ASSOCIATIONS AMONG DIETARY SUPPLEMENT USE, DIETARY INTAKE, AND CHRONIC HEALTH CONDITIONS OF OLDER ADULTS

by

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B.S., Kansas State University, 2002
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AN ABSTRACT OF A DISSERTATION

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Abstract

The frequency of dietary supplement use has increased in recent years, especially among older adults. National studies estimated 60-65% of older adults were using at least one dietary supplement, typically a multi-vitamin, multi-mineral (MVMM) supplement. Dietary supplement use has been reported to improve the micronutrient intakes of older adults. The current research study focused on the use of dietary supplements, dietary intakes, and impact of vitamin/mineral (VM) supplements on the nutrient intakes of older Kansans. Volunteer subjects, 60+ years of age, were recruited from 35 senior centers across Kansas. Subjects completed a questionnaire asking for demographic information, current health status, and dietary supplement use. Dietary supplement use was verified for 319 subjects. Two subsequent 24-hour diet recalls were completed by 312 subjects. The sample population was primarily white, non-Hispanic females. Nearly 86% of participants used at least one dietary supplement; most commonly MVMM, calcium, vitamin D, and fish oil. Dietary intake analyses compared intakes of dietary supplement (DS) users to non-dietary supplement (NDS) users. DS subjects consumed significantly higher dietary intakes of carbohydrate, fiber, vitamin A, and zinc than NDS subjects. The NDS group consumed undesirably higher intakes of total fat, saturated fat, and sodium. These results support previous findings that DS users consume healthier diets. The impact of VM supplement use on micronutrient intake compared only the intakes of subjects using VM supplements (n=263) to the Dietary Reference Intakes (DRI). Subjects were most likely to have inadequate dietary intakes of vitamin D, calcium, vitamin E, and magnesium. All micronutrient intakes were improved with the inclusion of VM supplements; most improved were vitamin E, folic acid, vitamin D, vitamin B6, and calcium. Despite supplementation, nearly half of subjects still exhibited low intakes of vitamin D, calcium, and magnesium. Supplementation did not consistently exceed the Tolerable Upper Limit established by the DRIs for most nutrients. In conclusion, dietary supplement use was very common in the sample

population, DS subjects had generally healthier diets, and VM supplement use improved micronutrient intake without contributing to concern for toxicity.

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CHAPTER 1 - Review of Literature and Justification

Dietary supplement use has become a popular method for consumers to prevent and/or treat chronic health conditions. Despite widespread use, associations between specific chronic health conditions and self-prescribed dietary supplement treatment have not been widely reported in the scientific literature. Additionally, little has been reported on the dietary value for using vitamin and mineral supplements among community-based older adult populations.

Dietary Supplements

With the passage of the Dietary Supplement Health and Education Act (DHSEA) of 1994, a dietary supplement was defined as "any product (other than tobacco) that is intended to supplement the diet; contains one or more dietary ingredients or their constituents; is intended to be taken by mouth as a pill, capsule, tablet, or liquid; and is labeled on the front panel as being a dietary supplement" [1]. Under this definition, botanical supplements like herbs, vitamins, minerals, other nutritive supplements like amino acids or fish oil capsules, and non-nutritive supplements like glucosamine or chondroitin were classified as dietary supplements.

DSHEA assumes safety of dietary supplements and their ingredients based on previous use. Thus the need for supplements to undergo the same rigorous pre-market testing as new drugs has been eliminated, even though some supplements may have biological activities similar to pharmaceutical drugs [1]. Current products can be labeled and sold as dietary supplements until the Food and Drug Administration (FDA) can provide proof the product is harmful to consumers' health. This presumption of safety more closely resembles the regulation of conventional foods where the proof of safety is the responsibility of the FDA rather than the food manufacturer [1]. In contrast, when new drugs are developed, it is the manufacturer who must provide sufficient evidence of product safety prior to receiving FDA approval [1].

Prevalence of Dietary Supplement Use

The number of Americans using dietary supplements has increased since the passage of DSHEA. A study by the Center for Alternative Medicine Research and Education in Boston, MA, reported herbal supplement use by adults (18 years and older) had increased from 2.5% in 1990 to 12.1% in 1997 and use of megavitamins increased from 2.4% to 5.5% during the same timeframe [2]. The National Health and Nutrition Examination Survey 1999-2000 (NHANES) found that 52% of all adults, 47% of men and 57% of women, had used at least one dietary supplement in the previous month [3].

Previous research studies reported dietary supplement use by older adults on both national and regional levels [2-6]. NHANES 1999-2000 reported that 63.3% of adults 60 years and older had used at least one dietary supplement in the preceding month, the highest of all age groups, and the Health and Retirement Survey (HRS) of 2000 found 65% of older adults were using dietary supplements [2, 3]. HRS reported that 72% of respondents aged 65 to 79 years and 66% of respondents over 80 years of age used either herbal and/or vitamin/mineral supplements [2].

Smaller, regional studies indicated high rates of dietary supplement use among older adults, reflecting the trend that increasing numbers of consumers of all ages were using dietary supplements [4, 5, 7, 8]. A 1997-1998 study in Galveston, TX of community living older adults (n=365), at least 77 years old, reported that 47% of subjects used herb and vitamin-mineral supplements [7]. A 1999 Northern California study of females (n=3109), in the Kaiser-Permanente Medical Care Program, showed that 84% of respondents 65 years and older had used at least one dietary supplement in the previous year [4]. A study of older adults (n=445), aged 65 years and over, in the Twin Cities area of Minnesota, revealed that 89.3% were using vitamin/mineral supplements and 66.3% were using herbal supplements [9]. The combined results from three studies (the Klamath Exceptional Aging Project, Dementia Prevention Study, and the Effects of Yoga and Exercise on Cognition in Healthy Elders Trial) of community-based older adults in Oregon found that nearly 90% of those aged 71-75 years and greater than 80% of those aged 76-80 used at least one dietary supplement [8]. Another study, recruiting free-living older adults (n=318) in western Oregon for the purpose of assessing dietary supplement use, reported that 100% of respondents age 65-74 used vitamin/mineral supplements

compared to 89% of those age 75-84, and 82% of those over the age of 84 [5]. Additionally, Weng et al. reported those using herbal supplements were more likely to use vitamin/mineral supplements and reported 97% of the study participants who used herbal supplements also used vitamin/mineral supplements [5].

Dietary Supplement Users

A user profile has emerged from previous studies investigating use of dietary supplement in the general U.S. population. The typical supplement user was middle-aged (45-64 years), female, white, more highly educated (at least some college), with higher income living in the Pacific Mountain states [2, 4, 10, 11]. Other factors predicting supplement use included regular physician visits, prescription drug use, and existence of arthritis or depression/anxiety[4, 12]. Factors that decreased the likelihood of dietary supplement use included being female, age 18-44 years, lower income levels (less than $20,000), and residing in the south [10, 11].

Though studies were limited, the profile of older adult supplement users was found to be similar to that of the national profile. Weng et al., found that older adult herbal supplement users were more likely to be white, non-Hispanic, college educated, and younger (average age of 79.6 years), though no gender difference was observed [5]. Gordon and Schaffer reported dietary supplement use was associated with white, non-Hispanic women, educated through high school, and in self-reported good health [4]. Profiles provided by previous research did not however establish a relationship between chronic health conditions and supplement use among older adults.

Health Behaviors

The use of dietary supplements has been associated with a variety of other behaviors, many of which were positive for health. In the general population, dietary supplement use had been positively associated with refraining from alcohol, not smoking, and being physically active [2, 13]. Cheung, et al. had associated physical activity, regular annual physicals, and no tobacco use with dietary supplements use in older adults [9]. Those using dietary and herbal supplements also tended to spend more out-of-pocket money to purchase prescription drugs and pay for other medical procedures [2, 14]. It was

unclear whether this indicated that dietary supplement users had more chronic diseases or were more oriented toward health-promoting behaviors.

Being of normal weight has been associated with increased use of vitamins and minerals [15, 16]. Data collected by the Duke Established Populations for Epidemiologic Studies of the Elderly (EPESE) in the early 1990s indicated that older adults who were underweight were more likely to take nutritive supplements like single-ingredient vitamins [17]. More recently, obesity has been associated with decreased supplement use [15].

Herbal supplement users were more likely to rate their health as excellent/very good compared to non-users whose self-rated health was more likely to be fair or poor [5, 11]. The EPESE study also indicated that those who did not use vitamin/mineral supplements were in poorer health based on the number of chronic conditions present [17].

Types of Dietary Supplements Used

Vitamin and Mineral Supplements

The dietary supplement industry was expected to top $27 billion in 2005 [18]. Thousands of different dietary supplements have been produced and are available for purchase, giving consumers endless choices. The number of older adults using a multivitamin varied greatly among studies and the groups of older adults surveyed. Nationally, the use of a multi-vitamin, multi-mineral (MVMM) supplement by older adults was reported as 38.9% and 49.4% by the NHANES 1999-2000 study and HRS, respectively [2, 3]. Regional studies have often shown higher rates of MVMM use in older adults. A 1999 study of Northern Californian women, over 65 years, found 82% of women had used MVMM supplements in the preceding year [4]. Weng et al. reported even greater use, with 93% of older adults living in a retirement community in western Oregon using MVMM supplements on a weekly basis [5].

A general MVMM had been reported as the most popular dietary supplement among older adults, though studies had found that older adults used single nutrient supplements as well [2, 3, 8]. The most common single nutrient supplements used by older adults were calcium, vitamin E, and vitamin C [16]. The HRS study reported vitamin E as the most frequently used single nutrient supplement, followed by calcium, and

vitamin C [2].

Non-Vitamin, Non-Mineral Supplements

Studies investigating the use of non-vitamin, non-mineral (NVNM) supplements had shown an increase in supplement use, especially in persons over 65 years [10]. Even with the exclusion of vitamin and mineral supplements, the Slone Survey, a nationwide telephone survey conducted between February 1998 and December 2002, found 22.7% of older men and 26.1% of older women used dietary supplements [10]. The most commonly reported NVNM supplements, excluding herbal supplements, were lutein, glucosamine, and chondroitin [6, 10]. Evaluation of herbal supplement use in older adults had found garlic, ginseng, and ginkgo biloba to be the most commonly used [2, 11].

Kelly et al. reported a change in the use of herbs as a single preparation supplement [10]. The change is believed to reflect the leveling off of use and in some cases declining use may be associated with the increased combining of herbs with other products like multivitamin supplements, foods, and beverages [10]. The focus of advertisements for multivitamin preparations seems to be switching away from providing nutrients, which may be lacking in the diet, to recommending nutrients for prevention of chronic disease [10]. Further, the addition of herbs is a concern because of inadequate information and a lack of clinical trials that show benefit.

Reasons for Dietary Supplement Use

The increased use of dietary supplements and other complementary and alternative medicine (CAM) therapies has been attributed to several different factors. The main reasons described in previous studies included dissatisfaction with conventional medical practices, the increased costs associated with conventional medicine, desire for self-treatment of one's health, and the prevention/treatment of health conditions [11, 12, 19]. Promotion of general health and curiosity were other reasons given for dietary supplement use [10-12]. Those relying on alternative medicine as their primary form of health care were more likely to distrust conventional practitioners and hospitals. Alternative medicine users conveyed more dissatisfaction with conventional health care, desired greater control over health care, and placed greater emphasis on personal values regarding health [19].

Dissatisfaction with Current Health Care

The lack of conventional medicine's ability to cure chronic diseases has left many adults, especially older adults, dissatisfied with their current medical care and sent them in search of alternative treatments [20]. Shahrokh et al. found evidence that individuals not finding "relief" with current treatments were being pushed away from conventional medical care in favor of alternative treatments [21]. A study of older adults in Illinois found that use of herbal supplements was linked to greater dissatisfaction with current medical treatments [21]. Additionally, the perception that herbs were safer than conventional treatments had been associated with increasing popularity of non-traditional therapies like herbal supplements [20].

Medical Costs

The cost of prescription drugs and other medical expenses can be a burden for older adults living on a fixed budget. Previous reports had shown that those who could not afford prescription drugs were more likely to use herbs [11]. In one of very few studies addressing the cost of dietary supplements, the average annual expenditure for older adults using dietary supplements in 2000 was estimated to be $173 [2]. The HRS study estimated the average cost of herbal supplements used by the 209 older adults using herbs to be $125 per person, slightly more than $10 per month [2]. Similar amounts were reported in a 1999-2000 study of older adults (57+ years) living in the Kansas City metro area; the report indicated that 48% of participants using dietary supplements spent less than $5 a month, 27% spent $5-$10, 16% spent $10-$20, and 1% reported monthly expenditures greater than $100 on dietary supplements [14]. Another study estimated that 42% of older adult herbal supplement users spent less than $10 per month on supplements [5]. Even though estimates provided by these studies may be inaccurate, the amount spent on dietary supplements is still likely far less than the amount spent by an older adult for prescription drugs, further adding to the enticement of using dietary supplements. Estimated annual prescription drug costs were $811 for adults 65-79 years and $796 for those over 80 years [22].

Self Management of Health Care

A recent study of older adults residing in a retirement community in Oregon showed that herbal supplement users believed they have more control over their health when using supplements [5]. Fifty-four percent of the responding older adults using herbal supplements indicated that herbal products were "more natural" than prescription or over-the-counter drugs, but only 20% thought the herbal products were more effective [5]. Marinac et al. believed that the popularly reported response of using dietary supplements for "general health purposes" by older adults was representative of their desire to be involved with their own health care [14].

Prevention and Treatment of Health Conditions

Some studies found that dietary supplement users, especially herbal supplement users, had used the products to maintain health and prevent potential health problems [23]. A study of older adult women in Florida reported that 36% of the participants used dietary supplements in the prevention or treatment of health problems, and 56% of the products consumed were in prevention of health problems or maintenance of health [23]. Dietary supplement use had been reported to treat both acute and chronic illnesses [5]. The 2002 NHIS CAM study indicated that those with chronic, but non life-threatening health conditions like headaches, insomnia, and gastrointestinal conditions were more likely to use non-vitamin dietary supplements; those with more serious chronic conditions like heart disease, stroke, and diabetes were least likely to use non-vitamin supplements [24]. Dietary supplements had commonly been reported in the treatment of arthritis and improvement of memory [14, 25].

Other Reasons for Supplement Use

Older adults using dietary supplements and other forms of CAM had reported using therapies to decrease the feelings of stress, prevent acute illnesses like colds, and boost energy [5, 12]. Another study found that participants used dietary supplements out of curiosity, to determine whether positive benefits were gained [11]. "Added benefits of supplements" was a reason cited by 91.4% of older adults participating in a study conducted by Shahrokh, et al. for using dietary supplements [21]. Beliefs that dietary supplements benefit the user and improve health appeared to have a significant influence

on the decision to continue use [14, 23]. Finally, dietary supplements were reportedly perceived as natural products and safer than prescription drugs [26].

Health Risks Related to Dietary Supplement Use

Several concerns have been raised about increased use of dietary supplements among older adults, particularly use of herbal supplements. First, the potential for adverse interactions between supplements and pharmaceutical drugs is a concern. Pharmaceutical drugs include both over-the-counter and prescription drugs. The greater number of pharmaceutical medications taken by older adults and slower excretion rates may lead to potential toxicities [20]. Analysis of the 2002 NHIS CAM data set indicated that 1 in 5 U.S. adults using NVNM dietary supplements were also taking at least one prescription drug [24].

Another publication from New Mexico Aging Process Study (NMAPS) reported adverse interactions of drugs and dietary supplements [6]. Medications most often associated with adverse effects had blood-thinning properties of prescription anticoagulant drugs or over-the-counter medications like aspirin and other NSAIDS [6]. Many of the dietary supplements involved in adverse interactions, including garlic, gingko biloba, and chondriotin, also had blood thinning properties [6]. The popular herb ginkgo is known to enhance the effects of warfarin, a commonly used blood thinner prescribed for older adults with cardiovascular conditions [27].

Additionally, between supplement interactions are a concern because many older adults use more than one supplement on a regular basis. About 48% of older adult herb users reported, in a 2002 study, taking two or more different herbs [11]. The use of multiple supplements combined with unsupervised self-medicating practices further increased chances of an adverse supplement-supplement interaction. Yoon and Horne reported that older adults were not always aware of what they were consuming, especially in cases where multiple ingredients were present in the supplement and the label contained very small print [23]. Another concern with herbal supplements in older adults was the inconsistency of products among different brands and in some cases, even within the same brand [23].

Next, dietary supplement use was reported to possibly delay or replace conventional treatment provided by qualified medical practioners [27]. Nearly 60% of adults participating in the 2002 NHIS CAM survey reported avoiding or delaying health care due to medical costs; adults using herbal supplements were more likely to delay conventional medical care [11].

Additionally, when dietary supplement users did visit their physicians, dietary supplement use was not discussed during the visit. The NMAPS study found that 92.9% of older adults were taking NVNM supplements without supervision of a medical doctor or other health professional [25]. Common reasons given by adults for nondisclosure of dietary supplement use included the belief that the information was not important to the physician, and the physician did not ask the patient about supplement use [28]. In further support, Cheung et al. found the most common reasons for older adults not to disclose CAM use were "not being asked" (38.5%), "didn't think about it" (22%), and "didn't think it was important to my care" (22%) [9]. Most patients, who had discussed supplement use with their physician, indicated that they initiated the conversation themselves [29].

Finally, there is a lack of regulation in the dietary supplement industry. DSHEA has left safety and product quality in the hands of the product manufacturer, with the FDA charged to prove that a product is unsafe for consumption [26]. Therefore, dietary supplements do not undergo the same strict safety checks as pharmaceutical drugs. Further a lack of product standardization assuring that active ingredients present in a product are in the amounts listed on the label and the potential for contamination are further examples that DSHEA poses additional risks especially for those using dietary supplements [20]. In June 2007 the FDA released the final rule for the Current Good Manufacturing Practices (CGMPs) for dietary supplements [30]. The CGMPs were developed to improve consumer safety by ensuring unadulterated and properly labeled dietary supplements are available [30].

Dietary supplement use appeared to empower the consumer, but many may not be aware of potential risks when using herbs and other supplements. In a study by Weng et al., 30% of older adults thought that all supplements were tested for safety, 35% disagreed that herbs would cause side effects, and 48% disagreed with the statement that

herbs should not be taken with other medications [5]. Another study revealed that 70% of older adults believed that the FDA tested supplements and 60% believed that supplements were regulated in the same manner as prescription drugs [14]. The lack of knowledge among older adults regarding the regulation of supplements also places them at risk.

