DIETARY SUPPLEMENTS AND COLLEGE STUDENTS: USE, KNOWLEDGE, & PERCEPTION

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DIETARY SUPPLEMENTS AND COLLEGE STUDENTS: USE, KNOWLEDGE, & PERCEPTION (120 pp.)

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This study examined the use, knowledge, and perception of dietary supplements of college students (n=231). This cross-sectional, retrospective, comparative study was part of a larger study examining data from students enrolled in a general sophomore-level nutrition course during the spring semester of 2017. Data examined for the current study included demographic and dietary supplement questionnaires. The demographic survey asked students their age, class standing, gender, ethnicity, field of study, and grade point average. Students were also asked about dietary supplement use and provided pictures of product labels and ingredients of supplements taken by them at the time the survey was completed. Users and non-users of dietary supplements answered questions regarding their knowledge of products including regulation, proven effectiveness, and safety. Perception of dietary supplements was assessed by asking users and non-users how strongly they agreed with statements regarding product effectiveness, safety, and sources of information. Descriptive statistics were used to analyze demographic information and sources of dietary supplement information. Independent-t-tests were used to test for significant differences with dietary supplement knowledge and perception responses for users and non-users. Chi-square (χ^2) tests of independence and Fisher's exact tests were

used to test for significant differences between gender and the type of dietary supplement product used.

Nearly one-half (47.6%) of students reported consuming dietary supplements. The majority of students in this sample were female, Caucasian, and in their freshman year of college. Students' use of MVM single nutrient, herbal, weight loss, fish oil, fiber, and other did not significantly differ by gender. Protein supplement use in males, however, was significantly higher than in females ($p<0.05$). Overall, users and non-users correctly responded to less than half of the knowledge questions with no significant difference between the two groups. Perception of dietary supplements for users and non-users was neutral with no significant difference between the two groups.

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CHAPTER I

INTRODUCTION

Dietary supplements are products containing one or more of a vitamin, mineral, herb, botanical, amino acid, or other dietary substance used to supplement the diet by increasing total dietary intake; or an extract, constituent, concentrate, metabolite, or combination of previous ingredients (Federal Food, Drug, and Cosmetic Act, 2013). Spending $37 billion on products annually, half to two-thirds of Americans take some form of dietary supplement with multivitamins being the most frequently used (Dickinson & MacKay, 2014; National Institutes of Health Office of Dietary Supplements, 2016). Dietary supplements are intended to add further nutritional value to the diet when nutrient adequacy cannot be met from food intake alone (U.S. Food and Drug Administration, 2017).

College students are a particular population of interest due to reports of higher dietary supplement intake, approximately 14% more than the public (Lieberman et al., 2015). Furthermore, collegiate athletes are more likely than their peers to take dietary supplements with 89% reporting use for a desire to gain a competitive edge and improve athletic performance (Froiland, Koszewski, Hingst, & Kopecky, 2004). This may be since young adults are more likely to be open and experiment with health alternatives during this period of life (Von Ah, Ebert, Ngamvitroj, Park, & Kang, 2004). Young adults have indicated a positive perception of dietary supplements, viewing products as offsetting negative behaviors and believing they can improve health (Valentine, Schumacher, Murphy, & Ma, 2018). However, young adult dietary supplement users

have demonstrated misconceptions regarding proven health claims, testing for product safety, and supplements labeled as "natural" (Miller & Russell, 2004).

Many college students are establishing independence for the first time and adopting health behaviors that persist throughout life (Nelson, Story, Larson, Seumark, Sztainer, & Lytle, 2008). College students commonly report negative health behaviors including low physical activity, poor diet, and high alcohol intake (Nelson et al., 2008). Common use of dietary supplements among college students may be due to the belief that products can counteract the effects of negative health behaviors (Valentine et al., 2018). The high prevalence of dietary supplements among college students is a growing concern since young adults generally develop health habits that persist throughout life, products can be potentially harmful and costly, and health benefits have not been proven (Harel et al., 2013; Kantor, Rehem, Du, White, Edward, & Giovannucci, 2016).

Statement of the Problem

Dietary supplement use is common in the United States with approximately half reporting regular use (Dickinson, Blatman, El-Dash, & Franco, 2014). College students are increasingly using dietary supplements for alternative methods of improving health and appearance (Hoyte, Kennon, & Heard, 2013). This may be due to influential advertisement claims and many newly marketed sport and herbal supplements that are aimed to attract the attention of young adults (Lieberman et al., 2015). Furthermore, college students are more open to experimenting with health alternatives and express a strong perception of dietary supplement effectiveness (Jackson, Lyons, Roberts, Geary, & Williams, 2010). Students that used dietary supplements reported feeling more

knowledgeable about products and self-reported having better health compared to non-users (Valentine et al., 2018).

Although supplement use has been examined extensively among the adult population, influences for dietary supplement use in college students is limited and conflicting. Health behaviors associated with young adult dietary supplement users include both positive and negative characteristics (Gardiner et al., 2007). Previous research has found that college students feel they are somewhat or very knowledgeable about dietary supplements yet most commonly site receiving information from the internet (Valentine et al., 2018). There is limited research about the reasons influencing use and perception related to dietary supplement information amongst college students (Hoyte, Albert, & Heard, 2013). Evaluating patterns of dietary supplement intake in college students and understanding their knowledge and perception regarding dietary supplements may help to develop educational tools for appropriate use among this population.

Purpose Statement

The purpose of this study is to examine the use, knowledge, and perception of dietary supplements of college students.

Hypotheses

Hypothesis 1: Males and females will differ in use of type of dietary supplement.

Hypothesis 2: Knowledge of dietary supplements will differ between users and non-users.

Hypothesis 3: Perception of dietary supplements will differ between users and non-users.

Operational Definitions

Dietary supplement – Products containing one or more of a vitamin, mineral, herb, botanical, amino acid, or other dietary substance used to supplement the diet by increasing total dietary intake; or an extract, constituent, concentrate, metabolite, or combination of previous ingredients.

College student – Students enrolled at Kent State University.

Knowledge – An individual's familiarity, awareness, and understanding of dietary supplements by means of facts, information, and descriptions.

Perception – An individual's belief, feeling, and attitude towards dietary supplements.

User- An individual that took one or more dietary supplement(s).

Non-user- An individual that did not take any dietary supplements.

CHAPTER II

REVIEW OF LITERATURE

Dietary Supplements

Dietary supplements are products containing one or more of a substance including vitamins, minerals, herbs, botanicals, amino acids, enzymes, organ tissues, glandular, or metabolites (U.S. Food and Drug Administration, 2017). They are ingested orally and come in the form of a tablet, capsule, soft gel, gel cap, liquid, powder, or food item. Dietary supplements are intended for use when micronutrient or macronutrient adequacy is not met from dietary intake alone (U.S. Food and Drug Administration, 2017). The different types of dietary supplements include multivitamin-multimineral (MVM), single vitamin or mineral (SVM), herbal, protein, fatty acid, and weight loss products (Bailey et al, 2011). They are commonly used for reasons other than nutrient deficiency including to reduce risk of specific chronic diseases such as heart disease and cancer, as part of a healthy lifestyle, and to improve sleep or physical performance (Bailey et al, 2011).

Dietary supplements are unique in that they share qualities of both pharmaceutical drugs and food (Saldanha, 2005). Drugs are designed to treat or cure a disease, while food is required to fuel the body (Gershwin, Borchers, Keen, Hendler, Hagie, & Greenwood, 2010). Dietary supplement products are intended to supplement the diet when vital nutrients are not acquired from the diet alone (U.S. Food and Drug Administration, 2017). Similar to drugs, they are most often taken in the form of a tablet or capsule and are commonly used to improve health (Saldanha, 2005). They are comparable to food in that they are held to the same standards of post market regulation

and contain substances found naturally in food items (Gershwin et al., 2010). Supplements are particular in that unlike food which is essential for life, and drugs that sustain life for many, dietary supplements are not critical for survival (Quinones, Winsor, Patino, Hoffman, 2013).

Regulation of Dietary Substances

The U.S. Food and Drug Administration (FDA) oversees the regulation of dietary supplements (U.S. Food and Drug Administration, 2017). In response to public pressure for a dietary supplement industry with less government jurisdiction, the Dietary Supplement Health and Education Act (DSHEA) was introduced in 1994 (Quinones et al., 2013). Dietary supplement consumers and manufacturers advocated for easier access as well as current and accurate information regarding supplement products (U.S. Food and Drug Administration, 1995). As a result, DSHEA dramatically reduced the FDA's regulatory involvement and transferred responsibility of ensuring product safety of dietary supplements from the FDA to the manufacturing companies (Hathcock, 2001).

The amendment to the Federal Food, Drug, and Cosmetic Act established a definition for dietary supplements and provided a framework for regulation of product safety, marketing, and manufacturing (Food and Drug Administration, HHS, 2007). Products existing prior to DSHEA 1994 are assumed safe and do not require FDA approval before marketing; however, dietary supplements containing a new ingredient developed after DSHEA are required to be proven safe by tests chosen by the manufacturer (Gahche et al., 2011). Only in response to consumer reports of serious

adverse events is the FDA permitted to evaluate a product for safety and remove the dietary supplement from market if proven dangerous (Gardiner et al., 2008).

In accordance with the FDA, the Federal Trade Commission (FTC) is responsible for monitoring dietary supplement advertisement claims by means of print, broadcast, infomercials, catalogs, and direct marketing tools (Federal Trade Commission, 2011). The FTC enforces that product advertisements must be truthful and substantiated and must not be misleading (DeAngelis & Fontanarosa, 2003). Marketing claims of dietary supplements may include structure and function properties but are prohibited from making statements that they can prevent, treat, or cure a disease or illness (U.S. Food and Drug Administration, 2016). When manufacturing companies make statements that lack scientific evidence of a dietary supplements purpose, the FTC acts to inform consumers and stop false and deceptive advertising (Proposed Framework for Evaluating the Safety of Dietary Supplements, 2002; U.S. Food and Drug Administration, 2016).

In 2006, the Dietary Supplement and Nonprescription Drug Consumer Act (DSNDCPA) amended the Federal Food, Drug, and Cosmetic Act once more to establish a mandatory adverse event reporting system to the FDA's Med-Watch program (U.S. Food and Drug Administration, 2009). Prior to the DSNDCPA, dietary supplement companies could voluntarily choose to report adverse events associated with their product to the FDA (Quinones et al., 2013). This amendment requires a Med-Watch report be submitted to the FDA in no more than 15 business days from when the manufacturing company was notified of a serious adverse event (Gardiner et al., 2008). A serious adverse event is one that: "results in death, a life-threatening experience, inpatient

hospitalization, a persistent or significant disability or incapacity, or a congenital anomaly or birth defect" (Klotter, 2007; U.S. Food and Drug Administration, 2009).

The FDA established a final rule for Current Good Manufacturing Practice (CGMPs) of dietary supplements in 2007 (Food and Drug Administration, HHS, 2007). CGMPs are the regulatory standard to which pharmaceutical companies must adhere to in order to manufacture, package, label, or hold dietary supplements in a manner that is consistent and reproducible (U.S. Food and Drug Administration, 2015). The final rule issued minimum requirements to assure quality of products and ensure that a dietary supplement contains what the manufacturer intends (Food and Drug Administration, HHS, 2007). A finished dietary supplement should consist of the proper ingredient, purity, strength, and composition intended but CGMPs do not account for clinical testing of products for safety or efficacy (Crowley & FitzGerald, 2006; Food and Drug Administration, 2007). Manufacturers are accountable for developing a process to achieve consistent and reliable products by way of testing and examining dietary supplements (Food and Drug Administration, 2007). The type of quality assurance test performed on dietary supplements is at the discretion of the manufacturers, not the FDA, meaning companies can complete the bare minimum of product testing and acquire raw materials from poorly reputable sources to save money (Liva, 2007). Furthermore, businesses that make or supply the source of raw ingredients are not held to the same regulation standards (Ashar, 2010).

Based on DSHEA, manufacturing companies are not required to provide evidence that a dietary supplement is safe and label claims are truthful before releasing it to the

public (National Institutes of Health Office of Dietary Supplements, 2011). Dietary ingredients marketed prior to October 15, 1994 are assumed safe in contrast to new dietary ingredients created after the enactment of DSHEA (Federal Food, Dug, and Cosmetic Act, 2004). In the case of new dietary ingredients developed after October 15, 1994, the manufacturer is required to notify the FDA that there is evidence that the product is expected to be safe, although the FDA provides no description of how this should be done (Pawar & Grundel, 2017). Instead, if a dietary supplement is suspected to be adulterated, the FDA must prove the product is unsafe before removing it from the market (Hathcock, 2001). An adulterated dietary supplement or ingredient is one that:

> " (A) presents a significant or unreasonable risk of illness or injury under – (i)conditions of use or suggested in labeling, or, (ii) if no conditions of use are suggested or recommended in labeling; under ordinary conditions of use; (B) is a new dietary ingredient for which there is inadequate information to provide reasonable assurance that such ingredient does not present a significant or unreasonable risk of illness or injury; (C) the Secretary declares to pose an imminent hazard to public health or safety or…; (D) is or contains a dietary ingredient that renders it adulterated under the conditions of use recommended or suggested in labeling of such dietary supplement" (Federal Food, Dug, and Cosmetic Act, 2004).

Although manufacturers do not need to prove a dietary supplement is safe before putting it on the market, the FDA needs substantial proof of adulteration by means of adverse

events reports that a product is unsafe to ban it from market (Frankos, Street, & O'Neill, 2009).

