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Dietary Supplement Use and Beliefs among College Students Enrolled in an Introductory Nutrition Course

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To the Graduate Council:

I am submitting herewith a thesis written by Amy Denice Webb entitled "Dietary Supplement Use and Beliefs among College Students Enrolled in an Introductory Nutrition Course." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Marsha Spence, Major Professor

We have read this thesis and recommend its acceptance:

Betsy Haughton, Trena Paulus

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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DIETARY SUPPLEMENT USE AND BELIEFS AMONG COLLEGE STUDENTS ENROLLED IN AN INTRODUCTORY NUTRITION COURSE

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Amy Denice Webb
August 2009

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Acknowledgements

I want to first thank the chair of my thesis committee, Dr. Marsha Spence, for her knowledge and guidance in completing this project. I also want to thank my other committee members, Dr. Trena Paulus and Dr. Betsy Haughton, for the time they put into my project and the advice given by them. Next, I want to thank my statistical consultant Cary Springer for all of her assistance in completing the statistical analysis for this project. Most importantly I want to thank my family for their unending support during all my years of schooling.

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Abstract

The purpose of this study was to assess differences in the use of dietary supplements and beliefs related to their use based on college major, physical activity frequency, and weight status among college students enrolled in an introductory nutrition class. A secondary database consisting of introductory nutrition students at University of Tennessee, Knoxville during spring semester 2008 was used and contained a sample of 306 participants. Data were taken from results of a two part survey. The first section asked participants to respond about their use of dietary supplements and the second section asked participants to respond to their beliefs statements about supplements. Dietary supplements were assessed in 3 categories: vitamin and minerals, herbals, and ergogenic aids. Results showed that the most commonly used dietary supplements were vitamins and minerals with 228 (74.5%) of respondents reporting that they consumed at least 1 vitamin or mineral supplement in the last 12 months. While only 23 (7.5%) respondents reported using ergogenic aids, the use of this supplement category varied the most based upon major, weight status, and physical activity. Non-health-related majors (19.6% versus 9.0% of Health-related majors, $p<0.01$), overweight and obese individuals (26.7% versus 8.2% of normal and underweight respondents, $p<0.001$), and those who exercised daily (21.7% compared to 8.2% who exercised weekly or less, $p<0.001$) were more likely to take them. Major played no role in health beliefs scores, but individuals that exercised daily and those who were overweight or obese had higher mean beliefs scores, showing stronger health beliefs related to dietary supplements. Use of ergogenic aids varied the most based upon study variables. Therefore, future research should focus on determining reasons for this.

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Part I: Literature Review

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Introduction

With the enactment of the Dietary Supplement Health and Education Act of 1994 (DSHEA), the definition of a dietary supplement was largely expanded. Previous to this, a dietary supplement was considered to be composed only of essential nutrients, such as vitamins, minerals, and proteins. According to DSHEA, a dietary supplement is defined as:

> *"…a product (other than tobacco) that is intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin; mineral; an herb or other botanical; an amino acid; a dietary substance for use by man to supplement the diet by increasing the total daily intake; or a concentrate, metabolite, constituent, extract, or combinations of these ingredients.*
>
> *A dietary supplement is intended for ingestion in pill, capsule, tablet, or liquid form; is not represented for use as a conventional food or as the sole item of a meal or diet; and is labeled as a 'dietary supplement.'*[p.1, 1]

With the expansion of the definition of dietary supplements came an increased number of products on the market categorized as a dietary supplement. As a result, several recent research studies have looked at trends related to the consumption of dietary supplements.

One group found to use dietary supplements is the college population. While some studies have been conducted with this group, most have largely focused on athletes, not the population as a whole. Therefore, it is important that more research about college students' use and beliefs about supplements be conducted. For this reason, the proposed study aims to

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examine dietary supplement patterns in a subgroup of the college population. The following is a review of the current literature on the topic of dietary supplements use and beliefs.

Dietary Supplement Use in the General Population

Two nationally representative surveys have examined dietary supplement use in the United States. These are the National Health and Nutrition Examination Survey (NHANES) and the National Health Interview Survey (NHIS).

NHANES III was conducted by the National Center for Health Statistics (NCHS) from 1988-1994. It was a cross-sectional survey that was designed to give nationally representative data and prevalence estimates for several different nutrition, health status, and health condition measures.[2] Radimer and associates examined the data from NHANES III related to dietary supplements to uncover possible trends.[3]

Surveys were conducted as part of an in-home interview. Participants were asked during the interview if they had taken any vitamins or minerals in the past month; up to 17 different products could be listed by interviewers. Interviewers only queried participants on vitamin and mineral use, but often other types of dietary supplements were reported.[2] In this study those supplements not classified by NCHS as being predominantly vitamins or minerals were referred to as "other" supplements. The other supplements then were broken down into 6 categories, which is further explained in the article.[3]

Only 3.6% of the population studied reported taking any non-vitamin, non-mineral (NVNM) supplements. When looking at the total amount of NVNM supplements reported, garlic and lecithin were reported the most often. Reported rates of herbal and dietary supplement

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use tended to be higher in the following 5 groups: those older than 35 years; individuals of "other" race/ethnicity; individuals that had a higher alcohol intake (averaging above 1 drink per week); people who were obese; and those that had more healthful lifestyle habits (i.e. former smokers, higher fruit and vegetable consumers, and exercisers). Actual rates for these groups varied based on type of supplement being examined (herbal, other biologic and nutrient, body building, weight loss, any other). However, no associations were found based on region, urbanization, education, and income in this study.[3]

NHIS is another national survey that is conducted annually with the goal of gathering health information on the non-institutionalized, civilian household population in the United States. It is completed in-person and is carried out by the NCHS.[4] In 1987 and 1992 the NHIS included a supplemental questionnaire, the Cancer Supplement and the Cancer Risk Factor Survey. The aim of this questionnaire was to examine variables of interest to cancer control research. In 2000 a different supplemental questionnaire entitled the Cancer Control Module was included. All questionnaires asked participants about the frequency of intake of multivitamins (MV), vitamins A, C, and E, and calcium supplements during the preceding 12 months. In the 1987 questionnaire respondents were queried also on the number of pills taken per day and pill dosage. In addition, the 2000 Cancer Control Module inquired about the frequency of use of nonvitamin, nonmineral (NVNM) supplements in addition to the MV and single vitamins and minerals included in the 1987 and 1992 surveys. The participants who reported taking a NVNM supplement were asked to indicate which supplements they used from a list generated by the researchers.[5]

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When looking at the findings the prevalence of taking a vitamin/mineral (VM) supplement anytime in the previous 12 months did not change significantly between 1987 and 2000. The number reporting daily use, however, was more than 10% greater in 2000 than in either 1987 or 1992 (23.2% and 33.9%, respectively). This difference was found in all subgroups except Hispanic men and women of other races/ethnicities. When looking at VM supplement use in 2000 alone, generally women (38.7%), non-Hispanic whites (37.4%), and those 65 years and older (50.4%) had the highest frequencies of use.[5]

It was found that VM supplement use significantly increased as education increased ($p<0.01$) from less than 9th grade up to some college. It also increased significantly ($p<0.01$) as individuals' income increased from below the poverty level to at or above the poverty level. When looking at regions, those in the Midwest and South had the lowest frequency of use (34.4% and 32.0%, respectively) and those in the West and Northeast had the highest (34.4% and 36.0%, respectively). Use in the Northeast, Midwest, and West was significantly greater than use in the South ($p<0.01$). Former smokers were more likely to take a VM supplement daily (43.3%, $p<0.01$). Those who did not exercise were least likely to take VM supplements (28.5%, $p<0.01$).[5]

When herbal/botanical and NVNM supplements were examined, it was found that 14.5% of US adults reported taking a NVNM supplement in the last year, while 6.0% reported using one daily. The NVNM supplements taken daily by more than 15% of users were: other herbal/botanical supplements, Echinacea, Ginkgo biloba, garlic pills, ginseng (American, Asian), and St John's wort. NVNM supplement users tended to be non-Hispanic whites (6.8%, $p<0.01$),

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at least 35 years of age ($p<0.01$), those with any amount of college education (7.4%, $p<0.01$), at or above the poverty level (6.5%, $p<0.01$), consumers of any amount of alcohol ($p<0.01$), former smokers (8.3%, $p<0.01$), and current exercisers at any frequency ($p<0.01$).[5]

In summary, based on 2 nationally representative surveys, the percent range of individuals consuming any NVNM supplements varied greatly from 3.6% in NHANES III[3] and 14.5% in NHIS.[5] Garlic was found to be a popular herbal supplement in both surveys.[3, 5] Some common characteristics found by both were that NVNM supplement users were more likely to be older and have healthy lifestyle habits, such as exercising and being former smokers.[3, 5] However, while the NHIS results found a higher proportion of users to be more highly educated and of higher income level,[5] the NHANES III found no associations based on these characteristics.[3] The association of higher levels of education to supplement use could be important when examining the college population as it could mean that the college years are when supplement users begin consuming dietary supplements.

Dietary Supplement Use in Specific Population Groups

While nationally representative surveys provide useful information on many aspects of health and wellness, dietary supplement intake is not typically one of the primary objectives. Therefore, studies that are targeted towards gathering dietary supplement information may provide more in depth views of trends, although they may consist of smaller, more homogenous populations.

Many of these studies focus on particular population groups, whether it is certain age groups, professions, or medical conditions. Studies examining specific population groups are

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important in that they may determine if differences exist or not based on certain characteristics. For this reason, the following section will discuss studies focusing on specific populations and dietary supplement use.

Adults

Data from the VITamins And Lifestyle (VITAL) study, a longitudinal cohort of 77,500 50-76-year-old adults from western Washington State who were recruited from a commercial list of Washington State residents, assessed several different lifestyle characteristics as well as intake of 20 herbals/specialty supplements and 16 VM supplements. The study, which used questionnaires from 2000-2002, focused on regular use of dietary supplements, defined here as supplements taken at least once per week for a minimum of 1 year. Respondents were questioned on their intake for the previous 10 years.[6]

Results found that 1/3 of the VITAL cohort reported current use of at least 1 of the 20 herbal/specialty supplements listed. Women were more likely to take supplements overall. The 5 most commonly used supplements by women were glucosamine, chondroitin, Ginkgo biloba, fish oils, and garlic pills. Men took glucosamine, chondroitin, saw palmetto, garlic pills, and Ginkgo biloba most frequently. When considering VM supplement use versus NVNM supplement use, 40% of men and 46% of women reported exclusive use of VM supplements, while only 1.2% of the total sample reported use of NVNM supplements but no use of VM supplements.[6]

NVNM supplement users were found more likely to be women, older (70+ years), and better educated (some schooling beyond high school) when compared to nonusers ($p<0.01$).

