J., R. Gougeon., P. Pecharz, P. Jones, R. Ross, and E. Marliss. 1997. Whole-body protein turnover in the healthy elderly. *Am J Clin Nutr.* 66:880-889.

Moran, M. and E. Reed. 1993. Are congregate meals meeting clients' needs for "heart healthy" menus? *Journal of Nutrition for the Elderly*. 13: 3-9.

Moyer, W. and A. Balsm. 1996. Nutrition program for the elderly.

Journal of Nutrition for the Elderly. 16:33-42.

Munro, H. 1989. The Challenges of Research into Nutrition and Aging. In Nutrition, Aging, and the Elderly, ed. H. Munro, D. Danford, chapter 1:1-10. New York: Plenum Press.

Niedert, K., B. Dorner, C. Gerwick, M. Posthauer, and C. Sichterman. 1998. Risk Factors Associated with Poor Nutritional Status. In Nutrition Care of the Older Adult, chapter 7: 67-75. Chicago, IL: The American Dietetic Association.

National Research Council. 1989. Recommended Dietary Allowances. Washington, D.C.: National Academe Press.

National Research Council. 1992. Recommended Dietary Allowances. Washington, D.C.: National Academe Press.

Neyman, M., G. Block, M. Johns, J. Sutherlin, R. McDonald, and S. Zidenberg-Cherr. 1998. Effect of participation in congregate-site meal programs on the energy and nutrient intakes of Hispanic seniors. *J Am Diet Assoc.* 98:460-1462.

Neyman, M., S. Zidenberg-Cherr, and R. McDonald. 1996. Effect of participation in congregate-site meal programs on nutritional status of the healthy elderly. *J Am Diet Assoc*. 96: 475-483.

Omdahl, J., P. Garry, L. Hunsaker, W. Hunt, and J. Goodwin. 1982. Nutritional status in a healthy elderly population: Vitamin D. *Am J Clin Nutr*. 36:1125-1233.

Pennington, J. and B. Young. 1991. Total Diet Study nutritional elements, 1982-1989. *J Am Diet Assoc.* 91:179-183.

Roe, D. 1984. Adverse Nutritional Effects of OCT Drug Use in the Elderly. In Drugs and Nutrition in the Geriatric Patient, ed D. Roe, chapter 7:121-133. New York: Churchill Livingstone.

Roe, D. 1992. Geriatric Nutrition, 3rd ed. Englewood Cliffs, New Jersey: Prentice-Hal, Inc.

Rosenberg, I., R. Russell and B. Bowman. 1989. Aging and the Digestive System. In Nutrition, Aging, and the Elderly, ed. H. Munro, D. Danford, chapter 3: 43-60. New York: Plenum Press.

Rubenstein, L. 1990. An Overview of Aging-Demographics, Epidemiology, and Health Services. In Geriatric Nutrition- A Comprehensive Review, ed. J. Morley, Z. Glick, L. Rubenstein, chapter 1:1-10. New York: Raven Press.

Russell, R. 1990. Gastrointestinal Function and Aging. In . In Geriatric Nutrition- A Comprehensive Review, ed. J. Morley, Z. Glick, L. Rubenstein, chapter 17:231-237.

Russell, R. 1997. New views on the RDAs for older adults. *J Am Diet Assoc.*

97: 515-518.

Rusell, R., and P. Suter. 1993. Vitamin requirements of elderly people: An update. *Am J Clin Nutr*. 58:4-14.

Rusell, R., and P. Suter. 1989. Vitamin Nutriture and Requirements of the Elderly. In Nutrition, Aging, and the Elderly, ed. H. Munro, D. Danford, chapter 10: 245-291. New York: Plenum Press.

Ryan V. and M. Bower. 1989. Relationship of socioeconomic status and living arrangements to nutritional intake of the older person. *J Am Diet Assoc.* 89:1805-1807.

Safford F. and G. Krell. 1992. Gerontology for Health Professionals- A Practice Guide. Washington, DC: NASW Press.

Sandstead, H. 1982. Copper bioavailability and requirements. *Am J Clin Nut.* 35: 809-814.