Types of Dietary Supplements

Dietary supplements are classified by the type of ingredient they contain including vitamins, minerals, botanicals, amino acids, fatty acids, and enzymes (National Institutes of Health Office of Dietary Supplements, 2011). Products are often categorized for the population they are intended for with formulas varying based on age, gender, and physiological state (Bellows et al., 2014). The purported health function of the dietary supplement typically influences the type of product and ingredients it contains as well (Dickinson et al., 2014). Dietary supplements are ingested orally and can be in the form of tablets, capsules, lozenges, gel caps, chewables, powders, or syrups (U.S. Food and Drug Administration, 2015).

Vitamin and mineral supplements are the most common type of dietary supplement used in the United States with Americans spending $30 billion annually on them (Bellows et al., 2014). They are available as individual nutrients and as a combination of multiple micronutrients (Dickinson et al., 2014). Single vitamin or mineral (SVM) as well as multivitamin-mineral (MVM) supplements come in a wide variety of brands, ingredient composition, and product type (Wallace, McBurney, & Fulgoni, 2014). Children, adults, and elderly commonly use vitamin and mineral supplements with use increasing with age (Macpherson, Pipingas, & Pase, 2012). In the United States, approximately 40% of adults and 30% of children use vitamin and mineral supplements (Bellows et al., 2014).

Multivitamin-Multimineral Supplements. Dietary supplements that contain three or more vitamin or mineral ingredients are classified as MVM supplement; however, not all products are labeled as such (Yetley, 2007). MVM typically include all the essential micronutrients and supply the recommended daily amount (RDA) intended for a specific age and gender. Many individuals obtain the required vitamins and minerals through their diet and when taken daily, MVM can put an individual at risk for excessive intake (Bellows et al., 2014). Products sometimes contain ingredient amounts exceeding the RDA and when MVM are taken in combination with other dietary supplements or fortified food products, it may result in daily intakes that are above the tolerable upper limit (UL) (Carlsohn, Cassel, Linne, & Mayer, 2011). The UL is the maximum daily intake unlikely to cause adverse health effects; therefore, exceeding the UL increases the risk of an individual experiencing a nutrient toxicity and health complications from over consumption of micronutrients (National Institutes of Health Office of Dietary Supplements, 2014).

The most frequently used dietary supplement is MVM with one-third of all Americans reporting regular use (National Institutes of Health Office of Dietary Supplements, 2016; Rock, 2007). According to NHANES, 40 percent of adult men and women report taking MVM supplement daily (Gahche et al, 2011). The most common reason for MVM supplement use is for overall health maintenance and to fill nutrient gaps in the diet (Webb, 2006). MVM supplements encompass a broad category of dietary supplements with specialized formulas for age, gender, and purpose including enhanced performance or energy, menopause, hair growth, pregnancy, and to assist

individuals with diabetes and other diseases (National Institutes of Health Office of Dietary Supplements, 2016; Yetley, 2007). Products are commonly available in the form of tablets, capsules, and gummies and may accompany ingredients other than vitamins and minerals such as botanicals, dietary fiber, and macronutrients (Yetley, 2007). Additionally, MVM supplements are more likely to be used for longer durations compared to other dietary supplement products (Macpherson, Pipingas, & Pase, 2012).

Single Vitamin or Mineral Supplements. SVM dietary supplements are products containing one vitamin or mineral (Ashar, 2010). Due to the health benefits that high intake of vitamins and minerals in the diet provide, SVM supplements are often used to prevent chronic disease such as cardiovascular disease and cancer (Fortmann, Burda, Senger, Lin, & Whitlock, 2013). For instance, supplementation of vitamins B12, B6, and folic acid have been studied to see if there is a decreased risk of cardiovascular disease, while supplementation of antioxidants A, C and E have been examined for a reduced risk of certain cancers (Fezeu, Ducros, Gueant, Guilland, Andreeva, Hercberg, & Galan, 2018; Koushik et al., 2015). However, a systematic evidence review that looked at twenty-four randomized, controlled studies found no consistent evidence that vitamin and mineral supplementation reduced the incidence of cancer or cardiovascular disease in healthy individuals without nutritional deficiencies (Fortmann et al., 2013).

SVM products are used when a person experiences a nutrient deficiency due to inadequate intake from the diet or malabsorption problems impairing the body's ability to absorb nutrients from food (U.S. Food and Drug Administration, 2011). In cases when an individual has a nutrient deficiency, high supplementation of the nutrient may be

beneficial for a limited period to replenish the vitamin or mineral and reverse symptoms (U.S. Department of Health and Human Services, 2015). Vitamin and mineral supplements can contain anywhere from ten to one-hundred times the dietary reference intake (DRI) and can cause potentially serious health effects when taken in excess for an extended time (Bunchorntavakul & Reddy, 2013). For this reason, it is important to consult with a medical professional prior to using high dosages of vitamin and mineral supplements. Instances when a SVM supplement may be appropriate is for those experiencing iron-deficiency anemia, breastfed or partially breastfed infants, strict vegans, menopausal and postmenopausal women, and those with a restrictive diet (Bellows et al., 2014).

Non-vitamin Non-mineral Supplements. Dietary supplements other than vitamins and minerals may contain a combination of herbs, probiotics, amino acids, and other substances such as fish oil and digestive enzymes (Kemper, Amata-Kynvi, Dvorkin, & Whelan, 2003). Nearly 40 percent of American adults' report use of products other than vitamin and mineral supplements (Blendon, Benson, Botta, & Weldon, 2013). Among those, the most popular product consumed by Americans is fish oil supplements (Xin, Wei, & Li, 2012). Fish oil contains the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahecaenoic acid (DHA) (Argo et al., 2015). Dietary sources of EPA and DHA are known to reduce inflammation in the body and are linked to other possible health benefits such as depression, anxiety, and cancer yet this has not been proven (Grey & Bolland, 2014). Fish oil supplements are used most widely after vitamins and minerals

despite the supplemental version of EPA and DHA not displaying the same health benefits as it does from food (Xin et al, 2012).

Weight Loss Supplements. Products marketed as weight loss supplements are the next leading contributor of dietary supplement sales in the United States (Talbott, 2003). With more than two-thirds of adults in the United States either overweight or obese, many people turn to weight loss supplements as an easier method of losing weight compared to the more difficult approach of diet and lifestyle changes (National Institutes of Health Office of Dietary Supplements, 2017). Advertisements of weight loss supplements can be misleading by claiming benefits such as rapid weight loss and quick fixes (Saper, Eisenberg, & Phillips, 2004). Weight loss supplements are often marketed as "natural", "guaranteed", or as a "scientific breakthrough" which may be falsely interpreted as safe and effective among consumers (U.S. Food and Drug Administration, 2015). Among the 15% of American adults who report using weight loss supplements, young obese women are most likely to use them (Blanck et al., 2007).

Weight loss supplements are more likely than other dietary supplement products to present with complications from use (Haller & Benowitz, 2000). Ephedra is the most notorious of weight loss supplements for causing unreasonable risk of injury or illness in consumers and was banned from market in the United States in 2004 (Betheseda, 2008). Users of ephedra containing caffeine supplements experienced modest, short-term weight loss compared to placebo groups, making it a popular dietary supplement during the 1990's (Shekelle et al., 2003). Before ephedra was banned in the United States, the FDA received over 900 adverse event reports attributing the use of supplements containing

ephedra with stroke, myocardial infarction, kidney disease and in 37 cases sudden death (Betheseda, 2008).

There are currently over 400 weight loss products on the market that contain ingredients such as caffeine, Garcinia cambogia, guar gum, probiotics, bitter orange, hoodia gordonii, and more (National Institutes of Health Office of Dietary Supplements, 2017). Some suggested mechanisms of dietary supplements assisting in weight loss include increasing energy expenditure, increasing satiety, reducing fat synthesis, blocking dietary fat absorption, and modulating carbohydrate metabolism (Saper et al., 2004). A systematic review that analyzed thirty clinical trials, systematic reviews and meta-analyses discovered that there is no convincing evidence for most dietary supplements as aids in reducing body weight (Pittler & Ernst, 2004).

A more recent form of weight loss supplement includes meal replacement products which are fortified bars and shakes with defined nutrient and calorie content (Davis et al., 2010). Rather than consume essential nutrients from food sources, shakes and bars are enriched with protein, carbohydrates, vitamins and minerals to replace one or two meals per day (Treyzon et al., 2008). While one randomized, control study found that meal replacement dieters lost significantly more weight than a food-based meal plan, another similar study found no difference between a high protein food diet and a protein-enriched meal replacement diet (Davis et al., 2010; Treyzon et al., 2008). The individuals who lost weight from meal replacements gained significantly more weight back compared to the food-based dieters, indicating that a meal-replacement diet is not a sustainable method of controlling weight (Davis et al., 2010).

Sports Supplements. Sports supplements consist primarily of protein and amino acid blends but may also include vitamins, minerals, carbohydrates, botanicals, caffeine, or any combination of these (Gotson & Correia, 2010). Protein supplements are considered a form of ergogenic aid which are methods used to improve athletic performance (Maughan, King, & Lea, 2004). The well-known benefits associated with dietary proteins role in exercise performance and recovery has helped lead to a multi-billion-dollar industry of supplemental protein (Whitehouse & Lawlis, 2017). Although protein supplements have not proven the same athletic performance enhancing benefits as dietary protein, it is still the most common dietary supplement consumed among both amateur and professional athletes (Pasiakos, Lieberman, & McLellan, 2014; Van Thuyne, Van Eenoo, & Delbeke, 2006).

Athletes and college students report higher use of sport supplements compared to the public, 85% and 64% respectively (Hoyte, Albert, & Heard, 2013; Maughan, Depiesse, & Geyer, 2007). Furthermore, 88% of collegiate athletes appear to use sport supplements due to increased pressure to excel physically, to aid in recovery after workouts, and to meet increased nutrient demands from intense exercise (Burns, Schiller, Merrick, & Wolf, 2004). In contrast to other categories of dietary supplements, sports supplements are more commonly used in males than females and younger individuals compared to adults and elderly (Evans, Ndetan, Perko, Williams, & Walker, 2012; Gotson et al, 2010). Younger athletes in adolescence to teenage years are increasingly exploring sports supplements and other aids for improved appearance and physical ability as well (Calfee & Fadale, 2006).

Sports supplements are often advertised as bodybuilding products, endurance enhancers, detoxes, for increased energy, fat burning, joint support, muscle recovery, testosterone boosting, and water loss (Lawrence et al, 2002). Sport supplements may be sold as meal replacements or for pre- or post-workout and commonly come in powders, drinks, bars, and capsules (Gotson et al, 2010). Like other dietary supplements, sports supplements have become increasingly available for purchase online. Less-credible online sources of sports supplements come with an increased risk of being contaminated with substances such as synthetic hormones, heavy metals, microbiological agents, and other harmful substances (Maughan, 2012). Furthermore, label claims of sport supplements content and effectiveness can be inaccurate and misleading to consumers (Juhn, 2003). This may cause athletes to avoid caution with sports supplements and take nutrients exceeding the RDA which may be harmful (Maughan et al, 2004).

Herbal Supplements. Herbal supplements are a type of botanical and consist of a plant or plant part such as seeds, leaves, stems, bark, roots or flowers (Botanical Dietary Supplements, 2011). Use of herbal products for medical treatment has been recorded in China as early as 2800 B.C. and has continuously gained attention in the western civilization for its perceived health benefits (Sturluson, 2014). One in six American's use botanical supplements on a regular basis for their medicinal or therapeutic properties (Gershwin et al., 2010). Herbal supplements are more commonly used among college students than other populations with between 30% to 70% reporting use (Carroll, Spence, & Paulus, 2009; Stasio, Curry, Sutton-Skinner, & Glassman, 2010). Users mistakenly presume herbal products that claim they are "all natural" are undoubtedly safe, which is

not the case (Bellows et al., 2014). Traditionally, the most popular herbal supplements in the United States are ginkgo biloba, St. John's wort, ginseng, garlic, and Echinacea (Ayranci, Son, & Son, 2005). They are most often linked with supporting brain function and mood elevation such as improving depression, increasing energy, aiding with sleep and reducing stress (Talbott, 2003).

Based on nationally representative data from analysis of the National Health Interview Survey (NHIS), people aged eighteen to thirty years old use of non-vitamin non-mineral (NVNM) supplements is greater among one in five young adults (Gardiner et al., 2007). Another study that looked at five hundred six undergraduate college students found that 79% of the sample had used at least one herbal supplement in the past twelve months (Johnson et al., 2006). Factors related to herbal supplement use among this study population found increased age and health symptoms such as pain, fatigue, sleep problems and mood changes to be prevalent and a common reason for use of products such as ginseng, Echinacea, green tea, and chamomile (Johnson et al., 2006). Several studies looked at herbal supplement use in combination with other complementary and alternative medicine (CAM) therapies such as meditation, message therapy and yoga (Johnson et al., 2006; LaCaille & Kuvaas, 2011). These studies indicate that college students often use herbal supplements in combination with CAM as methods to improve mental and emotional health, making it difficult to attribute if the dietary supplement taken is responsible for the health benefits reported by users (LaCaille & Kuvas, 2011).