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Normal weight individuals were more likely to take NVNM supplements than very obese persons (defined by the authors as a body mass index (BMI) of 35 or greater) ($p< 0.001$). African Americans and Asians/Pacific Islanders had lower odds of consuming dietary supplements compared to whites (OR=0.64, 0.60, and 1.0, respectively). However, American Indians/Alaska Natives had higher odds of consuming them (OR=1.27).[6]

When examining the odds of NVNM supplement use associated with health-related behavior, smokers were found to be less likely to take them compared to non-smokers (OR=0.52), individuals who exercised at any frequency were more likely to use NVNM supplements than those who did not exercise ($p<0.001$), and persons who took baby aspirin 3 or more times a week were more likely to take NVNM supplements compared to those who took less or none (OR=2.00, $p<0.001$). In addition, respondents who were screened for cancer or who ate a low-fat diet or consumed 5 or more servings of fruits and vegetables a day were more likely to consume NVNM supplements ($p<0.001$).[6]

A 2003 study analyzing NVNM supplement characteristics of a health maintenance organization in California found similar results. The Kaiser Permanente Adult Member Health Survey was a general health survey mailed to 40,000 members of Kaiser Permanente Medical Care Program of Northern California (KPMCP). Participants were at least 20 years of age. The survey ascertained dietary supplement use through 2 questions; one included a checklist of 19 different complementary and alternative medicine (CAM) modalities; and another focused on nutritional supplements with a checklist of several different supplements, i.e. vitamin C, calcium, Ginkgo biloba, St. John's wort, etc.[7]

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In this population it was found that use of herbal supplements was much greater than use of nonherbal supplements (29.3% versus 10.4%, respectively). The herbal supplements most commonly used were Echinacea and Ginkgo biloba. Glucosamine was the most frequently reported nonherbal supplement by men and women over age 45 years.[7]

Like the VITAL study,[6] nearly 1/3 of the KPMCP study population reported taking a NVNM supplement in the previous 12 months. The most frequent users were females between 45 and 64-year-old, whites, and college graduates. As educational level increased, so did supplement use. Also similar to the VITAL study findings,[6] use was more common among those with higher alcohol intakes, former smokers, exercisers, and individuals who ate more fruits and vegetables ($p<0.0001$).[7]

A Minneapolis/St Paul, Minnesota-based study focused on the use of herbal supplements only, found a much higher reported rate of use at 61.2% in the past 12 months. The survey was designed to assess prevalence of use of any herbal products, use of 13 specific herbs, demographic characteristics, and use of MV and individual nutritional supplements. Use of products was asked for the preceding 12 months. Rationale for using specific herbs was investigated also.[8]

Ginseng, Echinacea, garlic, Ginkgo biloba, St John's wort, ginger, ephedra, and goldenseal were reported to be taken by at least 10% of the study population. For 5 of the herbs the most reported reason for use was to promote general health/well-being. Approximately 13% reported taking herbs to promote weight loss, and 27.5% reported drinking herbal tea for medicinal purposes. Participants who had taken 1 of the 13 specific herbs examined were asked

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to rate the effectiveness on a scale of 1 (very ineffective) to 5 (very effective). For 11 of the 13 herbs, less than 60% rated them as effective or very effective.[8]

When participants were asked how they learned about the herbs, family or friends and written materials were the leading sources of information for users of 9 of the 13 herbs. Healthcare professionals (HCP) were the least frequently reported source of information for 10 of the herbs.[8]

The sample consisted of individuals 18 years and older living in the metropolitan area, randomly selected from Minnesota Department of Public Safety Driver and Vehicle Service Division data tapes. The sample size was much smaller at 376,[8] compared to the VITAL study population of 61,587 [6] and the KPMCP study population of 15,985.[7] Like the previously discussed studies, [6-7] those who reported using an herbal product were significantly more likely to be women (p= 0.005). Unlike the previous studies, [6-7] those who reported using herbals had a lower mean age than nonusers. Users were also more likely to report using a MV or individual nutritional supplements (p= 0.001).[8]

The International Population Study on Macronutrients and Blood Pressure (INTERMAP) gathered data on nutrient intake to determine the effect on blood pressure. Data were collected in 4 countries, including 8 samples from the US. A total sample of 2,195 male and female participants between the ages of 40 to 59 years was gathered from the US. Supplement use was asked during in-person interviews, and participants who responded that they took supplements were given a dietary supplement form to complete.[9]

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Nutrition Data System (NDS) was used to analyze diet and supplement intake. For this reason supplement users were dichotomized into two groups, NDS supplement users and non-NDS supplement users. Supplements found in NDS included mostly vitamins and minerals. Non-NDS supplements were therefore mostly herbals/botanicals.[9]

The study found that 52% of respondents reported using dietary supplements. Of these, 29% used NDS-listed supplements only, and 23% used non-NDS-listed supplements. The most frequently used non-NDS supplements included Ginkgo biloba, ginseng, bioflavonoids, and phospholipids.[9]

A significantly higher percentage of women (56%, $p<0.001$), 50-59-year-olds (56%, $P<0.001$), and Asian Americans (63%, $p<0.01$) reported any type of supplement use. Hispanic African Americans reported the lowest use of supplements when looking at race/ethnicity (39%). As for region of the country, the population from Honolulu, HI reported the most frequent use of supplements (67%), and participants in Minneapolis, MN reported the lowest use (53%).[9] This is consistent with the findings NHIS study findings that lowest use was in the Midwest, while highest use was in the West.[5]

Lifestyle characteristics found to correlate with use were similar to those found in research previously discussed here.[3, 5-7] Former smokers (OR=1.47, $p<0.0001$) were more likely to be supplement users, while being a current smoker versus nonsmoker (OR=0.63, $p<0.0001$) or overweight/obese according to BMI (OR=0.87, $p=0.0027$) was inversely related to supplement use. Also, persons with diabetes (OR=1.32, $p=0.0915$), those on antihypertensive

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medications (OR=1.25, p=0.0378), and those consuming a special diet (OR=1.32, p= 0.0163) were more likely to take supplements.[9]

A longitudinal study examining NVNM supplement use of individuals 43 to 86 years of age from Beaver Dam, Wisconsin found similar relationships between demographics and lifestyle characteristics. Participants were originally examined from 1988-1990 (n = 4926) and 3 follow-up examinations were completed at 5 year intervals (n = 2375 at last examination). Prevalence rates of NVNM supplement use increased from 5% at the original examination (1988-1990) to 30% at the final evaluation (2003-2005). The most commonly used supplements were lecithin, garlic, omega-3 fatty acids, ginseng, glucosamine, Ginkgo biloba, and saw palmetto.[10]

At the last 2 follow-up exams women ($p<0.01$ in 1998-2000 and 2003-2005), those with a household income above $20,000 ($p=0.02$ in 1998-2000 and $p<0.01$ in 2003-2005), and individuals who had more than a high school education ($p<0.01$ in 1998-2000 and $p=0.05$ in 2003-2005) were more likely to take NVNM supplements. Vitamin and mineral use and taking more medications was associated with NVNM supplement use at all follow-up exams ($p<0.05$). A history of sedentary behavior ($p<0.01$ in 1998-2000 and 2003-2005), current smoking ($p<0.01$ in 1988-1990, 1998-2000, and 2003-2005), and hypertension ($p<0.01$ in 1998-2000 and $p=0.04$ in 2003-2005) were more common in non-users. NVNM supplement use was found to be associated with a significant reduction in mortality also ($p= 0.02$).[10]

A 2007 study used data from the Continuing Survey of Food Intakes by Individuals (CSFII) and Diet and Health Knowledge Survey. The total sample from CSFII was 4, 384 adults

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age 51 years and older. Data from the Diet and Health Knowledge Survey were used to assess predictors of supplement use. The sample for this survey was 2,571. The surveys were nationally representative. Supplement information was gathered in-person, and included information on types and frequency of consumption.[11]

Approximately 50% of respondents took dietary supplements. More women (47%) took them than men (37%, $p<0.001$), as found previously. The mostly frequently used was VM supplements. In men, those 71 years and older (OR=1.0, $p<0.05$), living in metropolitan areas (OR=1.65, $p<0.05$), and those with a high school education or higher (OR=1.0, $p<0.01$) were more likely to take supplements. In women, those who were white (OR=1.0, $p<0.01$), vegetarians (OR=2.30, $p<0.01$), living in the West (OR=1.0, $p<0.01$), and nonsmokers (OR=1.0, $p<0.05$) were more likely to take supplements. The only predictive factor that was significant for both men and women was those consuming a diet consistent with Dietary Guidelines for Americans recommendations were more likely to be supplement users (OR=1.65 and $p<0.001$ for men and OR=1.62 and $p<0.05$ for women).[11]

In review, research focusing on dietary supplement use in adults found many commonalities. First, dietary supplement users tended to be women, older, more educated, and at a higher income.[6-11] Also, they typically partook in similar health-related behaviors, such as exercising, consuming more fruits and vegetables, being at a healthier weight, being former or non-smokers, taking more medications, and consuming alcohol.[6-7,9-11] Further, research showed that the percent of supplement users was higher in the West and lower in the Midwest and South when compared to other parts of the country.[9-11] MV use was associated with increased use of

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NVNM supplements.[6,8,10] Some of the most common NVNM supplements were Ginkgo biloba, garlic, ginseng, glucosamine, and Echinacea.[6-11]

The studies in the adult population found higher education and income to be related to dietary supplement intake. As discussed previously, this may mean that individuals begin using supplements while in college and continue using them throughout adulthood. Women are more likely to take supplements than men in the adult population, which may mean that this is also a difference in the college population. Finally, those with healthier lifestyle habits have proven to be more likely to be dietary supplement users in the adult population.

Older Adults

Several studies examining supplement intake have been conducted in older adults. One example is a 2007 study, which surveyed supplement use of 267 older adults that found that 21% took at least 1 herbal or dietary supplement at the time of the survey. The most frequently used were glucosamine, garlic, Echinacea, and Ginkgo biloba. White women with at least some college education were the most likely to report taking supplements, and preservation of health was the greatest indicator for use of supplements.[12]

The objective of Kirkpatrick's 2006 study was to examine the use of NVNM supplements among rural older adults living in southeast and south central Idaho. Three hundred sixty-five older adults, ages 60 and older, completed the study questionnaire. A total of 144 (39.5%) reported using NVNM supplements in the past 12 months. Glucosamine, garlic, chondroitin, Echinacea, and Ginkgo biloba were the 5 most commonly used supplements. As seen in other

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studies discussed here, [8,12] the majority of participants reported using NVNM supplements to maintain their health (75.6%).[13]

When asked about efficacy of supplements, most respondents reported that all of the NVNM supplements they used were effective. Further, the majority of the study population said that they did not think NVNM supplements were safer than prescription medications or over the counter (OTC) medications (65.1% and 59.0%, respectively). Most felt that some NVNM supplements could be dangerous, could have side effects, and some could interact with prescription medications (85.5%, 90.9%, and 89.1%, respectively).[13]

Demographically, this study found that those who took NVNM supplements were younger and those who reported having a chronic disease used them at a higher rate. However, no relationship was found based upon gender, education, or income level.[13]

In conclusion, the 2 studies that examined older adults and dietary supplement use had some conflicting results. Some similar findings were the types of NVNM supplements taken by respondents: garlic, glucosamine, Echinacea, and Ginkgo biloba.[12-13] Also these were comparable to those found to be most popular in the general adult population.[3,5-9,11] Another common finding was that respondents reported that they consumed supplements to preserve or maintain their health.[12-13] This was similar to studies focusing on the adult population, also.[8] Demographically, the 2007 study found that white women with at least some college education were more likely to be supplement users.[12] This is again consistent with studies focused on adults.[6-11] However, the 2006 study found no relationship between supplement use and gender,

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education, or income level, but did find that those who were younger and reported having a chronic disease consumed supplements at a higher rate.[13]

Adolescents

Knowing patterns of supplement use in the adolescent population may provide insight about supplement use in college students. A Canadian study looked at use of nutritional supplements in adolescents, examining those reported to influence performance and body mass. A total of 333 adolescents between the ages of 13 and 19 years completed the survey.[14]

More males than females used supplements in this population, although use of any supplement was less than 50% regardless of gender. The most popular supplements reported were MV and mineral supplements taken by 42.5% of the participants. Protein supplements were the next most popular at 13.5%, with less than 10% reported use for the remaining supplements.[14]

When examining age differences, only L-carnitine use significantly increased with age ($p=0.04$). When examining the relationship between physical activity and supplement intake, it was found that individuals who consumed creatine or protein supplements participated in significantly more hours of physical activity than those who did not consume creatine or protein supplements ($p = 0.05$).[14] The increased use of protein supplements in the adolescent population in comparison to the adult population may mean there is an increased use of protein supplements in the college population, as this trend may carry over to the college years.