Association Between Dietary Supplement Use and Chronic Diseases

A few recent research studies had associated the use of dietary supplements with the presence of chronic conditions in older adults, but none had investigated use of specific dietary supplements in the treatment of chronic conditions. Results of a study by Gordon and Schaffer indicated that supplement use varied by chronic condition [4]. Health conditions most commonly associated with alternative medicine use in older adults (65+ years) were reported from a 1997-1998 nationwide telephone survey; they included arthritis, back pain, heart disease, allergies, and diabetes [31]. Lung disorders, gastrointestinal problems, fatigue, depression, and hypertension had also been associated with alternative medicine use in older adults [31].

Osteoarthritis and Rheumatoid Arthritis

Arthritis, particularly osteoarthritis, had been strongly tied to dietary supplement use [32]. A small survey of 89 patients, aged 19-93 years, receiving care at a rheumatology clinic in 1997-1998, reported that grape seed, lutein, cranberry, and ginkgo biloba were the most common plant derived products used [33]. Those same patients also used multivitamins, calcium, glucosamine, and chondroitin [33]. Randomized-controlled trials reported in 2006 identified Devil's claw, ginger, glucosamine, and chondroitin as other treatments used for osteoarthritis [32].

Chronic Back Pain

Chronic pain, most specifically chronic back pain, had been associated with dietary supplement use, but little is known about use of CAM therapies, particularly dietary supplements for treatment of chronic pain [19]. The 2002 NHIS CAM data set reported that 16.8% of adults over 18 years were using CAM therapies to treat back pain, 6.6% to treat neck pain, and 2.4% to treat reoccurring pain [34]. Foster et al. reported that

21% of adults 65+ years were using alternative medicine treatments to treat chronic back pain, though which form of alternative medicine is used to treat the condition was not specified [31].

Heart Disease

The Improving Cardiovascular Outcomes in Nova Scotia (ICONS) study reported the use of CAM therapies in a subsample (n=107) of adults (average age 64.3 years) diagnosed with cardiovascular disease; 35% of whom used mega dose vitamins of E, C, B, and A [35]. Herbal supplements were used by 32% of those participants, including garlic, Echinacea, and flax seed [35]. Twenty-two percent of participants reported use of nonherbal supplements with the most popular being fish oil, glucosamine, and coenzymes [35]. Other studies had reported participants with heart disease using Echinacea, garlic, ginseng, ginkgo biloba, glucosamine (with or without chondroitin), and hawthorn in adults over 18 years of age [36, 37]. It is unclear whether any participants were using the dietary supplement for treatment of their cardiac condition, or for treatment of other conditions, or as a preventive mechanism.

Diabetes

Diabetes was not often associated with the use of dietary supplements, though a recent study by Arcury et al., found that community living older adults with diabetes, average age 74 years, in central North Carolina, used supplements and other food therapies as forms of self-treatment [38]. Vitamins were used in the treatment of diabetes by 5.7% of those study participants, 2.4% used minerals, and 2.4% used herbs [38]. A very small study investigating supplement use among older women with diabetes in northwest Colorado reported that multivitamins were most commonly used among this population [39]. Despite the small sample size, Oldham et al. concluded that participants were not using the supplements to control blood glucose levels or as part of a treatment regimen for diabetes [39].

Hypertension

Use of dietary supplements in the treatment of hypertension was not widely reported because studies often grouped the condition with cardiovascular disease. The

2002 NHIS CAM study reported that participants with hypertension did use CAM therapies, though a specific form was not associated [34]. Previously, garlic had been reported as a CAM treatment for lowering blood pressure [37].

Depression

A study of older Northern Californian women reported that use of herbal supplements and other non-vitamin, non-mineral supplements nearly doubled in persons who reported depression [4]. The NHIS CAM study also indicated that participants with depression reported CAM use, though the exact therapy was not reported [34]. The herb St. John's Wort had been reported as a treatment for depression in adults [37].

Lung Diseases

Current evidence does not strongly support the use of dietary supplements for treatment of chronic obstructive pulmonary disorder (COPD) [40]. A review of published studies from Europe and China reported that herbal supplements such as *Panax ginseng* and Echinacea had been tested in clinical trials of patients with COPD with only limited success [40]. NHIS 2002 reported persons with lung disease were most likely to choose biologically based CAM therapies compared to other CAM therapies [41]. An Australian study of CAM found MVMM supplements, B-complex, vitamin C, and fish oil were the most commonly used supplements by patients (60+ years) with COPD [42]. In the U.S., the NHIS study indicated that 41% of adults with lung diseases, including COPD used a CAM therapy in the previous year, though the exact therapy was not reported [41]. These studies illustrated the use of dietary supplements by individuals with COPD and lung diseases, but did not establish an association between uses of specific supplements for lung disease treatment.

Macular Degeneration

Investigations in the Age-Related Eye Disease Study (AREDS) identified a combination of vitamin C, vitamin E, β-carotene, and zinc reduced progression of age-related macular degeneration [43]. The purpose of the study by Chang et al. was to assess the use of dietary supplements, particularly vitamin C, vitamin E, β-carotene, and zinc, in patients diagnosed with age-related macular degeneration [43]. A multivitamin was found

to be the most popular supplement, though 68% of the subjects in their study were supplementing with at least one of the AREDS nutrients [43].

Methods for Surveying Dietary Supplement Use

Published studies evaluating the frequency of dietary supplement consumption have used dissimilar terms on questionnaires. Simply including the term "non-vitamin/non-mineral supplement" may increase the number of respondents indicating use of that type of dietary supplement. A higher prevalence rate was reported when using the term "non-vitamin/non-mineral supplements" rather than "herbal supplements" [44]. The authors suggested either providing examples of herbal supplements by name or dropping the category of herbs all together in favor of a more general "non-vitamin/non-mineral supplement" category [44]. This was proposed to reduce confusion among participants, who may not recognize differences between herbal supplements and non-vitamin/non-mineral supplements [44].

Diet Assessment

The most recently developed standard of dietary assessment is the Dietary Reference Intakes (DRI), a set of values unique to each nutrient used to evaluate the intake of healthy individuals over time [45]. The Estimated Average Requirement (EAR) is the first value calculated under the DRIs. The EAR refers to the level of nutrient intake needed to meet the needs of half the population based on age and gender categories [45]. The Recommended Dietary Allowance (RDA) was established from EAR values and refers to the level of intake needed to meet the needs of 97-98% of healthy individuals of a particular age and gender group [46]. When there was insufficient evidence to develop an EAR value, the nutrient was assigned an Adequate Intake (AI) level [45]. AI is the estimated level of nutrient intake believed to be adequate for healthy individuals within a specific age and gender group [45]. Finally, the Tolerable Upper Limit (UL) refers to the highest level of intake that can be consumed daily without risk of adverse health effects [45].

The EAR is preferred for analyzing dietary intakes when available, but the AI is used when no EAR exists [45]. Inadequate nutrient intakes are assumed for persons falling

below the EAR limits even though it is possible that subjects are still meeting their individual needs [45]. In contrast, the AI cannot be used to determine dietary inadequacy of a given population, but can assess the prevalence of dietary inadequacy [45]. Finally, the UL can be used to determine the portion of the sample population at risk of an adverse effect from excessive intakes [45].

Diet and Dietary Supplements

Advancing age alters nutritional needs; in particular older adults have increased need for vitamins B6, B12, D, and calcium [47]. At the same time, energy needs for older adults decrease, as metabolic rate slows and lean muscle mass is lost. Additionally, the iron needs of women decrease following menopause.

Dietary Intake of Older Adults

As is the case with the rest of the nation, older adults are also at risk for over-consuming calories. This was very evident in a recent study of rural Midwestern women, aged 50-69 years, which reported nearly 50% of participants had energy intakes greater than their Estimated Energy Requirement (EER) [48]. Higher than recommended fat intakes seemed to be a contributing factor to higher energy intakes. In that study, average fat intake was 39% of total calories. A study of older adults (men and women) in Georgia found that fat comprised nearly 40% of caloric intakes [49].

Studies have investigated the micronutrient intakes of older adults, finding deficiency of calcium and zinc intakes more frequently than deficiencies of the other nutrients. NHANES III reported that 75% of older males and 87% of older females had dietary intakes of calcium below recommended levels [50]. With the inclusion of dietary supplements in the analysis, dietary intakes were considered improved, but 60% of males and 66% of females still had intakes below recommended levels [50]. A study of 130 community dwelling older adults in rural North Carolina, aged 70+ years, found that 65% of participants had deficient dietary intakes of at least one of the eight micronutrients analyzed [51]. Based on the 1989 Recommended Dietary Allowances (RDA) the participants' diets were most likely to be deficient in zinc (60%), followed by vitamin B6 (38%) and calcium (24%) [51]. Though, when mean intakes were compared to current DRI values, a greater number of both males and females would have had insufficient intakes

of calcium than vitamin B6 or zinc. In contrast, NHANES III found that both men and women had adequate intakes of zinc, although 35-45% of participants had inadequate intakes [50].

Results of the Continuing Survey of Food Intakes by Individuals (CSFII) survey reported 50% of all participants had low intakes of folate, vitamin E, and magnesium [52]. An important note is that folic acid fortification of grain products began in 1998, thus the report of low folate cannot be accurately applied to older adults today. Vitamin/mineral supplementation, used by 43% of participants, was shown to improve intakes of most nutrients by older adults by an estimated 75% [52]. Vitamin E and folate intakes were the most improved after supplementation was included [52]. Analysis of the CSFII data confirmed that some subjects exceeded the Tolerable Upper Limit (UL) through the use of dietary supplements [52]. The nutrients most likely to exceed the UL were iron and zinc for males and iron and vitamin A for females [52].

Relationship Between Dietary Intake and Supplement Use

Previous studies indicated that dietary supplement users tended to live healthier lifestyles, e.g. refrained from smoking, exercised regularly, etc., and consumed more nutrient dense foods than would be expected [53]. In support of the theory, a survey of 18-79 year olds in Germany found that females regularly using dietary supplements had an unrelated, but statistically higher intake of dietary fiber [54]. Female supplement users consumed more fruits, vegetables, milk products, and fish than non-users [54]. The diets of male supplement users were not significantly different than their non-user counterparts, but did have higher intakes of cereals, milk products, nuts and seeds, vegetable fat, and fruit/vegetable juice [54]. Other studies have also linked fruit and vegetable intake as well as lower fat intake to dietary supplement users [16, 53].

Further supporting the theory that dietary supplement users consumed more healthful diets were the results reported by Houston et al.; dietary supplement users were more likely than non-users to report consciously limiting their intakes of fat, cholesterol, sugar, and caffeine [49]. The same dietary supplement users self-reported consuming more fiber and greater amounts of nutrient dense foods [49]. The dietary intakes of MVMM

users did not significantly differ from non-users in terms of energy, grams of protein, percent calories from fat, or fiber intake [49].

In most other studies higher micronutrient intakes have been associated with dietary supplement use. The Beaver Dam Eye Study of Wisconsin adults, aged 43-86, reported higher dietary intakes of α-carotene, β-carotene, folate, riboflavin, thiamin, vitamin C, vitamin E, calcium, iron, and zinc among users of a MVMM supplement [53]. Using the data set from the 1994-1996 CSFII survey, Sebastian et al. compared the dietary intakes of supplement users to non-supplement users [52]. Males aged 51-70 years taking dietary supplements consumed statistically higher amounts of vitamin C, calcium, and magnesium from food than nonusers [52]. Only magnesium intake was statistically higher for males over 70 years [52]. Female supplement users in both the 51-70 and 71+ age groups had statistically greater dietary intakes of vitamin B6, folate, vitamin E, and magnesium [52]. Contrasting the previously mentioned results were the findings by Houston et al. that showed dietary intakes of calcium, vitamin E, and vitamin C were not significantly different between dietary supplement users and non-users [49].

The studies reviewed focused on dietary intakes of dietary supplement users, and many support the belief that dietary supplement users have more nutrient-dense diets. Despite this theory, little is known about actual dietary intakes of older adult dietary supplement users and whether the presence of a chronic health condition impacts diet and/or supplement intake.

Conclusion

The American population is aging and by 2030 it is estimated that there will be more than 70 million adults over age 65, comprising 20% of the total U.S. population [55]. With increasing age comes the accumulation of risk for chronic health conditions, higher health care costs, and potential for a decreased quality of life. Dietary supplements may be viewed as an effective alternative method to prevent some chronic health conditions and relieve other conditions untreated by conventional medical treatments.

With the use of dietary supplements expected to continue to increase, more information on current dietary and supplement practices, especially among older adults, is needed. Understanding the current dietary supplement habits of older adults will

provide a more accurate profile of the older adult supplement user and provide insight to the potential self-medicating practices of older adults. Investigation of dietary intake will provide additional knowledge on the eating habits of older adults in Kansas as well as correlate dietary supplement use and dietary intake.

Review of previously published research studies lead to the hypothesis that older adults with chronic health conditions would report more frequent use of dietary supplements than older adults without a chronic health condition. Additional research hypotheses developed for the purpose of the current research study included 1) dietary supplement users would report higher dietary micronutrient intakes non-dietary supplement users and 2) the use of MVMM supplements would cause most older adults to exceed recommended intakes of many micronutrients. Thus, the purpose of the present study was to:

1. Determine the frequency and types of dietary supplements used by older adult Kansans
2. Identify supplements currently being used in the treatment of select chronic health conditions by older Kansans
3. Evaluate the current dietary intakes of older Kansans
4. Measure the impact of dietary supplement use on dietary adequacy within the older Kansan population.

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CHAPTER 2 - Factors Predicting Use of Specific Dietary Supplements and Justification for Use as Provided by Older Adult Kansans

Abstract

Background: Previous studies have shown dietary supplement use was very common among older adults. Particularly, multi-vitamin, multi-mineral (MVMM) supplements were the most frequently consumed dietary supplement. The typical dietary supplement user has been characterized as a well-educated white, non-Hispanic female in good health. The purpose of this research study was to identify factors that significantly predicted the use of specific dietary supplements and to present self-reported justifications for dietary supplement use.

Methods: Volunteer subjects 60 years and older were recruited from senior centers throughout Kansas. Data was collected through the use of a questionnaire addressing demographic information, current health status, and dietary supplement use. Subjects (n=319) completed two follow-up telephone interviews to verify dietary supplement use, rationales for use, and dietary intakes.

Results: The sample population was predominately female (72.7%), white, non-Hispanic (93.1%), and had visited a physician within the previous six month period (72.7%). Nearly 86% of subjects used at least one dietary supplement. Most frequently reported dietary supplements were MVMM, calcium, vitamin C, vitamin D, vitamin E, fish oil, and glucosamine. Common factors predicting use of the specific dietary supplements included recency of physician visit, gender, presence of arthritis, and cancer diagnoses. Most common justifications for use were "prevention and treatment of health condition," "recommended/told to take," and "no reason."

Conclusions: Dietary supplement use was very prominent among the current population. More recent physician's visits was the most significant factor in predicting the use of specific dietary supplements. Subjects reporting arthritis were much more likely to use specific dietary supplements and subjects reporting cancer diagnoses were

less likely to use dietary supplements. "Disease/health condition prevention and treatment" was the most common reason for using dietary supplements. In particular, arthritis was a consistent factor predicting specific dietary supplement use.

Background

Widespread usage of dietary supplements by older adults had been previously reported with rates of use among adults 60+ years of age estimated to be 60-65% [1, 2]. Regional reports found dietary supplement usage to be much higher, approximately 84-87% [3, 4]. A general multi-vitamin, multi-mineral (MVMM) preparation was consistently the most used dietary supplement [2, 3, 5]. Other frequently reported vitamin/mineral (VM) supplements included calcium, vitamin E, and vitamin C [2, 6]. Non-vitamin, non-mineral (NVNM) supplements reportedly used by older adults included glucosamine, chondroitin, lutein, and coenzyme Q10 [7, 8]. The most common herbal supplements had previously been ginkgo biloba and garlic [7, 8]. Previous work indicated that older adults were more likely to use vitamin/mineral (VM) supplements than non-vitamin, non-mineral (NVNM) or herbal supplements [2, 3].

Dietary supplement users are characterized as well-educated white, non-Hispanic females with higher income levels, and in self-perceived good health [3, 7, 9]. White, non-Hispanic females were the most frequent users of VM and herbal supplements [10]. The National Health Interview Survey (NHIS) of 2000 showed increased use of VM supplements associated with advancing age [10]. NHIS respondents with poorer health status were less likely to use vitamin and mineral supplements [10].

Studies reporting uses of CAM had linked the consumption of dietary supplements to health maintenance, prevention of future illness, and treatment of chronic health conditions [11]. Rationale for herbal and NVNM supplement use was associated with the promotion of health and well-being and prevention of illness [7, 12, 13]. Memory improvement and preservation of cognitive capacity was associated with herbal and NVNM supplements [12, 13]. Dietary supplements had been reported in the treatment of chronic conditions like arthritis, chronic pain, heart disease, and allergies [3, 5, 9, 13, 14]. Prevention and treatment of acute conditions such as the common cold or gastrointestinal ailments had been tied to use of dietary supplements, particularly NVNM supplements [5, 13].

Previous research studies identified frequently used dietary supplements, established a dietary supplement user profile, and identified general reasons for

supplement use. Few studies, however, have focused on the use of specific dietary supplements in the treatment of specific chronic conditions by older adults. Therefore, the purpose of the current study was to report factors predictive of the use of specific dietary supplements to provide insight regarding justifications for dietary supplement use by an older adult population.

Methods

Study Design

This cross-sectional study enrolled English speaking community-based older adults, to investigate the reasons for use of dietary supplements in adults >60 years of age with telephone access, residing in Kansas. Participants were recruited from 36 senior centers throughout Kansas between June 2007 and November 2007. Senior centers were randomly selected from each of the eleven Kansas Area Agency on Aging Districts and proportionately sampled to reflect the most recent Census Bureau population estimates available. Recruitment began with site visits to each senior center willing to participate. Qualifying individuals completing the questionnaire were entered into a drawing for a small raffle prize ($8 value) given away at each senior center.

A questionnaire addressing demographic characteristics, health status, and use of 35 pre-selected dietary supplements was completed by 374 participants. The health status portion of the questionnaire queried the presence of ten researcher-selected chronic health conditions identified from the literature and common in older adults: arthritis, cancer, chronic pain, diabetes, depression, heart disease, high blood pressure, high cholesterol, lung diseases, and macular degeneration. Participants were contacted via telephone to verify dietary information, dietary supplement use, and obtain reasons for using supplements. Three hundred nineteen participants (232 females, 87 males) completed the study with telephone verification. Study participants were excluded from analysis if they were not available for follow-up (n=41) or if <60 years of age (n=6). Questionnaires that were excluded had a higher proportion of male subjects and were less likely to use dietary supplements than those included in the final analysis. Human subject approval was obtained through the Kansas State University Institutional Review Board and all subjects provided written informed consent.