Schlenker E. 1993. Nutrition in Aging. 2nd ed. St.Louis: Mosby.

Shoaf, L. and M. Mitchell. 1996. Nutrition for the older adult. *Top Clin Nutr.* 11:70-76.

Smith, C. 1990. Drug-Food/Food-Drug Interactions. In Geriatric Nutrition-A Comprehensive Review, ed. J. Morley, Z. Glick, L.Rubenstein., chapter 29:371-395. New York: Raven Press.

Splett, P. 1994. Federal food assistance programs. *Nutrition Today.* March/April: 6-13.

Stabler, S., J. Lindenbaum, and R. Allen. 1996. The use of homocysteine and other metabolites in the specific diagnosis of vitamin B-12 deficiency. *J. Nut.* 126:1266S-1272S.

Stevens, D., L. Grivetti, and R. McDonald. 1992. Nutrient intake of urban and rural elderly receiving home-delivered meals. *J Am Diet Assoc.* 92:714-718.

Taaffe, D., J. Thompson, G. Butterfield, and R. Marcus. 1995. Accuracy of equation to predict basal metabolic rate in older women. *J Am Diet Assoc*. 95:1387-1392.

The 24-Hour Food Recall (Videorecording): In service Training Program. 1998. Stillwater, OK: Oklahoma State University, Oklahoma Cooperative Extension Service.

Timiras, P. 1994. Aging of the Skeleton, Joints and Muscles. In Physiological Basis of Aging and Geriatrics, ed. P. Timiras, chapter 21: 259-272. Boca Raton: CRC Press.

Timiras, P. 1994. Aging of the Gastrointestinal Tract and Liver. In Physiological Basis of Aging and Geriatrics, ed. P. Timiras, chapter 20: 247-257. Boca Raton: CRC Press.

Timiras, M. 1994. The Kidney, the Lower Urinary Tract, the Prostate, and Body Fluids. In Physiological Basis of Aging and Geriatrics, ed. P. Timiras, chapter 19: 235-246. Boca Raton: CRC Press.

Vailas, L., S. Nitzke, M. Becker, and J. Gast. 1998. Risk indicators for malnutrition are associated inversely with quality of life for participants in meal programs for older adults. *J Am Diet Assoc.* 98: 548-553.

Voe, R. 1997. Federal program nourished poor elderly. *JAMA.* 278:1301.

Wapnir, R. 1998. Copper absorption and bioavailability. *Am J Clin Nut.* 67: 1054S-1060S.

Welch, T. 1998. Liquid assets: hydration in the older adult. *The Consultant Dietitian.* 22:3-8.

Willis, L., J. Godwin, K. Lee, L. Mosqueda, P. Garry, P.Liu, R. Linn, and S. Wayne. 1997. Impact of psychosocial factors on healthy outcomes in the elderly. *Journal of Aging and Health.* 9:396-415.

Willett, W. 1997. Weight loss in the elderly: Cause or effect of poor health? *Am J Clin Nutr*. 66:737-738.

Wisconsin Age Profiles Research & Education Project of the WI Dept. of Health and Social Services, Division of Community Services, Bureau on Aging. 1995. Wisconsin's Older People.

Wisconsin Two-Year State Plan on Aging. 1997. Bureau of Aging and Long Term Care Resources division of Supportive Living Department of Health and Family Services.

Whitney, E. and S. Rolfes. 1999. Understanding Nutrition. Belmont, CA: West/ Wadworth.

Whitney, E., C. Cataldo, and S. Roldes. 1994. Understanding Normal and Clinical Nutrition, 4th ed. Minneapolis/ St. Paul: West Publishing Company.

Yamaguchi, L., A. Coulston, N. Lu, L. Dixon, and L., Craig. 1998. Improvement in nutrient intake by elderly meals-on wheels participants receiving a liquid nutrition supplement. *Nutrition Today*. 33:37-44.

Young, E. and E, Urban. 1986. Aging, the Aged, and the Gastrointestinal Tract. In Nutrition, Aging, and Health, ed. E. Young, chapter 4:91-131. New York: Alan R. Liss Inc.