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Weight Loss

Trends in supplement use for certain conditions are frequently studied. Weight loss is one example of this. A recent study examined characteristics of those using supplements for weight loss from a nationally representative sample consisting of 3,500 adults 18 years and older. Survey results showed that 62.7% of study participants considered themselves overweight or overweight in the past. More than 65% reported ever making a serious weight loss attempt. BMI was calculated from participants' self-reported height and weight. Based on calculated BMI, 37.9% were overweight and 37.5% were obese at the time of the survey.[15]

Of those who reported ever making a serious weight loss attempt, 33.9% reported using a dietary supplement for weight loss. Women were more likely to use dietary supplements than men (44.9% versus 19.8%, respectively), and young adults from 25 to 34-years-old were most likely to use dietary supplements (52.3%, OR=3.81) when compared to adults under 25 years and above 34 years. More African Americans and Hispanics used dietary supplements than whites (48.7%, 41.6%, and 31.2%, resepectively). Also, those with less education, lower incomes, and no health insurance were more likely to use dietary supplements. All of these findings differ from other studies not focusing on weight loss.[3,5-13,15]

Blanck and colleagues studied the use of nonprescription dietary supplements for weight loss. This study consisted of a nationally representative population of 6,634 adults aged 18 years and older. Results showed that 15.2% of all adults had ever used a supplement for weight loss. Prevalence was higher in women (11.3%) than in men (6.0%). Use was highest in those 18 to 34-years-old (26.8%) and lowest in those over 55-years-old (5.7%). Odds of using a weight loss

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supplement increased with BMI (OR=1.13 for BMI of 25.0-29.9, and OR=1.12 for BMI greater than or equal to 30.0), but no differences were seen for race/ethnicity or education. However, the odds of ever using a supplement were lower among Hispanics compared to non-Hispanic whites (OR=068),[16] which is not what Pillitteri and associates found in their study examining supplement use and weight loss.[15] Close to 1/3 of those using a weight loss supplement in the past year had discussed it with a HCP.[16]

Use of dietary supplements for weight loss is more common in women than men in both studies by Pilliteri and Blendon.[15-16] While studies in other populations found that supplement use increased with age,[3,5-11] Pilliteri and Blendon found their populations' supplement use increased with decreasing age.[15-16] These 2 studies differed, however, on their findings regarding use of dietary supplements for weight loss and demographic characteristics such as race/ethnicity, education, and income.[15-16] Because use of dietary supplements for weight loss is more common in the young adult population, this could be a commonly cited reason for dietary supplement intake in college students, specifically college women, as women are also more likely to use weight loss supplements than men.[6-12, 15-16]

Healthcare Professionals (HCPs)

Another study surveyed HCPs at their point of enrollment in an online class pertaining to dietary supplements. A total of 1,249 HCPs were surveyed and 81% reported use of vitamin, mineral, or other non-herbal dietary supplements in the past week. Use did vary by profession, with nurses (88%) and physician assistants and nurse practitioners (84%) having the highest use, and pharmacist (66%) and trainees (72%) having the lowest use. Trainees consisted of

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individuals training as physicians, clinical nurses, nurse practitioners or physician assistants, pharmacists, or dietitians. The supplements most frequently used were MV, calcium, vitamin B, vitamin C, and fish oil. Respondents who were of older age, were female, had a high knowledge of dietary supplements (as measured by a true/false and multiple-choice test), and discussed dietary supplements with patients were more likely to be users.[17] With over 80% of HCPs using non-herbal dietary supplements, it could mean that supplement use is more common in college students who are majoring in health-care related fields.

Conclusion

After reviewing findings on existing research regarding the use of dietary supplements in populations other than college students, several commonalities have been discovered. It has been found by the majority of these studies that females were more likely to use dietary supplements than males.[5-12,14-17]

Another similar demographic characteristic found in most of the studies was an increased likelihood of consuming dietary supplements with an increase in income and/or education.[6-7,10-12] These findings could show a higher probability that college students will one day use dietary supplements as they are at a higher level of education and are likely to have higher incomes in the future than those without college degrees.

Certain lifestyle characteristics were found to be linked to dietary supplement use. These included being a former or non-smoker, consuming alcohol, participating in exercise or physical activity, being at a normal weight, and consuming a higher amount of fruits and vegetables.[6- 9, 11, 14]

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Certain NVNM supplements have been found to be used by higher proportions of the study populations by the majority of research discussed here. These include: Ginkgo biloba, garlic, Echinacea, glucosamine, ginseng.[6-13]

College Students and Dietary Supplement Use

Some studies looking at dietary supplement use have been conducted with college students. However, most research has focused on use in athletes with only a few studies that have examined the college population overall. The focus of the section is to review existing literature on supplement use in the college population.

General College Population

Perkin and colleagues surveyed 1,000 university students, both undergraduate and graduate, to determine the prevalence of NVNM supplement use. Seventy-six percent of the study sample was undergraduates. The mean age of the study population was 26 years (range 18-68 years). Among the participants, 26.3% reported use of a NVNM supplement with the most frequently used being ginseng, Echinacea, and protein powder/amino acids. The majority of users were white. Most users rated their health as "excellent or good," and 73% reported exercising more than 3 times per month. Major reasons for use were to improve energy, promote weight loss, and burn fat. Women were more likely to use supplements for weight loss, while men were more likely to use them to build muscle.[18]

No significant differences were found between users and non-users related to gender, ethnicity, health, or status as an athlete. Use was more common in the 24 to 26-year-olds and the 27 to 30-year-olds, and least reported in 18 to 20-year-olds (p= 0.037). Current smokers were

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significantly more likely to be supplement users than nonsmokers (p= 0.02),[18] which is the opposite of findings from studies in other population groups.[3,5-7,9-11] Those who reported exercising more than 3 times per month were also more likely to be supplement users when compared to those who exercised fewer than 3 times per month (p= 0.001).[18]

A 2001 study by Newberry and associates assessed NVNM supplement use in a college population through surveys completed by 272 students. Of the survey respondents, 48.5% reported using a NVNM supplement during the past 12 months. There was a small difference in the percent of female users versus male users (51.2% and 44.7%, respectively). Slightly more than 1/3 of the supplement users cited the media as their primary source of information on supplements. However, less than 10% reported getting information from HCPs. Only 41% said that they had informed their HCPs that they were taking a NVNM supplement.[19]

Supplement users and non-users were not different based on age, ethnicity, gender, perceived dietary adequacy, class standing (first through fifth year of study), or exercise patterns. NVNM supplement use was significantly related to use of vitamin/mineral supplements and beliefs that NVNM supplements were effective in preventing and controlling certain diseases ($p<0.001$). Users were more likely to be majoring in a health-related profession ($p<0.05$).[19]

The most frequently used supplements were Echinacea, ginseng, St John's wort, Ginkgo biloba, ephedra products, chamomile, and garlic. More than half reported they took supplements to promote good health, prevent disease, or enhance immune function. The majority of supplement users felt that the NVNM supplements they were taking were effective.[19]

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Stasio and colleagues looked at the number of students reporting use of herbal and dietary supplements in the previous week. Of 201 students, 70.6% reported using an herb or dietary supplement in the past week. More students were found to take supplements in the spring semester (80.2%) compared to the summer semester (68.8%) (p= 0.048). More women (80.0%) than men (64.5%) were found to take supplements (p= 0.015).[20]

In the general college population there does not seem to be as strong of a relationship between gender and dietary supplement use as the rest of the population, as only 1 of these 3 studies found a significant difference in use between women and men.[18- 20] Common NVNM supplements appear to be similar in the college population and general population with ginseng, Echinacea, Ginkgo biloba, and garlic reported by a large proportion of the study populations.[6-13,18- 19] However, 1 study reported that protein supplements were frequently used, coinciding with consumption of these in adolescents, and thus supporting the hypothesis that use may carry over into college.[14,18]

Along with the higher use of protein supplements, use of dietary supplements to gain muscle mass or strength was commonly reported by males.[18] However, females were more likely to report using supplements to lose weight, which is similar to findings regarding supplement use in the adult population for weight loss.[15, 18] The most common sources for information on dietary supplements were family and friends and the media.[18-19]

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Student Athletes

One 2004 study focused specifically on athletes from a Division I school and their nutritional supplement use, including energy supplements, protein supplements/weight gainers, vitamin supplements, mineral supplements, herbals, and other supplements. Two hundred and seven athletes, age 19 years and older, completed the questionnaire developed by the researchers.[21]

When asked to write their own definition of a supplement, 34% replied with all or parts of the statement: "a supplement is a product that helps to increase performance, strength, muscle, and enhance recovery."[p. 107, 21] Of the athletes surveyed, 23% reported regularly using a nutritional supplement. While 39% responded that they did not use supplements, most did not consider calorie and fluid replacement products as nutrition supplements. Less than 6% reported they never used these products.[21]

Approximately 67% of athletes surveyed reported taking a vitamin of some sort, while 26% reported using herbal supplements. Males were significantly more likely to use energy and protein supplements ($p<0.05$), while females were significantly more likely to use vitamins and minerals ($p<0.05$).[21]

When examining sources of supplement information, the results differed somewhat from previous study findings.[18-19] Family members were still the number 1 source of information, followed closely by fellow athletes. Other popular sources were athletic trainers, registered dietitians, friends, strength coaches, and their coach. Less than 10% reported going to a

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pharmacist, professional athlete, or television, radio, or the internet for information about supplements.[21]

When asked why they took supplements, more than 40% said for their health, to improve strength and power, to increase energy, or for weight or muscle gain. Males were found to be more likely to take supplements ($p<0.05$) to improve strength or power, increase weight/muscle gain, and improve speed and agility when compared to females. Females were significantly more likely to take supplements ($p<0.05$) because of an inadequate diet or "for their health" than males.[21]