Prevalence of Dietary Supplement Use in the United States

The number of dietary supplements products available on the market in the United States is currently over 75,000, which has greatly expanded from 1994 when only 4,000 different products existed (U.S. Government Accountability Office, 2009; Wallace, 2015). The global dietary supplement industry was estimated to be valued at 133.1 billion dollars in 2016, with American's spending almost 37 billion dollars annually on products (National Institutes of Health Office of Dietary Supplements, 2016). In 2024, it is projected that the global dietary supplement market will reach 278 billion dollars due to the growing prevalence of consumers taking them to enhance intake of essential nutrients (Grand View Research, 2018). Vitamin supplements contribute the most to the overall market revenue of dietary supplements, accounting for approximately 48% of total sales, followed by minerals, botanicals, and amino acids (Wallace, 2015).

Increased awareness that adequate intake of micronutrients provides health benefits and reduces risk of non-communicable diseases has influenced the growth of the dietary supplement industry (Wallace, 2015). According to the eighth edition Dietary Guidelines for Americans (DGA) from 2015 to 2020, many vitamins and nutritionally-essential minerals are under-consumed by Americans of certain age and gender groups including vitamins A, D, E, and C, and choline, calcium, magnesium, iron, potassium, and fiber (U.S. Department of Health and Human Services, 2015). Furthermore, vitamin D, calcium, iron, potassium, and fiber are under-consumed to the point of potentially causing adverse health outcomes (U.S. Department of Health and Human Services, 2015). To achieve adequate intake of micronutrients for proper metabolic,

developmental, and growth processes as well as for good health across the lifespan, the DGA recommends regular consumption of nutrient-dense foods and in certain cases and populations, fortified foods and dietary supplements (Blumberg, Frei, Fulgoni, Weaver, & Zeisel, 2017).

According to the Centers for Disease Control and Prevention (CDC), more than half of United States adults consume dietary supplements daily (Kantor et al., 2016). The National Health and Nutrition Examination Survey (NHANES) is a continuous program of studies conducted by the National Center for Health Statistics (NCHS) to provide information on the health and nutritional status of adults and children in the United States (National Health and Nutrition Examination Survey, 2017). The data generated from NHANES has shown that regular use of dietary supplements has continuously increased overtime among adults aged 20 years of age and older, from 33% during the 1970's to 53% from 2003-2006 (Gahche et al., 2011). Dietary supplement use increases with age with individuals reporting consumption among 34% of people aged 20 to 39, 50% aged 40 to 59, and 67% over the age of 60 (Bailey et al., 2013). Among the 31% of children who consume dietary supplements, infants younger than one-year old use products the least at 11%, followed by teenagers aged 14 to 18 years old at 25%, and the highest use reported among four to eight-year-old children at 48% (Picciano et al., 2007). The reported prevalence of dietary supplements from NHANES represents individuals that use products in the preceding thirty days; therefore, use is higher when occasional or seasonal use is accounted for (Dickinson et al., 2014). The prevalence of consumers

reporting regular use of multiple dietary supplement products has increased overtime as well to 36% of Americans in 2011 compared to 28% in 2007 (Dickinson et al., 2014).

Use of dietary supplements is estimated to be higher for several populations. Dietary supplement use increases with age, with 70% of elderly men and women reporting regular use (Bailey et al., 2011). Common types of dietary supplements used among the elderly include multivitamin-mineral, calcium, and vitamin D supplements for reasons being more site-specific such as heart, eye, joint, and bone health (Bailey et al., 2013). Additionally, college students report higher dietary supplement intake than the general population, with approximately 66% of young adults using a product regularly (Lieberman et al., 2015). Athletes report high use of dietary supplements as well, with 60% reporting regular use and elite athletes reporting even greater use of dietary products among 85% of individuals (Knapik, Steelman, Hoedebecke, Austin, Farina, & Lieberman, 2016; Maughan, Depiesse, & Geyer, 2007). Common reasons athletes use dietary supplements include to gain a competitive edge by enhancing physical performance through increased muscle mass, quicker recovery after workouts, and to boost energy levels (Knapik et al., 2016). Protein supplements such as pre-workout, creatine, and whey protein are among the supplements commonly used by athletes (Maughan et al., 2007).

The rapid expansion of the dietary supplement market may be due to increased interest in consumers seeking alternative methods of health improvement and the passage of DSHEA limiting the governments regulatory involvement (Quinones et al., 2013). Consumers are increasingly resorting to dietary supplements as a means of improving

health due to research demonstrating that certain chronic diseases are related to dietary factors (Bailey et al., 2013). For instance, individual's that frequently consume foods high in vitamins, minerals, whole grains, and omega-3 fatty acids have a lower risk of developing coronary artery disease, ischemic stroke, diabetes, and some forms of cancer (Willett, Koplan, Nugent, Dusenbury, Puska, & Gaziano, 2006). Dietary supplement advertisements often promote a product by stating a nutrients biological function and linking it to a desired health effect, despite there being conflicting evidence that supplements are as beneficial as nutrient-dense foods (Wheatley & Spink, 2013). In addition, consumers source of dietary supplement information often comes from the internet, making it difficult for users to identify advertisements that are truthful compared to ones that are deceptively making health claims to increase product sales (Wheatley et al., 2013).

Reasons for Dietary Supplement Use

The primary reason for dietary supplement use among American consumers is to promote health and reduce risk of disease (Bailey et al, 2011). Health conscious consumers are becoming increasingly interested in maintaining health and preventing consequences associated with debilitating lifestyle choices such as poor diet, minimal exercise, tobacco use, and excessive intake of alcohol (Radimer et al, 2004). This has led people to conveniently seek optimum nutrition from pills and powders rather than natural food sources, even when health care professionals promote obtaining nutrients from a balanced diet (National Institutes of Health Office of Dietary Supplements, 2011). In addition, dietary supplements appeal to individuals who are more reliant on forms of self-

care health methods that do not rely on expensive resources of information and treatment (Tindle, Davis, Phillips, & Eisenberg, 2005).

Another reason for dietary supplement use among Americans is to fill nutrient gaps in the diet (Bellows et al, 2014). This is especially common for those with diet restrictions or individuals in a particular life stage that require increased nutrients. Vegetarians, vegans, and those following other diets restricting food group intakes may benefit from vitamin B12, vitamin D, calcium, iron and zinc supplements since these nutrients are consumed in low amounts from the diet (Elorinne et al., 2016). Those with restricted caloric intake will struggle to meet nutrient adequacy from the diet and may benefit from MVM or protein supplement (Samadi, Zeinali, Habibi, & Ghotbodhin-Mohammadi, 2016). For instance, individual's battling certain diseases or that have experienced a major injury may benefit from a protein supplement containing essential vitamins and minerals to help fight infections and aid in recovery (Samadi et al., 2016). Women of child-bearing age and that are pregnant, or breastfeeding are advised to supplement the diet with folate, iron, or a prenatal vitamin to support increased physiological demands (Bellows et al., 2014). It is recommended that adults over 50 years old and menopausal women consume vitamin B12, calcium, and vitamin D supplements (Manson & Bassuk, 2014). Lastly, physicians may prescribe individuals with health conditions affecting digestion, appetite, and nutrient absorption an appropriate dietary supplement (Bellows et al., 2014).

Many consumers of dietary supplements use products that are intended for managing specific health conditions (National Institutes of Health Office of Dietary

Supplements, 2011). People following a complementary or alternative medical plan may choose to use dietary supplements in combination with or instead of conventional medicine (National Center for Complementary and Integrative Health, 2016). Fish oil is commonly used to protect cardiovascular health (Grey et al, 2014). Antioxidant vitamins A, C, and E are related to immune function with many reporting uses for protection against heart disease and cancer (Bellows et al, 2014). Iron supplementation is commonly used by individuals with iron-deficiency anemia (Stoltzfus & Dreyfuss, 1998). Female adults report high intake of calcium and vitamin D supplements for bone support and prevention of osteoporosis (Manson & Bassuk, 2014).

Consumers also use dietary supplements to improve physical performance and appearance (Calfee & Fadale, 2006). Those that exercise regularly report taking products to replenish nutrients and avoid weakness after workouts, to increase strength and muscle, and to improve performance (Gotson et al, 2010). Males are much more likely than females to take sport supplements for improved speed and agility, strength, and muscle gain (Froiland, Koszewski, Hingst, & Kopecky, 2004). Dietary supplements related to performance enhancement are protein powders, amino acid blends, and other sport supplements (Froiland et al, 2004). Females are more likely to report reasons of dietary supplements for improved physical appearance by means of weight loss and for healthier hair, skin, and nails (Bailey et al, 2013). Weight loss supplements often contain a variety of herbal ingredients and specialized MVM products containing B vitamins and collagen are advertised as promoting better looking hair, skin and nails.

Sources of Dietary Supplement Information

The National Center for Complementary and Integrative Health (NCCIH) recommends a health care provider as a reliable source of dietary supplement information (National Institute for Complementary and Integrative Health, 2014). This is because medical professionals are likely to know of products backed by more scientific testing and can identify any potential drug and dietary supplement interactions to avoid (U.S. Food & Drug Administration, 2017). While most people consult with health providers for concerns related to health and well-being, that is not always the case with dietary supplements (Clarke, Black, Stussman, Barnes, & Nahin, 2015).

Dietary supplements along with other natural products and mind-body practices are a form of complementary and alternative medicine (National Center for Complementary and Integrative Health, 2016). This is opposed to conventional medicine which requires medical doctors and health professionals for intervention and treatment of illness or disease (Barnes, Bloom, & Nahin, 2008). Conventional treatments are evidence-based and include drugs, surgery, physical therapy, and nutritional and lifestyle interventions (Richardson, Sanders, Palmer, Greisinger, & Singletary, 2000). Unlike conventional medicine, dietary supplement safety and efficacy is not always well defined and information is sought more often from internet, news sources, family, and friends rather than health care practitioners (Blendon, DesRoches, Benson, Brodie, & Altman, 2001; Navarro, Khan, Bjornsson, Seeff, Serrano, & Hoofnagle, 2017).

Popular media sources of dietary supplement information include television, radio, print, and internet (Froiland et al, 2004). Media sources as a primary source of

dietary supplement information among young adults may be common due to this population being extremely reliant on digital technology (Scofield & Unruh, 2006). Although convenient and inexpensive, information from media sources can often be contradictory and confusing. In addition, information on dietary supplements from media is often vague and strong worded to draw in consumers attention and increase sales. Coaches and athletic trainers are also reported as sources of information regarding dietary supplements, especially among athletes (Burns et al, 2004).

Dietary supplement information coming from health professionals may be low due to many Americans feeling that doctors are not good sources of information on dietary supplement products and feel biased against their use (Blendon et al., 2001). Among those interviewed from various gyms and recreational facilities, over half admitted to choosing not to discuss their use of dietary supplements with health professionals and instead were self-prescribed (Gotson et al, 2010). In general, health professionals advocate increased consumption of fruits, vegetables, and whole grains as a means of receiving essential nutrients (Lichtenstein & Russel, 2005). This is because current data does not prove that dietary supplements can prevent or treat diseases, which is the most common reason for taking products, unlike a well-balanced diet (Rautiainen, Manson, Lichtenstein, & Sesso, 2016). This may explain why consumers are resilient to discuss dietary supplement use with health professionals.

Health Issues Associated with Dietary Supplements

Originally, dietary supplements were designed to support nutrient adequacy, especially for populations with higher risk of experiencing nutritional deficiency (U.S.

Food and Drug Administration, 2017). Populations with greater potential of experiencing malnutrition from low nutrient intake in the United States include those restricting food choices such as vegetarians, pregnant women, elderly, children, those with food-intolerances, and chronically ill individuals (Bellows et al, 2014). When dietary supplements are consumed according to recommended serving size, most users do not experience negative health consequences from products (Talbott, 2003). However, America's minimal government oversight and the belief that dietary supplements are inherently safe increases risk of complications associated with use (Barrett, 2007; Blendon et al., 2001).

Adverse events related to dietary supplements attribute to an estimated 23,000 emergency department visits and 2,100 hospitalizations each year (Geller et al, 2015). Weight loss, sexual-enhancement, and sport supplements were among the more common dietary supplement products linked to adverse events with symptoms such as cardiovascular events and liver injury (Geller et al, 2015; Zheng & Navarro, 2017). Potential health issues associated with dietary supplement use include: "some dietary supplements are inherently unsafe; lax regulation increases risks of contamination with harmful substances and adulteration; dietary supplements present dangers to special populations; spending on dietary supplements represents an enormous health-related expenditure of unsubstantiated value; use of dietary supplements may compromise or delay treatment with therapies of proven efficacy" (American Society of Health-System Pharmacists, 2004; Quinones et al., 2013).

Dietary supplements are distributed as over the counter products, allowing manufacturers to distribute them without proof of its safety and effectiveness (Ashar, 2010). An over the counter drug product is marketed directly to consumers without recommendation of a health care professional (Klotter, 2007). Unlike drugs which must first pass clinical trials proving there is substantial evidence they are safe and effective, dietary supplements are not approved by the FDA before they are released to the public (FDA Regulation of Drugs versus Dietary Supplements, 2015; Gibson & Taylor, 2005). For the FDA to investigate a dietary supplement, a product must present serious adverse events in people taking them and pose a significant threat to the health of Americans to be removed from the market (Haller, Kearney, Bent, Ko, Benowitz, & Olson, 2008).

Manufacturers are not required to register dietary supplements with the FDA meaning they have limited information on product number, types, and ingredients on the marketplace (Navarro et al, 2017). This makes it extremely difficult for the FDA to monitor the thousands of products on the market and restricts the ability to identify negative health consequences that could possibly be related to dietary supplements (Navarro et al, 2017). Instead, the FDA relies on manufacturers, consumers, health care professionals, and poison control centers to report adverse events related to dietary supplement use (Gardiner et al., 2008). Previous research has demonstrated adverse events from dietary supplements often go undetected and thus underreported (Quinones et al., 2013).

