10-8-2013

Theory of planned behavior to predict multivitamin/mineral use

Heather Petraszko

Theory of Planned Behavior to Predict Multivitamin/Mineral Use

by

Heather Petraszko

Thesis

Submitted to the School of Health Promotion and Human Performance

Eastern Michigan University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

in

Health Education

Thesis Committee:

Kay Woodiel, Ph.D, Chair

John Carbone, Ph.D.

Joan Cowdery, Ph.D.

October 8, 2013

Ypsilanti, Michigan

Abstract

This health behavior research study utilizes the theory of planned behavior (TPB) to explore female collegiate lightweight rowers' (FCLR) decision to use multivitamin/mineral supplements (MVS). This study aimed to determine the relationship between FCLR salient beliefs, attitudes, subjective norms, and perceived behavior control (PBC) towards MVS, intention to use MVS, and use of MVS. Subjects were recruited from sixteen collegiate lightweight women's rowing programs within the United States and Canada and asked to complete an online survey. Results confirmed that the subjects' attitudes and PBC, but not subjective norms, were associated with intention to use MVS. In agreement with TPB assumptions, behavioral intention most strongly predicted decision to use MVS. Such findings on the factors contributing to FCLR decision to use MVS may improve sports nutritionists' ability to make recommendations for MVS use by weight-class athletes when use is deemed appropriate.

Table of Contents

LIST OF TABLES

CHAPTER 1: Introduction and Background

Background and Summary

Dietary supplement usage is common among Americans. According to 2003-2006 National Health and Nutrition Examination Surveys (NHANES) data, approximately half of Americans over the age of 1 year use dietary supplements, with multivitamin/mineral supplements (MVS) consumed most frequently (Centers for Disease Control and Prevention [CDC], 2006; Bailey et al., 2011). While most professional nutrition organizations, including the Academy of Nutrition and Dietetics, do not advocate that healthy adults use vitamin and mineral supplements, these organizations do recognize that there are population subgroups for which a supplement may be warranted to ensure that nutrient needs are fully met. For example, it is the combined position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine that those "athletes who restrict energy intake or have severe weight loss practices, who eliminate one or more food groups from their diet, or who consume unbalanced and low micronutrient-dense diet may benefit from a daily multivitamin/mineral supplement" (Rodriquez & DiMarco, 2009). Athletes who participate in weight class-controlled sports such as rowing, wrestling, boxing and martial arts are known to engage in extreme weight loss practices in order to meet a standard weight set for competition (Terry, Lane, & Warren, 1999; Oppliger, Steen, & Scott, 2003). Female collegiate lightweight rowers (FCLR) are an example of athletes who are more likely to restrict dietary intake as a means of weight control, increasing the risk of inadequate oral intake and micronutrient deficiencies (Karlson, Black Becker, & Merkur, 2001). Regular use of MVS in accordance with Dietary Reference Intakes (DRIs) recommendations is a relatively safe means of reducing risk of

micronutrient deficiencies in dieting athletes; however the factors that influence the decision of FCLR to use or not use MVS is currently unknown.

Theoretical Framework

Developed from the Theory of Reasoned Action (Ajzen & Fishbein, 1980), the Theory of Planned Behavior (TPB) was proposed by Ajzen in 1985. The TPB was used as the theoretical framework for this study. The TPB is based on identifying which factors ultimately influence one's decision to engage in a particular behavior. The TPB assumes that behavioral intention is the strongest predictor of actual behavior, and that salient beliefs, attitudes, subjective norms, and perceived behavioral control (PBC) determine behavioral intention (Ajzen, 1991). In practice, the TPB is commonly used to predict health behaviors including women's decision to use MVS (Pawlak, Connell, Brown, Meyer, & Yadrick, 2005; Pawlak et al., 2008).

Purpose of Study

The purpose of this study was to determine the extent of the relationship between FCLR salient beliefs, attitudes, subjective norms, and PBC towards MVS, intention to use MVS, and use of MVS based on constructs of the TPB.

Significance of Study

Research indicates that FCLR engage in extreme weight loss practices in order to meet body weight criteria set for participation in competitions. Such includes restrictive eating and reduced energy intake. Few National Collegiate Athletic Association (NCAA)- sponsored initiatives exist to reduce the occurrence of restrictive eating patterns as means of reducing body weight in this population (Torres-McGehee, Green, Leaver-Dunn, Leeper, Bishop, & Richardson, 2011; Vinci, 1998; Becker, McDaniel, Bull, Powell, & McIntyre, 2012). Furthermore, there is a paucity of literature describing the prevalence of use, as well as

motivational factors leading to use or non-use of dietary supplements to provide missing nutrients in weight-class athletes' diets. An analysis of athletes' salient beliefs, intentions, and MVS use contributes to understanding the factors which lead to their use or non-use. Such findings may improve sports nutritionists' ability to make recommendations for MVS use by weight-class athletes when use is deemed appropriate.