An earlier study on vitamin and mineral supplement use in Division I athletes found 56.7% reported using a supplement, with 18% citing regular use. The most frequently reported supplements were MV with minerals, followed by vitamin C, MV (no minerals), B-complex vitamins, and calcium. The most common reasons for taking supplements were "recommended by family member or friend" and "improve athletic performance." Females were significantly ($p<0.05$) more likely to report "recommended by family member or friend" or "recommended by physician or pharmacist" as reasons for use. Males were significantly ($p<0.05$) more likely to cite "improve athletic performance" and "build muscle."[22]

In conclusion, there was no relationship between gender and supplement use among student athletes.[21-22] Family members were a popular source of information regarding supplements; however this population was more likely to report receiving information from more reliable sources like athletic trainers and registered dietitians, than the general college population.[18-19, 21- 22] As with the general college population, males were found to commonly cite

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building muscle and increasing strength as reasons for taking dietary supplements[18, 21-22] and were more likely to take protein supplements than females.[18, 21]

Students in Healthcare Related Schools

When discussing supplement use among college students, looking at students' majors can play a part. Newberry and associates found that students majoring in healthcare professions were more likely to take dietary supplements.[19] Other studies have looked at students in healthcare related schools for supplement use trends.[23-24]

Harris and colleagues studied attitudes towards complementary and alternative medicine (CAM) among pharmacy students. Sixty-three students were surveyed. The majority had positive attitudes towards CAM. However, 30% believed that the results of CAM were typically due to placebo effect. Fifty-three percent cited a desire to see CAM therapies validated in a scientific manner. More than 50% of student respondents felt that herbal medicine and nutritional supplements were effective. When use of herbal and nutritional supplements was examined, 20% and 35% took them, respectively. Sources most commonly used for gathering information about CAM therapies were pharmacy and other professional journals, peer professionals, other HCPs, mass media, and the internet.[23]

Spencer and associates studied vitamin and mineral supplement use among US medical students. The study was longitudinal and consisted of 2,316 medical students from 16 medical schools. Slightly over half of the students reported regularly using MV supplements as freshmen (defined by authors as first year medical students) and this level continued throughout medical school. Regular MV supplement use was significantly associated with being a woman

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(p=0.0003), having a BMI over 18.5 (p=0.003), consuming more than the median servings fruits and vegetables (2.7) per day (p=0.001), following the CDC recommendations for exercise (p<0.0001), and having better overall personal health habits (p=0.002). Regular calcium intake was associated with these variables in addition to being in a later year of medical school, having a personal or family history of osteoporosis, and not currently using tobacco. Students who were encouraged by their family to eat healthy (p<0.001), were vegetarians (p<0.05), consumed more than the median servings of fruits and vegetables (2.7) per day (p<0.001), drank heavily (men only) (p<0.01), followed CDC recommendations for exercise (p<0.01), and reported an above-average personal health score (p<0.01) were more likely to take "other" vitamin/mineral supplements.[24]

Users of any of the supplements studied were significantly more likely to be women, to eat more fruits and vegetables, or to regularly exercise (p<0.01). They were modestly more likely to have personal physicians who emphasized prevention, to be vegetarian, and to perceive nutrition counseling as highly relevant. Within the previous month 63% of women and 50% of men had taken any of the supplements asked about.[24]

Conclusion

Studies examining supplement use in the college population have been done. However, unlike studies in other populations, few demographic characteristics have emerged as being strongly related to dietary supplement intake. For example, females were found to be significantly more likely to take dietary supplements in only 2 of the studies discussed here.[18-24] Physical activity and health were only found to have a significant relationship to dietary

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supplement intake in medical students.[18-24] Some characteristics that have been determined are the use of dietary supplements for increasing muscle mass and strength in males and for weight loss in females.[18,21-22] More research needs to be done to establish what characteristics are associated with dietary supplement intake in the college population.

General Population's Attitudes and Beliefs towards Dietary Supplements

A few studies have examined individuals' thoughts and beliefs towards dietary supplements, mostly pertaining to safety and efficacy of these products. Blendon and colleagues examined national views of the use and regulation of supplements by the government. Data were taken from several different nationally representative polls. After reviewing the data, 48% of all American adults surveyed reported taking supplements. Users were more likely to be white, have higher levels of education, be older than 45 years, and to be uninsured.[25]

Blendon and colleagues also found that a majority of respondents had positive views regarding the health benefits from taking dietary supplements. All together, 85% of participants reported that dietary supplements were good for people's health and well-being. Regular users were more likely to respond that supplements were beneficial for all conditions that the surveys asked about. Results showed that regular users felt strongly in the usefulness of various dietary supplements regardless of the scientific evidence. Seventy-one percent of regular users reported that they would continue to take a supplement even if a government agency reported it was most often ineffective. When asked if the U.S. Food and Drug Administration (FDA) specifically claimed a product was ineffective, the response was no different.[25]

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Over two-thirds of supplement users reported telling their regular physician about their use. Forty-nine percent of users felt physicians are prejudiced against supplement use and 44% believed their own physician knew little or not much about dietary supplements. Most users (57%) felt that claims made by supplement manufacturers in advertisements were generally true. Those who weren't regular users were significantly less likely ($p<0.001$) to believe this, with 45% of those sometimes using supplements and 25% of those never using supplements reporting they thought the claims were generally true.[25]

Just over half of the participants knew that supplements were not regulated by the government, while 35% thought that they were. These results were similar in regular users. The majority supported government regulation to ensure safety and purity of supplements, consistent doses, and true advertising claims. Eighty-one percent of respondents supported giving the FDA the power to require new supplements to be tested for safety before being sold. Eighty percent supported giving the FDA the authority to remove supplements from the market if they were proven unsafe. The levels were similar for regular users.[25]

In the adult population is has been shown that supplement users have stronger beliefs in the health benefits of dietary supplements than non-supplement-users. Blendon also found that those who used supplements would continue to use them even if the FDA claimed that they were ineffective. Over 1/3 of the study population erroneously thought that dietary supplements were regulated by the FDA. This raises the question of whether the college population also has the same misconceptions regarding dietary supplements and their usefulness and safety.

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College Students' Attitudes and Beliefs towards Dietary Supplements

Dodge and Kaufman looked at what factors played a role in causing college students to believe dietary supplements are safe and effective. The study consisted of 262 students who were asked to read and answer questions pertaining to different descriptions of dietary supplements. Knowledge, effectiveness, safety, supplement use, and demographics were all questioned.[26]

Results showed almost 24% of respondents reported ever using a dietary supplement. More men were found to have a history of dietary supplement use than women, at 34% and 18%, respectively ($p<0.01$). Men were more likely to report using supplements to improve physical performance, $t(61) =4.03$, $p<0.01$, while women were more likely to report using supplements to aid weight loss, $t(61) = -2.74$, $p<0.01$. Men rated the sample product as safer, $F(1, 196)= 16.86$, $p <0.05$, and more effective, $F(1, 124) = 4.01$, $p>0.05$, than women did.[26]

Overall knowledge of the role of the FDA in regulating supplements was low. Men were more knowledgeable than women, and those who reported using supplements were more knowledgeable than those who reported not using them. Those who were asked to examine the sample product claiming FDA approval rated the product as safer than those who examined the sample product claiming no FDA approval.[26]

Study Purpose

Other studies conducted within the college-aged population have found that vitamin and minerals are more popular dietary supplements than other categories of supplements. However, most of these studies have been conducted in Division I college athletes, who may be more

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concerned in regards to what supplements they consume than the typical college students due to regulations of the NCAA. Therefore, a higher proportion of non-athlete college students may consume other types of dietary supplements. Due to limited research in this population, this was an area that warranted further investigation.

In studies examining health beliefs regarding dietary supplements in the general population it was found that those who consumed supplements at a higher frequency held more positive beliefs regarding dietary supplements. This area of research is limited in the college population; therefore this study examined this further.

Newberry found that those students in health-related majors were more likely to take dietary supplements.[19] Other studies examining this variable have not been conducted, warranting the need for more research on this.

In the majority of the existing literature it was found that those who were of normal weight were more likely to consume dietary supplements. One time that this differed was when looking at the use of supplements for weight loss. As expected, in this instance the use of supplements increased with BMI. Since it was of interest to see if these same differences existed in the college population, this study looked at differences based on weight status.

When examining the current literature, it was found that in the general population individuals who exercise regularly were more likely to take dietary supplements. For this reason, this study looked to see if there were differences in dietary supplement use based on reported frequency of physical activity in the college population.

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Little research on health beliefs regarding dietary supplements has been done in the general population, let alone the college population. In the studies that have been conducted regarding this, differences in beliefs based on physical activity, weight status, and academic major have not been considered. Since it was found that difference in types and frequencies of dietary supplement use have been found based on these variables, it was of interest to see if differences in beliefs also existed.

Secondary Data Analysis

Secondary data are data collected for a different intention than the research for which they are being used.[27] Secondary data analysis differs from primary research in that primary analysis requires data collection and analysis, while secondary analysis only involves the application of analytical techniques to data that have been collected by others.[28] There are many archives of data containing characteristics from millions of participants, from many surveys, countries, and time periods.[29]

Data archives may consist of nationally representative samples that are collected by government agencies such as NHANES and NHIS, both mentioned previously in this review. These larger data sets are generally good for examining questions about specific health and disease topics. Smaller data sets from private firms, charitable organizations, and academic institutions are available. These types of data sets usually contain information on more specific population groups, and may be better for more specialized topics. An example of this is the data set that was used for this research. When using these smaller data sets, researchers must insure that the population is large enough to yield reliable results.[28]

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This study used a secondary data set. The data set consisted of demographic characteristics of college students enrolled in an introductory nutrition course at the University of Tennessee, Knoxville, information regarding types of dietary supplements used by these students, frequency of supplement use, and beliefs regarding supplements. These data were examined to determine differences in dietary supplement use and beliefs based on different demographic characteristics.

The secondary data set that was used for this research consisted of a sample of 306 students. This sample is fairly large and should yield reliable results. Another advantage of this sample is that it contained data on a very specific topic, dietary supplement use in college students. As gathered from the literature review, data are not largely available for the college population regarding dietary supplements. Several studies that have been conducted on this topic used smaller data sets than the one available for use in this study. The data set for this study contained information from non-athlete college students, unlike many of the studies in this age group that focused only on student athletes. Results from this population may vary greatly from those of college students who are non-athletes.

There are a few limitations of using secondary analysis. One issue is that when using secondary data, it can prove more of a challenge to assure that the data are valid. While validity is also important when dealing with primary data, it is easier to ensure, as quality control can be built into the design. However, with secondary data the researcher must often take it as is.[27] The survey questions may not have asked precisely for the information the researcher was looking for, and research questions may have to be tweaked to better match the available data. With

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primary data collection, the investigator can write the survey to assure that questions asked gather the information they are searching for. If survey items are imprecise measures of the concepts the researcher has in mind it may also increase the chance for invalidity. Another issue is errors that existed in the original survey are often undetectable, and when the data are used for purposes other than their original use these errors may be amplified.[28]

Discussion of the Survey

The knowledge and beliefs portion of the proposed survey data set was initially used to test for conceptual change based on a blogging course enhancement regarding dietary supplements. The survey information on supplement use and frequency was used to determine the information presented in class lectures and other education regarding supplements. The entire survey was given as a pre-test and the knowledge and beliefs segment also was administered as a post-test. This study used only the pre-test results.