Only since 2006 did the FDA mandate manufacturers report adverse events associated with their product to the government Med-Watch program (U.S. Food and

Drug Administration, 2009). Consumers must first alert the manufacturer of a problem with product use and only in the case of severe adverse events is notification required (Quinones et al., 2013). However, consumers are inclined to associate dietary supplements as beneficial for health and fail to relate a product with any negative side effects (Klein, 2004). Along with consumer tendency to not attribute adverse events that may result from dietary supplements, some health care professionals do not feel they are informed enough to suspect and report supplement use as a cause for health problems (Suchard, Suchard, & Steinfeldt, 2004; Winslow & Shapiro, 2002). In one study, only 10% of physicians that had encountered patients experiencing adverse events associated with dietary supplement use reported it to the FDA (Pascale, Steele, Attipoe, O'Connor, & Deuster, 2016). Under reporting of adverse events along with the severity of harm required to notify the FDA makes it difficult for products causing health issues to be identified and assessed (Quinones et al., 2013).

This minimal oversight of supplement regulation poses a threat to users considering products may be adulterated (Harel, Harel, Wald, Mamdani, & Bell, 2013). Previous research has demonstrated that many dietary supplements do not contain the stated ingredients and amount on the product label and sometimes contain harmful ingredients (Navarro et al, 2017). For instance, in 2008, a manufacturer produced a dietary supplement that contained roughly 200 times more than what the label stated of selenium (MacFarquhar et al, 2010). The MVM product was advertised for maintaining energy and sustaining health and suitable for the entire family; meanwhile, users were experiencing symptoms of nutrient toxicity such as muscle and joint pain, headache,

weakness, gastrointestinal distress, and hair loss (MacFarquhar et al, 2010). From 2004 to 2012, 62% of the FDA's recalls involved products that involved units distributed intentionally (Harel et al, 2014).

In addition to dietary supplements containing incorrect amounts or specified nutrients, some products have been found to contain ingredients that do not fall under classification of dietary supplement (Harel et al, 2013). Banned substances such as steroids and ephedra have been detected in popular sport supplements (Chicago Tribune, 2012). One study found that greater than half of herbal supplements did not contain products listed on the label (Newmaster, Grguric, Shanmughanandhan, Ramalingam, & Ragupathy, 2013). Furthermore, 32% of the herbal products examined did not even contain the main ingredient (Newmaster et al, 2013).

Consumers of dietary supplements are often unfamiliar with the regulatory system in place regarding product safety, efficacy, and market advertising (Ashar, Miller, Pichard, Levine, & Wright, 2008). Unaware that manufacturers do not always make statements supported by scientific evidence, consumers often mistrust labeling claims of dietary supplements which can be persuasive and misinterpreted (DeAngelis et al, 2003; Lieberman et al, 2015). One study found that over half of herbal product vendors on web sites claimed to prevent, diagnose, or cure diseases, which is specifically stated as prohibited by the FDA and FTC (Morris & Avorn, 2003). Dietary supplement users have reported they believe the FDA and FTC approve products and advertisements and roughly half were unsure of the government's role in regulation (Ashar et al, 2008). Consumers that use dietary supplements in combination with other over the counter

products or prescribed medications may also be unaware of possible health issues from drug interactions since many are unlikely to discuss use with their physicians (Yetley, 2007).

In addition, consumers often overlook a quality source of dietary supplements. The United States Pharamacopeial (USP) Convention evaluates product safety and indicate dietary supplements that: "contain the ingredients listed on the label, in the declared potency and amount; does not contain harmful levels of specified contaminants; will break down and release into the body within the specified amount of time; and has been made using safe, sanitary and well-controlled manufacturing practices according to FDA and USP guideline" (What does the USP Verified Mark tell you?, 2017). Products that bear an official USP monograph are held to a higher standard of safety than other dietary supplements; however, sources of supplements containing this seal are sparse and more expensive (Gardiner et al., 2008).

Dietary supplement users that have reported an adverse event associated with product use most commonly report experiencing heart problems or chest pain (Timbo, Ross, McCarthy, & Lin, 2006). In a nationally representative study of United States adults aged eighteen years or older, MVM were the most common dietary supplement taken as well as the most reported product to cause an adverse event. 74% of supplement users that had experienced an adverse event were taking multiple dietary supplements or prescription drugs. Less than half of those that had experienced an adverse event discussed it with their physician, one-quarter reported it to a health authority and less than 10% notified the manufacturer (Timbo et al., 2006).

Dietary Supplement Use in College Students

College students are likely to have different characteristics than the general population such as age and higher socioeconomic status as well as engaging in similar activities of attending class, studying, playing sports, and various other recreational activities (U.S. Department of Education, 2012). Health behavior of college students are often similar to one another as well. For instance, 60% of students are likely to report poor-quality of sleep, (Lund, Reider, Whiting, & Prichard, 2010). College students report frequently missing meals, specifically breakfast, and are likely to rate eating habits as poor for reasons of lack of time, money, and motivation (Silliman, Rodas-Fortier, & Neyman, 2004). A meta-analysis demonstrated that roughly half of college students self-reported being physically inactive and failed to meet the American College of Sport Medicine's recommendations for exercise (Keating, Guan, Pinero, & Bridges, 2005). Other negative health behaviors such as tobacco and alcohol use are also common among young adults (Gardiner et al, 2002).

Dietary supplement use is unique to that of college students than other populations as well. Overall use of dietary supplements among college students is higher with 66% reporting regular use compared to 53% of NHANES respondents which surveys adults and children (Kennedy et al, 2013; Lieberman et al, 2015). Furthermore, an estimated 8 million young adults in the United States consume nonvitamin, nonmineral (NVNM) supplements such as weight loss, sport and herbal supplements (Gardiner, Kemper, Legedza, & Phillips, 2007). NVNM use in college students has been reported by nearly half of dietary supplement consumers while other age groups report a

much lower prevalence of one in six adults taking NMNM (Ayranci et al., 2005; Gershwin et al., 2010). Weight loss, sport and herbal supplements are typically considered high-risk supplements since they are found to be adulterated and cause adverse events more often than vitamin and mineral supplements (Newberry, Beerman, Duncan, McGuire, & Hilliers, 2010), Among an estimated 23,000 emergency department visits and 2,100 hospitalizations per year in the United States attributed to dietary supplement use, more than one-quarter involved use of weight-loss, herbal and energy products in young adults (Geller et al, 2015).

NVNM use may be high in this population due to young adults reporting a strong perception of dietary supplement effectiveness in previous research. Particularly, 76% of young adults that engaged in regular exercise and 63% of college athletes believed the dietary supplements they consumed were effective while only 38% of users that reported being sedentary believed they were effective (Valentine, Schumacher, Murphy, & Ma, 2018). In another study examining NVNM supplementation in college students, results indicated a significant difference in users and non-user's perception of dietary supplement effectiveness in preventing or treating disease (Newberry et al., 2010). Of 71 students that took dietary supplements, 77.5% perceived MVM to be effective at promoting health and 86.0% believed herbal supplements were effective at relieving anxiety and depression. Although in an acceptable weight range in terms of body mass index (BMI), 77.8% of students that considered themselves slightly to greatly overweight and took supplements to promote weight loss viewed them as effective (Newberry et al., 2010).

Athletes are among the most frequent users of dietary supplements when examining college students. In a study with almost 90% of college athletes that took dietary supplements, the most common types were energy drinks, calorie replacement products, MVM, creatine and vitamin C (Froiland et al., 2004). Commonly used among athletes, calorie or meal replacement products are drinks or bars used as a substitute meal for food and contain controlled quantities of calories and nutrients (Davis et al., 2010). They are used by athletes that require an increased number of calories from intense physical activity and have limited time to prepare food.

Interestingly, college students often have poorer health habits compared to the public but are more likely to report higher dietary supplement use, which is recognized by many as a positive health behavior (Ayranci et al., 2005). This could possibly be due to individuals attempting to offset a negative behavior (Perkin, Wilson, Schuster, Rodriguez, & Allen-Chabot, 2002). A previous study using data from the National Health Interview Survey (NHIS) found a positive correlation between negative health behaviors and use of NVNM supplements in young adults aged 18 to 30 years old (Gardiner et al., 2007). The use of NVNM in young adults was significantly higher among current or former smokers, moderate to heavy alcohol consumers, those taking prescription medication, and those who engaged in a high level of physical activity. Among the dietary supplements users, only 24% reported discussing their use with a medical professional, which is especially a concern to those who consume prescription medications and risk experiencing a negative health interaction (Gardiner et al., 2007).

In addition, college students are also less likely to consult with health professionals about dietary supplements than other populations (Sands, 2012). College students are increasingly deciding to turn to self-medication practices by using over the counter medications and dietary supplements rather than consult with a medical professional for health advice (Stasio et al., 2010). This is likely due to the ease and accessibility of over the counter and supplement products being accessible to the public, the assumption that dietary supplements are effective for their intended purpose, and the financial burden of seeking professional advice in cases when health insurance is not available (Sands, 2012). Instead, college students are more likely to report obtaining information regarding dietary supplement use from internet sources, family members, athletic trainers and friends (Froiland et al, 2004).

College students are also more susceptible to deceptive marketing claims since many sport, herbal, and weight loss supplement advertisements are geared toward young adults (Scofield et al, 2006). Although legal in the United States, many dietary supplements marketed as energy-enhancing, weight loss aiding and muscle enlarging products produce steroid-like effects and can negatively affect the cardiovascular system when used in great amounts (Kapner, 2008). To increase sales, manufacturers often take advantage of the weak regulatory system of dietary supplements and lack of understanding about these products potential adverse effects among this population by making incredulous health claims (DeLorme, Huh, Reid, & An, 2012). The tendency of college students to be prone to experimentation with dietary supplements and their innate

trust in their safety is a concern, especially since it is uncommon for them to consult use with a health professional (Sands, 2012).

CHAPTER III

METHODOLOGY

Research Design

The current investigation is a cross-sectional, retrospective, comparative study using pre-existing data obtained from college students enrolled in a general sophomore-level nutrition course at a public midwestern state university during the spring semester of 2017. Data comes from homework assignments and class projects completed by approximately 250 students enrolled in the Science of Human Nutrition. Students were from all majors and enrolled both part and full-time. After the semester concluded, class projects and homework assignments were gathered for analysis. Students' name and identification were removed from material and approval from Kent State's Institutional Review Board (IRB) was obtained to use data for the retrospective study.

Questionnaires used for the current study were obtained from approximately 250 data records including demographic, found in Appendix A, and dietary supplement surveys, found in Appendix B, C, D, and E. Students that took one or more dietary supplement product were considered "users" and those that did not use dietary supplements at the time the survey was taken were considered "non-users". Knowledge and perception of dietary supplements were the dependent variables used to compare the independent variable of users and non-users. In addition, the dependent variable of type of dietary supplement product used was compared to the independent variable of gender.

Sample

This retrospective study used data from class projects and homework assignments completed by Kent State University students enrolled in the Science of Human Nutrition during the spring semester of 2017. The general education course contained nine sections with approximately 1,000 students. As part of course requirements, students completed nine questionnaires including demographic, health perception and knowledge, lifestyle, physical activity, chronic disease, dietary supplement, breakfast consumption, sleep quality, and special diet surveys. Approximately 250 students from three of the nine sections contributed further data material by completing a four-day dietary record and having anthropometric measurements assessed.

Questionnaires

Among nine questionnaires distributed to students, the surveys that will be used in the current investigation include demographic and dietary supplement questionnaires. Approximately 250 data records containing students' questionnaires were included in the current study's analysis. In Appendix A, the demographic questionnaire included age, gender, ethnicity, marital status, and living arrangement. Students were asked to disclose their class standing, field of study, number of credit hours they are enrolled in for the current semester, and their grade point average. They were also asked to provide an estimate of their families combined annual household income and their personal monthly income. The survey asked if students have taken any previous college-level nutrition classes and their parents highest level of education. If students were currently employed they were asked what best describes their occupation. Health related information

including health insurance coverage, blood cholesterol levels, physical exams, allergies, and medical conditions were covered in the demographic survey as well.

The dietary supplement survey consisted of two sections. There were two different versions of the dietary supplement survey for users and non-users. Found in Appendix B, the first section of the dietary supplement questionnaire for users pertained to information about dietary supplements they took during the time the survey was taken. A survey packet was given for every product consumed by the student. Students selected the type of product taken and how frequently it was consumed. The dietary supplement brand, duration of use, cost, and amount consumed per time taken was filled in by the student.

Dietary supplement products that are labeled the same often contain different types and amounts of the same nutrient. For example, many products are labeled multivitamin and mineral supplements; however, there are many variations of ingredients and amounts depending on the brand and population it is intended for. For this reason, students were instructed to provide a picture taken by themselves of the dietary supplement including the product label, nutrition facts panel, and ingredient list for every supplement consumed.

The second section for the dietary supplement user questionnaire is included in Appendix C with topics including general information, reason for use, source of information, perception and knowledge. General information questions asked if the product was researched, if the nutrition facts panel was looked at prior to use, and if family or friends influenced use. Students were asked to rank the place they purchased

products from most frequently and check all sources of dietary supplement information with eighteen options such as the internet, social media, athletic trainers, friends, family, health care professionals, and sources not listed could be filled in. A score of one indicated a source was the most common place for the student to receive dietary supplement information from. The frequency of each students' response was then determined to identify the most commonly used sources of dietary supplement information.