Data Analysis

Statistical analyses were completed using the Statistical Program for the Social Sciences (version 15.0, 2006, SPSS Inc, Chicago, IL). Logistic regression examined factors predictive of dietary supplement use, MVMM, calcium, vitamin D, vitamin C, vitamin E, glucosamine, and fish oil. Independent variables included age, gender, ethnicity, income, education, physical activity, recency of physician visit, self-reported health status, alcohol use, tobacco use, arthritis, cancer, chronic pain, diabetes, depression, heart disease, high blood pressure, high cholesterol, lung diseases, and macular degeneration. Factors were considered statistically significant at p=.05. Justifications for dietary supplement use were evaluated and categorized into eight general areas. Frequencies were calculated to statistically analyze the reasons given for use.

Results and Discussion

Three hundred nineteen community-based subjects completed the study with verified dietary information and supplement use via telephone. Mean age of participants was 76.8 ± 7.4 years with a range of 60-96 years. Most participants were female (72%), white, non-Hispanic (93%), annual income less than <$24,000 (68%), with at least a high school education (89%). Most subjects refrained from alcohol use (80%), never smoked (60%), reported their health status as good or better (76%), and took prescription medications (87%). Table 2.1 contains a further description of demographic and health characteristics.

Chronic health conditions were very common with over 92% of participants reporting at least one condition; males reported a mean 2.7 ± 1.7 chronic conditions and females reported a mean of 2.6 ± 1.6 chronic conditions. High blood pressure (54.9%) and arthritis (52.7%) were the most prevalent chronic conditions followed by high cholesterol (34.8%), diabetes (26.3%), heart disease (23.5%), cancer (19.7%), chronic pain (19.4%), lung diseases (15%), depression (8.5%), and macular degeneration (8.2%).

Dietary supplement use was very prevalent with 85.9% of all subjects using at least one, similar to the 84-87% rate of use reported previously in regional studies [3, 15]. As expected, more females (90.5%) were users than males (73.6%). Females also

reported using more dietary supplements per person than males, 4.0 ± 3.0 and 2.6 ± 2.6, respectively. A listing of the most commonly used dietary supplements can be found in Table 2.2.

The most frequently reported dietary supplements were a multi-vitamin, multi-mineral (MVMM) (60.8%), calcium (51.7%), vitamin D (45.8%), fish oil (26.0%), vitamin C (20.4%), vitamin E (18.8%), and glucosamine (16.3%). These results are consistent with findings in previous studies [1, 2, 7, 8]. All calcium supplements that participants reported having access to, i.e. those sold in discount stores, chain drug stores, and mail order catalog, contained vitamin D. Therefore, all subjects using a calcium supplement, without other minerals, were classified as vitamin D users and accounts for the higher prevalence of use than in previous studies. The use of fish oil was higher than previously reported and may reflect an increase of use in recent years or physician influence. Herbal supplements were infrequently used by participants of the current study.

Factors Predicting Dietary Supplement Use

Factors found to be predictive of general dietary supplement use included gender ($p<.001$), self-reported health status ($p=.034$), and cancer diagnosis ($p=.014$). The current study found that females making regular physician visits and reporting good health status were most likely to use dietary supplements. This profile is similar to the "typical" dietary supplement user described in previous research, though education and income levels were not found to be predictive of general dietary supplement use[2, 3, 5, 7]. The significant decrease in dietary supplement users among subjects diagnosed with cancer is not consistent with previous studies[16]. The difference may possibly be a result of the types of cancer reported; skin cancer was most common in the current study. Other influential factors included recency of physician visits ($p=.065$) and diagnosis of macular degeneration ($p=.066$). Subjects reporting an interval greater than six months since their most recent physician visit were less likely to use dietary supplements; consistent with previous reports indicating more than two visits per year were associated with supplement use [19]. The significance associated with macular degeneration is a result of

having 96% of subjects who reported the condition also reporting dietary supplement use. The total number of subjects with macular degeneration was 26.

Table 2.3 reports the most significant factors in predicting use of MVMM, calcium, vitamin C, vitamin D, vitamin E, fish oil, and glucosamine. Factors statistically significant in predicting use of MVMM were gender (p=.002), education (p=.032), recency of physician visit (p=.025), and cancer diagnosis (p=.015). Female high school graduates reporting a physician visit in the previous six months were most likely to use MVMM. Higher education levels were previously associated with MVMM use and may be reflected in the nearly significant higher income levels (p=.089) [10]. An increased number of physician visits had been reported as linked to increased vitamin/mineral use [17]. Contrary to previous findings associating dietary supplement use and cancer, there was evidence that individuals with cancer were less likely to use MVMM. An earlier study of female subjects 55-74 years old found those with cancer less likely to use MVMM supplements than subjects without cancer [18].

Significant factors predicting calcium use included gender (p<.001), race (p=.015), recency of physician visit (p=.041), and diagnosis of arthritis (p=.003). The most likely users of calcium were white, non-Hispanic females reporting a physician visit within the preceding six months. Of the racial groups reported in the current study, white, non-Hispanic females had the greatest risk for developing osteoporosis. Further, those reporting more recent physician visits may be more aware of their bone density and therefore more motivated to use calcium supplements. The association between calcium use and arthritis does not appear to have any clinical relevance because calcium has not been linked to the prevention or treatment of arthritis.

Vitamin D use was predicted by gender (p=.001), race (p=.044), alcohol usage (p=.033), and diagnosis of arthritis (p=.002). Factors predicting vitamin D use were similar to those predicting calcium, a likely reflection of common inclusion in the same product. White, non-Hispanic females with arthritis were most likely to use vitamin D. The significance of alcohol use predicting in vitamin D use had not previously been reported, and may not have clinical relevance.

Use of fish oil was significantly predicted by younger age (p=.002) and diagnosis of macular degeneration (p=.044). Fish oil use has not previously been associated with

younger age, but higher use of NVNM supplements had been found in women under 74 years compared to those 75 years and older [3]. There is some indication that subjects in the current study were using fish oil to prevent or treat eye conditions, namely macular degeneration. Limited evidence indicates that the fatty acids contained within fish oil may help slow the progression of macular degeneration [19].

Factors statistically predictive of vitamin C use included diagnosis of arthritis (p=.001) and high blood pressure (p=.009). Vitamin C had previously been shown to be effective in slowing the rate of osteoarthritis progression, though there is no evidence that subjects in the current study were taking the supplement as a treatment [4]. The current study found subjects with high blood pressure were less likely to use vitamin C than those with normal blood pressure. This finding is consistent with previous work that found an inverse association between high blood pressure and use of vitamin C [21]. Higher education level (p=.051) was also a significant contributing factor in the use of vitamin C.

Vitamin E use was significantly predicted by physical activity level (p=.015), alcohol use (p=.031), tobacco use (p=.044), and presence of chronic pain (p=.037). Recency of physician visits (p=.053) was also found to be a contributing factor in determining vitamin E use. Subjects who exercised more often, drank alcohol weekly, never smoked, and reported having chronic pain were more likely to use vitamin E. Physical activity was a predicting factor for the use of vitamin E in the current study and is consistent with previous reports [11, 23]. Alcohol or tobacco use had not previously been shown to significantly predict vitamin E use [10, 20]. Previous reports have not specifically linked the use of vitamin E to the frequency of physician visits or chronic pain, though an increased number of chronic conditions had been [10].

The model predicting glucosamine use was not statistically significant, though the variable arthritis (p=.003) was statistically predictive. Subjects reporting arthritis were more likely to use glucosamine than those without arthritis. Education (p=.064), though not statistically significant, also contributed to the prediction of glucosamine use. Previous studies support both arthritis and having at least a high school degree as factors predicting the use of glucosamine [3].

Justification for Dietary Supplement Use

The justification for dietary supplement use varied greatly among the older adults surveyed. Interview responses to questions about why they were using each supplement were classified as 1) disease/health condition prevention and treatment, 2) no reason, 3) recommended/told to take, 4) general health, 5) behavioral reasons, and 6) part of another supplement. The most common reasons for use were disease/health condition prevention and no reason.

A variety of dietary supplements were used in the prevention or treatment of health conditions. Calcium (n=83) was used most frequently to "protect bones" and "prevent/treat osteoporosis." Fish oil (n=44) was most frequently used to treat high cholesterol and may reflect physician influence. Previous reports had found fish oil effective in lowering cholesterol levels by increasing high density lipoproteins and altering the size of low density lipoprotein [21]. Other conditions treated with fish oil included arthritis, heart disease, and macular degeneration. Fish oil was used in "prevention/treatment of cardiovascular problems" and "prevention/treatment of eye problems." The use of fish oil for eye problems supports the previously mentioned finding of the current study indicating that macular degeneration was predictive for using fish oil. Glucosamine (n=39) and chondroitin (n=24) were most frequently used in the prevention and treatment of arthritis and "joint problems." This finding supports the earlier reporting of arthritis as a significant predicting factor for use of glucosamine. Table 2.4 contains a complete listing of dietary supplements used in the treatment of specific chronic health conditions.

"No reason" was frequently reported as a justification for dietary supplement use. This category included those responding that it had been too long since they had begun taking the dietary supplement to recall the specific reason or that there really was no true justification for use. The New Mexico Aging Process Study found that approximately 10% of respondents did not remember why a particular supplement was being used [12]. Dietary supplements most often taken for "no reason" included calcium (n=38), vitamin D (n=33), vitamin C (n=20), vitamin E (n=20), B-complex (n=16), vitamin B12 (n=12), and glucosamine (n=10). The current finding raises some concerns about possible inappropriate use or over-consumption.

Dietary supplements were recommended most frequently by physicians, but also by family/friends, other healthcare professionals, etc. Physicians were reported to recommend calcium (n=20), fish oil (n=15), vitamin E (n=14), folic acid (n=11), and B-complex (n=10) particularly. Analyses of the current data found that less recent physician visits decreased the likelihood that calcium, vitamin D, or vitamin E was used. Therefore, it is possible that physicians were recommending or encouraging the use of dietary supplements, explaining why those with more recent visits were taking more dietary supplements.

General use of dietary supplements taken had previously been associated with health maintenance and well being [7, 12]. Vitamin B12 (n=13) was the supplement most associated with general good health. Subjects reported taking vitamin B12 to "increase energy/pep" and because "it's good for you." General health reasons associated with the use of vitamin C (n=12) included "it's good for you" and "believed it was deficient." B-complex (n=9) was used to "increase energy/pep" and "it's good for you." Fish oil (n=9) was used because "it's good for you."

Behavioral-based justifications for dietary supplements were reported infrequently. The use of calcium (n=5) and fish oil (n=5) was related to low dietary intake of milk and fish. Apple cider vinegar (n=4) was taken as an aide for weight loss. Finally, some dietary supplements were taken as part of a combined supplement preparation. For example, vitamin D (n=104) was almost exclusively taken as part of a calcium supplement. Other combined supplements consumed in the current study included magnesium and zinc with calcium and chondroitin with glucosamine.

Conclusions

The current study contributes to the understanding of factors predictive of the use of specific dietary supplements and provides insight into the rationale for why specific dietary supplements are used. An additional strength was the use of telephone interview to verify information provided by the participant on the questionnaire.

Limitations included the cross-sectional design that prevented inferences from being made about whether or not the dietary supplement used was in response to a particular condition or not. The disproportionate number of males to females may

potentially have altered the results and may be a result of the reliance on volunteers and study focus.

Future research studies may benefit from the investigation of the rationale for dietary supplement recommendations by physicians. The use of several specific dietary supplements in the current study was related to physician visits and recommendations reportedly made by them. Therefore, the results emphasize the need to capture the intent of physicians to recommend dietary supplement use. Further investigation of the perceived benefits of dietary supplements is also merited.

Dietary supplements were commonly used in the current study of Kansans and factors predicting use of specific supplements were identified. The most common factors that predicted supplement use were: arthritis, recency of physician visits, female gender, and level of education. Justifications reported by subjects for use of dietary supplements were most often prevention/treatment of health conditions and recommendation by their physicians. Therefore, it is concluded that older adults in the current study were most likely taking dietary supplements to help prevent/treat health conditions as evidenced by the provided justifications and relationship of conditions like arthritis and macular degeneration in predicting use. Physicians were influential in the decisions to use dietary supplements as revealed by the statistical significance of physician visit recency.

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Table 2.1 Demographic and health characteristics of older Kansans

	Total		Male		Female	
	n	%	n	%	n	%
Gender	319	100	87	27.3	232	72.7
Ethnicity						
White	297	93.1	79	24.8	218	68.3
Hispanic	8	2.5	5	1.6	3	0.9
Black	12	3.8	3	0.9	9	2.8
American Indian	2	0.6	2	0.6	0	0.0
Marital Status						
Widowed	153	48.0	19	5.9	133	41.7
Married	110	34.5	45	14.2	65	20.4
Monthly Income						
<$2000	170	53.3	44	13.8	122	38.2
>$2000	65	20.4	26	8.2	39	12.2
Did not know income level	32	10.0	7	2.2	25	7.8
Did not disclose	56	17.6	15	4.7	59	18.5
Education						
Less than high school	35	11.0	13	4.1	22	6.9
High school diploma	231	72.4	54	16.9	177	55.5
College degree	48	15.0	20	6.3	28	8.8
Eat at senior center						
Yes	269	84.3	77	24.1	192	60.2
Alcohol use						
Never drink	255	79.9	66	20.7	189	59.2
Drink weekly	49	15.4	19	6	30	9.4
Tobacco use						
Never used	192	60.2	31	9.7	161	50.4
Current user	16	5.2	9	2.8	7	2.2
Former user	101	32.7	46	14.4	55	17.2
Physical activity						
Not active	74	23.2	16	5.0	58	18.2
1-2 days/week	70	21.9	22	6.9	48	15.0
3-4 days/week	90	28.2	17	5.3	73	22.9
>5 days/week	79	24.8	30	9.4	49	15.4
Most recent doctor's visit						
Last month	144	45.1	43	13.5	101	31.7
2-6 months	118	37.0	32	10.0	86	27.0
>6 months	56	17.6	12	3.8	44	13.8
Current health status						
Fair/poor	106	33.2	30	9.4	76	23.8
Good	135	42.3	35	11.0	100	31.3
Excellent/very good	78	24.5	22	6.9	56	17.6
Prescription drug use						
Yes	290	90.1	81	25.4	209	6.3

Table 2.2 Frequency of dietary supplement use of older Kansans

	Total		Males		Females	
	n	%	n	%	n	%
MVMM	194	60.8	41	47.1	153	65.9
Calcium	165	51.7	21	24.1	144	62.1
Vitamin D	146	45.8	21	24.1	125	53.9
Fish oil	83	26.0	22	25.2	61	26.3
Vitamin C	65	20.4	12	13.8	53	22.8
Vitamin E	60	18.8	13	14.9	47	20.3
Glucosamine	52	16.3	11	12.6	41	17.8
B-complex	42	13.2	11	12.6	31	13.4
Magnesium	34	10.7	8	9.2	26	11.2
Chondroitin	33	10.3	4	4.6	29	12.5
Vitamin B12	33	10.3	2	2.3	31	13.4
Eye vitamin/mineral[a]	28	8.8	9	10.3	19	8.2
Flax seed oil	24	7.5	2	2.3	22	9.5
Iron	24	7.5	6	6.9	18	7.8
Folic acid	22	6.9	5	5.7	17	7.3
Zinc	22	6.9	5	5.7	17	7.3
Garlic	20	6.3	3	3.4	17	7.3
Apple cider vinegar	15	4.7	3	3.4	12	5.2
CoQ10	15	4.7	5	5.7	10	4.3
Lutein	14	4.4	4	4.6	10	4.3
Elderberry extract	11	3.4	3	3.4	8	3.4
Vitamin B6	11	3.4	1	1.1	10	4.3
Vitamin A	9	2.8	1	1.1	8	3.4
Chromium	8	2.5	3	3.4	5	2.2
Niacin	7	2.2	3	3.4	4	1.7
Selenium	7	2.2	1	1.1	6	2.6
Ginger	5	1.6	1	1.1	4	1.7
Echinacea	4	1.3	0	0.0	4	1.7
Gingko biloba	4	1.3	2	2.3	2	0.9

[a]Eye vitamin/mineral is a supplement preparation usually containing a combination of beta-carotene, vitamin C, vitamin E, zinc, copper, and selenium.

Table 2.3 Most significant factors predicting of specific dietary supplement use

Supplement	Gender	Education	Most recent physician visit	Arthritis	Cancer
MVMM	p=.002	p=.032	p=.025	p=.426	p=.015
Calcium	p<.001	p=.565	p=.041	p=.003	p=.054
Vitamin D	p=.001	p=.316	p=.075	p=.002	p=.126
Fish oil	p=.002	p=.286	p=.133	p=.690	p=.094
Vitamin C	p=.163	p=.051	p=.111	p=.001	p=.588
Vitamin E	p=.621	p=.061	p=.053	p=.065	p=.560
Glucosamine	p=.875	p=.064	p=.168	p=.003	p=.323

P-values provided in the table correspond to the level of significance associated with each factor from each logistic regression model.

Table 2.4 Dietary supplements used by older Kansans in the treatment of select chronic conditions

Chronic condition	Dietary Supplement	Number of Subjects Using Supplements For Treatment
Arthritis (n=168)*		
	glucosamine	16
	chondroitin	10
	calcium	4
	apple cider vinegar	3
	fish oil	2
	flax seed oil	2
	vitamin B6	1
Depression (n=27)*		
	St. John's wort	1
Diabetes (n=84)*		
	chromium	2
	vitamin C	1
Heart disease (n=75)*		
	fish oil	5
	EDTA	1
	folic acid	1
	vitamin E	1
High cholesterol (n=111)*		
	fish oil	22
	flax seed oil	8
	niacin	5
	garlic	3
	apple cider vinegar	1
High blood pressure (n=175)*		
	garlic	4
	fish oil	1
	magnesium	1
	vitamin E	1
Macular degeneration (n=26)*		
	eye vitamin/mineral	11
	lutein	2
	fish oil	1
	flax seed oil	1

*Represents number of persons reporting this diagnosis; not all subjects used supplements for treatment.

CHAPTER 3 - Impact of Vitamin and Mineral Supplement Use on Adequacy of Micronutrient Intakes of Older Adult Kansans

Abstract

Background: Older adults frequently use vitamin and mineral (VM) supplements, though little is known about the impact of supplements on dietary adequacy. While VM supplements have been shown to improve dietary intake, concerns have been raised over increased possibility of excessive nutrient consumption through the use of VM supplements.

Objective: The purpose of the current study was to evaluate the micronutrient intake of older adults with focus placed on the identification of nutrients most improved by VM supplement use, nutrients most likely to remain inadequate, and nutrients most likely to be consumed in excess.

Design: Volunteer subjects were recruited from 35 senior centers throughout Kansas. A questionnaire was used to collect demographic data, information on current health status, and use of dietary supplements. Subjects were then followed up by telephone to complete two 24-hour diet recalls and confirm VM supplement use.