The survey instrument consisted of 2 sections. The first section asked about use of specific dietary supplements. This segment was categorized further into vitamin/mineral supplements, herbal supplements, and other non-herbal, non-vitamin/mineral dietary supplements (i.e. Coenzyme Q10, chromium picolinate, creatine, etc.). A space was provided for respondents to list any herbal or non-herbal dietary supplements they might take that were not listed. Further, respondents were asked to indicate whether they took these daily, weekly, or monthly. In addition, this section consisted of demographic questions and questions regarding self-reported height, weight, and physical activity. The demographic questions included gender,

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age, academic major, and race/ethnicity. The second section inquired about respondents' beliefs regarding dietary supplement use.

The survey items were compiled from 2 different previously validated surveys.[19,30] The first came from Newberry and colleagues who designed a questionnaire to evaluate aspects related to NVNM dietary supplement use in undergraduate students enrolled at Washington State University. The survey instrument was pretested for face validity with 15 undergraduate students to assess clarity and subject matter. The questionnaire consisted of 25 items comprised mostly of closed, force-choice responses. A 5-point Likert scale ranging from excellent to poor was used to evaluate perceived dietary adequacy. Other topics included were gender, age, academic major, exercise patterns, ethnicity, and health practices.[19]

Newberry and associates survey included a list of 22 herbal dietary supplements and 13 non-herbal dietary supplements. Students were able to add any other dietary supplements that were not listed in the "other" category. Respondents were asked to include all dietary supplements taken in the previous 12 months and to give the reason they were taken, perceived efficacy, and side effects. Twenty-three possible reasons for taking the supplements were listed. An "other" category was included for the respondents to list any reasons not given by the questionnaire.[19] The survey to be used by the proposed study took the list of NVNM supplements and non-herbal, NVNM supplements from the Newberry and colleagues study. The demographic questions regarding academic major, race/ethnicity, exercise frequency, gender, and age also were used in this survey instrument.

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The other questionnaire used to develop the survey instrument used for primary data collection in the proposed study was designed to assess the prevalence of NVNM supplement use among students in a Turkish university by Ayranci, Son, and Son.[30] This questionnaire was divided into 2 sections and was based on a previous questionnaire that was tested for validity and reliability by Eldridge and Sheehan.[31] This survey also consisted of 2 segments: one consisting of items regarding types of supplements used and frequency of use, and the other consisting of items regarding health belief statements about dietary supplements. The survey was designed and pretested for face validity with undergraduate dietetics students at the University of Arizona. The survey then was modified and retested with students at a local community college. Reliability of the health beliefs index was tested using a reliability coefficient analogous to Chronbach's Alpha and was found to be .97 signifying a high internal consistency.[31]

The first section of the Ayranci and colleagues study examined consumption of NVNM supplements at the time of the survey or in the last year, previous use of supplements, and the probability of students considering using NVNM supplements in the near future. Seventy-three products were listed in the questionnaire, with the respondents having the ability to write in any that were not listed. If respondents indicated that they had taken a NVNM supplement they were further queried on topics including: the number used; the name of the products; frequency of use; total product consumption; length of product use; the reasons for using NVNM supplements; and general demographics.[30]

The second part of the questionnaire focused on nutritional beliefs about NVNM supplements. Respondents were asked about their opinions on NVNM supplement use and the

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health benefits associated with them to assess motivational factors related to supplement use in this population. Twenty-two opinions were given and a 5-point Likert scale was used with responses scored from 1 (disagree very strongly) to 5 (agree very strongly). Therefore, a higher score showed that the respondent had a higher belief in the health benefit associated with NVNM supplements. This section of the questionnaire was used for the beliefs portion of the survey used for the proposed study.[30]

The beliefs section of the questionnaire was tested for reproducibility by applying it to a sample of 59 randomly selected students. The students involved in the test/retest were not included in the final analyses. The reliability of the internal consistency of the data was calculated by Chronbach's alpha and was found to be 0.96, indicating a high internal consistency across nutritional-belief statements.[30]

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Part II: Dietary Supplement Use and Beliefs among College Students Enrolled in an Introductory Nutrition Course

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Abstract

Objective: To assess differences in the use of dietary supplements and beliefs related to their use based on academic major, physical activity frequency, and weight status of college students enrolled in an introductory nutrition class. *Participants:* Students in an introductory nutrition class from January to May 2008 were recruited. The final sample contained 306 participants. *Methods:* Participants were given a two-part survey. The first section asked participants to respond about their use of dietary supplements and the second section asked participants to respond to their beliefs statements about supplements. *Results:* The most commonly used supplements were vitamins and minerals with 228 (74.5%) respondents consuming at least 1 in the last 12 months. Ergogenic use varied the most based upon study variables. Non-health-related majors, individuals with BMIs >24.9 and daily exercisers were more likely to use them. Daily exercisers and those taking multiple herbs or ergogenics had the highest health beliefs scores. *Conclusions:* Use of ergogenics varied the most based upon study variables. Future research should focus on determining reasons for this.

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With the enactment of the Dietary Supplement Health and Education Act of 1994 (DSHEA), the definition of a dietary supplement was largely expanded. Previous to this, a dietary supplement was considered to be composed only of essential nutrients, such as vitamins, minerals, and proteins. DSHEA extended this definition to include ingredients such as herbs, metabolites, and extracts, among other ingredients, or combinations of these.[1] With the expansion of the definition of dietary supplements came an increased number of these products on the market.

Use of dietary supplements has increased in recent years. The National Health and Interview Survey (NHIS) data showed a 10% increase in the number of individuals that reported taking dietary supplements daily from 1987 to 2000.[2] In a longitudinal study Knudtson and associates found an increase in the prevalence rates of nonvitamin, nonmineral (NVNM) dietary supplement use from 5% in 1988-1990, to 30% in 2003-2005.[3] As a result researchers have become more interested in looking at characteristics related to the consumption of dietary supplements.

Previous research has shown some demographic and lifestyle characteristics are related to increased use of dietary supplement. Overwhelmingly, females are more likely to be consumers than males.[3-14] The likelihood of using dietary supplements also appears to increase with an increase in income and education.[3,5-6, 9-10] Certain lifestyle characteristics have been found to be linked to dietary supplement use. These include being a former or non-smoker, consuming alcohol, participating in exercise or physical activity, and being at a normal weight.[5-7, 9, 11]

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Studies in the general population have varied widely in the reported proportion of individuals consuming NVNM supplements (ranging from 4% by Radimer and colleagues[15] to 61% reported by Harnack and colleagues[7]), but most found a percent use between 25% and 35%.[3, 5-6, 8] Research in only college populations found that 26%[16] to 48%[17] of this population reported using a NVNM supplement. Stasio and colleagues found that over 70% of their study population reported taking any kind of dietary supplement.[18]

Because research has shown that typically a higher proportion of college students reported using supplements compared to the general population, it is important to have a good understanding of supplement use in the college population. The existing literature on this topic found differing results than those completed in other groups. For instance, few demographic characteristics were discovered to be strongly related to supplement intake in college, while several, such as gender, race/ethnicity, and age, were related to use in the rest of the population. However, the majority of these studies have been completed in very specific groups of students such as athletes and those in healthcare related schools. Of those that have looked at more general college populations, most have focused on NVNM use specifically. Therefore this study aimed to examine dietary supplement use in a subgroup of the college population.

The purposes of this project were to 1) describe the types of dietary supplements used by college students in the previous 12 months; 2) describe the frequency of use by college students in the previous 12 months; 3) determine if supplement use and frequency of use differed based on respondents' college major, weight status, and physical activity frequency; 4) determine if students' beliefs about the health benefits of dietary supplements differed based on respondents'

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college major, weight status, and physical activity frequency; and 5) determine if students' health beliefs regarding dietary supplements differed based on frequency of supplement use and types of supplements used. It was hypothesized that there would be significant differences in types and frequency of use of dietary supplements among respondents based on reported frequency of physical activity, academic major, and weight status based on previous research findings. Additionally, it was hypothesized that there would be significant differences in reported beliefs regarding dietary supplements among respondents based on reported frequency of physical activity, academic major, and weight status.

Methods

Research Questions

1. What types of dietary supplements are used by college students when dietary supplements are categorized in the following groups: vitamins and minerals; herbals; ergogenic aids; and other specified dietary supplements?
2. How frequently (daily, weekly, monthly, or do not use) are dietary supplements used by college students?
3. What differences in types of dietary supplement use and frequency of use exist based upon college major (health-related or non-health-related), frequency of physical activity (daily, weekly, monthly, rarely/never), and weight status (using the U.S. Centers for Disease Control and Prevention (CDC) BMI categories for underweight, normal, overweight, or obese)?

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4. What differences in beliefs regarding dietary supplements exist based upon college major (health-related or non-health-related), frequency of physical activity (daily, weekly, monthly, or rarely/never), weight status (using CDC BMI categories for underweight, normal, overweight, or obese), and use of vitamins and minerals, herbals, and ergogenic aids?

Hypotheses

1. There will be significant differences in types and frequency of use of dietary supplements among respondents based on reported frequency of physical activity, academic major, and weight status.
2. There will be significant differences in reported beliefs regarding dietary supplements among respondents based on the frequency of physical activity, academic major, and weight status reported.

Study Design

The study was a cross-sectional design. It used data from a secondary data set of introductory nutrition students as The University of Tennessee, Knoxville during spring semester 2008. Data were collected from a questionnaire given to the students, which was administered online via the class internet site. Students were asked to complete the questionnaire prior to attending a class lecture covering the topic of dietary supplements.

The survey consisted of 2 sections. The first inquired about use of specific dietary supplements. This segment was categorized further into vitamin/mineral supplements, herbal supplements, and other non-herbal, non-vitamin/mineral dietary supplements (i.e. Coenzyme

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Q10, chromium picolinate, creatine, etc.). The questions were close-ended and answers were on a Likert scale with possible answer choices of (1) daily, (2) weekly, (3) monthly, or (4) do not use. A space was provided for respondents to list any herbal or non-herbal dietary supplements they might take that were not listed. Further, respondents were asked to indicate whether they took these daily, weekly, or monthly. To analyze number of supplements taken vitamins and minerals and herbals were categorized into 3 groups: individuals who took 0, individuals who took 1 or individuals who took 2 or more of these supplements. Due to limited cell counts ergogenics were categorized into 2 groups: individuals who took 0 or individuals who took 1 or more. This portion of the survey included questions regarding height, weight, academic major and physical activity as well. Reported height and weight were then used to determine BMI calculated by weight in kilograms divided by height in centimeters squared. BMI was categorized using the U.S. Centers for Disease Control and Prevention (CDC) categories of underweight (<18.5), normal weight (18.5-24.9), overweight (25.0-29.9) and obese ($\geq$30.0). Because of small cell counts weight status was analyzed in 2 categories: underweight and normal (BMI < 25.0), and overweight and obese (BMI $\geq$ 25.0).

The second section questioned respondents' on health beliefs regarding dietary supplement use. Students were asked about their health beliefs regarding dietary supplements using 22 belief statements. Respondents were asked to give their level of agreement for each statement, using a 5-point Likert scale that included the following: (1) strongly disagree, (2) disagree, (3) no opinion, (4) agree, and (5) strongly agree. A total mean supplement health belief

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score was calculated. A higher score showed a stronger belief in the ability of supplements to hold certain health benefits.