A five-point Likert scale assessed reasons for dietary supplement use with answers ranging from (1) *strongly disagree* to (5) *strongly agree*. There were 33 reasons that addressed why participants took dietary supplements. Categories included physical performance enhancement, weight management, prevention of illness, mental health improvement, to treat a health condition, and an option otherwise not listed could be filled in. Dietary supplement knowledge was assessed with questions regarding safety, effectiveness and regulation standards of dietary supplements. Students could respond either "true", "false" or "I don't know". Correct answers were either "true" or "false" depending on the statement asked and a score of 1 was given for correct answers and 0 was given for incorrect responses and those that answered, "I don't know".

To measure perception, students were asked how strongly they agreed with six statements regarding dietary supplements. Statements were answered using a five-point Likert scale with answers that ranged from (1) *strongly disagree* to (5) *strongly agree*. The perception section covered reliability of sources of dietary supplement information, perceived effectiveness of products taken, and negative health implications associated

with use. A score of five indicated a positive perception while a score of one indicated a negative perception of dietary supplements. Responses were inverted for all questions that indicated the opposite perception towards dietary supplements.

For the first section of the dietary supplement survey for non-users in Appendix D, students were asked to fill out product information for a friend or family member to receive credit for the homework assignment. Questions asked information about product type, brand, frequency, duration, cost, and amount consumed by the friend or family. They were asked to submit a picture taken by them of the dietary supplement product label, nutrition facts panel, and ingredient list.

In the second section of the dietary supplement survey for non-users shown in Appendix E, students were asked if they had ever previously taken any supplement products, for what duration and when they used them. Reasons for not using dietary supplements and perception were measured using a five-point Likert scale with responses ranging from (1) *strongly disagree* to (5) *strongly agree*. Reasons for not taking dietary supplements included not wanting to spend money on them, not thinking they were effective, experiencing negative side effects, or not knowing enough about them. The dietary supplement survey for non-users in the second section asked the same questions to determine perception as well as the same knowledge questions regarding dietary supplement regulation, safety and effectiveness.

Data Collection Procedure

The data contributed from class materials was an integral part of the course and students received class credit for completing the questionnaires as homework or an in-

class assignment and the dietary record as a course project. Students made one-on-one appointments with a trained researcher to review their completed dietary record and check for accurate portion sizes and commonly missed food items. Collection of class assignments and projects were completed during the first two weeks of the semester during which students learned about non-nutrition related topics to avoid education of course materials influencing survey and diet record responses.

On the first day of class, the primary researcher visited each class and described the class projects and homework assignments. Students were given time to complete and turn in the demographic, health perception and knowledge, lifestyle, and physical activity surveys on the first day of class. The four-day food log and dietary supplement questionnaire packet were distributed to students as take-home assignments that were turned in the second week of the semester. Outside of class-time, students were expected to attend an anthropometric measurement appointment and interview session regarding the dietary record during the first class of the second week of the semester.

Graduate and undergraduate students majoring in nutrition were selected to partake in the nutrition and lifestyle research investigation. A registered dietitian and instructors of the Science of Human Nutrition course during the spring semester of 2017 held two training sessions for research staff that lasted approximately two hours each. The primary researcher trained and educated research staff to perform anthropometric measurements and assigned specific roles for data collection. The research staff rehearsed dietary record interviews and learned how to enter data into software for dietary quality analysis. In addition, researchers conducted a mock data collection to

ensure flow of operations was efficient and practiced anthropometric assessments to aid in accuracy of measurements.

Analysis

Data was analyzed using descriptive statistics including means, standard deviations, and frequency distributions. Student t-test was used to compare dependent variables of knowledge and perception with the independent variable of dietary supplement users and non-users. A mean knowledge score was calculated for each individual question for dietary supplement users and non-users. An overall mean score for users and non-users was calculated as well by averaging all of the knowledge questions.

An overall and individual mean score of perception statements for users and non-users was calculated to assess perception of dietary supplements in college students. Responses were inverted for all questions that indicated the opposite perception towards dietary supplements. A mean score of five would demonstrate a strong positive feeling while a score of one would demonstrate a strong negative feeling toward statements regarding dietary supplements. A chi-square test (X^2) examined the significance between the type of dietary supplements products used between male and female students. Statistical analysis was performed using SPSS for Windows (Version 24.0, SPSS Inc., Chicago, Illinois). Data was considered statistically significant at a value of $p<0.05$.

CHAPTER IV

JOURNAL ARTICLE

Introduction

Dietary supplements are products intended to add further nutritional value to the diet by filling in nutrient gaps that cannot be met from food intake alone (U.S. Food and Drug Administration, 2017). They contain products of one or more of the following including vitamins, minerals, herbs, botanicals, amino acids, or other dietary substances; are designed for ingestion and come in a variety of tablets, capsules, softgels, gelcaps, powders, liquids and chewables (Federal Food, Drug, and Cosmetic Act, 2013). Dietary supplements are used widely by Americans with half to two-thirds using some form of product (Dickinson & MacKay, 2014). In particular, college students report high use of dietary supplements, approximately 66% (Lieberman et al., 2015).

Many newly marketed sport and herbal supplements have attracted the attention of young adults in recent years from products advertising improved physical performance and appearance (Hoyte, Kennon, & Heard, 2013; Lieberman et al, 2015). In addition, dietary supplements have experienced growing popularity due to increased awareness of adequate intake of essential nutrients being linked to a decrease in non-communicable diseases such as cancer, cardiovascular disease and type II diabetes (Wallace, 2015). This may reflect why Americans most commonly report using dietary supplements to promote health and reduce risk of disease (Bailey, Gahche, Lentino, Dwyer, Engel, Thomas, Betz, 2011).

In response to American consumers high demand for dietary supplements, the number of products available on the market has grown from 4,000 in 1994 to over 75,000 present day (Wallace, 2015). The vast use of dietary supplements along with a decrease in regulation by the FDA after the passage of The Dietary Supplement Health and Education Act (DSHEA) is a concern since products are available to consumers with minimal testing of safety and effectiveness (Pawar & Grundel, 2017). Furthermore, consumers are more likely to receive dietary supplement information from less reliable sources such as the internet and unlikely to consult with a doctor or health care professional (Froiland, Koszewski, Hingst, & Kopecky, 2004).

The purpose of this study was to examine the use, knowledge, and perception of dietary supplements of college students. It was hypothesized that there will be a difference in knowledge and perception between dietary supplement users and non-users, as well as that males and females will differ in use of type of dietary supplement product.

Methodology

This cross-sectional, retrospective, comparative study was part of a larger study conducted at Kent State University evaluating diet and lifestyle characteristics of college students. The study received approval from Kent State's Institutional Review Board (IRB) for collection of existing documents and data. The aim of this study was to examine the use, knowledge, and perception toward dietary supplements of college students at a public midwestern university. The study was conducted based on data provided from students enrolled in a general sophomore-level nutrition course, The Science of Human Nutrition, during the spring semester of 2017. Research data came

from homework assignments and class projects including questionnaires regarding student demographics and dietary supplement use. Data consisted of approximately 250 students from three class sections which included all majors and part and full-time students.

Questionnaires

The questionnaires used in this study include demographic and dietary supplement surveys. In Appendix A, the demographic questionnaire asked students their age, gender, ethnicity, marital status and living arrangement, as well as class standing, field of study, number of credit hours enrolled in for the semester and grade point average. In addition, students were asked to provide an estimate of their families combined income and personal income if they were employed and if so, what best described their occupation. Students were questioned about prior nutrition education, their parents highest level of education, and health related information including insurance coverage, blood cholesterol levels, allergies and medical conditions.

The dietary supplement survey consisted of two sections with two different versions for users and non-users. For users, the first section in Appendix B asked students information about the dietary supplement taken including product type, brand, frequency, duration, cost and amount consumed. Users of dietary supplements filled out a packet for every product currently consumed by the student as well as supplied a picture of the product label and ingredient list. The second section of the dietary supplement survey for users found in Appendix C asked about general information, reason for use, perception and knowledge questions. Students ranked the place they

purchased products from most frequently and checked all sources they received dietary supplement information from.

In Appendix D, the first section of the dietary supplement questionnaire for non-users requested students fill out product information for a friend or family member that used dietary supplements as well as provide a picture of the product label and ingredient list. The second section of the dietary supplement survey for non-users in Appendix E asked students the same perception and knowledge questions as users of dietary supplements. In addition, non-users of supplements were asked if they had ever used dietary supplements previously and if so, what kind. Students were also asked to reveal their reasons for not taking dietary supplements.

Data Analysis

All data collected from homework assignments and class projects was exported to Microsoft Excel (Version 1805) and then to Statistical Package for the Social Sciences version 24.0 (SPSS, Chicago, Illinois). Surveys that were incomplete were not included in the final analysis. Descriptive statistics were used to examine frequencies, percentages, means, and standard deviation of variables including students' demographic and dietary supplement characteristics. Student-t-tests were used to test for significant differences with dietary supplement knowledge and perception responses for users and non-users. Chi-square (χ^2) tests of independence and Fisher's exact tests were used to test for significant differences between gender and the type of dietary supplement product used. Data was considered statistically significant at $p<.05$.

Results

Of the 236 students who were enrolled in the three sections of Science of Human Nutrition at the start of the spring semester 2017, 231 students completed the questionnaires and had data included for analysis. There were five students excluded from the final analysis due to unrealistic diet-records and incomplete surveys.

Table 1 shows a description of the demographic characteristics of students involved in the study. The majority of students were female, Caucasian, and in their freshman year of college. Among the 52 majors reported by students, the most common were nursing (12.6%), exercise science (10.4%), fashion merchandising (7.4%), undecided (7.4%), psychology (5.2%), and human development and family studies (5.2%). Three students in the class reported being a nutrition major. Of the 231 students, most of them had never taken a college level nutrition course prior to this class (97.4%).

Table 1

Demographic Characteristics of College Students Enrolled in a General Nutrition Course

Gender	%	n
Female	71.9	166
Male	27.7	64
Unknown	0.4	1
Total	100.0	231
Ethnicity	**%**	**n**
Caucasian	77.5	179
African American	11.3	26
Hispanic/Latino	3.0	7
Asian	2.2	5
Middle Eastern	1.6	4
Other	3.5	8
Unknown	0.9	2
Total	100.0	231
Class Rank	**%**	**n**
Freshman	55.0	127
Sophomore	26.4	61
Junior	11.7	27
Senior	6.5	15
Unknown	0.4	1
Total	100.0	231

Dietary Supplement Use in College Students Enrolled in a General Nutrition Course

Of the 231 students included in the sample, 110 respondents (47.6%) reported that they consumed dietary supplements. Among the users, 91 students took just one dietary supplement. There were 17.3% users that regularly took multiple dietary supplements with ten users who took two products, four users who took three products, one user who took four products, two users who took five products, and two users who took six products. This brought the total number of dietary supplements consumed by users to 149 products. Supplements most commonly taken in combination with other products were protein (n=18), followed by single vitamin or mineral (SVM) (n=12), multivitamin-mineral (MVM) (n=8), other (n=7), probiotic (n=4), herbal (n=4), fiber (n=2), fish oil (n=2), and weight loss (n=1).

Type of Dietary Supplements Used in College Students by Gender

Table 2 illustrates the comparison of dietary supplement products used between females and males. The nineteen individuals that took multiple dietary supplements brought the total number of different dietary supplements analyzed to 129. Students' use of MVM, SVM, herbal, weight loss, fish oil, fiber, and other did not significantly differ by gender. However, protein supplement use in males was significantly higher than in females. Therefore, hypothesis 1 was partially accepted that males and females will differ in use of type of dietary supplement.

Table 2

Types of Supplement Products Used by College Students Enrolled in a General Nutrition Course by Gender for Dietary Supplement Users (n=110) [a]

MVM [b]	Gender	n (%)	p-value
	Male	11 (21.6)	
	Female	40 (78.4)	0.212
	Total	51 (100.0)	
SVM [c]		n (%)	
	Male	4 (14.8)	
	Female	23 (85.2)	0.094
	Total	27 (100.0)	
Protein		n (%)	
	Male	16 (66.7)	
	Female	8 (33.3)	0.001*
	Total	24 (100.0)	
Herbal		n (%)	
	Male	0 (0.0)	
	Female	6 (100.0)	0.123
	Total	6 (100.0)	
Fish Oil		n (%)	
	Male	1 (25.0)	
	Female	3 (75.0)	0.917
	Total	4 (100.0)	
Probiotic		n (%)	
	Male	1 (25.0)	
	Female	3 (75.0)	0.917
	Total	4 (100.0)	
Weight Loss		n (%)	
	Male	0 (0.0)	
	Female	3 (100.0)	0.282
	Total	3 (100.0)	
Fiber		n (%)	
	Male	0 (0.0)	
	Female	3 (100.0)	0.282
	Total	3 (100.0)	
Other		n (%)	
	Male	3 (42.9)	
	Female	4 (57.1)	0.784
	Total	7 (100.0)	

[a] = 110 out of 231 students used dietary supplements (47.6%)

[b] = MVM = Multivitamin-mineral

[c] = SVM = Single vitamin or mineral

* statistically significant at $p>0.05$

Frequency of Dietary Supplement Use in College Students

Table 3 illustrates the frequency and types of different dietary supplements used in the study sample. One hundred forty-nine dietary supplements were examined for frequency of use due to the students who consumed multiple products. MVM was used the most frequently followed by protein, SVM and herbal. Most of the students took dietary supplements one time per day (72.5%) followed by more than one time per day (13.4%) and weekly (11.4%) with few students that took dietary supplements monthly (2.7%). Out of the twenty dietary supplements taken more than once per day, protein supplements and then SVM were the type of product most commonly taken between two to four times per day.