Subjects: Dietary intake and VM supplement use was analyzed for 263 community-based subjects. Mean age was 77.0±7.3 years. The sample was predominately female, white, non-Hispanic, with an income of <$24,000, and reported eating a noon meal at the local senior center.

Analysis: Chi-square was used to determine differences in VM supplement use between males and females. Dietary adequacy was determined by comparing the ratio of averaged dietary intake to the Dietary Reference Intakes (DRI). The analysis was stratified by nutrient intake from diet only and diet intake + supplements.

Results: Analysis of dietary intakes revealed intakes of vitamin D, vitamin E, calcium, and magnesium were most likely to be below recommended DRI. The inclusion of VM supplements most improved the intakes of vitamin E, vitamin D, vitamin B6, calcium,

and folic acid. Through the use of VM supplements intakes of niacin, folic acid, and vitamin A most commonly exceeded the Tolerable Upper Limit.

Conclusions: Dietary intakes of several nutrients were low in the current study. The use of VM supplements significantly improved the dietary intake of older adults for most vitamins and minerals without consistently exceeding the tolerable upper limit.

Introduction

Classic vitamin and mineral deficiencies are rarely seen in the United States, though inadequate micronutrient intakes are seen, especially among the older adult population [1]. Previous studies including the Continuing Survey of Food Intakes by Individuals (CSFII), 1994-1996, NHANES III, and NHANES 1999-2000 have shown micronutrient inadequacies among older adults [2-5]. Particularly, the intakes of calcium, magnesium, and vitamin E were very low among sampled populations [2, 3, 6]. Evidence has indicated that low intake of vitamins and minerals can increase risk for chronic conditions like heart disease, some cancers, and osteoporosis [1, 7]. Low intakes can be improved through increased dietary consumption, food fortification, or use of dietary supplements [8].

Previous studies estimated that over 60% of adults 60+ years of age used a multivitamin/mineral (MVMM) supplement regularly [9, 10]. Previous studies have also shown that vitamin/mineral (VM) supplementation significantly increased the number of participants achieving adequate nutrient intakes [2, 11].

In addition to the potential benefits of VM supplementation, there are also concerns with supplementation. The American Dietetic Association recognizes that VM supplement use may be of benefit to some older adults, but acknowledges that dietary supplements greatly increase risk for toxicities [12]. Previous studies have shown that dietary supplements occasionally exceed the Tolerable Upper Limit (UL) for a particular nutrient. Excessive intakes of iron, zinc, folic acid, and vitamin A have previously been associated with VM supplement use [2, 11]. The purpose of this study was to evaluate the impact of vitamin and mineral supplementation on the micronutrient intake of older adults attending senior centers in Kansas. The objectives were to identify nutrients most improved by supplement use, nutrients most likely to remain inadequate with supplementation, and nutrients most likely consumed in excess.

Methods

Sample

This cross-sectional study enrolled participants from 35 randomly selected senior centers across the state of Kansas. Senior center participants were selected to represent a mixed audience of older adults residing in Kansas. Approval for this study was obtained from the Institutional Review Board of Kansas State University. All participants provided informed written consent on the day of study enrollment.

Adults greater than 60 years of age, with self-reported cognitive ability and telephone access were recruited. A total of 374 volunteers were enrolled in the study. Individuals <60 years of age (n=6), incomplete questionnaire (n=1), and diagnosis of Alzheimer's disease (n=1). Volunteers were not provided compensation for their participation, but were entered into a drawing for a raffle prize ($8 value) presented at each center.

Procedures

Visits were made to each senior center from June 2007 thru November 2007 to recruit subjects. At enrollment, subjects completed a questionnaire providing demographic information, current health status, and dietary supplement use. Subjects were then contacted twice by telephone to complete two 24-hour diet recalls and confirm/clarify dietary supplement use. A trained researcher, a registered dietitian, using the multi-pass technique conducted the 24-hour diet recalls. Required telephone interviews were not completed for forty-four participants because no further contact was requested, they were unable to be reached by telephone, or withdrew due to cognitive or medical reasons.

Dietary intake was analyzed using Nutritionist Pro (version 3.1, 2006, Stafford, Texas). Intakes were analyzed in two groups, diet only and diet + supplementation. Standardized supplement and dosages were developed for all VM supplements reported as unknowns and any VM supplements not included in the dietary analysis software, e.g. folic acid, copper, etc., were manually added to the mean dietary intakes of each subject.

A full summary of standardized VM supplements can be found in Table 3.1. Adequacy of micronutrient intake was determined by comparing intake from the 24-hour diet recalls to the Dietary Reference Intake (DRI) values, the Estimated Average Requirement (EAR) and Adequate Intake (AI). Micronutrient intakes were converted into ratios representing the portion of the DRI met. A ratio was formed comparing micronutrient intake to the Tolerable Upper Limit (UL) to determine excessive intakes. The current analyses included only those subjects reporting VM supplement use (n=263) and therefore excluded all participants not using a VM supplement (n=49).

Statistical Analysis

All statistical analyses were performed using SPSS (version 15.0, 2006, SPSS, Inc, Chicago, IL). Chi-square tests were used to identify differences in micronutrient intakes between gender and age groups. The Mann-Whitney test was used to determine differences in mean numbers of supplements consumed compared by gender. Statistical significance was set at $p<.05$. Percent DRI was calculated and means used to determine adequacy of dietary intake. Dietary adequacy was evaluated by creating ratios of dietary intake to the EAR. Nutrients without EAR values were evaluated for sufficient intake by comparing the ratio of dietary intake to the AI. Nutrient intakes with ratios greater than 1.0 were considered adequate/sufficient. Any nutrient intake ratio below 1.0 was considered inadequate/insufficient. Excessive intake was determined by creating ratios of dietary intake to the UL. Nutrients with intake ratios above 1.0 were considered excessive.

Results

Two hundred sixty-three participants completed two 24-hour diet recalls and confirmed usage of at least one VM supplement. The study population was predominately female, white, non-Hispanic, and widowed with yearly income below $24,000. Most participants had at least a high school education and participated in the meal program through the senior center. Alcohol and tobacco use were rare among study participants. Chronic health conditions were reported by over 90% of subjects and the use of multiple prescription medications was common. Mean age of participants was 77.0 ±

7.3 years, 77.3 ± 7.5 years for females and 76.1 ± 6.8 years for males. Additional demographic and health characteristics can be found in Table 3.2.

A multi-vitamin, multi-mineral (MVMM) supplement was the most commonly used VM supplement. Other frequently reported VM supplements included calcium, vitamin D, vitamin E, and vitamin C. Female subjects used significantly ($p<.01$) more VM supplements than males, 3.1 ± 2.1 and 1.9 ± 2.0, respectively. A complete listing of VM supplements used is listed in Table 3.3.

Dietary micronutrient intakes are reported in Table 3.4. Vitamin intakes below recommended levels were most common for vitamin D in 100% of subjects, vitamin E in 97.0% of subjects and folic acid in 71.5% of subjects. All subjects met the DRI for niacin, 92.0% met the DRI for riboflavin, and 81.4% met the DRI for vitamin A. Mineral intakes most frequently below DRI levels were calcium in 97.7% of subjects and magnesium in 86.3% of subjects. The DRI was most commonly met for iron and selenium in 97.7% of subjects and 68.4% of subjects, respectively. Statistical differences were found between the percent of males and females achieving adequate intake levels for vitamin B12, folic acid, thiamin, calcium, chromium, copper, and selenium.

VM supplementation significantly impacted the micronutrient intake for a large number of participants. Subjects achieving adequate intakes was most improved for vitamin E, folic acid, vitamin D, vitamin B6, and calcium following the inclusion of VM supplements. The change in the number of subjects achieving recommended intakes are located in Table 3.4. Subjects exceeding the Tolerable Upper Limit (UL) can be found in Table 3.5. Supplementation was most likely to exceed recommended intakes of niacin in 42.2% of subjects, folic acid in 27.4% of subjects, and vitamin A in 22.1% of subjects.

Discussion

Vitamin/Mineral Supplement Use

Vitamin and mineral supplement use was very common in the current population, especially among females, and the types of VM supplements used were consistent with those previously reported. As anticipated, MVMM was the most commonly used dietary supplement in the current study [9, 10]. Vitamin E, vitamin C, and calcium had previously been reported as the most common single nutrient supplements [2, 9, 10, 13]. The high usage

of vitamin D in the current study had not been previously reported; the difference may be the result of supplement classification in the current study. Because the reported calcium supplements contained vitamin D, all subjects taking calcium were classified as taking both calcium and vitamin D, resulting in a higher rate of use than previously reported.

Dietary intake

Dietary intakes of vitamin A, vitamin B12, niacin, riboflavin, iron, and selenium were adequate in over 75% of the current study population. Similarly, the Continuing Survey of Food Intakes by Individuals, 1994-1996 (CSFII) that focused on older adults also found 75% of all participants had adequate intakes for vitamin B12 and iron, but did not report intakes of niacin, riboflavin, or selenium [2]. Adequate niacin and riboflavin intakes were reported in greater than 75% of the older adults enrolled in the Salsibury Eye Evaluation [14].

Greater than 50% of the current population had inadequate intakes of vitamin E, magnesium, folic acid, vitamin B6, and insufficient intakes of vitamin D and calcium. Low dietary intakes of vitamin E, magnesium, and calcium have been commonly reported in older adult populations [2-4, 14, 15]. The low intake of vitamin B6 was surprising because previous studies like CSFII and NHANES 1999-2000 reported that a majority of older adults had adequate intakes [2, 4]. While studies that have focused on regional populations, rather than national samples, were more likely to report inadequate vitamin B6 intakes, it is unclear why current study participants had such low intakes [14, 16]. Vitamin D intake has not previously been reported in large national studies like CSFII or NHANES.

Impact of Vitamin/Mineral Supplements on Dietary Intake

The use of VM supplements significantly improves the dietary intake of all micronutrients analyzed in the current study. Most improved was vitamin E, followed by folic acid, vitamin B6, and zinc. Vitamin E adequacy had previously been reported as most impacted by the inclusion of VM supplements [2, 11].

Despite most nutrient intakes significantly improving with VM supplement use, some intakes still remained inadequate in a large percentage of the current study population. In particular, magnesium, vitamin D, and calcium were most likely to remain

inadequate despite supplementation. Previously reported NHANES 1999-2000 data indicated that magnesium intake decreased with increasing age, and dietary supplements were an important source of the mineral [6]. MVMM were the most common sources of supplemental magnesium in the current study, but in most cases still did not provide sufficient nutrient amounts to meet standards. CSFII found that 30% of participants still had inadequate intakes despite supplementation [2]. The inadequate magnesium intakes found in the current study are a concern because low magnesium levels may cause hypocalcemia and interferes with vitamin D metabolism [7]. Further, low magnesium intakes have been associated with higher blood pressure levels [7]; over half of current subjects reported high blood pressure.

Even with widespread use of MVMM and calcium supplements containing vitamin D, intakes remained insufficient for nearly half of the population. Vitamin D intake was not previously reported with CSFII or NHANES data, but insufficient intakes of vitamin D have been linked to osteopenia, osteoporosis, and increased risk of bone fracture [17].

Calcium intakes remained low even with frequent supplementation. The major concern of insufficient calcium intakes among older adults is decreased bone mineral density and increased risk of bone fractures [7]. NHANES III found 60% of males and 66% of females had insufficient calcium intakes with the inclusion of dietary supplements, but used the Healthy People 2010 guideline for calcium intake of 924 mg/day as the reference value rather than the AI value from the DRIs [3]. In contrast to NHANES III, the current study found that 63% of participants were taking a calcium supplement in addition to the use of a MVMM containing calcium. NHANES III found that only 27% of participants did so [3]. Use of antacids was rarely reported in the current study and even fewer reported use as a calcium supplement.

Excessive Intake

While inadequate intakes remain a concern for older adults, the use of VM supplements increases the risk of excessive intake. Subjects in the current study were most likely to exceed the UL for niacin, folic acid, and vitamin A. Excessive niacin intakes have been reported in previous studies. The Hawaii-Los Angeles Multi Ethnic

Cohort (MEC) found 61% of participants exceeding the UL for niacin [11]. Excessive intakes in the current study were the result of B-complex and single nutrient niacin supplements. Five subjects in the current study reported taking therapeutic doses of niacin for treatment of high cholesterol. The UL has been set for niacin not so much to prevent toxicity as to prevent the adverse reaction known as flushing syndrome [18].

Supplementation exceeded the vitamin A UL for 7.6% subjects, though all exceeded the UL through a combination of provitamin A and beta-carotene. Thirty percent were taking single nutrient vitamin A supplements, recorded primarily as the preformed vitamin. Subjects exceeding the UL through the use of preformed vitamin A are at the greatest risk for toxicity [19]. Excessive long term consumption of provitamin A has been associated with increased hip fractures in postmenopausal women [20], a concern for the five female subjects currently exceeding the UL.

Excessive folic acid intakes in older adults have been a concern since fortification of grain products began in 1998. Folic acid supplementation has the potential to mask a B12 deficiency in older adults, increasing the risk of anemia and cognitive impairment [21]. Over 84% of subjects supplementing with folic acid exceeded the UL in the current study.

The results of the current study were strengthened by the enrollment of subjects from across the state. Further, the inclusion of VM supplements not included with the diet analysis software and careful attention to accurate reporting of the nutritional content of each of these supplements improved accuracy and provided strength to the results.

Limitations of the current study include the use of volunteer subjects, self-reported data, and use of standardized supplement data values. The current sample of subjects was comprised of volunteer participants who may differ from their non-participating counterparts, particularly with regard to dietary supplement use, cognitive function, and general health status. All data were self-reported and relied on the memory of the older adult, lending to the possibility that food items and/or dietary supplements were underreported, over-reported, or omitted entirely. The use of standard supplement amounts for unknowns may have underestimated intake and ultimately resulted in higher numbers of subjects with inadequate intakes from food plus supplements.

Future work should continue to investigate the dietary intake of older adults and focus specifically on food selection to identify why dietary intakes of some micronutrients are so low. Investigation should also focus on improvement of micronutrient intakes in community-based older adults through food selection.

Conclusion

The current study shows micronutrient intake of older adults is significantly impacted by the use of VM supplements. The number of subjects with sufficient levels of consumption greatly improved with the addition of VM supplements, especially MVMM. Despite the improvement, nearly half of the subject population still had insufficient intakes of calcium, magnesium, and vitamin D. Intakes above the UL were reported, but were not likely to cause severe adverse effects. The current results support older adults taking a daily, low-dose MVMM supplement. This is contrary to the current position of the American Dietetic Association (ADA), to obtain nutrients through food only rather than supplement the diet. Given the large number of subjects with insufficient dietary intakes, significant dietary changes must happen in order for current older adults to meet the ADA position. Therefore, without major dietary changes, the findings from this study indicate older adults may benefit from a low dose multivitamin/mineral, if not currently taking another multivitamin/mineral supplement.

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Table 3.1 Standardized nutrient values recorded for vitamin and mineral supplements when unspecified

Supplement Reported	Item/Amount Recorded
Multivitamin/mineral	Centrum Silver
Calcium + Vitamin D	400 mg calcium carbonate + 400 IU vitamin D
Chromium	200 mcg
Folic Acid	400 mcg [a]
Iron	18 mg
Magnesium	250 mg
Niacin	100 mg
Thiamin	100 mg
Vitamin A	10,000 IU
Vitamin B12	250 mg
Vitamin C	500 mg
Vitamin E	400 IU
Zinc	25 mg

[a] Converted to mcg Dietary Folate Equivalent (DFE) using 1.7mcg DFE to 1 mcg folic acid.

Table 3.2 Demographic and self-reported health characteristics of participants

	Male %	Female %
Gender	22.4	77.6
Race/Ethnicity (n=263)		
White, non-Hispanic	21.7	73.0
African American	0.8	2.7
Hispanic	0.0	1.5
Native American	0.4	0.0
Marital Status (n=262)		
Widowed	5.7	43.9
Married	11.8	22.5
Divorced	3.8	8.4
Single	1.5	2.3
Yearly Income (n=263)		
<$24,000	10.6	39.9
>$24,000	7.2	13.7
Did not report	4.9	23.6
Education (n=260)		
<High school	4.2	7.3
High school	8.5	28.1
Some college	5.4	31.9
College grad	5.0	9.6
Current Health Status (n=263)		
Excellent	1.5	5.3
Very good	7.6	19.8
Good	8.7	32.7
Fair	4.6	17.9
Poor	0.4	1.5
Alcohol Use (n=251)		
Never use	19.5	66.5
Consumes weekly	4.0	10.0
Tobacco Use (n=256)		
Never used	8.2	56.3
Current user	1.2	1.6
Former user	13.7	19.1
Meal at senior center (n=260)		
Yes	20.7	65.0
No	1.9	12.3

Table 3.3 Frequency and types of vitamin and mineral supplements used by older Kansans

	Total (n=263)	**Male** (n=59)	**Female** (n=204)
Supplement	*%*	*%*	*%*
Multivitamin/ mineral	72.6	67.8	74.0
Calcium	61.6***	33.9	69.6
Vitamin D	54.4***	33.9	60.3
Vitamin C	24.0	20.3	25.0
Vitamin E	22.4	22.0	22.5
B-complex	15.6	15.3	9.3
Magnesium	12.9	13.6	12.7
Vitamin B12	12.5**	3.4	15.2
Eye vitamin/ mineral[a]	10.6	18.6	14.7
Iron	9.1	10.2	8.8
Folic acid	8.4	8.5	8.3
Zinc	8.4	8.5	8.3
Vitamin B6	3.8	1.7	4.4
Vitamin A	3.4	1.7	3.9
Chromium	3.0	5.1	2.5
Niacin	2.7	5.1	2.0
Selenium	2.3	1.7	2.5
Thiamin	0.8	0.0	1.0

[a]Formulation designed to help maintain eye function, usually containing β-carotene, vitamin C, vitamin E, copper, and zinc.
**p<.01
***p<.001

Table 3.4 Micronutrient intakes below the Estimated Average Requirement (EAR) and Adequate Intake (AI) Reference Values for subjects by gender

	Food Only			Food + Supplement		
	Total	Male	Female	Total	Male	Female
	← *% Below EAR/AI* →					
Vitamins						
Vitamin A	18.6	16.9	19.1	3.8	1.1	4.4
Vitamin B6	61.2	55.9	62.7	13.3	8.5	14.7
Vitamin B12	23.2*	10.2	27.0	6.1	0.0	7.8
Vitamin C	52.9	59.3	51.0	16.7	18.6	16.2
Vitamin D[a]	100.0	100.0	100.0	51.7	57.6	50.0
Vitamin E	97.0	96.6	97.1	22.1	18.6	23.0
Folic Acid	71.5*	57.6	75.5	17.5	8.5	20.1
Niacin	0.0	0.0	0.0	0.0	0.0	0.0
Riboflavin	8.0	3.4	9.3	1.5	0.0	2.0
Thiamin	35.4	23.7	38.7	9.1	5.1	10.3
Minerals						
Calcium[a]	97.7*	93.2	99.0	49.8	59.3	47.1
Chromium	29.3**	44.1	25.0	12.5	15.3	11.8
Copper	37.3**	20.3	43.6	17.1	6.8	20.1
Iron	2.3	0.0	2.9	1.5	0.0	2.0
Magnesium	86.3	84.7	86.8	67.3	78.0	64.2
Selenium	31.6***	6.8	38.7	17.5	0.0	22.5
Zinc	53.2	57.6	52.0	15.6	13.6	16.2

[a]Nutrients with AI values
***p<.001, **p<.01, *p<.05

Table 3.5 Percent of subjects exceeding the Tolerable Upper Limit (UL) through use of all vitamin and mineral supplements and those exceeding the UL from single nutrient supplements only

	Exceeding UL %	Exceed UL with single nutrient VM %
Niacin	42.2	4.5
Folic Acid	27.4	23.6
Vitamin A	22.1	10.3
Magnesium	14.1	16.2
Iron	2.7	85.7
Calcium	1.9	100.0
Vitamin B6	0.4	0.0
Vitamin C	0.4	0.0
Vitamin D	0.4	100.0

CHAPTER 4 - Additional Findings

Additional findings excluded from Chapters 2 and 3 focus on the dietary intake of all older adults completing the dietary intake portion of the study. These results have not yet been developed into a manuscript, but are still important in describing the characteristics and dietary habits of older Kansans. Data further describing the characteristics and dietary intakes of older adults, classification of nutritional adequacy, and identification of differences in dietary intake between dietary supplement users and non-users is reported.