The knowledge and beliefs portion of the survey was initially used to test for conceptual change based on a blogging course enhancement regarding dietary supplements. The survey information on supplement use and frequency was used to determine the direction of class lectures and other education regarding supplements. The entire survey was given as a pre-test and the knowledge and beliefs segment was also administered as a post-test. This study used the pre-test results.

All students enrolled in the introductory nutrition class were required to finish the questionnaire. During spring semester 2008, 349 students were enrolled in the course. Data were gathered from 306 respondents giving a response rate of 87.7%. The database was initially used for a larger study which was approved by the University of Tennessee Institutional Review Board.

Analysis procedure

SPSS Statistics for Windows (v. 17.0, SPSS Inc., Chicago, IL) was used to analyze data. Mean frequency of use for each category of supplement was determined. Independent chi-squares were used to determine difference in frequency of use based upon major, weight status, and physical activity frequency. ANOVAs and t-tests were used to determine differences in health beliefs scores based on major, weight status, physical activity frequency, frequency of supplement use, and supplement type. The level of statistical significance was set at $p \leq .05$.

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Results

Demographic characteristics of the sample are shown in Table 1. Seventy-five percent were females and 24.5% were males. Sixty-five percent of the sample reported they were in a health-related professional major, versus 35% reporting belonging to a non-health-related major. Mean BMI among all respondents was 23.5, with males having an average calculated BMI of 25.2 and females 22.9.

The most commonly used dietary supplement was multivitamins (MV) with or without minerals with 167 (54.6%) respondents reporting they consumed a MV in the last 12 months. Overall 228 (74.5%) of the respondents reported they used at least 1 vitamin or mineral supplement in the last 12 months. Slightly more than half (50.7%) of the respondents reported using some type of herbal supplement in the previous 12 months, while only 39 (12.7%) reported taking an ergogenic aid and 23 (7.5%) reported using other types of dietary supplements. Table 2 shows the reported frequency of use for each dietary supplement. It includes both those supplements listed on the survey instrument, as well as those which respondents wrote in themselves.

Of those that reported consuming any vitamins or minerals, 69.3% (n= 158) took at least 1 daily, while the majority of herbal supplement users consumed herbs on a monthly basis (n=68, 44.7%), and the largest proportion of ergogenic users consumed at least 1 ergogenic a day (n=21, 63.6%).

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Table 1: **Demographic Characteristics**

Trait	Number (*N*=306)	%
Gender		
Male	75	24.5
Female	231	75.5
Race		
White	266	86.9
Black or African American	25	8.2
Other†	15	4.8
Age		
18-25	299	97.7
26-34	5	1.6
35+	2	0.6
Major		
Health Related‡	199	65.0
Non-Health Related	107	35.0
Frequency of Physical Activity§		
Daily	143	46.9
Weekly	116	38.0
Monthly or less	46	15.1
Body Mass Index		
Underweight (<18.5)	12	3.9
Normal (18.5-24.9)	219	71.6
Overweight (25.0-29.9)	50	16.3
Obese (≥30.0)	25	8.2

†Other includes Asian, Latino or Hispanic of any race, or 2 or more races
‡Health related majors include nutrition, nursing, exercise science, occupational therapy, pre-medicine, pre-pharmacy, pre-veterinary medicine, pre-dentistry, and pre-physical therapy. All other majors were considered non-health related.
§ *n*=305, all other groups *n*=306

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Table 2: Use of Dietary Supplements

Supplement	N†	%
Vitamins & Minerals		
Multivitamin	167	54.6
Vitamin C	128	41.8
Calcium	100	32.7
Iron	65	21.2
Vitamin D	63	20.6
Vitamin B12	61	19.9
Vitamin E	60	19.6
Potassium	56	18.3
Vitamin A	54	17.6
B-Vitamin Complex	54	17.6
Vitamin B6	44	14.4
Zinc	37	12.1
Magnesium	35	11.4
Thiamin	30	9.8
Riboflavin	26	8.5
Folate	25	8.2
Phosphorus	23	7.5
Niacin	23	7.5
Selenuim	21	6.9
Herbal Supplements		
Garlic	69	22.5
Cranberry	67	21.9
Premenstrual Formulas	41	13.4
Raspberry	40	13.1
Sleep Formulas	39	12.7
Ginseng	34	11.1
Chamomile	25	8.2
Echinacea	23	7.5
Guarana	19	6.2
Ginkgo Biloba	14	4.6
Ephedra Products	8	2.6
Spirulina	7	2.3
Goldenseal	4	1.3
St John's Wort	4	1.3
Saw Palmetto	3	1.0
Black Cohosh	3	1.0
Valarian Root	3	1.0
Kava Kava	2	0.7
Hawthorn	2	0.7
Gotukola	2	0.7

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Table 2 Continued

Supplement	N†	%
Other Herbals‡		
Green Tea	5	1.6
Herbal Tea	2	0.7
Immunity Formulas	2	0.7
Pomegrante Juice	1	0.3
Hoodia	1	0.3
Cinnamon	1	0.3
Milk Thistle	1	0.3
Detox Tea	1	0.3
Ergogenic Aids		
Creatine	27	8.8
Chromium Picolinate	7	2.3
Coenzyme Q	5	1.6
Androstenedione	5	1.6
HMB (beta-hydroxy-betamethylbutyrate)	3	1.0
Ambotrose	2	0.7
Other Ergogenic Aids‡		
Protein	15	4.9
NaNO (Nitric Oxide)	6	2.0
L-Glutamine	5	1.6
L-Carnitine	2	0.7
L-Arginine	1	0.3
BCAA	1	0.3
Beta-Alanine	1	0.3
Hydroxycut Hardcore	1	0.3
Pre-workout Stimulant	1	0.3
Plasma Volume Enhancer	1	0.3
Other Supplements‡		
Melatonin	10	3.1
Fish Oil	6	2.0
Flaxseed Oil	3	1.0
Fiber	2	0.7
Kefir	1	0.3
Lactoferrin	1	0.3
Creon 20	1	0.3
Juice PLUS+ Capsules	1	0.3
Glucosamine Chondroitin	1	0.3

†N= number of respondents that reported taking the supplement within the last 12 months
‡ Supplements listed within these categories were written in by the respondents with the exception of melatonin which was included on the original survey list

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Use of ergogenic aids varied the most based on major, physical activity and weight status. Students in non-health-related majors were significantly more likely to consume ergogenic aids compared to those in health-related majors, X^2 (1, N=306) = 7.01, p< 0.01. Respondents who were categorized as overweight or obese according to BMI were more likely to take ergogenic aids, while those who were underweight or normal weight were less likely to use them X^2 (1, N=306)=17.32, p<0.001. Frequency of physical activity was significantly associated with ergogenic aid consumption, as those that reported exercising daily were significantly more likely to use ergogenics than those that reported exercising less often, X^2(2, N= 306) =19.53, p<0.001.The only significant difference found with herbal or vitamin and mineral use and weight status, major, or frequency of physical activity was that non-health-related majors were significantly more likely than health-related majors to take 2 or more vitamin or mineral supplements, X^2(2, N=306)=9.87, p < 0.01.

Some differences in frequency of use existed based on other characteristics. Difference in frequency of herbal use based upon major was statistically significant, with health-related majors more likely to take herbs on a daily basis than non-health-related majors X^2(3, N=306) = 7.829, p=0.05. Frequency of use of ergogenics varied significantly based upon weight status, exercise, and gender. Those who were overweight or obese were significantly more likely to use ergogenics on a daily basis, while those who were at a normal weight or underweight were significantly more likely to never use ergogenic aids, X^2(3, N=306) = 15.58, p=0.001. Considering frequency of exercise, those who exercised daily were significantly more likely to take ergogenics on a daily basis, X^2(6, N=306) = 13.93, p<0.05. Females were significantly more

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likely to never take eregogenics, while males were significantly more likely to consume them on a weekly or daily basis, $X^2(3, N=306) = 73.45$, $p<0.001$. Characteristics of users versus nonusers of dietary supplements can be seen in Table 3.

There was no difference in beliefs scores based on students' majors. When amount of physical activity and beliefs scores were compared, it was found that those that exercised daily had significantly higher beliefs scores than those that exercised monthly or less, $F(2, 302) = 4.21$, $p<0.05$. Those who were classified as overweight or obese according to BMI category also had significantly higher beliefs scores than those who were normal weight or underweight, $t(304) = -2.205$, $p<0.05$. When looking at use of supplements and beliefs scores, those who took 2 or more herbs had significantly higher beliefs scores than those that did not take herbs, $F(2, 303) = 8.76$, $p<0.001$, and those that took 1 or more ergogenic aids had significantly higher beliefs scores than those that did not take ergogenics, $t(304) = -4.05$, $p<0.001$. No difference in scores was found based on vitamin and mineral use. Comparisons of health beliefs scores based on different characteristics can be seen in Table 4.

Post-hoc Analyses

Because previous research had shown females are often more likely to take dietary supplements than males post-hoc analyses were run to see if any differences existed within this sample. When considering gender and dietary supplement use, significant differences were found for herbal supplements and ergogenic aids. Females were significantly more likely to consume 1 herbal

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Table 3: Traits of Dietary Supplement Users and Nonusers Based Upon Supplement Type

Supplement Category	Trait	% Users	% Nonusers
Vitamin and Minerals	Gender		
	Male	77.3	22.7
	Female	73.6	26.4
	Major**		
	Health Related	70.9	29.1
	Non-Health Related	81.3	18.7
	Frequency of Physical Activity		
	Daily	78.3	21.7
	Weekly	75	25
	Monthly or less	60.9	39.1
	Body Mass Index		
	<25.0	74	26
	≥25.0	76	24
Herbals	Gender**		
	Male	46.7	53.3
	Female	51.9	48.1
	Major		
	Health Related	48.2	51.8
	Non-Health Related	55.1	44.9
	Frequency of Physical Activity		
	Daily	49.7	50.3
	Weekly	56	44
	Monthly or less	39.1	60.9
	Body Mass Index		
	<25.0	48.9	51.1
	≥25.0	56	44
Ergogenic Aids	Gender***		
	Male	44	56
	Female	2.6	97.4
	Major*		
	Health Related	9	91
	Non-Health Related	19.6	80.4
	Frequency of Physical Activity***		
	Daily	21.7	78.3
	Weekly	6	94
	Monthly or less	2.2	97.8
	Body Mass Index***		
	<25.0	8.2	91.8
	≥25.0	26.7	73.3

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

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Table 4: Mean Dietary Supplement Health Belief Scores Based Upon Traits and Supplement Use

Trait	Mean Score
Gender***	
Male	3.54
Female	3.31
Major	
Health Related	3.38
Non-Health Related	3.35
Frequency of Physical Activity*	
Daily	3.44
Weekly	3.32
Monthly or less	3.26
Body Mass Index*	
<25.0	3.34
≥25.0	3.46
Vitamin & Mineral Use	
0	3.31
1	3.36
2 or more	3.40
Herbal Use***	
0	3.27
1	3.39
2 or more	3.50
Ergogenic Aid Use***	
0	3.33
1 or more	3.62

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

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supplement $X^2(2, N=306) = 11.43$, $p<0.05$ than were males. Males were significantly more likely to consume ergogenic aids when compared to females $X^2(1, N=306) = 87.27$, $p<0.001$. Frequency of vitamin and mineral use varied significantly based upon gender, with males more likely to take them on a daily basis, and females more likely to use them on a monthly basis, $X^2(3, N=306) = 8.33$, $p<0.05$. Males were also more likely to consume ergogenic aids on a daily or weekly basis when compared to females, $X^2(3, N=306) = 73.45$, $p<0.001$. Finally, when considering health beliefs scores males had significantly higher health belief scores than females with a mean score of 3.5 for males and 3.3 for females, $t(304) = 4.18$, $p<0.001$.