Table 3

Frequency of Different Types of Dietary Supplements Used Among College Students

Type of Supplement (n)	>1x/day	Daily	Weekly	Monthly
MVM [a] (51)	0	49	1	1
Protein (38)	11	20	7	0
SVM [b] (31)	4	23	3	1
Herbal (8)	3	4	1	0
Other (7)	2	3	1	1
Fish Oil (4)	0	3	1	0
Probiotic (4)	0	4	0	0
Weight Loss (3)	0	1	2	0
Fiber (3)	0	1	1	1
Total (149)	20	108	17	4

[a] = MVM = Multivitamin Multimineral

[b] = SVM = Single Vitamin or Mineral

Dietary Supplement Knowledge of Users and Non-Users

Table 4 displays the difference in overall knowledge of dietary supplement users and non-users. Overall, users and non-users correctly responded to less than half of all the knowledge questions with no significant difference between the two groups. However, when knowledge questions were looked at individually, three responses did significantly differ. The mean score for users and non-user's individual knowledge questions is shown in Table 5. Significantly more users than non-users answered correctly to the statement: "the more protein supplement you take, the more muscle you will build", "dietary supplements should fulfill labeling health claims" and "supplement contents are not standardized among manufacturers". In this case, the correct answers were false for the first two questions and true for the third question.

Table 4

Overall Assessment of Dietary Supplement Knowledge in Users & Non-Users Among College Students

Item	Supplement user or non-user	N [a]	Mean ± SD [b]	p-value
Overall Knowledge	Non-user	100	0.28±0.177	0.057
	User	107	0.33±0.222	

a = number of users and non-users may differ due to incomplete responses
b = scores based on 'true', 'false' and 'I don't know' responses

Table 5

Assessment of Dietary Supplement Knowledge in Users & Non-Users Among College Students

Item	Supplement user or non-user	N [a]	Mean ± SD [b]	p-value
Herbal Supplements are safe to use because they come from "natural sources"	Non-user	100	0.33±0.473	0.179
	User	115	0.29±0.454	
Effectiveness of dietary supplements has been supported by long or short-term clinical studies	Non-user	100	0.13±0.338	0.123
	User	114	0.10±0.297	
The more protein supplement you take, the more muscle you will build	Non-user	99	0.49±0.503	0.002*
	User	115	0.65±0.478	
Dietary supplements should fulfill labeling health claims	Non-users	100	0.03±0.171	0.029*
	Users	114	0.06±0.241	
The FDA regulates the ingredients in dietary supplements	Non-users	100	0.21±0.409	0.144
	Users	115	0.25±0.436	
Dietary supplements including herbs can be dangerous when combined with prescription medications	Non-users	101	0.58±0.495	0.333
	Users	115	0.62±0.488	
Supplement contents are not standardized among manufacturers	Non-user	101	0.22±0.415	0.004*
	Users	115	0.30±0.462	

a = number of users and non-users may differ due to incomplete responses
b = scores based on 'true', 'false' and 'I don't know' responses
* statistically significant at $p > 0.05$

Dietary Supplement Perception of Users and Non-Users

There was no significant difference found in mean overall perception statements regarding dietary supplements between users and non-users, displayed in Table 6. Overall, the results indicate that college student users and non-users have a neutral perception of dietary supplements safety, effectiveness and regulation. Table 6 shows the mean, standard deviation and level of significance for the six individual perception questions answered by college student users and non-users of dietary supplements. When perception responses were looked at individually, two questions were significantly different between dietary supplement users and non-users. Non-users had a significantly more positive perception compared to users when asked how strongly they believe "the labels on dietary supplements are helpful to understand if it is appropriate for me" and "supplements can cancel out the effects of bad habits like smoking, drinking and not exercising".

Table 6

Overall Dietary Supplement Perception in Users and Non-Users Among College Students

Item	Supplement user or non-user	N [a]	Mean ± SD [b]	p-value
Overall Perception	Non-user	98	2.92±0.369	0.958
	User	122	2.87±0.369	

a = number of users and non-users may differ due to incomplete responses
b = scores based on a Likert scale where (1) meant *strongly disagree* and (5) meant *strongly agree*

Table 7

Individual Statements Regarding Dietary Supplement Perception in Users and Non-Users Among College Students

Item	Supplement user or non-user	N [a]	Mean ± SD [b]	p-value
I believe the labels on dietary supplements are helpful to understand it if is appropriate for me	Non-user	100	3.97±0.731	0.033*
	User	123	3.85±0.878	
I believe the source I receive my information on supplements from is reliable	Non-user	100	3.99±0.643	0.413
	User	124	4.07±0.677	
I believe dietary supplements can have adverse side effects	Non-user	100	3.74±0.787	0.880
	User	124	3.68±0.739	
I believe dietary supplements can affect my health in a negative way	Non-user	100	3.58+0.831	0.427
	User	124	3.42±0.856	
I believe supplements can be used as a substitute for a good diet	Non-user	98	2.52±0.955	0.427
	User	123	2.30±0.958	
I believe supplements can cancel out the effects of bad habits like smoking, drinking, and not exercising	Non-user	100	2.40±1.005	0.033*
	User	123	2.10±0.918	

a = number of users and non-users may differ due to incomplete responses
b = scores based on a Likert scale where (1) meant *strongly disagree* and (5) meant *strongly agree*
* statistically significant at $p > 0.05$

Sources of Dietary Supplement Information in College Students

The most frequent sources of dietary supplement information among college student users and non-users is displayed in Table 8.

Table 8

Most Frequent Sources of Dietary Supplement Information Among College Student Users and Non-Users

Sources	Frequency
Internet	33
Medical Doctor	33
Family	30
Friend	17
Health Food Retailer	13
Pharmacist	10
Coach	5
Registered Dietitian	5
Athletic Trainer	4
Newspaper	3
Journal Article	3
Social Media	2
Book	2
Blog	1
Television	1
Magazine	1

Discussion

The purpose of this study was to examine college students use, knowledge, and perception of dietary supplements. The study results indicated: 1) there was a significant difference between males and females in use of protein supplements; however, there was no significant difference between males and females in use of other dietary supplements; therefore, Hypothesis 1 was partially accepted 2) there was no significant difference in overall knowledge between dietary supplement users and non-users; thus, Hypothesis 2

was rejected; 3) there was no significant difference in overall perception between dietary supplement users and non-users; thus, Hypothesis 3 was rejected.

Dietary Supplement Use in College Students

Adequate intake of vitamins and minerals supports health benefits including a decreased incidence of cancer, type II diabetes, and cardiovascular disease (Wallace, 2015). One method individuals attempt to improve or maintain good health is by increasing micronutrient intake from use of dietary supplements. While research indicates that a diet high in a variety of healthy food sources such as fruits, vegetables and whole grains is the best source of vitamins and minerals, many choose to take dietary supplements to fill in any nutrient gaps in their diet. This is a concern since dietary supplements have not proven to provide the same health benefits as dietary vitamins and minerals, some dietary supplements are adulterated, and there is a higher likelihood of supplement users experiencing a nutrient toxicity which can cause health complications (Fortmann. 2013; Quinones, 2013).

The results of the current investigation showed that a little less than half (47.6%) of college students surveyed were consuming dietary supplements at the time the questionnaire was taken. This is slightly less than overall supplement use of the U.S. population which is reported by 53% of Americans (Gahche et al., 2011). When looking at the college student population, overall dietary supplement use in the current study is reported by 18% less than other college student samples (Lieberman et al., 2015). One possible explanation for this is that previous studies examined dietary supplements used in the past six to twelve months, while this study asked students to report products they

were currently taking. Use of dietary supplements is often reported higher when seasonal use of products is asked (Dickinson et al., 2014).

Other possible explanations of why this sample demonstrated lower dietary supplement use could be that the current sample consisted primarily of freshman students and dietary supplement use typically increases with age, with a higher number of upperclassmen reporting use compared to lowerclassmen (Johnson & Blanchard, 2006). In addition, many studies exploring dietary supplement use in college students were done in athlete populations who were linked to a higher rate of supplement use between 60% to 88% (Knapik, Steelman, Hoedebecke, Austin, Farina, & Lieberman, 2016). The current study involved general college students and included only eighteen athletes in the total sample (7.8%). Students were also asked to complete the dietary supplement survey as a homework assignment, therefore it is possible users did not claim to take products to avoid completing the assignment.

MVM was reported as the most common dietary supplement used among the students in this study sample accounting for 34.2% of overall products. Use of MVM in this study was comparable to overall American supplement users who report taking MVM supplements most frequently (Gahche et al., 2011). A study that examined college students from five U.S. universities also found MVM to be the most commonly consumed type of supplement (41.8%) (Lieberman et al., 2015). These results are also consistent with collegiate female athletes who report using MVM most frequently (36%) (Herbold, Visconti, Frates, & Bandini, 2004). These results differ from several studies examining dietary supplement use in young adults with more commonly reported

products including protein and herbal supplements (Johnson et al., 2006; Newberry et al., 2010). This discrepancy may be due to the present study population consisting of more females who are more likely to take dietary supplements and MVM compared to men (Bailey et al., 2011). Females are most likely to report using dietary supplements to improve overall health or to fill in nutrient gaps, which may be why MVM are popular supplements for females (Froiland et al., 2004). Health benefits such as decreased incidence of cancer, type II diabetes, and cardiovascular disease is supported by adequate intake of essential vitamins and minerals and may explain why MVM products are popular among college students and the general population (Wallace, 2015).

Protein was the second most commonly used dietary supplement when examining the total number of products taken by all users. One-quarter of all products taken by this study population were protein supplements, yet there were fewer protein users compared to SVM users. This is due to students that took multiple protein supplements, which were the type of product most commonly taken in combination with other supplements in this study. Other college populations have reported a greater number of students that take multiple dietary supplements per week compared to this study, 41% and 17% respectively (Lieberman et al., 2015). Protein supplements are not used as commonly among the general population with four other product types used more frequently; MVM, SVM, fish oil and herbal supplements (Bailey et al., 2013). Athletes are the most frequent users of protein supplements for their perceived benefits of improving athletic performance and increasing muscle mass (Whitehouse & Lawlis, 2017). This may

explain the growing trend of college students to use protein supplements to improve physical appearance.

Results of this study were consistent with other samples of college populations, where MVM was taken most followed by SVM and protein supplements (Lieberman et al., 2015). In this study, males were significantly more likely than females to consume protein supplements; a similar finding to other studies examining dietary supplement use in overall college students (Valentine et al., 2018). Males commonly report using supplements to build muscle and increase athletic performance which may be why protein products are higher than in females who are more likely to use dietary supplements for overall health (Froiland et al., 2004).

SVM were taken by the second most users of dietary supplements after MVM yet were the third most common supplement used overall, with 27 total users and overall prevalence of 20.8%. The most common reason for taking SVM is to improve or prevent chronic diseases (Fortmann, Budra, Senger, Lin, & Whitlock, 2013). SVM products are likely to contain nutrient amounts exceeding the dietary reference intake (DRI) with some users believing greater intake will have an increased effect (Bunchorntacakul & Reddy, 2013). Common SVM products taken by this study population included biotin, iron, calcium, and vitamin C and D. The prevalence of use of calcium and vitamin D is consistent with overall Americans who have increased use of these products over time (Gahche et al., 2011). Vitamin D supplements have gained interest in recent years for its perceived benefits linked to multiple diseases including depression, osteoporosis, diabetes, cardiovascular health and certain cancers (Prentice et al., 2013). Previous

research has also indicated use of vitamin C and iron is a common SVM used by college students (Lieberman et al., 2015). Biotin on the other hand is a vitamin supplement that has gained attention more recently for its perceived benefits in promoting hair growth and has not been reported extensively in previous research (Glynis, 2012).

Herbal supplements were consumed by 5.4% of users in this sample of college students including products such as echinacea, garcinia cambogia and ginkgo biloba. Prevalence of herbal supplements in this study sample is less when compared to other studies examining college student populations. Various studies have found herbal product use as high as 75% and 79% when examining college students dietary supplement use for the past twelve months (Johnson et al., 2006). This may be due to the previous studies including herbal substances such as green or chamomile tea in their analysis whereas this study only examined products labeled as herbal supplements. The National Health Interview Survey in 2007 found 17.6% of young adults used herbal supplements in the past twelve months, which decreased from 2002 when 20.0% reported use (Wu, Wang, & Kennedy, 2011). Declining rates of herbal supplement use among young adults may be due to a shift in consumer demand for products intended to improve performance and appearance rather than treat specific conditions such as cardiovascular disease (Wu et al., 2011). Once more, this study only asked about current supplement use which may explain why herbal supplement use was low in this sample compared to the previous studies examining use for the entire year.

Comparison of Dietary Supplement Users and Non-Users Knowledge

In the current study, overall knowledge was similar for both users and non-users. Both groups mean score of overall dietary supplement knowledge was below average. Compared to other studies of this kind, results were similar in that young adults do not demonstrate a great amount of knowledge concerning possible health consequences associated with use and proven effectiveness of dietary supplement products (Whitehouse et al., 2017). In one study examining dietary supplement knowledge in college students, non-users commonly reported not using products due to a lack of supplement knowledge whereas users were significantly more likely to self-report being somewhat to very knowledgeable about dietary supplements compared to non-users (Valentine et al., 2018).