Subjects

Three-hundred twelve volunteer participants completed two 24-hour recalls in addition to a questionnaire addressing demographic characteristics, health characteristics, and dietary supplement use. Data were analyzed for all older adults and then divided into two groups for further analyses. The first group was comprised of subjects reporting dietary supplement use (DS) and the remaining non-dietary supplement (NDS) using subjects made up the second group. A comparison of the demographic characteristics of the two groups can be found in Table 4.1 and health characteristics are in Table 4.2.

Table 4.1 Demographic characteristics comparing dietary supplement users (DS) and non-dietary supplement users (NDS)

	Total[a]		DS[b]		NDS[c]	
	n	%	n	%	n	%
Gender						
Male	84	26.9	64***	20.5	20	6.4
Female	228	73.1	207	66.3	21	6.7
Ethnicity						
White	292	93.6	255	81.7	37	11.9
Black	12	3.8	10	3.2	2	0.6
Hispanic	6	1.9	4	1.3	2	0.6
American Indian	2	0.6	2	0.6	–	–
Marital Status						
Widowed	151	48.4	133	42.6	18	5.8
Married	108	34.6	95	30.4	13	4.2
Divorced	39	12.5	32	10.3	7	2.2
Single	13	4.2	10	3.2	3	1.0
Monthly Income						
<$500	14	4.5	12	3.8	2	0.6
$501-$2000	149	47.8	126	40.4	23	7.4
$2001-$3500	45	14.4	39	12.5	6	1.9
$3501-$5000	17	5.4	16	5.1	1	0.3
>$5001	2	0.6	2	0.6	–	–
Did not disclose	85	27.2	76	24.4	9	2.9
Currently employed						
No	263	84.3	230	73.7	33	10.6
Yes	35	11.2	30	9.6	5	1.6
Education						
Less than high school	34	10.9	30	9.6	4	0.6
High school	117	37.5	100	32.1	17	1.3
Some college/ vocational school	112	35.9	99	31.7	13	4.2
Bachelor degree	28	9.0	24	7.7	4	5.4
Postgraduate degree	17	5.4	15	4.8	2	1.3

[a] For characteristics totaling less than 312, the remaining subjects did not answer the question.
[a] DS = Dietary Supplement user
[a] NDS = Non-Dietary Supplement user
***p=.001

Table 4.2 Self-reported health characteristics of dietary supplement users (DS) and non-dietary supplement users (NDS)

	Total[a]		DS[b]		NDS[c]	
	n	%	n	%	n	%
Eat at senior center						
Yes	263	84.3	230	73.7	33	10.6
No	45	14.4	38	12.2	7	2.2
Alcohol use						
Never drink	249	79.8	221	70.8	28	9.0
1-2 drinks/week	35	11.2	27	8.7	8	2.6
3-4 drinks/week	5	1.6	3	1.0	2	0.6
≥5 drinks/week	9	2.9	8	2.6	1	0.3
Tobacco use						
Never used	190	60.9	170	54.5	20	6.4
Current user	14	4.4	7	2.2	7	2.2
Former user	99	31.7	87	27.9	12	3.8
Physical activity						
Not active	74	23.7	69	21.6	5	1.6
1-2 days/week	70	22.4	65	20.4	5	1.6
3-4 days/week	90	28.8	83	26.0	7	2.2
>5 days/week	79	25.3	71	22.3	8	2.5
Most recent doctor's visit						
Last month	141	45.2	122	39.1	19	6.1
2-6 months	116	37.2	107	34.3	9	2.9
6-12 months	41	13.1	33	10.6	8	2.6
>12 months	13	4.2	9	2.9	4	1.3
Current health status						
Excellent	21	6.7	19	6.1	2	0.6
Very good	83	26.6	77	24.7	6	1.9
Good	131	42.0	111	35.6	20	6.4
Fair	69	22.1	59	18.9	10	3.2
Poor	8	2.6	5	1.6	3	1.0
Prescription drug use						
Yes	285	91.3	249	79.8	36	11.5
No	25	8.0	20	6.4	5	1.6
Chronic Condition						
Yes	290	92.9	251	80.4	39	12.5
No	22	7.1	20	6.4	2	0.6

[a] For characteristics totaling less than 312, the remaining subjects did not answer the question.
[a] DS = Dietary Supplement user
[a] NDS = Non-Dietary Supplement user

Table 4.3 Vitamin/mineral supplements used by gender and age group

	Gender		Age Group					
	Male	**Female**	**<70**	**71-74**	**75-79**	**80-84**	**85-89**	**>90**
MVMM	41	151	38	43	46	42	19	4
Eye vitamin/mineral[a]	9	19	3	5	6	6	6	2
B-complex	11	31	6	11	11	10	3	1
Calcium	21	142	25	35	40	33	23	7
Chromium	3	5	3	3	–	2	–	–
Folic acid	5	17	8	4	3	4	2	1
Iron	6	18	3	6	4	4	6	1
Magnesium	8	26	6	7	6	8	7	–
Niacin	3	4	2	1	3	1	–	–
Selenium	1	6	2	1	2	1	1	–
Vitamin A	1	8	2	2	2	2	1	–
Vitamin B12	2	31	3	10	5	7	5	3
Vitamin B6	1	10	2	3	2	2	1	1
Vitamin C	12	52	16	13	10	11	10	4
Vitamin D	20	124	24	31	34	26	22	7
Vitamin E	13	47	11	13	10	14	10	2
Zinc	5	17	3	5	5	5	3	1

[a]Eye vitamin/mineral refers to specially designed supplement containing β-carotene, vitamin C, vitamin E, copper, and zinc.

Available heights and weights of 294 subjects were used to calculate body mass indices (BMI). The remaining 18 subjects either declined to be weighed, were physically unable to stand without support (i.e. confined to a wheelchair or relied on a walker), or left before being measured. The mean BMI of the population was 29.1 ± 6.0, a strong indication the population is overweight. There was no difference between mean BMIs for men and women, 29.3 ± 4.8 and 29.2 ± 6.4, respectively. Mean BMI did not differ significantly between the DS group and NDS group, 29.2 ± 6.0 and 29.4 ± 5.8, respectively. Figure 4.1 displays BMI by age group and shows a downward trend in BMI with advancing age.

Greater than 75% of participants were classified as overweight or obese based on BMI estimates. The highest rate of obesity (>50%) was found among males <70 years and females 71-74. Prevalence of obesity was lower in the older age groups. BMI is classified into six categories: underweight (<18.5), normal (18.5-24.9), overweight (25-29.9), obese I (30-34.9), obese II (35-39.9), and obese III (≥40).

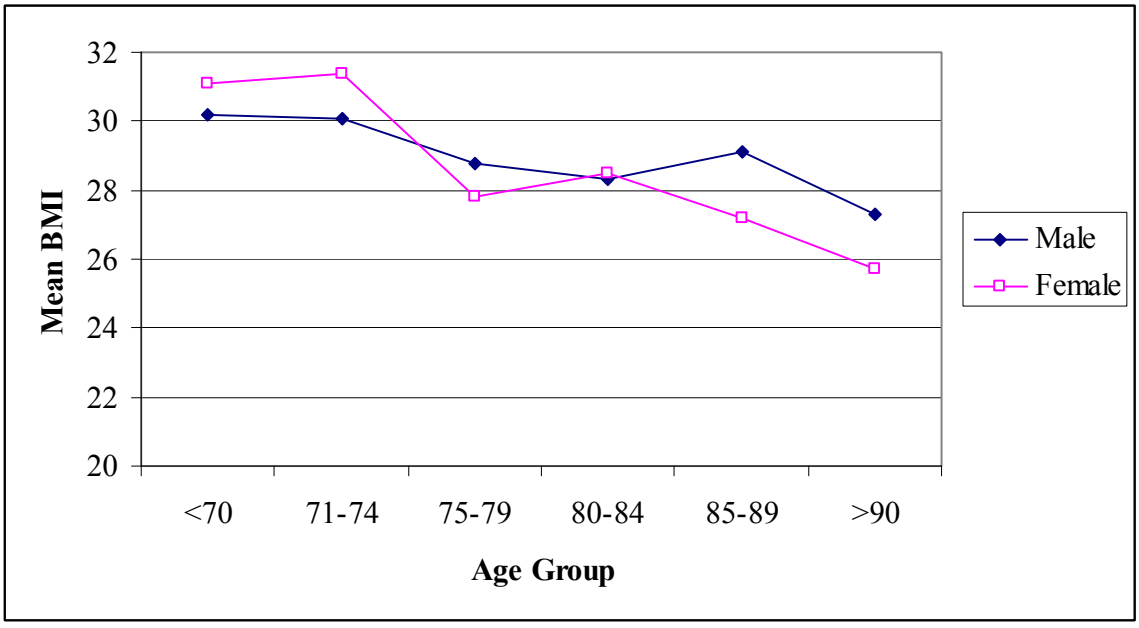

Figure 4.1 Mean Body Mass Index (BMI) per age and gender group
Normal BMI is found within the range of 18.0-24.9.

Table 4.4 Body Mass Indices by percent of gender and age group

	Underweight		Normal		Overweight		Obese I		Obese II		Obese III	
	n	%	n	%	n	%	n	%	n	%	n	%
Total												
Male	–	–	14	17.3	36	44.4	20	24.7	10	12.3	1	1.2
Female	1	0.5	57	26.8	78	36.6	38	17.8	25	11.7	14	6.6
<70												
Male	–	–	3	18.9	5	31.3	6	37.5	2	12.5	–	–
Female	1	2.8	7	19.4	12	33.3	8	22.2	2	5.6	6	16.7
71-74												
Male	–	–	2	9.5	10	47.6	6	28.6	2	9.5	1	4.7
Female	–	–	9	18.8	14	29.2	11	22.9	9	18.8	5	10.4
75-79												
Male	–	–	3	20.0	7	46.7	2	13.3	3	20.0	–	–
Female	–	–	22	40.0	18	32.7	6	10.9	6	10.9	3	5.5
80-84												
Male	–	–	5	26.3	8	42.1	4	21.1	2	10.5	–	–
Female	–	–	8	19.0	18	42.9	11	26.2	5	11.9	–	–
85-89												
Male	–	–	1	14.3	3	42.9	2	28.6	1	14.3	–	–
Female	–	–	7	28.0	14	56.0	2	8.0	2	8.0	–	–
>90												
Male	–	–	–	–	3	100.0	–	–	–	–	–	–
Female	–	–	4	57.1	2	28.6	–	–	1	14.3	–	–

Energy Intake

The mean energy intake for males was 1641.8 ± 426.9 Kcal and 1321 ± 317.6 Kcal for females. Energy intake significantly decreased with advancing age ($p<.01$). All energy intakes were calculated from food sources only, no supplements were included. The mean energy intake by gender and age group can be found in Figure 4.2.

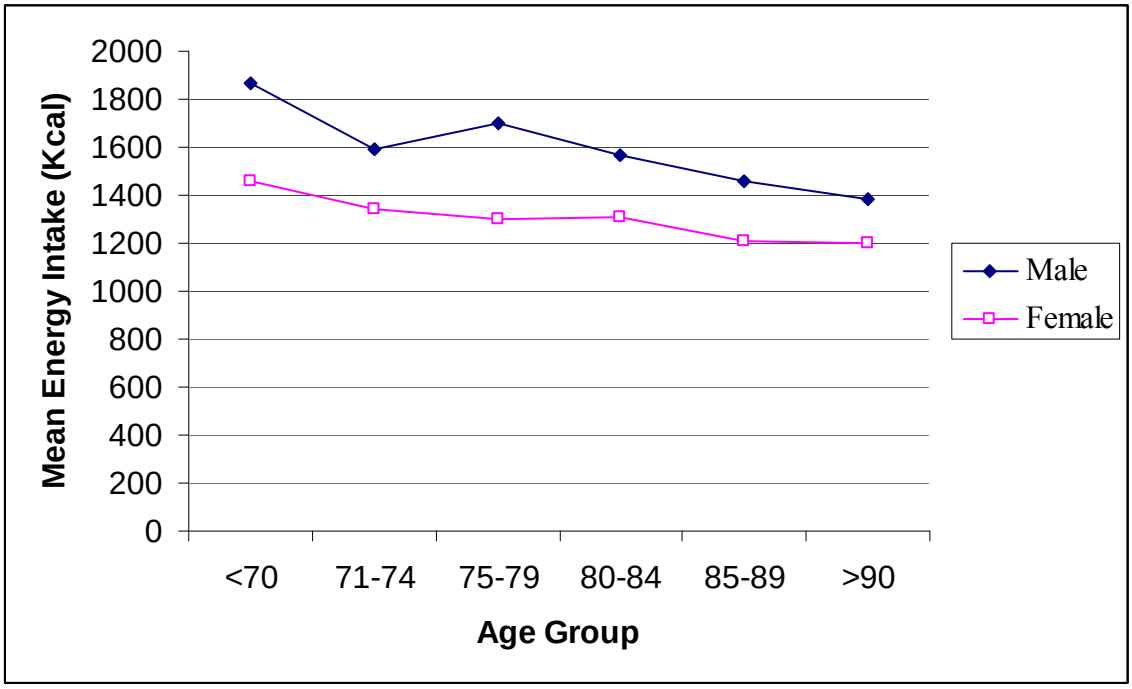

Figure 4.2 Comparison of mean energy intake

Table 4.5 Mean energy intakes compared by supplement use and gender

Supplement Use	Male	Female
	mean ± SD	**mean ± SD**
No	1767 ± 508 Kcal	1288 ± 290 Kcal
Yes	1603 ± 395 Kcal	1325 ± 321 Kcal

Macronutrient Intake

The percent of energy intake from protein, carbohydrate, and fat was compared to the Acceptable Macronutrient Distribution Range (AMDR) recommendations to determine whether subjects consumed recommended amounts. According to the AMDR recommendations, the dietary distribution for macronutrients should fall between 10-35%

protein, 45-65% carbohydrate, and 20-35% fat. Data was analyzed according to dietary supplement use and gender. Small differences exist between the DS and NDS groups, particularly within carbohydrate and fat intake. Both males and females in the DS group had lower intakes of fat and higher intakes of carbohydrate as compared to the NDS group.

Saturated fat, cholesterol, and fiber were compared to recommended values. Intake recommendations for saturated fat and cholesterol were not included in the AMDR recommendations or within the Dietary Reference Intakes (DRI). The 2005 Dietary Guidelines for Americans (DG) were used for comparison instead. According to the DG, saturated fat intake is to remain below 10% of total energy intake and cholesterol intake below 300 mg. The recommended intake for fiber is taken from the DRI values as an Adequate Intake (AI). Mann-Whitney tests were used to test the hypothesis that the distributions of dietary intakes for DS and NDS groups were equal. Table 4.6 reports the mean percent of macronutrient intake by gender and age and Table 4.7 reports the macronutrient intakes of DS and NDS subjects.