Similar to previous research findings, this study found that the more physically active respondents were, the more likely they were to take dietary supplements, particularly ergogenic aids. Individuals categorized as overweight or obese were significantly more likely to take ergogenic aids as well. Post hoc analysis was run to determine if there was a relationship between these two groups. After running the analysis, it was found there was no relationship between the overweight and obese group and those that exercised more frequently, X^2 (2, N =305) = 1.848, p = 0.397.

Comment

Research has shown that males typically consume dietary supplements to increase performance and aid in building strength and muscle mass. [16, 19-21] This goes along with the finding that more males consumed ergogenic aids than females, as they are commonly used for the same reasons. It is likely the reason those participating in daily physical activity were consuming ergogenics as well.

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Those that were overweight and obese were also using ergogenic aids at a higher rate. One explanation for this could be that these participants were more likely to exercise, and therefore had a higher muscle mass, putting them in the overweight or obese category. However, post hoc analysis showed no relationship between those that exercised more frequently and those that were overweight or obese. This may mean that 2 separate groups were consuming ergogenic aids at a higher rate, regular exercisers and those who are overweight or obese.

One explanation for the use of ergogenic aids by overweight and obese individuals could be that they were using them as weight loss aids. However, if this were true you may expect to see less of a difference between use in women versus use in men, as previous research has pointed to weight loss as a reason women take dietary supplements. [12-13,16] This study did not assess reasons for supplement use.

This study found that non-health-related majors were more likely to use dietary supplements than those students in health-related majors. This is different from findings by Newberry and colleagues[17] who found that users of NVNM supplements in their study were significantly more likely to have majored in a health-related profession. There were some differences in the study design. When looking at the make-up of the Newberry study population almost half were health- related and half were non-health-related. In our study, 65% were health-related, versus 35% non-health-related. Newberry conducted a random sample of the entire student body, while this study used students enrolled in an introductory nutrition course possibly explaining the difference in the populations. Another difference is this study assessed the use of multiple types of dietary supplements, unlike the Newberry study which only

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examined NVNM supplements. Further, the Newberry study was conducted in the west and this study was conducted in the south. Research has shown that dietary supplement use tends to be more prevalent in the west and less prevalent in the south when compared to other areas of the country.[3,8-9] This could affect health-related majors thoughts on supplement use and explain differences in the findings between these 2 studies.

We found that 28.6% of health-related majors took 2 or more herbal supplements, compared to 40.2% of non-health-related majors. However, health-related majors were significantly more likely to have taken herbal supplements on a daily basis than non-health-related majors. Gardiner and colleagues found that healthcare professionals with higher knowledge scores regarding supplements were more likely to have been using them.[14] Therefore, the lower use of supplements overall, but more regular consumption by those who do take them, could be a sign of increased knowledge regarding supplements among health-related majors. The majority of the health beliefs statements in the survey were based on popular opinion and had little scientific evidence behind them, therefore if health-related majors were more knowledgeable you would likely expect their health belief scores to be lower. This was not the case as no difference was found in the health belief scores based on major. However, this study did not assess knowledge of dietary supplements, which could be an area for future exploration.

A large proportion of previous studies on dietary supplements found that women were more likely to consume them when compared to men. In this study there were no differences in use in vitamins and minerals, and while women were more likely to take 1 herbal supplement,

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men were more likely to use ergogenic aids. This may be expected, as most of the ergogenic aids included in our survey were popularly used for increasing strength and muscle mass as discussed above. Men more frequently consumed vitamin and mineral supplements and ergogenic aids on a daily basis when compared to women.

These findings raise the question 'why are men more prone to supplement use during college, while women seem to take them more in other populations?' Research[16, 19-21] shows that young adult men take supplements mainly to enhance workouts, and it is likely as they get older the use of these supplements decreases, as it has been shown that physical activity in men is negatively associated with age.[22] Another possible explanation may be that older women use dietary supplements to treat certain chronic diseases that are not prevalent in college-age women. Satia-Abouta and colleagues[23] found in a study that examined supplement use and medical conditions in older adults that women were more likely to take supplements than men. In addition, in 13 of 21 medical conditions examined, individuals with the disorder used supplements more often that those without. The sample for this study consisted mainly of 18-24 year olds, and therefore differences in use based upon age could not be analyzed. Future research should focus on delineating the reasons for the difference in supplement use based on age.

Another focus of this study was to determine if differences existed in health beliefs regarding dietary supplements, based on an average health belief score. The results showed that individuals who took 2 or more herbal supplements or 1 or more ergogenics had significantly higher beliefs scores than those who used fewer of these supplements. This was similar to

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previous research findings. [19, 24] Also, males had a higher mean belief score than females as did individuals who reported exercising more frequently. These 2 groups were more likely to take ergogenic aids. These findings are of particular concern, as ergogenic aids are more likely to have little scientific evidence regarding their safety and effectiveness when compared to vitamins and minerals or herbal supplements. In addition, they tend to be products that have marketing aimed towards young adults in magazines, supplement stores, on television, and the internet. While this study did not inquire about source of information regarding supplements, other studies have found that college populations tend to receive information from these outlets. [16-17]

Blendon and colleagues[23] found that the majority of regular supplement users in their study felt that claims made by manufacturers were true. Conversely, they found those who took supplements less often were significantly less likely to believe manufacturers' claims. In addition, they found that just over half of the sample knew that dietary supplements were not regulated by the government and that regular supplement users were more likely to believe in the usefulness of dietary supplements regardless of the scientific evidence. For this reason it is important that healthcare providers and health educators on college campuses be knowledgeable about the use of NVNM supplements, like ergogenic aids, and inform students about the safety and efficacy of these products.

The present study does have limitations. Since the sample was taken from students enrolled in an introductory nutrition class it was not randomly selected, decreasing the generalizibility of the results. The demographic characteristics showed that whites, females, and students enrolled in health-related majors were overrepresented, which too may decrease the

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generalizability to all college students. Data were self-reported which always increases the chance for bias and decreases the reliability of the findings.

While this may not be the ideal sample to use for representation of the general college population, it is a good representation of students enrolled in introductory nutrition courses. When utilized in this manner it could be a valuable tool for developing lessons regarding dietary supplement use in this subgroup of the larger college population. Another strength of this study is that it focuses on a unique population that has yet to be investigated. Most research examining supplement use in college students has focused on student-athletes and is not generalizable to the larger college population. While this study did contain a larger proportion of health-related majors, it did still contain non-health-related majors that could be used for comparisons.

Future Research

The present study found men were more frequent consumers of vitamins and minerals and herbal supplements than women. They also were more likely to use ergogenic aids. However, research in older population has almost always found women to be significantly more likely to take dietary supplements. Future research should aim to determine why this difference exists between different age groups.

The significantly higher use of ergogenic aids in men, those who exercise regularly, and overweight and obese individuals is worth noting. Future research should focus on establishing reasons for increased use in these groups compared to others. Knowledge of supplements should also be assessed in these individuals, as ergogenic aids are often perceived to be more effective than they actually are.

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Professional Implications

This study highlights the high use of dietary supplements in the college population. MVs were the most commonly used supplements, but use of other supplements that are more controversial was also seen, such as ergogenic aids. It is important that healthcare providers are knowledgeable to the fact that this population does consume dietary supplements so that steps can be taken to educate college students on the topic.

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Appendices

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Appendix A: Extended Methods

Purpose

The purpose of this project was to determine differences in use of dietary supplements and differences in health beliefs regarding dietary supplements in introductory nutrition students based upon college major, frequency of physical activity, and weight status. Research regarding dietary supplement use in college students is limited, and of those studies that have been conducted a large portion of them consist of college athletes. Therefore few studies are generalizable to a larger college population. Also, few characteristics have been linked to dietary supplement use in the college population. For these reasons this study aimed to determine characteristics related to dietary supplement intake and beliefs, as well as examine a larger more generalizable subgroup of the college population.

Sample

The sample for this study comes from a secondary database consisting of individuals enrolled in a large introductory nutrition course during spring semester 2008 at the University of Tennessee, Knoxville. Data were collected from a questionnaire given to the students, which was administered online via the class internet site.

Students were asked to complete the questionnaire prior to attending a class lecture covering the topic of dietary supplements. All students enrolled in the class were required to finish the questionnaire. However, only the data gathered from those giving consent were included in the database. The total number of students enrolled in the course was 349. Of those,

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315 consented to participate in the study. Data were collected from 308 students who consented to participate, and of these 2 were removed because they did not complete any of the survey questions, leaving a final sample of 306. Extra credit was given to those who agreed to participate in a larger study, approved by the University of Tennessee Institutional Review Board, which used a portion of this data to research course enhancement.

Variables

The independent variables in this study were (a) respondents' frequency of physical activity reported as daily, weekly, monthly, or rarely/never; (b) the respondents' weight status as calculated by self-reported weight in kilograms divided by reported height in meters squared and categorized as underweight, normal, overweight, or obese using CDC guidelines; and (c) reported academic major, categorized as either health-related or non-health-related. The dependent variables were (a) the frequency of dietary supplement use reported by respondents as daily, weekly, monthly, or sometimes/rarely; (b) the type of reported supplements used categorized as: vitamins and minerals, herbals, ergogenic aids, and other specified dietary supplements; and (c) mean supplement health belief scores.

Operational Definitions

Independent Variables

Physical Activity. Frequency of physical activity was measured by 1 item incorporated in the demographics portion of the survey. The question asked "how often do you exercise?" The question was close-ended with possible answers being daily, weekly, monthly, or rarely/never.

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Monthly and rarely/never were collapsed into one category during analysis due to small cell counts.

Weight Status. Weight status was determined by BMI. BMI was calculated using self-reported data on height and weight. The formula is as follows: weight (kg)/height (m^2). Weight status was categorized using CDC guidelines as underweight (BMI below 18.5), normal (BMI of 18.5-24.9), overweight (BMI of 25.0-29.9), and obese (BMI of 30.0 and above). During analysis weight status was collapsed into two categories: underweight/normal weight or overweight/obese. This was due to small cell counts.