When examining individual questions, users demonstrated better knowledge of dietary supplement effectiveness and regulation compared to non-users. When asked if the more protein supplement taken will help build more muscle, significantly more users correctly answered that statement as being false. Significantly more users than non-users correctly answered false when asked if dietary supplements should fulfill label health claims. Lastly, significantly more users than non-users correctly answered true when asked if supplement contents are not standardized among manufacturers. All responses were considered statistically significant at $p>0.05$.

The mean dietary supplement knowledge scores for both users and non-users were very low to responses regarding effectiveness of products. Most students responded incorrectly with “true” or “I don’t know” when asked if effectiveness of dietary supplements was supported by long or short-term clinical studies as well as if dietary

supplements should fulfill labeling health claims. This indicates that both users and non-users are unclear about the proven effectiveness of dietary supplements. Conversely, a dietary supplement knowledge question concerning safety was above average for both users and non-users. Over 50% of both users and non-users answered correctly that dietary supplements including herbs can be dangerous when combined with prescription medications which was a true statement. These results indicate that college students may have better knowledge of dietary supplement safety and less knowledge of regulation standards and effectiveness of dietary supplements.

Comparison of Dietary Supplement Users and Non-Users Perception

The current study showed that both users and non-users have a similar overall perception of dietary supplements. Mean overall dietary supplement perception scores of both users and non-users were slightly positive. Perception regarding efficacy of dietary supplement was favorable in a previous study with all product types viewed as effective by at least 70% of all reported consumers (Valentine et al., 2018). Unlike the results of the current study, other research indicates that dietary supplement users generally have a more positive perception of products than non-users (Heikkinen, Alaranta, Helenius, & Vasankari, 2011).

Two individual perception questions regarding dietary supplement sources and effectiveness did differ significantly between users and non-users (p>0.05). Significantly more non-users had a positive belief that the labels on dietary supplements help them understand if it is appropriate for them to use. In addition, significantly more non-users than users believed that supplements could cancel out the effects of bad habits such as

smoking, drinking and not exercising. Approximately 80% of both users and non-users felt positively that source they receive dietary supplements from is reliable. This may be due to this sample reporting health care professionals as being one of the most common sources of dietary supplement information, which is higher than other studies of college students.

Sources of Dietary Supplement Information

The results of the current study indicate that dietary supplement users most frequently receive information from the internet and medical doctors. This is followed by family, friend, health food retailer, pharmacist, coach, registered dietitian and athletic trainer. These findings are different from other studies. In college students, one-third of supplement users reported media as their most frequent source of information and only one-tenth received information about the product they were consuming from a health professional (Newberry et al., 2010). Among young adult athletes, the primary source of information regarding dietary supplements came from their coach (58%) (Whitehouse et al., 2017). Collegiate female athletes reported family as their major source of dietary supplement information (Herbold et al., 2004). College student males state the most popular source of product information from the internet while college student females are more likely to receive information from their families (Lieberman et al., 2015).

Limitations

A potential limitation of this study is that questionnaire data was self-reported, thus responses may be dishonest. Dietary supplement surveys were given to students as a take-home assignment meaning students could have discussed answers amongst one

another. Students may have been discouraged from disclosing dietary supplement use since it was to be done as a homework assignment. In addition, male college students were underrepresented in this research on dietary supplements compared to females. Relatively few questions were asked of students to determine knowledge and perception of dietary supplements and future studies may benefit from a more thorough questionnaire. Unlike other studies examining dietary supplements, this study did not ask students about any adverse events that may have been related to product use. This information could have been useful to help educate students on ways to avoid negative health effects from supplements and instruct them on proper ways to report adverse events.

Application

Despite its limitations, this study provides further information on dietary supplement use, knowledge and perception of college students. Dietary supplement products were used by just under half of the students sampled in this study. Prevalence of dietary supplement use in this sample of students was lower than other studies examining college students. Several users took more than one dietary supplement which was comparable to that of other studies. Except for protein supplements, type of products did not significantly differ between males and females.

This study demonstrated that both dietary supplement users and non-users were not well educated on product regulation, safety and effectiveness overall. This is a concern since previous research has indicated that dietary supplement users feel they are well informed about products use and effectiveness. There seems to be a gap between the

level of knowledge on dietary supplements college students perceive to have and their actual familiarity with supplement products. Perception of dietary supplement effectiveness and appropriate use is slightly high among college student users and non-users.

Conclusion

Dietary supplement use is prevalent among college students. Users and non-users of dietary supplements demonstrate below average knowledge of products and education of safety, effectiveness and regulation would benefit this population. These findings suggest that college students perceived dietary supplement effectiveness as favorable among both users and non-users. This indicates that knowledge and perception of dietary supplements in unlikely to impact product use and that other factors such as health behaviors and lifestyle characteristics are more likely to determine use of products.

APPENDIXES

APPENDIX A

DEMOGRAPHIC QUESTIONNAIRE

Appendix A

Demographic Questionnaire

NUTR 23511

Demographic Questionnaire

Your name and any information you provide will remain confidential and will be used only for research purposes.

Demographic Questionnaire

ID #_____

Name: _____

Date of Birth: ___/___/____ Age: _____

Weight: _____ (lb.'s) Height: _____ (ft.' in")

1) What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other: _____

2) Current class standing?

- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior
- ☐ Graduate Student

3) Major of Study: _____

4) Current Semester Credit Hour Course Load: _____ Hours

5) What is your GPA?

- ☐ 3.51 to 4.0
- ☐ 3.1 to 3.5
- ☐ 2.51 to 3.0
- ☐ 2.0 to 2.5
- ☐ <2.0
- ☐ Not sure/ would not like to answer

6) Have you taken any college level nutrition course prior to this course, Science of Human Nutrition?

- ☐ Yes
- ☐ No

7) What is your ethnicity?

- ☐ White/Caucasian
- ☐ Black/African American
- ☐ Hispanic/Latino

☐ Asian/Pacific Islander

☐ Middle Eastern

☐ American Indian/Native American

☐ Other: _____

8) Do you have a car?

☐ Yes

☐ No

9) Mother's highest level of education:

☐ High school or less

☐ Some College

☐ Associates Degree

☐ Bachelor's Degree

☐ Master or Doctoral Degree

☐ Unsure

10) Father's highest level of education:

☐ High school or less

☐ Some College

☐ Associates Degree

☐ Bachelor's Degree

☐ Master or Doctoral Degree

☐ Unsure

11) Are you currently employed? *(if yes, are you full or part time and if part time how many hours do you work per week)*

☐ Yes

☐ Fulltime ☐ Part-time _____ hours/week

☐ No

12) Which best describes your occupation?

☐ Management

☐ Business/Finance (Sales, Personal Business, Self Employed Business)

☐ Natural/applied sciences

☐ Health occupations

☐ Education

☐ Art/culture/recreation sport

☐ Sales/retail

☐ Transport, Trades (Driver)

☐ Agriculture (Sanitarian, Farming)

☐ Manufacturing

☐ Customer service (Call Center)

☐ Restaurant service (waiter, waitress, receptionist or cook)

☐ Construction

☐ Other: _____

13) Which of the categories best describes your total annual combined household income for your family from all sources? (check one)

☐ Less than $5,000

☐ $ 5,000 to $ 14,999

☐ $ 15,000 to $ 29,999

☐ $ 30,000 to $ 49,999

☐ $ 50,000 to $ 69,999

☐ $ 70,000 to $ 89,999

☐ $ 90,000 to $ 109,999

☐ $ 110,000 to $ 129,999

☐ $ 130,000 to $ 149,999

☐ $ 150,000 or more

☐ Unsure

14) What is your monthly income?

_____/month

☐ Prefer Not to answer

15) Are you covered by a health insurance?

☐ Yes

☐ No

☐ Not sure

16) Have you ever had your blood cholesterol level checked?

☐ Yes

Do you know what the level was? Yes, _____ mg/dL

No, I don't know _____

☐ No

☐ Not sure

17) Do you get a yearly physical exam from your physician?

☐ Yes

☐ No

☐ Have before, but not this year

18) Are you currently married?

☐ Yes

☐ No

19) Do you have children?

☐ Yes

☐ No

20) What are your current living arrangements?

☐ On campus

☐ Off campus apartment/renting local alone

☐ Off campus apartment/renting local with significant other

☐ Off campus apartment/renting local with roommate

☐ Commuter living with parent(s)

☐ Other: _____

21) Do you currently have any medical conditions? (check all that apply)

☐ Crohn's disease

☐ Inflammatory bowel disease

☐ Irritable bowel syndrome (IBS)

☐ Cystic fibrosis

☐ Celiac Disease

☐ Lactose Intolerance

☐ Constipation/hemorrhoids

☐ Anemia

☐ Asthma

☐ Hypertension

☐ Cancer

☐ Diabetes

☐ Cardio Vascular Disease (heart disease, stroke, aneurysm irregular heart beat etc.)

☐ Kidney disease

☐ Liver disease

☐ Arthritis

☐ Fibromyalgia

☐ Fungal/bacterial infection

☐ Genetic disease

☐ TMJ

☐ HIV/AIDS

☐ Migraines

☐ Hyper-Thyroid

☐ Hypo-Thyroid

☐ Other: _____

☐ I do not have any medical condition

22) Do any of the medical conditions you mentioned above restrict your food consumption? (For example, avoiding milk/dairy products due to lactose intolerance)

☐ Yes

☐ No

23) Do you have any current food allergies (check all that apply)?

☐ cow's milk

☐ eggs

☐ peanuts

☐ fish

☐ shellfish

☐ tree nuts (such as cashews or walnuts)

☐ wheat

☐ soy

☐ food coloring

☐ fruits or vegetable

☐ Other: _____

☐ I do not have any allergy

APPENDIX B

DIETARY SUPPLEMENT QUESTIONNAIRE SECTION 1: FOR USERS

Appendix B

Dietary Supplement Questionnaire Section 1: For Users

Science of Human NUTR 23511
Homework # (10 points)- FOR USER
Spring, 2017

Last Name_____
ID#_____
Instructor_____

This homework is designed for us to investigate your knowledge and perception about dietary supplements you are currently taking. You will have a chance to learn about your supplement(s) and the recommended intake.

A dietary supplement is a product intended to supplement the diet and contains one or more dietary ingredient such as vitamins, minerals, herbs, botanicals, amino acids, protein, or their constituents. It is intended to be taken by mouth as a pill, capsule, tablet, liquid, powder, spray, or bar.

Please follow the steps below to complete your homework

Using your cell phone, tablet, etc. take a picture(s) of the supplement bottle showing its name and brand. It should be a real picture(s) of the supplement you are taking, the ones available online will not count.

Print the picture(s) and attach it to this form. If you prefer, you can insert it (them) from your phone onto the form.

Go online to print out a food label of your supplement and attach it to this form as well. If the label is not available online, take a picture of the label on the actual product and attach it to this form. The label should show entire information clearly for grading purpose.

There are two parts of the form to be completed to receive full credit. The pictures described above should be included with the first section.

Section 1:

a. Supplement questions
b. Pictures of the supplement(s) you are taking

Section 2:

c. General questions
d. Reason for taking supplement(s) questions
e. Perception questions
f. Knowledge questions

SECTION 1

DIETARY SUPPLEMENT QUESTIONS

For those who take only one supplement you may fill out the appropriate information below for Supplement #1. For those taking more than one dietary supplement there are identical sections provided for you to complete.

Supplement #1

1. What is the name of the supplement?

   _____

2. What is the brand of the supplement?

   _____

3. Select the type of dietary supplement you take.

   a. Pill/tablet/capsule
   b. Bar
   c. Powder
   d. Liquid
   e. Spray
   f. Other, please specify_____

4. How often do you take the supplement?

   a. Daily, if so please go to 4a
   b. Weekly, if so please go to 4b
   c. Monthly, if so please go to 4c
   d. Seasonally, if so please go to 5c
   e. Only on occasion (less than one time per month)

   4a. How many times do you take the supplement per day?

   _____times/day

4b. How many times do you take the supplement per week?

_____times/week

4c. How many times do you the supplement per month?

_____times/month

4d. What season do you take the supplement? You may circle more than one.

Summer Fall Winter Spring

5. How much do you take of the supplement per time?

Type of supplement	How much you take per time
Pill/tablet/capsule	_____each
Powder	_____spoons/scoops
Bar	_____each
Liquid	_____fluid ounces
Spray	_____# of squirts
Other	_____

6. How long have you been taking the supplement?

_____years and _____months

7. What is the price of the supplement?

$_____

APPENDIX C

DIETARY SUPPLEMENT QUESTIONNAIRE SECTION 2: FOR USERS

Appendix C

Dietary Supplement Questionnaire Section 2: For Users

SECTION 2

Science of Human NUTR 23511
Homework # - (FOR USER)
Spring, 2017

Last Name_____
ID#_____
Instructor_____

GENERAL INFORMATION QUESTIONS
Pease answer all the questions below.

1. Did you research information about the supplement prior to buying/choosing it?

   Yes_____
   No_____

2. Did you look at the nutrition facts label prior to buying/choosing the supplement?

   Yes_____
   No_____

3. Do any of your family members or friends take this supplement?

   Yes, if so check all that apply

   _____Mother
   _____Father
   _____Grandmother
   _____Grandfather
   _____Aunt
   _____Uncle
   _____Sibling

_____Friend

No_____

4. Where do you usually buy the supplement(s)? Rank your answers with 1 being the place you buy them most often and 5 being the least.