Table 4.6 Comparison of subjects meeting macronutrients needs reported by age and gender

	Male		Female		<70		71-74		75-79		80-84		85-89		>90	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
% protein																
below AMDR	–	–	3	1.0	1	0.3	1	0.3	–	–	1	0.3	–	–	–	–
within AMDR	84	26.9	224	71.8	54	17.3	70	22.4	74	23.7	63	20.2	35	11.2	12	3.8
above AMDR	–	–	1	0.3	–	–	–	–	–	–	1	0.3	–	–	–	–
% carbohydrate																
below AMDR	29	9.3	64	20.5	19	6.1	26	8.3	17	5.4	20	6.4	7	2.2	4	1.3
within AMDR	54	17.3	160	51.3	35	11.2	45	14.4	57	18.3	44	14.1	26	8.3	7	2.2
above AMDR	1	0.3	4	1.3	1	0.3	–	–	–	–	1	0.3	2	0.6	1	0.3
% fat																
below AMDR	1	0.3	8	2.6	1	0.3	2	0.6	2	0.6	2	0.6	1	0.3	1	0.3
within AMDR	34	10.9	130	41.7	21	6.7	32	10.3	45	14.4	39	12.5	23	7.4	4	1.3
above AMDR	49	15.7	90	28.8	33	10.6	37	11.9	27	8.7	24	7.7	11	3.5	7	2.2
% saturated fat																
within DG	18	5.8	93	29.8	13	4.2	23	7.4	29	9.3	30	9.6	14	4.5	2	0.6
above DG	66	21.2	135	43.3	42	13.5	48	15.4	45	14.4	35	11.2	21	6.7	10	3.2
Cholesterol																
within DG	55	17.6	195	62.5	44	14.1	52	16.7	63	20.2	52	16.7	30	9.6	9	2.9
above DG	29	9.3	33	10.6	11	3.5	19	6.1	11	3.5	13	4.2	5	1.6	3	1.0
Fiber																
below AI	81	26.0	204	65.4	48	15.4	66	21.2	70	22.4	59	18.9	31	9.9	11	3.5
within AI	3	1.0	24	7.7	7	2.2	5	1.6	4	1.3	6	1.9	4	1.3	1	0.3

AMDR = Acceptable Macronutrient Distribution Range
AI = Adequate Intake
DG = Dietary Guidelines

Table 4.7 Macronutrient intake of dietary supplement users (DS) versus non-dietary supplement users (NDS)

	Total				Male				Female			
	DS		NDS		DS		NDS		DS		NDS	
	n	%	n	%	n	%	n	%	n	%	n	%
% Protein												
below AMDR	3	1.1	–	–	–	–	–	–	3	1.4	–	–
within AMDR	268	98.9	40	97.6	64	100.0	20	100.0	204	98.6	20	95.2
above AMDR	–	–	1	2.4	–	–	–	–	–	–	1	4.8
% Carbohydrate												
below AMDR	78	28.9	15	36.6	21	32.8	8	40.0	57	27.5	7	33.3
within AMDR	188	69.4	26	63.4	42	65.6	12	60.0	146	70.5	14	66.7
above AMDR	5	1.8	–	–	1	1.6	–	–	4	2.0	–	–
% Fat												
below AMDR	9	3.3	–	–	1	1.6	–	–	8	3.9	–	–
within AMDR	146	53.9	18	43.9	27	42.2	7	35.0	119	57.5	11	52.4
above AMDR	116	42.8	23	56.1	36	65.3	13	65.0	80	38.6	10	47.6
% Saturated Fat												
within DG	100	36.9	11	26.8	16	25.0	2	10.0	84	40.6	9	42.9
above DG	171	63.1	30	73.2	48	75.0	18	90.0	123	59.4	12	57.1
Cholesterol												
within DG	222	81.9*	28	68.3	44	68.8	11	55.0	178	86.0	17	85.0
above DG	49	18.1	13	31.7	20	31.3	9	45.0	29	14.0	4	19.0
Fiber												
below AI	245	90.4	40	97.6	62	96.9	19	95.0	183	88.4	21	100.0
above AI	26	9.6	1	2.4	2	16.9	1	5.0	24	11.6	–	–

*p<.05

The NDS group was found to have significantly lower mean carbohydrate and fiber intakes ($p<.05$) and significantly higher mean fat and cholesterol intakes than DS subjects. No statistical differences were found between the two groups for the intakes of protein and saturated.

Table 4.8 Mean percent nutrient intakes for dietary supplement users (DS) and non-dietary supplement users (NDS)

	DS		NDS		
	% mean	**SD**	**% mean**	**SD**	*p-value*
% Protein	17.3	3.5	17.3	4.8	.428
% Carbohydrate	49.4	7.6	46.5	7.3	.017
% Fat	33.1	7.0	36.1	6.5	.014
Saturated fat	111.5	31.3	119.3	30.8	.076
Cholesterol	66.1	38.7	82.4	41.3	.008
Fiber	64.5	26.7	52.6	26.7	.014

Micronutrient Intake

The Estimated Average Requirement (EAR) or Adequate Intake (AI) values from the DRI recommendations were used to compare the micronutrient intake of the current study participants. Adequate micronutrient intakes are defined as an intake exceeding the EAR value. Chi-square was used to determine statistical differences in intake between men and women, among age groups, and between dietary supplement users and non-users.

Vitamins analyzed in this study include vitamin A, vitamin B6, vitamin B12, vitamin C, vitamin D, vitamin E, and folic acid. Comparison of vitamin intakes from all participants to the EAR values found the following inadequacies: vitamin A (22%), vitamin B6 (24%), vitamin B12 (24%), vitamin C (54%), vitamin E (97%), and folic acid (77%). Because vitamin D was compared to the AI value, adequacy of population intake cannot be determined, although 100% of the population had intakes below the AI, indicating that current intakes are believed insufficient to maintain general health. Intakes of vitamin B12 ($p<.01$) and folic acid ($p<.001$) were significantly different between men and women. No other statistical differences were found. Vitamin intakes are presented by age and gender in Table 4.9.

Table 4.9 Gender and age comparison of dietary intake to Estimated Average Requirement (EAR) and Adequate Intake (AI) for select vitamins

	Male		Female		<70		71-74		75-79		80-84		85-89		>90	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Vitamin A																
below EAR	20	23.8	49	21.5	15	4.8	21	6.7*	20	6.4	10	3.2	2	0.6	1	0.3
above EAR	64	76.2	179	78.5	40	12.8	50	16.0	54	17.3	55	17.6	33	10.6	11	3.5
Vitamin B6																
below EAR	45	53.6	145	63.6	33	10.6	49	15.7	40	45.1	38	12.2	22	7.1	8	2.6
above EAR	39	46.4	83	36.4	22	7.1	22	7.1	34	10.9	27	8.7	13	4.2	4	1.3
Vitamin B12																
below EAR	10	11.9	66	28.9**	14	4.5	22	7.1	16	5.1	12	3.8	10	3.2	2	0.6
above EAR	74	88.1	162	71.1	41	13.1	49	15.7	58	18.6	53	17.0	25	8.0	10	3.2
Vitamin C																
below EAR	51	60.7	117	51.3	31	9.9	46	14.7	40	12.8	32	10.3	13	4.2	6	1.9
above EAR	33	39.3	111	48.7	24	7.7	25	8.0	34	10.9	33	10.6	22	7.1	6	1.9
Vitamin E																
below EAR	80	95.2	222	97.4	53	17.0	69	22.1	72	23.1	64	20.5	34	10.9	10	3.2
above EAR	4	4.8	6	2.6	2	0.6	2	0.6	2	0.6	1	0.3	1	0.3	2	0.0
Folic Acid																
below EAR	47	56.0	176	77.2	41	13.1	54	17.3	48	15.4	45	14.4	24	7.7	11	3.5
above EAR	37	44.0	52	22.8***	14	4.5	17	5.4	26	8.3	20	6.4	11	3.5	1	0.3
Vitamin D																
below AI	84	26.9	228	73.1	55	17.6	71	22.8	74	23.7	65	20.8	35	11.2	12	3.8
above AI	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

*p<.05, **p<.01, ***p<.001

The number of subjects achieving adequate vitamin intakes in the DS group compared to the NDS group was determined using Chi-square analysis. Vitamin A was the only significantly different intake comparing DS to NDS subjects. Comparison of vitamin intakes can be found in Table 4.10.

Table 4.10 Comparison of dietary intake to Estimated Average Requirement/Adequate Intake for select vitamins by dietary supplement use

	Total				Male				Female			
	DS		NDS		DS		NDS		DS		NDS	
	n	%	n	%	n	%	n	%	n	%	n	%
Vitamin A												
below EAR	53	19.6**	16	39.0	14	21.9	6	30.0	39	18.8	10	47.6
within EAR	218	80.4	25	61.0	50	78.1	14	70.0	168	81.2	11	52.4
Vitamin B6												
below EAR	164	60.5	26	63.4	35	54.7	10	50.0	129	62.3	16	76.2
within EAR	107	39.5	15	36.6	29	46.2	10	50.0	78	37.7	5	31.4
Vitamin B12												
below EAR	63	23.2	13	31.7	8	12.5	2	10.0	55	26.6	11	52.4
within EAR	208	76.8	28	68.3	56	87.5	18	90.0	152	73.4	10	47.6
Vitamin C												
below EAR	145	53.5	23	56.1	39	60.9	12	60.0	106	51.2	11	52.4
within EAR	126	46.5	18	43.9	25	39.1	8	40.0	101	48.8	10	47.6
Vitamin D												
below AI	271	100.0	41	100.0	64	100.0	20	100.0	207	100.0	21	100.0
within AI	–	–	–	–	–	–	–	–	–	–	–	–
Vitamin E												
below EAR	262	96.7	40	97.6	61	95.3	19	95.0	201	97.1	21	100.0
within EAR	9	3.3	1	2.4	3	4.7	1	5.0	6	2.9	–	–
Folic Acid												
below EAR	193	71.2	30	73.2	36	56.3	11	55.0	157	75.8	19	90.5
within EAR	78	28.8	11	26.8	28	43.8	9	45.0	50	24.2	2	9.5

**p<.01

Minerals analyzed in this study included calcium, iron, sodium, and zinc. Iron and zinc both have EAR values while calcium and sodium have AI values. The mineral EAR comparisons found only 3% of the population with inadequate intakes of iron and 55% with inadequate zinc intakes. Calcium intakes were below the AI for 96% of all participants and 7% had intakes below the AI for sodium. The tolerable upper limit (UL) for sodium was exceeded by 46% of all participants. Intakes of calcium ($p<.001$) and sodium ($p<.001$) were significantly different between men and women. No other statistical differences were found between men and women or among age groups. Mineral intakes are presented by gender and age in Table 4.11.

Chi-square analyses were used to determine statistical differences in the number of subjects with adequate intake between the DS and NDS groups. The number of subjects with inadequate zinc intake ($p<.05$) was significantly different between the DS group and the NDS group. Subjects achieving adequate intakes for iron, calcium, and sodium were not statistically significant when comparing the DS group to the NDS group. Sodium intake levels ($p<.001$) were significantly different between male DS subjects and male NDS subjects. No other gender differences were found when comparing the DS group to the NDS group. Table 4.12 reports the comparison of DS and NDS mineral intake levels.

Table 4.11 Gender and age comparison of dietary intake to the Estimated Average Requirement or Adequate Intake for select minerals

	Male		Female		<70		71-74		75-79		80-84		85-89		>90	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Calcium																
below AI	76	90.5	225	98.7***	51	16.3	69	22.1	72	23.1	63	20.2	35	11.2	11	3.5
above AI	8	9.5	3	1.3	4	1.3	2	0.6	2	0.6	2	0.6	–	–	1	0.3
Iron																
below EAR	–	–	8	3.5	1	1.4	3	1.8	1	1.9	2	1.7	1	0.9	–	–
within EAR	84	100.0	220	96.5	54	17.3	68	21.8	73	23.4	63	20.2	34	10.9	12	3.8
Sodium																
below AI	–	–	22	9.6***	2	0.6	4	1.3	4	1.3	5	1.6	5	1.6	2	0.6
within AI	33	39.3	114	50.0	23	7.4	34	10.9	35	11.2	33	10.6	17	5.4	5	1.6
above AI	51	60.7	92	40.4	30	9.6	33	10.6	35	11.2	27	8.7	13	4.2	5	1.6
Zinc																
below EAR	49	58.3	123	53.9	34	10.9	42	13.5	36	11.5	35	11.2	20	6.4	5	6.6
within EAR	35	41.7	105	46.0	21	6.7	29	9.3	38	12.2	30	9.6	15	4.8	7	5.4

***p<.001

Table 4.12 Dietary supplement use and gender comparison of intake to Estimated Average Requirement or Adequate Intake for select minerals

	Total				Male				Female			
	DS[a]		NDS[b]		DS		NDS		DS		NDS	
	n	%	n	%	n	%	n	%	n	%	n	%
Iron												
below EAR	7	2.6	1	2.4	–	–	–	–	7	3.4	1	4.8
within EAR	264	97.4	40	97.6	64	100.0	20	100.0	200	96.6	20	95.2
Zinc												
below EAR	143	52.8*	29	70.7	36	56.3	13	65.0	107	51.7	16	76.2
within EAR	128	47.2	12	29.3	28	43.8	7	35.0	100	48.3	5	23.8
Calcium												
below AI	263	97.0	38	92.7	59	92.2	17	85.0	204	98.6	21	100.0
within AI	8	3.0	3	7.3	5	7.8	3	15.0	3	1.4	–	–
Sodium												
below AI	20	7.4	2	4.9	–	–	–	–	20	9.7	2	9.5
within AI	134	49.4	13	31.7	32	50.0	1	5.0	102	49.3	12	57.1
above UL	117	43.2	26	63.4	32	50.0*	19	95.0	85	41.1	7	33.3*

[a]Dietary Supplement users
[b]Non-Dietary Supplement users
*p<.05

Table 4.13 presents the results from the analysis between the mean percent intake of the DRI between DS and NDS subjects. The distribution of micronutrient intakes between the two groups was tested using the Mann-Whitney U test. Subjects in the DS group had significantly higher intakes of vitamin A ($p<.001$) and zinc ($p<.05$), and significantly lower intakes of sodium ($p<.05$) than did NDS subjects. No other statistically significant differences were found.

Table 4.13 Comparison of micronutrient intakes between dietary supplement users and non-users

	DS[a]		NDS[b]		
	Mean % of DRI[c]	**SD**	**Mean % of DRI**	**SD**	*p-value*
Vitamin A	252.5	204.3	153.7	97.3	p=.001
Vitamin B6	97.1	44.8	92.2	43.3	p=.589
Vitamin B12	198.9	265.9	158.5	100.6	p=.197
Vitamin C	115.3	86.9	102.9	72.3	p=.495
Vitamin E	28.3	442.0	25.1	22.8	p=.641
Vitamin D	20.0	14.9	21.5	19.9	p=.849
Folic Acid	94.0	67.4	82.8	47.5	p=.435
Calcium	52.8	21.8	54.8	26.5	p=.845
Iron	222.1	94.0	211.3	87.3	p=.738
Sodium	188.0	65.4	206.9	63.0	p=.020
Zinc	107.6	63.4	88.8	40.1	p=.013

[a]Dietary Supplement user
[b]Non-Dietary Supplement user
[c]Dietary Reference Intakes

Summary

In general, the current study reported diets with low energy intake, acceptable macronutrient intakes, high intakes of saturated fat and sodium, and low intakes of fiber. Inadequate micronutrient intakes were common. Most subjects consumed inadequate intakes of vitamin B6, vitamin C, vitamin E, folic acid, and zinc. Insufficient intakes of vitamin D and calcium were found for nearly all subjects. Excessive sodium intake was common.

The dietary intakes between the DS and NDS groups did differ. Subjects in the NDS groups had undesirably higher intakes of total fat, saturated fat, and sodium, whereas subjects in the DS group consumed greater quantities of most of the

micronutrients. The DS group statistically consumed more carbohydrate, fiber, vitamin A, and zinc. Therefore, these results support the theory that DS subjects may already consume more healthful diets than NDS subjects.

CHAPTER 5 - Summary and Overall Conclusions

This cross-sectional study investigated the use of dietary supplements and the dietary intake of older adult Kansans. The current research study: 1) determined types of dietary supplements used and the frequency of use, 2) identified dietary supplements used in the treatment of chronic conditions, 3) evaluated the current dietary intake, and 4) measured the impact of vitamin/mineral supplements on dietary adequacy.

Type and Frequency of Dietary Supplement Use

Older adults in the current study used a wide variety of dietary supplements. A general multi-vitamin, multi-mineral supplement was most common followed by calcium, vitamin D, fish oil, vitamin C, vitamin E, and glucosamine. A concern surrounding the use of dietary supplements has been that the supplement may not be taken at regular intervals and therefore, nullify any potential benefits. Most dietary supplements, especially vitamin/mineral supplements, were taken daily and therefore increase the likelihood that maximum benefit will be achieved.

Treatment of Chronic Conditions

Dietary supplements were associated with the treatment of ten pre-selected chronic conditions. Most common was the use of fish oil in the treatment of high cholesterol. Glucosamine and chondroitin were frequently cited in the treatment of arthritis. An eye vitamin/mineral was reported in the treatment of macular degeneration. The current results support the use of dietary supplements in the treatment of specific chronic conditions, but the justifications for use more strongly support a duel prevention and treatment role.

Current Dietary Intake

Energy intakes of participants tended to be lower than expected, though macronutrient consumption fell within normal ranges. Diets were further characterized by high saturated fat intakes and very low fiber intakes. Subjects were most likely to

have insufficient micronutrient intakes of vitamin B6, vitamin C, vitamin E, folic acid, vitamin D, calcium, and zinc. Additionally, DS subjects were more likely to have higher intakes of most micronutrients and fiber. DS subjects were also consumed less total fat, saturated fat, and sodium.

Impact of Vitamin/Mineral Supplements

Vitamin/mineral supplementation had a positive effect on dietary intake. Nutrients most improved through supplement use included vitamin E, folic acid, vitamin B6, and zinc. Despite supplementation, intakes of magnesium, vitamin D, and calcium remained low in almost half of participants. Supplementation did cause some subjects to exceed the Tolerable Upper Limit (UL). Nutrients most likely to exceed the UL were niacin, folic acid, vitamin A, and magnesium.

Limitations

Limitations of the current study include the reliance on a volunteer population and sole use of senior centers for recruitment. The focus of the study may potentially have discouraged some older adults from participating, particularly those not taking dietary supplements. The use of senior centers to recruit subjects was convenient, but may not fully represent community-based older adults in Kansas.

Further, the use of 24-hour diet recalls placed additional burden on the cognitive function of study participants to accurately recall previous dietary intake. Inaccurate recollection or portion size estimation may have led to underreporting or omission of foods in the current study. Additionally, telephone interviews completed on Sunday or Monday reflected weekend intake (a time when without meals at the senior center) and may not be representative of "normal" weekday intake, therefore accounting for some discrepancy between BMI and energy intake.

Finally, the diet analysis software contributed to study limitations. First, a majority of the foods contained in the database were brand name foods and were not part of the senior center meal program. The software was also unable to accurately calculate vitamin A intake as μg RAE. This resulted in the calculation of an estimated intake that

may have ultimately underestimated the intake for individuals with high beta-carotene intake as well as high supplement intakes.

Future Research

The current study provides evidence that physicians are influencing older adult dietary supplement choices and merits future investigation into the rationale for making such recommendations. Further investigation into the dietary choices of older adults is needed. There is indication of significant shortcomings in many micronutrient intakes from food sources within community-based older adults. Additional research is needed to develop EAR values for calcium and vitamin D, thereby possibly lowering the number of subjects with insufficient intakes.

Implications

The current study indicates many older Kansans are self-prescribing dietary supplements to prevent or treat health conditions. The dietary intake analyses found several nutrients with low intakes putting older adults at an increased risk for dietary inadequacies. Vitamin/mineral supplements significantly impacted the intakes of all micronutrients. This indicates that older adults may benefit from a low dose general multi-vitamin, multi-mineral supplement. While there is a risk of toxicity from vitamin/mineral supplements, results in the current study indicate that few subjects would be at significant risk.

Conclusion

Dietary supplement use is very prominent among older adults in the current study and vitamin/mineral supplementation can be very influential on dietary intake. Analysis of dietary intake has found adequate macronutrient intakes, but found significant risk with the low intake of several micronutrients. Vitamin/mineral supplementation helps correct many of the low intakes, but still leaves the intake of several key nutrients low.

Appendix A - Approval to Conduct Human Subjects Research

University Research
Compliance Office
203 Fairchild Hall
Lower Mezzanine
Manhattan, KS 66506-1103
785-532-3224
Fax: 785-532-3278
http://www.ksu.edu/research/comply

TO: Valentina Remig
Human Nutrition
212 Justin Hall

Proposal Number: 4307

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: May 24, 2007

RE: Approval of Proposal Entitled, "Association Among Dietary Supplement Use, Dietary Intake, and Chronic Conditions of Older Adults."