College Major. College major was assessed in an open-ended question with respondents writing in their major in the space provided. Responses varied widely as students from any academic major could enroll in the course in which the survey instrument was given. Additionally, the course was a requirement for certain health sciences majors (i.e. nursing, nutrition, and exercise science), but students from other areas enrolled to fulfill a life sciences requirement or as an elective. The majors were categorized as either health-related or non-health-related. Health-related referred to majors in physical health. The following majors were categorized as health-related: exercise science; nutrition; nursing; pharmacy; occupational therapy; pre-physical therapy; pre-veterinary medicine; pre-dentistry; and pre-medicine. All other academic majors were considered non-health-related. This was based on classifications by Newberry and colleagues[1] and areas of study at the University of Tennessee, Knoxville.

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Dependent Variables

Dietary Supplement Intake. Dietary supplement intake was assessed by a total of 47 items: 20 about specific vitamin/mineral supplements; 20 regarding specific herbal supplements; and 7 that queried other non-herbal, non-vitamin/mineral dietary supplements. Table 1 lists all dietary supplements included in the survey instrument by supplement category. Melatonin was only analyzed to determine number of respondents who took it, because the sample in this group was so small. To analyze number of supplements taken vitamins and minerals and herbals were categorized into 3 groups: individuals who took 0, individuals who took 1 or individuals who took 2 or more of these supplements. Due to small cell counts ergogenic aids were categorized into 2 groups: individuals who took 0 or individuals who took 1 or more. Respondents were asked to indicate their frequency of consumption on a fixed scale with possible answers including: (1) daily, (2) weekly, (3) monthly, or (4) do not use.

Dietary Supplement Beliefs. Students were asked about their health beliefs regarding dietary supplements using 22 belief statements. These belief statements were taken from a previously validated questionnaire that was also tested for reproducibility.[2] Respondents were asked to give their level of agreement for each statement, using a 5-point Likert scale that included the following: (1) strongly disagree, (2) disagree, (3) no opinion, (4) agree, and (5) strongly agree. A total score was taken across all 22 belief statements, and a mean score was calculated from this. A higher score showed a stronger belief of the respondent in the ability of supplements to hold certain health benefits.

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Analysis procedure

Research Question 1: What types of dietary supplements are used by college students when dietary supplements are categorized in the following groups: vitamins and minerals; herbals; ergogenic aids; and other specified dietary supplements?

To determine what types of dietary supplements are used by college students, we looked at the reported percentage of use for each category of supplement included in the survey

Research Question 2: How frequently (daily, weekly, monthly, or do not use) are dietary supplements used by college students?

To determine frequency of use of dietary supplements by college students, we examined for each of the 4 main types of supplements the frequency of use as daily, weekly, monthly, and rarely/never.

Research Question 3: What differences in types of dietary supplement use and frequency of use exist based upon college major (health-related or non-health-related), frequency of physical activity (daily, weekly, monthly, rarely/never), and weight status (underweight, normal, overweight, or obese)?

Dietary supplement type was a dependent, nominal variable. Frequency of dietary supplement use was a dependent, ordinal variable. Number of supplements being taken was a dependent, ordinal variable. College major was an independent, nominal variable. Frequency of physical activity and weight status were independent, ordinal variables. In order to analyze the data for this research a chi-square of independence was used. Chi-square measures the

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independence of 2 nominal variables and determines if what is observed is significantly different from what is expected by chance.[3]

Research Question 4: What differences in beliefs regarding dietary supplements exist based upon college major (health-related or non-health-related), frequency of physical activity (daily, weekly, monthly, or rarely/never), weight status (underweight, normal, overweight, or obese) and use of vitamins and minerals, herbals, and ergogenic aids?

Belief scores were calculated for each belief statement as discussed above. A total health belief score was calculated, and then a mean score was determined from this. These scores were dependent, continuous variables. College major was an independent, nominal variable. Frequency of physical activity and weight status were independent, ordinal variables.

College major consisted of 2 mutually exclusive categories: health-related or non-health-related. Weight status consisted of 2 mutually exclusive categories as well: underweight/normal weight or overweight/obese. To determine the difference in mean belief scores for this variable an independent samples t-test was used. A t-test determines if the difference between 2 means is significantly different than zero.[3]

Because frequency of physical activity consisted of more than 2 categories an Analysis of Variance (ANOVA) was used. An ANOVA is a statistical test used to compare 3 or more means at one time through the use of variances.[3] ANOVA also requires that the measures for the dependent variables be interval/ratio, dichotomous, or ordinal with equal appearing intervals. This is so a mean and variance can be calculated.[3] The health beliefs scores were tested to determine if a normal distribution existed, as this is necessary for use of ANOVA.

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Appendix B: Survey Instrument

Nutrition 100 Pre-Test Spring 2008

1. Gender

○ Male ○ Female

2. Age

○ 18-25 ○ 26-34 ○ 35-39 ○ 40-49 ○ 50+

3. Major

4. Race/Ethnicity

Caucasian	Black/African American	Asian	American Indian and Alaskan native	Native Hawaiian and other Pacific Islander

5. Height

6. Weight

7. How often do you post content online?

○ Daily ○ Weekly ○ Monthly ○ Rarely/never

8. What other Internet activities do you typically do on a daily basis? (Email, surfing, IM, update personal home page, wikis, etc.)

9. How often do you exercise?

○ Daily ○ Weekly ○ Monthly ○ Rarely/never

10. What type of exercise do you normally do?

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For questions 11-32, please select the choice which best represents your level of agreement with the following statements.

11. Vitamin/mineral supplements can provide stamina and energy.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

12. People can maintain their health by taking vitamins and minerals above the RDAs.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

13. People can live longer by taking vitamin/mineral supplements even though they eat a balanced diet.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

14. Vitamin/mineral supplements can reduce stress.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

15. Vitamin C can prevent or treat colds.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

16. Vitamin/mineral deficiencies can affect a person's learning ability.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

17. Low intakes of vitamins and minerals can cause chronic diseases such as cancer.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

18. Vitamin/mineral supplements can help recovery from fatigue.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

19. Vitamin/mineral supplements can prevent or treat skin diseases such as acne.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

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20. Extra vitamins and minerals can retard aging.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

21. Supplements can promote weight loss.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

22. Supplements can enhance athletic performance.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

23. Supplements can burn up fat.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

24. Supplements can promote skin and hair health.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

25. Supplements can help you build muscle.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

26. Supplements can help improve your mood.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

27. Supplements can act as aphrodisiac.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

28. Supplements can help you sleep.

Strongly Disagree Disagree No Opinion Agree Strongly Agree

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29. Supplements can relieve stress.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

30. Supplements can improve circulation.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

31. Supplements can help you gain weight.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

32. Supplements can prevent illnesses such as cancer, osteoporosis, high blood pressure, etc.

○ Strongly Disagree ○ Disagree ○ No Opinion ○ Agree ○ Strongly Agree

Please answer questions 33-52 by selecting the choice that best describes how often you have used the listed vitamin and mineral supplements in the last month.

33. Multi-Vitamin/Mineral

○ Daily ○ Weekly ○ Monthly ○ Do not use

34. Multi-Vitamin

○ Daily ○ Weekly ○ Monthly ○ Do not use

35. B-Vitamin Complex

○ Daily ○ Weekly ○ Monthly ○ Do not use

36. Vitamin A

○ Daily ○ Weekly ○ Monthly ○ Do not use

37. Thiamin

○ Daily ○ Weekly ○ Monthly ○ Do not use

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38. Riboflavin

○ Daily ○ Weekly ○ Monthly ○ Do not use

39. Niacin

○ Daily ○ Weekly ○ Monthly ○ Do not use

40. Vitamin B6

○ Daily ○ Weekly ○ Monthly ○ Do not use

41. Vitamin B-12

○ Daily ○ Weekly ○ Monthly ○ Do not use

42. Vitamin C

○ Daily ○ Weekly ○ Monthly ○ Do not use

43. Vitamin D

○ Daily ○ Weekly ○ Monthly ○ Do not use

44. Vitamin E

○ Daily ○ Weekly ○ Monthly ○ Do not use

45. Folate

○ Daily ○ Weekly ○ Monthly ○ Do not use

46. Calcium

○ Daily ○ Weekly ○ Monthly ○ Do not use

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47. Iron

○ Daily ○ Weekly ○ Monthly ○ Do not use

48. Magnesium

○ Daily ○ Weekly ○ Monthly ○ Do not use

49. Phosphorus

○ Daily ○ Weekly ○ Monthly ○ Do not use

50. Potassium

○ Daily ○ Weekly ○ Monthly ○ Do not use

51. Selenium

○ Daily ○ Weekly ○ Monthly ○ Do not use

52. Zinc

○ Daily ○ Weekly ○ Monthly ○ Do not use

53. Do you think you should take a vitamin/mineral supplement? If so, what kind and why? If not, justify why not.

Please complete questions 54-73 by selecting the choice that best represents how often you have taken the following herbal dietary supplements in the last month.

54. Echinacea

○ Daily ○ Weekly ○ Monthly ○ Do not use

55. Ginseng

○ Daily ○ Weekly ○ Monthly ○ Do not use

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56. St. John's Wort

Daily Weekly Monthly Do not use

57. Ginkgo Biloba

Daily Weekly Monthly Do not use

58. Ephedra Products

Daily Weekly Monthly Do not use

59. Chamomile

Daily Weekly Monthly Do not use

60. Garlic

Daily Weekly Monthly Do not use

61. Goldenseal

Daily Weekly Monthly Do not use

62. Kava Kava

Daily Weekly Monthly Do not use

63. Premenstrual Formulas

Daily Weekly Monthly Do not use

64. Sleep Formulas

Daily Weekly Monthly Do not use

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65. Spirulina

Daily Weekly Monthly Do not use

66. Raspberry

Daily Weekly Monthly Do not use

67. Guarana

Daily Weekly Monthly Do not use

68. Black Cohosh

Daily Weekly Monthly Do not use

69. Valarian Root

Daily Weekly Monthly Do not use

70. Gotukola

Daily Weekly Monthly Do not use

71. Cranberry

Daily Weekly Monthly Do not use

72. Hawthorn

Daily Weekly Monthly Do not use

73. Saw Palmetto

Daily Weekly Monthly Do not use

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74. Please list any other herbal dietary supplements that you take and indicate whether you take them daily, weekly, or monthly.

Please answer questions 75-81 by selecting the choice that best represents how often you have taken any of the following non-herbal dietary supplements in the last month.

75. Chromium Picolinate

○ Daily ○ Weekly ○ Monthly ○ Do not use

76. Creatine

○ Daily ○ Weekly ○ Monthly ○ Do not use

77. Coenzyme Q

○ Daily ○ Weekly ○ Monthly ○ Do not use

78. Melatonin

○ Daily ○ Weekly ○ Monthly ○ Do not use

79. Ambotrose

○ Daily ○ Weekly ○ Monthly ○ Do not use

80. HMB (beta-hydroxy-betamethylbutyrate)

○ Daily ○ Weekly ○ Monthly ○ Do not use

81. Androstenedione

○ Daily ○ Weekly ○ Monthly ○ Do not use

82. Please list any other non-herbal dietary supplements that you take and indicate whether you take them daily, weekly, or monthly.

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Vita

Amy Webb was born on September 26, 1984 in Columbus, Ohio. She was raised in Pedro, Ohio and graduated from Rock Hill Senior High School in Ironton, Ohio in 2003. She then attended The Ohio State University where she obtained her B.S. in Allied Medicine with a concentration in Medical Dietetics in June 2007.

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