_____Grocery store (Giant Eagle, Acme, etc.)
_____Pharmacy (CVS, Walgreens, etc.)
_____Vitamin shop/health store (GNC, Vitamin World, etc.
_____Internet (Amazon, health stores website, etc.)
_____Other, please specify_____

REASON FOR TAKING DIETARY SUPPLEMENT(S)
Why do you take the dietary supplement(s)?

5. To build muscle mass

Strongly Disagree Disagree Neutral Agree Strongly Agree

6. To prevent muscle loss

Strongly Disagree Disagree Neutral Agree Strongly Agree

7. To enhance physical performance

Strongly Disagree Disagree Neutral Agree Strongly Agree

8. To boost energy level

Strongly Disagree Disagree Neutral Agree Strongly Agree

9. To help recover after workouts quicker

Strongly Disagree Disagree Neutral Agree Strongly Agree

10. To prevent or treat muscle soreness after workouts

Strongly Disagree Disagree Neutral Agree Strongly Agree

11. To help weight control

Strongly Disagree Disagree Neutral Agree Strongly Agree

12. To burn fat or calories faster

Strongly Disagree Disagree Neutral Agree Strongly Agree

13. To enhance weight loss

Strongly Disagree Disagree Neutral Agree Strongly Agree

14. As a meal replacement

Strongly Disagree Disagree Neutral Agree Strongly Agree

15. To control appetite

Strongly Disagree Disagree Neutral Agree Strongly Agree

16. To help digestion and metabolism

Strongly Disagree Disagree Neutral Agree Strongly Agree

17. To detoxify the body

Strongly Disagree Disagree Neutral Agree Strongly Agree

18. To boost immunity

Strongly Disagree Disagree Neutral Agree Strongly Agree

19. To improve quality of sleep

Strongly Disagree Disagree Neutral Agree Strongly Agree

20. To improve memory or cognition

Strongly Disagree Disagree Neutral Agree Strongly Agree

21. To manage anxiety or stress

Strongly Disagree Disagree Neutral Agree Strongly Agree

22. To treat depression

Strongly Disagree Disagree Neutral Agree Strongly Agree

23. To control cravings for alcohol or smoking

Strongly Disagree Disagree Neutral Agree Strongly Agree

24. To prevent dry eyes or vision loss

Strongly Disagree Disagree Neutral Agree Strongly Agree

25. To prevent hearing loss

Strongly Disagree Disagree Neutral Agree Strongly Agree

26. To prevent dental problems

Strongly Disagree Disagree Neutral Agree Strongly Agree

27. To strengthen hair or nails

Strongly Disagree Disagree Neutral Agree Strongly Agree

28. To help with skin trouble (e.g. to reduce acne)

Strongly Disagree Disagree Neutral Agree Strongly Agree

29. To treat allergies

Strongly Disagree Disagree Neutral Agree Strongly Agree

30. To prevent cancer

Strongly Disagree Disagree Neutral Agree Strongly Agree

31. To prevent heart disease

Strongly Disagree Disagree Neutral Agree Strongly Agree

32. To prevent diabetes

Strongly Disagree Disagree Neutral Agree Strongly Agree

33. To prevent osteoporosis

Strongly Disagree Disagree Neutral Agree Strongly Agree

34. To prevent nutritional deficiency

Strongly Disagree Disagree Neutral Agree Strongly Agree

35. To treat nutritional deficiency

Strongly Disagree Disagree Neutral Agree Strongly Agree

36. To treat any medical condition other than mentioned above

Strongly Disagree Disagree Neutral Agree Strongly Agree

37. Other, please list_____

Strongly Disagree Disagree Neutral Agree Strongly Agree

38. Where do you get information about the dietary supplement(s)? Rank up to 8 with 1 being the most commonly used source.

_____Internet
_____Magazine
_____Television
_____Book
_____Blog
_____Journal article
_____Newspaper
_____Instagram
_____Facebook
_____Twitter
_____Pinterest
_____Friend

_____Family member
_____Teacher
_____Coach
_____Trainer
_____Health food retailer (such as GNC or Vitamin World)
_____Pharmacist
_____Medical doctor
_____Dietitian
_____Other health care professional, please specify_____
_____Other, please specify_____

PERCEPTION QUESTIONS
Select how strongly you agree with the statements below

I believe….

39. The labels on dietary supplements are helpful to understand if it is appropriate for me.

Strongly disagree Disagree Neutral Agree Strongly Agree

40. The source I receive my information on supplements from is reliable.

Strongly disagree Disagree Neutral Agree Strongly Agree

41. The supplements that I take are effective for what I am trying to treat, prevent, etc.

Strongly disagree Disagree Neutral Agree Strongly Agree

42. I understand which supplements are best suited for my desired health changes.

Strongly disagree Disagree Neutral Agree Strongly Agree

43. Dietary supplements can have adverse side effects.

Strongly disagree Disagree Neutral Agree Strongly Agree

44. Dietary supplements can affect my health in a negative way.

Strongly disagree Disagree Neutral Agree Strongly Agree

45. Dietary supplements can be used as a substitute for a good diet.

Strongly disagree Disagree Neutral Agree Strongly Agree

46. Dietary supplements can cancel out the effects of bad habits like smoking, drinking, or not exercising.

Strongly disagree Disagree Neutral Agree Strongly Agree

KNOWLEDGE QUESTIONS

Please select one option of true, false, or I don't know to the statements below. (The FDA is the United States Food and Drug Administration.)

47. Herbal supplements are safe to take because they come from "natural sources"

_____True
_____False
_____I don't know

48. Effectiveness of dietary supplements has been supported by long or short-term clinical studies

_____True
_____False
_____I don't know

49. The more protein supplement you take, the more muscle you will build

_____True
_____False
_____I don't know

50. Dietary supplements should fulfill labeling claims

_____True
_____False
_____I don't know

51. FDA regulates the ingredients in dietary supplements

    _____True
    _____False
    _____I don't know

52. Dietary supplements including herbs can be dangerous when combined with prescription medications

    _____True
    _____False
    _____I don't know

53. Supplement contents are not standardized among manufacturers

    _____True
    _____False
    _____I don't know

APPENDIX D

DIETARY SUPPLEMENT QUESTIONNAIRE SECTION 1: FOR NON-USERS

Appendix D

Dietary Supplement Questionnaire Section 1: For Non-Users

Science of Human NUTR 23511
Homework # (10 points)- FOR FAMILY/FRIEND USERS
Spring, 2017

Last Name_____
ID#_____
Instructor_____

This homework is designed for us to investigate your knowledge and perception about dietary supplements. Since you do not take a dietary supplement yourself, select a family member or friend that currently takes them. You will have a chance to learn about the supplement they take and the recommended intake.

A dietary supplement is a product intended to supplement the diet and contains one or more dietary ingredient such as vitamins, minerals, herbs, botanicals, amino acids, protein, or their constituents. It is intended to be taken by mouth as a pill, capsule, tablet, liquid, powder, spray, or bar.

Please follow the steps below to complete your homework

Using your cell phone, tablet, etc. take a picture(s) of the supplement bottle showing its name and brand. It should be a real picture(s) of the supplement you are taking, the ones available online will not count

Print the picture(s) and attach it to this form. If you prefer, you can insert it (them) from your phone onto the form.

Go online to print out a food label of your supplement and attach it to this form as well. If the label is not available online, take a picture of the label on the actual product and attach it to this form. The label should show entire information clearly for grading purpose.

Complete the forms provided regarding the dietary supplement

<u>Section 1</u>

a. Supplement questions
b. Picture(s) of supplement

<u>Section 2</u>

c. General questions
d. Reason for not taking supplements
e. Perception questions
f. Knowledge questions

SECTION 1

DIETARY SUPPLEMENT QUESTIONS

For those who do not currently take a dietary supplement, please choose a family member or friend that does and fill out the following information.

Supplement #1

8. What is the name of the supplement?
   _____

9. What is the brand of the supplement?
   _____

10. Select the type of dietary supplement they take.

    a. Pill/tablet/capsule
    b. Bar
    c. Powder
    d. Liquid
    e. Spray
    f. Other, please specify_____

11. How often do they take the supplement?

    a. Daily, if so please go to 4a
    b. Weekly, if so please go to 4b
    c. Monthly, if so please go to 4c
    d. Seasonally, if so please go to 5c
    e. Only on occasion (less than one time per month)

4a. How many times do you take the supplement per day?
_____times/day

4b. How many times do you take the supplement per week?

_____times/week

4c. How many times do you the supplement per month?

_____times/month

4d. What season do you take the supplement? You may circle more than one.

Summer Fall Winter Spring

12. How much do they take of the supplement per time?

Type of supplement	How much you take per time
Pill/tablet/capsule	_____each
Powder	_____spoons/scoops
Bar	_____each
Liquid	_____fluid ounces
Spray	_____# of squirts
Other	_____

13. How long have they been taking the supplement?

_____years and _____months

14. What is the price of the supplement?

$_____

APPENDIX E

DIETARY SUPPLEMENT QUESTIONNAIRE SECTION 2: FOR NON-USERS

Appendix E

Dietary Supplement Questionnaire Section 2: For Non-Users

SECTION 2

Science of Human NUTR 23511
Homework # - (FOR NON-USER)
Spring, 2017

Last Name_____
ID#_____
Instructor_____

GENERAL INFORMTATION QUESTIONS
Please answer all the questions below.

1. Have you ever had a dietary supplement before?
   Yes_____
   No_____ if so skip ahead to #7

2. How long did you take the supplement for?

   a. Only tried it a few times, less than 10
   b. Regularly for several weeks but less than 1 month
   c. Regularly for 1-6 months
   d. Regularly for 7 months to 1 year
   e. 1-3 years
   f. 4-6 years
   g. 7-9 years
   h. 10 or more years

3. When did you take the supplement? You may select more than one answer
   a. During infancy (from birth to 2 years)
   b. During childhood (2 to 10 years)
   c. During adolescence (10 to 20 years)
   d. Early adulthood (20 to 40 years)

4. Why did you stop taking the supplement? You may select more than one answer
   a. Do not want to keep spending money on them

b. Do not think they were effective
c. Experienced a negative side effect
d. Do not know enough about them
e. Do not believe you need them due to a balanced diet
f. Kept forgetting to take them
g. Doctor recommended you stop taking them
h. Other, please specify_____

5. Have you ever experienced negative health effects from taking dietary supplements?
   Yes, if so please specify_____
   No_____

6. How much of the supplement were you taking?

   a. The daily recommendation
   b. Less than the daily recommendation
   c. More than the daily recommendation

REASON FOR TAKING DIETARY SUPPLEMENT(S)

Why don't you take dietary supplement(s)?
Select how strongly you agree with the statements below
I believe….

1. I do not believe dietary supplements are effective

   Strongly disagree Disagree Neutral Agree Strongly Agree

2. I believe dietary supplements cost too much money

   Strongly disagree Disagree Neutral Agree Strongly Agree

4.I do not have enough information about dietary supplements

   Strongly disagree Disagree Neutral Agree Strongly Agree

5. I believe my diet is balanced enough and I will not benefit from dietary supplements

   Strongly disagree Disagree Neutral Agree Strongly Agree

6. I believe taking dietary supplements is too much of a hassle

Strongly disagree Disagree Neutral Agree Strongly Agree

7. I have previously experienced negative health effects from taking dietary supplements

Strongly disagree Disagree Neutral Agree Strongly Agree

8. I have heard of someone that experienced negative health effects from taking dietary supplements

Strongly disagree Disagree Neutral Agree Strongly Agree

9. Other_____

Strongly disagree Disagree Neutral Agree Strongly Agree

PERCEPTION QUESTIONS

Select how strongly you agree with the statements below
I believe….

1. The labels on dietary supplements are helpful to understand if it is appropriate for me.

Strongly disagree Disagree Neutral Agree Strongly Agree

2. The source I receive my information on supplements from is reliable.

Strongly disagree Disagree Neutral Agree Strongly Agree

3. Dietary supplements can have adverse side effects.

Strongly disagree Disagree Neutral Agree Strongly Agree

4. Dietary supplements can affect my health in a negative way.

Strongly disagree Disagree Neutral Agree Strongly Agree

5. Dietary supplements can be used as a substitute for a good diet.

Strongly disagree Disagree Neutral Agree Strongly Agree

6. Dietary supplements can cancel out the effects of bad habits like smoking, drinking, or not exercising.

Strongly disagree Disagree Neutral Agree Strongly Agree

KNOWLEDGE QUESTIONS

Please select one option of true, false, or I don't know to the statements below. (The FDA is the United States Food and Drug Administration.)

1. Herbal supplements are safe to use because they come from "natural sources".
   _____True
   _____False
   _____I don't know

2. Effectiveness of dietary supplements has been supported by long or short-term clinical studies.
   _____True
   _____False
   _____I don't know

3. The more protein supplement you take, the more muscle you will build.
   _____True
   _____False
   _____I don't know

4. Dietary supplements should fulfill labeling claims.
   _____True
   _____False
   _____I don't know

5. FDA (US Food and Drug Administration) regulates the ingredients in dietary supplements.
   _____True
   _____False
   _____I don't know

6. Dietary supplement including herbs can be dangerous when combined with prescription medications.

   _____True

_____False
_____I don’t know

7. Supplement contents are not standardized among manufacturers

_____True
_____False
_____I don’t know

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