The Committee on Research Involving Human Subjects has reviewed your proposal and has granted full approval. This proposal is **approved for one year from the date of this correspondence, pending "continuing review."**

APPROVAL DATE: May 24, 2007

EXPIRATION DATE: May 24, 2008

Several months prior to the expiration date listed, the IRB will solicit information from you for federally mandated "**continuing review" of the research**. Based on the review, the IRB may approve the activity for another year. **If continuing IRB approval is not granted, or the IRB fails to perform the continuing review before the expiration date noted above, the project will expire and the activity involving human subjects must be terminated on that date. Consequently, it is critical that you are responsive to the IRB request for information for continuing review if you want your project to continue.**

In giving its approval, the Committee has determined that:

☒ There is no more than minimal risk to the subjects.
☐ There is greater than minimal risk to the subjects.

This approval applies only to the proposal currently on file as written. Any change or modification affecting human subjects must be approved by the IRB prior to implementation. All approved proposals are subject to continuing review at least annually, which may include the examination of records connected with the project. Announced post-approval monitoring may be performed during the course of this approval period by URCO staff. Injuries, unanticipated problems or adverse events involving risk to subjects or to others must be reported immediately to the Chair of the IRB and / or the URCO.

Appendix B - Informed Consent Form

Statement of Informed Consent

Association Among Dietary Supplement Use, Dietary Intake, and Chronic Health Conditions of Older Adults

Purpose of the Study
The purpose of this work is to study the relationships among dietary supplement use, presence of chronic conditions, and dietary intake of men and women 65+ years of age.

Project Sponsor
The American Dietetic Association Foundation has provided support for this project.

Research Project

I understand that I am volunteering to take part in a research study being performed by people in the Department of Human Nutrition at Kansas State University, Manhattan, KS.

I understand that this study will ask some personal questions, like my age. I may choose to not answer any questions without penalty. I will also report my chronic health conditions and use of dietary supplements like vitamins, minerals, and herbs. My height and weight will be taken today by trained project staff. I understand that I will also receive two telephone calls on later dates asking about my dietary habits and supplement use. The first telephone call will be scheduled at my convenience and no sooner than one week after today, the second call, also at a time that I request, will be scheduled within eight weeks of enrollment.

I have the chance to ask questions of the researcher(s). The survey will take approximately 15 minutes to complete and I may ask for help if it is needed. Two telephone calls will follow. Each will take about 30 minutes. I understand that no medical procedures are involved, physical risks are minimal, and I can hear well enough to use the telephone.

I understand that all of my information will be kept confidential. My information will not be shared or used by others not associated with the research study. Information that I provide will be coded and reported in a way that will not identify me.

I also understand that my participation is voluntary. I may withdraw from the study at any time. I will tell you today if I prefer not to be in the telephone part of the study.

My signature on the next page indicates that I have read and understand this consent form and agree to the study terms. My signature also means that I have received a signed and dated copy of this consent form for my files.

If I have questions about this study, I may contact:

Dr. Valentina (Tina) Remig, faculty member, Department of Human Nutrition
Kansas State University, 206 Justin Hall, Manhattan, KS 66506
Phone number: 785-532-0172 Email address: remig@ksu.edu

Dr. Rick Scheidt, Chair, Committee on Research Involving Human Subjects
University Research Compliance Office (URCO), Kansas State University
203 Fairchild Hall. Manhattan. KS 66506 Phone: (785) 532-3224

Please circle the best day(s) for you to be reached by telephone:

Sunday **Monday** **Tuesday** **Wednesday** **Thursday** **Friday**

Please circle the best time to reach you by telephone:

morning **afternoon** **evening**

Do not call before:_____ AM Do not call after: _____PM

_____

Name (please print) Date

_____

Signature

_____

Project staff signature Date

Appendix C - Survey Questionnaire

Subject Information

Name: _____

Telephone Number: (_____) _____- _____

Email Address: _____

Date of Birth: _____/_____/_____
Month Day Year

Home Zip Code: _____

Part 1. General Information
Please answer the following questions by checking or filling in the O (circle) that best describes you. If you make a mistake, simply cross out the wrong answer.

1. Gender (select one):

   O Male O Female

2. Ethnic origin (mark one):

   O White O Black
   O Hispanic O American Indian/Alaskan Native
   O Asian/Pacific Islander O Other: _____

3. Marital status:

   O Married OWidowed, how long _____
   O Divorced O Single

4. Estimated ***monthly*** income:

   O Less than $500 (less than $6,000 yearly)
   O $501-$2,000 (about $6,001-$24,000 yearly)
   O $2,001-$3,500 (about $24,001-$42,000 yearly)
   O $3,501-$5,000 (about $42,001-$60,000 yearly)
   O More than $5,001 (more than $60,001 yearly)
   O I do not wish to disclose my income
   O I do not know my income level

5. Are you *currently* employed?

   O Yes O No

6. Highest level of *formal education*:

- O Less than high school
- O High school degree
- O Some college or vocational training
- O Bachelors degree
- O Postgraduate degree

7. Do you participate in the meal program offered at your local senior center?

- O Yes
- O No

8. Alcohol use (beer, wine, or hard liquor):

- O Never drink
- O 3-4 drinks/week
- O 1-2 drinks/week
- O 5 or more drinks/week

9. Tobacco use:

- O Never smoked or used smokeless tobacco (chew or dip)
- O Currently tobacco user
  - O Smoke
  - O Use smokeless tobacco
  - How *much* do you smoke and/or chew? _____
  - How many *years* have you smoked and/or chewed? _____
- O Former smoker or smokeless tobacco user
  - O Smoked
  - O Used smokeless tobacco
  - How *much* did you smoke and/or chew? _____
  - How many *years* did you smoke and/or chew? _____
  - How *long* since you *quit* smoking and/or chewing? _____

10. How *often* do you participate in physical activity such as walking or weight lifting for at least 30 minutes?

- O Not active
- O 1-2 days/week
- O 3-4 days/week
- O 5 or more days/week

11. How recent was your *last visit* to a physician?

- O In the last month
- O In the last 2-6 months
- O In the last 6-12 months
- O More than 12 months ago

12. How would you rate your *current health*?

O Excellent
O Very good
O Good
O Fair
O Poor

13. Are you currently taking any *prescription* drugs (medicines)?

O No
O Yes

How many different prescriptions are you currently taking? _____

14. Have you ever been told by any of the following individuals to take a dietary supplement? Check all that apply.

O Physician (doctor)
O Dietitian
O Nurse
O Physical therapist
O Chiropractor
O Family member/friend
O None of the listed persons

Part 2. Health Status

Please check all conditions with which you have been diagnosed.

O Arthritis
O Cancer, specify type _____
O Chronic pain (example: chronic back pain, fibromyalgia, similar conditions)
O Diabetes
O Feelings of sadness, decreased energy, hopelessness (lasting longer than 2 weeks per year)
O Heart disease (coronary heart disease, cardiovascular disease, etc)
O High blood pressure
O High cholesterol
O Lung diseases (emphysema, chronic obstructive pulmonary disease, bronchitis, asthma)
O Macular degeneration
O Other conditions, please describe _____

Part 3. Supplement Use
Please mark any supplements you are currently using and how often by placing in a checkmark in the correct box.

	Frequency						
Supplement	**More than once a day**	**Once a day**	**5-6 times /week**	**3-4 times/ week**	**1-2 times/ week**	**2-3 times/ month**	**1 time/ month**
Multivitamin, No minerals (Example: Focus Factor)							
Multivitamin and minerals (Example: One-A -Day, Centrum Silver, Equate, Geritol Complete, etc.)							
B Complex							
Ocuvite							
Calcium							
Chromium							
Folate (Folic acid)							
Iron							
Magnesium							
Niacin							
Selenium							
Vitamin A							
Vitamin B12							
Vitamin B6							
Vitamin C							
Vitamin D							
Vitamin E							
Zinc							

	Frequency						
Supplement	**More than once a day**	**Once a day**	**5-6 times /week**	**3-4 times/ week**	**1-2 times/ week**	**2-3 times/ month**	**1 time/ month**
Echinacea							
Garlic							
Ginger							
Ginkgo biloba							
Ginseng							
Hawthorn							
Saw Palmetto							
St.John's Wort							
Valerian							
Apple cider vinegar							
Chondroitin							
Coenzyme Q10							
EDTA							
Elderberry Extract							
Fish oil							
Flax seed oil							
Glucosamine							
Lutein							
Other:							

If you are not currently taking any of the dietary supplements listed above, please initial here to let us know that you have read the list. _____

DO NOT FILL OUT

ID # _____

District # _____

Center _____

Weight _____ lbs

Height _____ in

Interviewed Y N

Appendix D - Chronic Condition and Dietary Supplement Verification Form

Name:_____ ID#:_____ Date:_____

Condition	Supplement(s) Used	Amount

OtherNotes:_____

Appendix E - Food Intake Record

Name:_____ ID:_____ Date:_____

Time	Food	Amount

Reliable recall: Y N_____

Usual intake: Y N_____

Appendix F - Participating Senior Centers

Table F.1 Senior centers participating in subject recruitment

Senior Center	Location
Oakley Senior Center	Oakley, KS
Vernon Senior Center	Kansas City, KS
Norton Senior Center	Norton, KS
Wellington Senior Center	Wellington, KS
Papan's Landing Senior Center	Topeka, KS
Holton Senior Center	Holton, KS
Derby Senior Center	Derby, KS
Concordia Senior Center	Concordia, KS
Beam Senior Center	Meade, KS
Scott City VIPs	Scott City, KS
Humboldt Senior Center	Humbolt, KS
Trinity Senior Center	Leavenworth, KS
Linwood Senior Center	Wichita, KS
McPherson Senior Center	McPherson, KS
Roeland Park Senior Center	Roeland Park, KS
Gardner Senior Center	Gardner, KS
Ottawa Senior Center	Ottawa, KS
Council Grove Senior Center	Council Grove, KS
DeSoto Senior Center	DeSoto, KS
Orchard Park Senior Center	Wichita, KS
LULAC Senior Center	Topeka, KS
Pratt Senior Center	Pratt, KS
Overland Park Senior Center	Overland Park, KS
El Dorado Senior Center	El Dorado, KS
East Topeka Senior Center	Topeka, KS
Fort Scott Senior Center	Fort Scott, KS
Merriam Community Center	Merriam, KS
Leon Senior Center	Leon, KS
Salina Senior Center	Salina, KS
Bird City Senior Center	Bird City, KS
Silver Lake Senior Center	Silver Lake, KS
Lincoln Senior Center	Lincoln, KS
Sterling Friendship Meals	Sterling, KS
Emporia Senior Center	Emporia, KS
Haysville Senior Center	Haysville, KS

Appendix G - Additional Results from Analysis of Dietary Supplement Use

Table G.1 Persons recommending the use of dietary supplements

	Total		Males		Females	
	n	%	n	%	n	%
Doctor	133	48.5	35	12.8	98	35.8
Family member/friend	34	12.4	11	4.0	23	8.4
Chiropractor	19	6.9	1	0.4	18	6.6
Dietitian	14	5.1	2	0.7	12	4.4
Nurse	13	4.7	2	0.7	11	4.0
Physical therapist	3	1.1	0	0.0	3	1.1

A total of 274 participants reported dietary supplement use. Percentages were calculated by using only those indicating they were currently using dietary supplements.

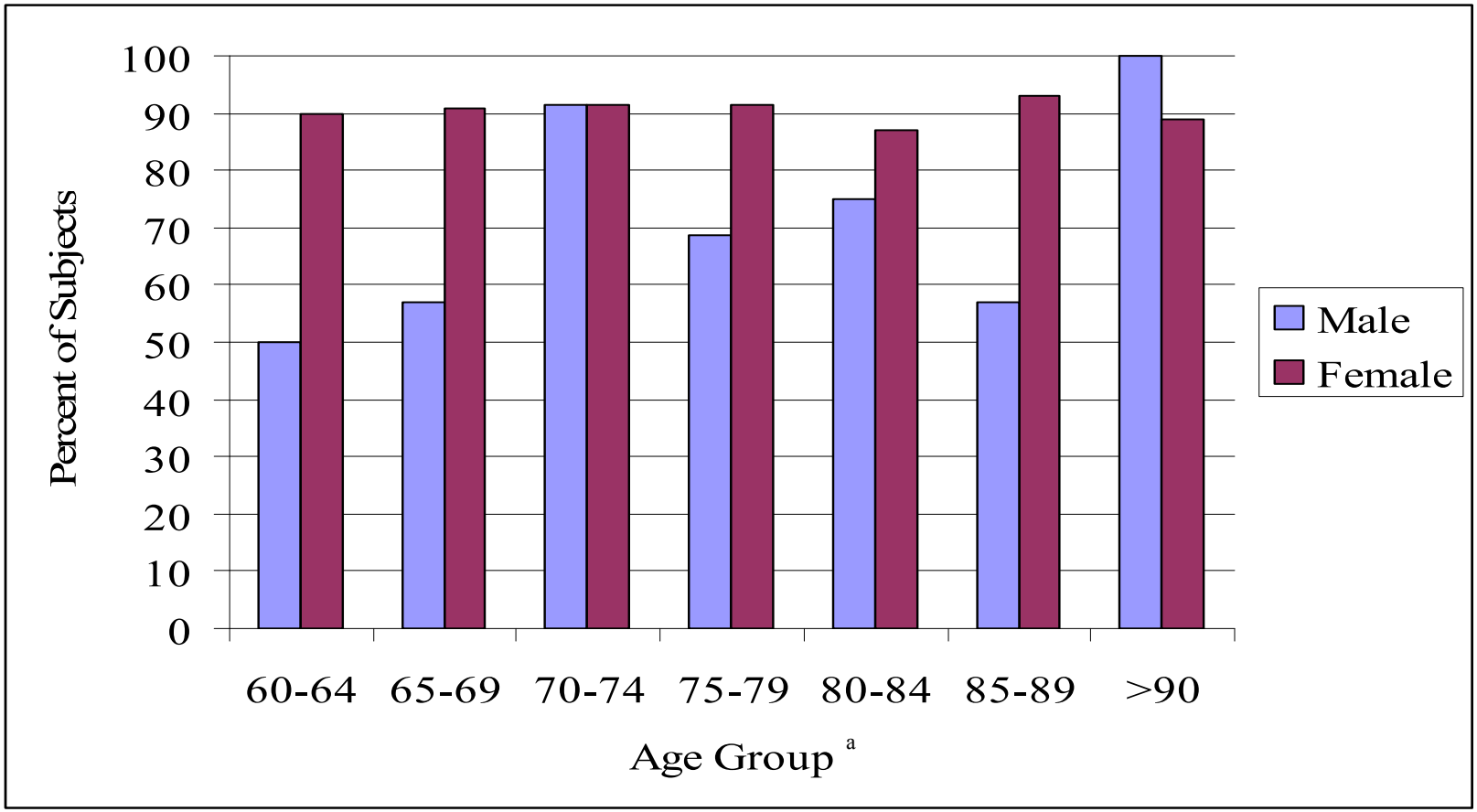

Figure G.1 Percent of subjects using dietary supplements. Females overall use more dietary supplements than males (p=.001).

[a]Age in years

Table G.2 Types of dietary supplements used by age group

	60-64		65-69		70-74		75-79		80-84		85-89		>90	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total Dietary Supplements	11	78.6	28	77.8	74	91.4	64	86.5	55	83.3	31	86.1	11	91.7
VM Supplements	10	71.4	28	77.8	70	86.4	61	82.4	54	81.8	31	86.1	11	91.7
Herbal Supplements	1	7.1	3	8.3	14	17.3	7	9.5	3	4.5	3	8.3	1	8.3
NVNM Supplements	8	57.1	13	36.1	44	54.3	34	45.9	26	39.4	11	30.6	4	33.3

VM supplements were used by 83% of subjects, herbal supplements by 10%, and NVNM supplements by 44%.

Table G.3 Associations between mixed nutrient supplement use and select chronic conditions

	MVMM		Eye vitamin/mineral		B-Complex	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Arthritis						
Yes	107	61	16	152	24	144
No	87	64	12	139	18	133
Cancer						
Yes	31*	32	9	54	8	55
No	163	93	19	237	34	222
Chronic pain						
Yes	41	21	5	57	11	51
No	153	104	23	234	31	226
Diabetes						
Yes	91	144	7	21	9	33
No	34	50	77	214	75	202
Depression						
Yes	17	10	2	26	4	23
No	177	115	25	266	38	254
Heart disease						
Yes	41	153	9	66	13	62
No	34	91	19	225	29	215
High blood pressure						
Yes	107	68	16	12	124	153
No	87	57	159	132	20	22
High cholesterol						
Yes	71	40	11	100	7	104
No	123	85	31	177	21	187
Lung diseases						
Yes	33	15	6	42	5	43
No	161	110	36	235	23	248
Macular Degeneration						
Yes	16	10	3	23	12***	14
No	178	115	39	254	16	277

*p<.05
***p<.001

Table G.4 Associations between single nutrient vitamin supplements and select chronic conditions

	Folic acid		Niacin		Vitamin A		Vitamin B12		Vitamin B6		Vitamin C		Vitamin D		Vitamin E	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Arthritis																
Yes	16	152	2	166	5	163	23	145	8	160	48***	120	92**	76	39*	129
No	6	145	5	146	4	147	10	141	3	148	17	134	54	97	21	130
Cancer																
Yes	5	58	2	61	4	59	8	55	2	61	13	50	24	39	12	51
No	17	239	5	251	5	251	25	231	9	247	52	204	122	134	48	208
Chronic pain																
Yes	3	59	1	61	2	60	6	56	5	58	15	47	30	32	15	47
No	19	238	6	251	7	250	27	230	7	250	50	207	116	141	45	212
Diabetes																
Yes	7	77	0	84	1	83	12	72	3	81	19	65	35	49	18	66
No	15	220	7	228	8	227	21	214	8	227	46	189	111	124	42	193
Depression																
Yes	5*	22	1	26	2	25	7*	26	3	81	19	65	35	49	18	66
No	17	275	6	286	7	285	20	266	8	284	57	235	131	161	56	236
Heart disease																
Yes	11**	64	2	73	2	73	10	65	7**	68	18	57	31	44	11	64
No	11	233	5	239	7	237	23	221	4	240	47	197	115	129	49	195
High blood pressure																
Yes	14	161	2	173	2	173	13	162	6	169	27*	148	81	94	31	144
No	8	136	5	139	7	137	20	124	5	139	38	106	65	79	29	115
High cholesterol																
Yes	10	101	3	108	1	110	12	99	4	107	19	192	53	58	18	93
No	12	196	4	204	8	200	21	187	7	201	46	162	93	115	42	166
Lung diseases																
Yes	2	46	1	47	5	43	0	48	8	40	19	29	5	43	3	45
No	20	251	6	265	7	264	28	243	11	260	57	214	127	144	55	216
Macular Degeneration																
Yes	2	24	1	25	2	24	4	22	2	24	4	22	10	16	6	20
No	20	273	6	287	7	286	29	264	9	284	61	232	136	157	54	239

*p<.05, **p<.01, ***p<.001

Table G.5 Associations between single nutrient mineral supplements and select chronic conditions

	Calcium		Chromium		Iron		Magnesium		Selenium		Zinc	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Arthritis												
Yes	103***	62	2	166	15	153	20	148	2	166	13	155
No	65	89	6	145	9	142	14	137	5	146	9	142
Cancer												
Yes	27	36	2	61	9*	54	7	56	–	63	2	61
No	138	118	6	250	15	241	27	229	7	249	20	236
Chronic pain												
Yes	36	129	1	31	7	55	7	55	1	61	5	57
No	26	128	7	250	17	240	27	230	6	251	17	240
Diabetes												
Yes	39	45	5	79	8	76	10	24	1	83	9	75
No	126	109	3	232	16	219	74	211	6	229	13	222
Depression												
Yes	17	10	1	26	3	24	4	23	2	25	9	75
No	148	144	7	285	21	271	30	262	5	287	19	273
Heart disease												
Yes	34	41	1	74	2	73	9	66	2	73	8	67
No	131	113	7	237	22	222	25	219	5	239	14	230
High blood pressure												
Yes	89	86	2	173	15	160	19	156	2	173	10	165
No	76	68	6	138	9	135	15	129	5	139	12	132
High cholesterol												
Yes	57	54	2	109	4	107	11	100	1	110	4	107
No	108	100	6	202	20	188	23	185	6	202	18	190
Lung diseases												
Yes	22	26	1	47	5	43	4	44	2	46	–	48
No	143	128	7	264	19	252	30	241	6	265	19	252
Macular Degeneration												
Yes	14	12	1	25	5*	21	2	24	1	25	2	24
No	151	142	7	286	19	274	32	261	6	287	20	273

*p<.05, **p<.01, ***p<.001

Table G.6 Associations between herbal supplements and select chronic conditions

	Echinacea		Garlic		Ginger		Gingko		Ginseng		Hawthorn		Saw Palmetto		St. John's Wort		Valerian	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Arthritis																		
Yes	2	166	9	159	3	165	2	166	–	168	1	167	–	168	–	168	–	168
No	2	149	11	140	2	149	2	149	–	151	–	151	2	149	1	150	1	150
Cancer																		
Yes	–	63	–	63	–	63	–	63	–	63	1	62	–	63	1	62	–	63
No	4	252	20	236	5	251	4	252	–	256	–	256	2	254	–	256	1	255
Chronic pain																		
Yes	–	62	2	60	–	62	–	62	–	62	1	61	–	62	–	62	–	62
No	4	253	18	239	5	252	4	253	–	257	–	257	2	255	1	256	1	256
Diabetes																		
Yes	–	84	4	80	1	83	2	82	–	84	1	83	–	84	–	84	–	84
No	4	231	16	219	4	231	2	233	–	235	–	235	2	233	1	234	1	234
Depression																		
Yes	–	84	4	80	1	83	2	82	–	84	1	83	–	84	–	27	–	27
No	4	288	20	272	5	287	4	288	–	292	–	292	2	290	1	291	1	291
Heart disease																		
Yes	–	75	2	73	1	74	–	75	–	75	1	74	1	74	–	75	–	75
No	4	240	18	226	4	240	4	240	–	244	–	244	1	243	1	243	1	243
High blood pressure																		
Yes	–	175	9	166	2	173	1	174	–	175	1	174	2	173	1	174	–	175
No	4	140	11	133	3	141	3	141	–	144	–	144	–	144	–	144	1	143
High cholesterol																		
Yes	–	111	7	104	2	109	–	111	–	111	–	111	1	110	1	110	–	111
No	4	204	13	195	3	205	4	204	–	208	1	207	1	207	–	208	1	207
Lung diseases																		
Yes	2	46	–	48	1	47	–	48	–	48	–	48	–	48	–	48	–	48
No	4	267	18	253	5	266	3	268	271	–	1	270	2	269	1	270	1	270
Macular Degeneration																		
Yes	1	25	1	25	–	26	–	26	–	–	–	26	–	26	–	26	1	25
No	3	290	19	274	5	288	4	289	–	–	1	292	2	291	1	292	–	293

Table G.7 Associations between non-vitamin, non-mineral supplements and select chronic conditions

	Apple Cider Vinegar		Chondroitin		Co Q10		EDTA		Elderberry Extract		Fish Oil		Flax Seed Oil		Glucosamine		Lutein	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Arthritis																		
Yes	10	158	22	146	5	163	–	168	5	163	46	122	12	156	38**	130	6	162
No	5	146	11	140	10	141	1	150	6	145	37	14	12	139	14	137	8	143
Cancer																		
Yes	2	61	5	58	2	61	–	63	2	61	12	51	4	59	9	54	4	59
No	13	243	28	228	13	243	1	255	9	247	71	185	20	236	43	213	10	246
Chronic pain																		
Yes	4	58	10	52	3	59	–	62	–	62	17	45	5	57	11	51	1	61
No	11	246	23	234	12	245	1	256	11	246	66	191	19	238	41	216	13	244
Diabetes																		
Yes	6	78	7	26	2	82	1	83	2	82	25	59	5	79	14	70	4	80
No	9	226	77	209	13	222	–	235	9	226	58	177	19	216	38	197	10	225
Depression																		
Yes	3	24	5	22	–	27	–	27	1	26	7	20	1	26	5	22	–	27
No	12	280	28	264	15	277	1	291	10	282	76	216	23	269	47	245	14	278
Heart disease																		
Yes	2	73	4	71	–	75	–	75	4	71	18	57	4	71	7	68	1	74
No	13	231	29	215	15	229	1	243	7	237	65	179	20	224	45	199	13	231
High blood pressure																		
Yes	10	165	15	160	7	168	–	175	7	168	48	127	8*	167	27	148	7	168
No	5	139	18	126	8	136	1	143	4	140	35	109	16	128	25	119	7	137
High cholesterol																		
Yes	5	106	9	102	4	107	–	111	3	108	35	76	10	101	16	95	2	109
No	10	198	24	128	11	197	1	207	8	200	48	160	14	194	36	172	12	196
Lung diseases																		
Yes	4	44	4	44	1	47	–	48	1	47	9	39	1	47	7	41	1	47
No	11	260	29	242	14	257	1	270	10	261	74	197	23	248	45	226	13	258
Macular degeneration																		
Yes	1	25	1	25	1	25	–	26	1	25	9	17	2	24	4	22	5	21
No	14	279	32	261	14	279	1	292	10	283	74	219	22	271	48	245	9	284

*p<.05, **p<.01

Appendix H - Additional Dietary Supplements Reported

Table H.1 Additional supplements reported by participants

Supplement Reported	Number of Subjects
Cinnamon	5
Cranberry	4
Mixed herbal supplement	3
Potassium	3
Cardio Balance®	2
Cod liver oil	2
Lecithin	2
Thiamin	2
Aloe vera	1
Alphabetic®	1
Alpha lipoic acid	1
Astragalus root	1
Cardio Sterol®	1
Cardio Tabs®	1
Cardio Tea®	1
Cayenne	1
Cholesterol Support®	1
Gelatin tabs	1
Green tea supplement	1
Hyaluronic acid	1
Iiodine	1
L-lysine	1
Milk thistle	1
MSM	1
Red yeast rice	1
Tumeric	1
Ultimate Brain Food®	1
Vitamin K	1

Appendix I - Complete Listing of Reasons for Dietary Supplement Use

Table I.1 Reasons for dietary supplement use

Supplement	Reason	n	% of users/ supplement
B-Complex	no reason	16	35.6
	doctor recommended/told to take	6	13.3
	for energy/pep/feeling tired	5	11.1
	relative/friend recommended	3	6.7
	for health/good for	2	4.4
	thought it was low/needed	2	4.4
	for nerves	2	4.4
	prevent chronic conditions/future problems	1	2.2
	read about it	1	2.2
	increase immunity/prevent cold/flu	1	2.2
	decrease blood pressure	1	2.2
	dermatologist recommended for warts	1	2.2
	prevent chronic conditions/future problems	1	2.2
	help brain function and prevent nightmares	1	2.2
	doctor told to take for polio syndrome	1	2.2
	kids were born with deficiency	1	2.2
Calcium	for bones	48	27.4
	no reason	38	21.7
	for osteoporosis/osteopenia	27	18.6
	doctor recommended/told to take	14	8.0
	for health/good for you	9	5.1
	does not drink milk	4	2.3
	recommended by non-MD health professional	4	2.3
	arthritis	3	1.7
	prevent chronic conditions/future problems	3	1.7
	read about it	2	1.1
	leg/muscle cramps	2	1.1
	test showed it was needed	2	1.1
	heart	2	1.1
	relative/friend recommended	1	0.6
	always taken	1	0.6
	spouse takes	1	0.6
	for joints	1	0.6
	takes because of calciuria	1	0.6
	supposed to take with Actinol	1	0.6
	dentist told to take after having children	1	0.6
	shrinking	1	0.6
	post menopausal	1	0.6
	fingernails were flakey	1	0.6
	has a deficiency in bones because of diabetes	1	0.6
	read it might help with arterial fibrillation	1	0.6

Supplement	Reason	n	% of users/ supplement
Eye Vitamin/ Mineral	macular degeneration	11	39.3
	for eyes	11	39.3
	no reason	3	10.7
	recommended by non MD health professional	2	7.1
	spouse is taking	1	3.6
Chromium	no reason	2	25.0
	diabetes/glucose regulation	2	25.0
	read about it	2	25.0
	always taken	1	12.5
	taking to help breakdown fat	1	12.5
Folic Acid	doctor recommended/told to take	9	40.9
	no reason	3	13.6
	read about it	2	9.1
	good for heart	2	9.1
	heart disease	1	4.5
	good for you	1	4.5
	increase immunity/prevent cold	1	4.5
	antioxidant	1	4.5
	prostate	1	4.5
	does not eat enough veggies	1	4.5
Iron	prevent/treat anemia	12	50.0
	doctor recommended/told to take	6	25.0
	no reason	5	20.8
	diverticulosis bleeding	1	4.2
Magnesium	no reason	9	26.5
	in supplement with calcium	8	23.5
	doctor recommended/told to take	4	11.8
	leg/muscle cramps	3	8.8
	read about it	2	5.9
	blood pressure	1	2.9
	relative/friend recommended	1	2.9
	for energy/pep/feeling tired	1	2.9
	for heart	1	2.9
	read that it might help w/ arterial fibrillation	1	2.9
	was low for a few years	1	2.9
	read it was good for your system	1	2.9
	for restless leg	1	2.9

Supplement	Reason	n	% of users/ supplement
Niacin	taking for cholesterol	5	71.4
	no reason	1	14.3
	thought it was low/needed	1	14.3
Selenium	no reason	2	28.6
	read about it	2	28.6
	for bones	1	14.3
	recommended by chiropractor/homeopath	1	14.3
	antioxidant	1	14.3
Vitamin A	no reason	3	37.5
	relative/friend recommended	2	25.0
	for hair/nails/skin	2	25.0
	with vitamin D	1	12.5
Vitamin B12	no reason	12	36.4
	feeling tired/give more energy/give pep	7	21.2
	for health/good for you	4	12.1
	doctor recommended	3	9.0
	thought it was low/needed	2	6.1
	relative/friend recommended	1	3.0
	increase immunity/prevent cold	1	3.0
	for bones	1	3.0
	carpel tunnel	1	3.0
	has taken for mouth sores	1	3.0
Vitamin B6	no reason	4	36.4
	arthritis	1	9.1
	for health/good for you	1	9.1
	doctor recommended/told to take	1	9.1
	thought it was low/needed	1	9.1
	for carpel tunnel syndrome	1	9.1
	might help prevent water retention	1	9.1
	might help stress	1	9.1

Supplement	Reason	n	% of users/ supplement
Vitamin C	no reason	20	30.0
	increase immunity/prevent cold/flu/pneumonia	20	30.0
	doctor recommended/told to take	6	9.0
	for health/good for you	6	9.0
	thought it was low/needed	4	6.0
	feeling tired/give more energy/give pep	3	4.5
	relative/friend recommended	2	3.0
	diabetes	1	1.5
	read about it	1	1.5
	recommended by chiropractor/homeopath	1	1.5
	for eyes	1	1.5
	antioxidant	1	1.5
	help heart	1	1.5
Vitamin D	with calcium supplement	104	70.7
	no reason	33	22.4
	doctor recommended/told to take	2	1.4
	read about it	2	1.4
	for health/good for you	1	0.7
	for osteoporosis treatment/prevention	1	0.7
	not getting enough sun	1	0.7
	read that it helps with absorption of other vitamins	1	0.7
	taking as a prescription	1	0.7
	taking with vitamin A	1	0.7

Supplement	Reason	n	% of users/ supplement
Vitamin E	no reason	20	34.5
	heart	9	15.5
	doctor recommended/told to take	5	8.6
	read about it	3	5.2
	antioxidant	2	3.4
	for memory/deter Alzheimer's	2	3.4
	friend/family recommended	2	3.4
	leg cramps	2	3.4
	recommended by chiropractor/homeopath	2	3.4
	blood pressure	1	1.7
	blood thinner	1	1.7
	for joints	1	1.7
	good healing power	1	1.7
	heart disease	1	1.7
	recommended by chiropractor/homeopath	1	1.7
	recommended to take by non-MD health professional	1	1.7
	siblings have Parkinson's and doctor thought it might help	1	1.7
	spouse taking	1	1.7
	taking for breast cyst	1	1.7
	with calcium	1	1.7
Zinc	with calcium	8	34.8
	no reason	6	26.1
	increase immunity/prevent colds	2	8.7
	hair/skin/nails	2	8.7
	with magnesium	2	8.7
	always taken	1	4.3
	memory/prevent Alzheimer's	1	4.3
	prostate	1	4.3
Echinacea	increase immunity/prevent cold/flu	3	75.0
	no reason	1	25.0
Garlic	no reason	8	38.1
	for health/good for you	5	23.8
	blood pressure	4	19.0
	cholesterol	3	14.3
	replaced cholesterol meds that "make lower legs hurt"	1	4.8

Supplement	Reason	n	% of users/ supplement
Ginger	GI problems/stomach ailments	3	60.0
	no reason	2	40.0
Gingko	for memory	3	75.0
	for bones	1	25.0
Hawthorn	relative/friend recommended	1	100.0
Palmetto	prostate	2	100.0
St. John's	depression	1	100.0
Valerian	to help with sleep	1	100.0
Apple Cider Vinegar	weight loss	4	23.5
	for arthritis	3	17.6
	for health/good for you	3	17.6
	no reason	2	11.8
	high cholesterol	1	5.9
	prevent chronic condition/future problems	1	5.9
	always taken	1	5.9
	told to take by non-MD medical professional	1	5.9
	GI problems	1	5.9
Chondroitin	joint problems	13	40.6
	arthritis	10	31.3
	no reason	4	12.5
	taking w/ glucosamine	3	9.7
	for bones	1	3.1
	recommended by chiropractor/homeopath	1	3.1
CoQ10	no reason	4	26.7
	doctor recommended/told to take	4	26.7
	for heart	3	20.0
	protect against cholesterol medication	2	13.3
	test showed it was needed	1	6.7
	recommended by chiropractor/homeopath	1	6.7
Edta	heart disease	1	100.0

Supplement	Reason	n	% of users/ supplement
Elderberry Extract	increase immunity/prevent cold	4	36.4
	for health/good for you	2	18.2
	takes for allergies	1	9.1
	good for asthma and blood pressure	1	9.1
	winter only	1	9.1
	help clean arteries	1	9.1
	no reason	1	9.1
Fish Oil	high cholesterol	22	25.3
	doctor recommended/told to take	10	11.5
	for health/good for you	9	10.3
	for heart	9	10.3
	no reason	6	6.9
	does not eat fish regularly/doesn't like fish	5	5.7
	heart disease	5	5.7
	for triglycerides	5	5.7
	eyes	4	4.6
	for arthritis	2	2.3
	spouse taking	2	2.3
	for macular degeneration	1	1.1
	friend/family recommended	1	1.1
	read about it	1	1.1
	for leg/muscle cramps	1	1.1
	recommended by chiropractor/homeopath	1	1.1
	high blood pressure	1	1.1
	to help with arterial fibrillation	1	1.1
	help keep regulated	1	1.1
Flax Seed Oil	high cholesterol	8	33.3
	no reason	6	25.0
	for arthritis	2	8.3
	for health/good for you	2	8.3
	for macular degeneration	1	4.2
	doctor recommended/told to take	1	4.2
	told to take by non-MD medical professional	1	4.2
	for heart	1	4.2
	for eyes	1	4.2
	alternates with fish oil	1	4.2

Supplement	Reason	n	% of users/ supplement
Glucosamine	for joints	21	39.6
	arthritis	16	30.2
	no reason	10	18.9
	for bones	2	3.8
	relative/friend recommended	1	1.9
	read about it	1	1.9
	recommended by chiropractor/homeopath	1	1.9
	thought work best for aches and pains	1	1.9
Lutein	for eyes	6	42.9
	no reason	3	21.4
	macular degeneration	2	14.3
	recommended/told to take by non-MD health professional	2	14.3
	relative/friend recommended	1	7.1

Appendix J - Dietary Reference Intakes

Table J.1 Dietary Reference Intakes

		Males		Females	
		51-70 years	>70 years	51-70 years	>70 years
Vitamins					
	Vitamin A (µg RAE/d)	900	900	700	700
	Vitamin C (mg/d)	90	90	75	75
	Vitamin D (IU)	400	600	400	600
	Vitamin E (mg/d)	15	15	15	15
	Thiamin (mg/d)	1.2	1.2	1.1	1.1
	Riboflavin (mg/d)	1.3	1.3	1.1	1.1
	Niacin (mg/d)	16	16	14	14
	Vitamin B6 (mg/d)	1.7	1.7	1.5	1.5
	Folic Acid (µg DFE/d)	400	400	400	400
	Vitamin B12 (µg/d)	2.4	2.4	2.4	2.4
Minerals					
	Calcium (mg/d)	1200	1200	1200	1200
	Chromium (µg/d)	30	30	20	20
	Copper (µg)/d	700	700	700	700
	Iron (mg/d)	6	6	5	5
	Magnesium (mg/d)	350	350	265	265
	Selenium (µg/d)	45	45	45	45
	Zinc (mg/d)	9.4	9.4	6.8	6.8