Research Questions and Hypotheses

This study aimed to determine the relation between salient beliefs, attitudes, subjective norms, PBC, and behavioral intention to use MVS among MVS users and non-users of the FCLR population. It was hypothesized that positive attitudes and subjective norms, and high PBC towards MVS use would be associated with high behavioral intention to use MVS. The relation between FCLR behavioral intention to use MVS and decision to use MVS was evaluated. It was hypothesized that high behavioral intention to use MVS would be associated with decision to use MVS.

Definitions

1. Multivitamin/mineral supplement (MVS) - A dietary supplement containing three or more vitamins with at least one mineral.
2. Theory of Planned Behavior (TPB) - A social behavior theory concerned with individual motivational factors as determinants of the likelihood of performing a specific behavior.
3. Lightweight women's rowing- A division of women's rowing requiring that individual competitors weigh no more than 130 pounds/59 kg and the average weight of the crew not exceed 125 pounds/56.8 kg per rower.

Chapter 2: Review of Literature

The use of dietary supplements, including MVS, is popular in the United States (CDC, 2006). The reasons for consuming MVS are many, but most center around the belief that improved nutrition and health status will result from consumption. While most professional nutrition organizations including the Academy of Nutrition and Dietetics, and the American College of Sports Medicine do not advocate the use of MVS by healthy adults, there are population subgroups for which a micronutrient supplement may be warranted to ensure nutrient needs are fully met. Athletes who participate in weight class-controlled sports are more likely than athletes in non weight class-controlled sports to benefit from regular use of an MVS as these athletes are at greatest risk for developing restrictive eating-related nutrient deficiencies. An analysis of athletes' decisions as they pertain to MVS use will contribute to a better understanding of the specific factors which lead to use or non-use.

Supporting Literature

Dietary supplement usage is extremely common among Americans. According to 2003-2006 NHANES, 49% of Americans over the age of 1 year report using at least one dietary supplement within the past month. MVS are the most commonly used dietary supplement, with 33% of the population reporting use of MVS (CDC, 2006). Other commonly consumed dietary supplements include botanical supplements (14%) and amino acids (4%) (CDC, 2006; Bailey et al., 2011).

Multivitamins/minerals. Wide variability in micronutrient content exists amongst the MVS available to consumers. The term micronutrient refers to both vitamins and minerals. Although most MVS contain at least 10 vitamins and minerals, NHANES considers any vitamin preparation containing at least three vitamins and one mineral to be a MVS (CDC, 2006). MVS

often contain more than 100% of the Recommended Daily Allowance (RDA) for vitamins and most minerals (Huang et al., 2006). MVS are an effective way to increase micronutrient intakes to meet recommended levels, with the extent of increase dependent upon one's initial nutrition status and the micronutrient content of the MVS. MVS have shown effectiveness in raising blood concentrations of vitamin A, vitamin B6, vitamin B12, vitamin C, vitamin E, folate, and zinc after 12- and 24-week interventions (Earnest, Cooper, Marks, & Mitchell, 2002).

MVS are classified as dietary supplements under the 1994 Dietary Supplement Health and Education Act (DSHEA). As defined by Congress, dietary supplements include all orally consumed products intended to supplement one's diet. This includes MVS, as well as herbs, botanicals, metabolites, extracts and concentrates. MVS preparations may be found in tablet, capsule, liquid, powder, bar, soft gel or gel cap formulas. The United States Food and Drug Administration (FDA) regulates the marketing of all MVS and the safety of MVS containing new ingredients through post-marketing surveillance/adverse event reporting, as dietary supplements are not subject to the same strict pre-market approval process as prescription drugs (United States Food and Drug Administration [US FDA], 2010).

The prevalence of MVS use differs across American adult subgroups. Women and older adults report the greatest intake of MVS. Completion of higher education, regular physical activity, and being a non-Hispanic white are factors that are also associated with greater likelihood of MVS use. Overweight and obese individuals as well as those who smoke have been identified as subgroups with lower prevalence of MVS use (Baily et al., 2011; Jasti, Siega-Riz, & Bentley, 2003). Use of MVS is common among collegiate athletes. Previous research on dietary supplement use among 207 male and female collegiate athletes attending an NCAA Division I university found that 47% of athletes self-reported use of an MVS (Froiland, Kozewski, Hingst,

& Kopecky, 2004). Furthermore, MVS has been identified as the most popular dietary supplement among female collegiate athletes. Research on female athletes involving nine different collegiate sports, including rowing, found that 39% of subjects reported use of a MVS. The majority of those consuming MVS reported taking them on a daily basis (Herbold, Bridget, Visconti, & Bandini, 2004).

Theory of Planned Behavior. Reasons for MVS use are wide and complex. Social, psychological, and knowledge factors have been shown to influence an individual's decision to use dietary supplements, including MVS. Social cognitive approaches to understanding reasoning behind health behaviors have frequently utilized the Theory of Planned Behavior (TPB). This model, developed by Ajzen (1991), proposes that behavior most strongly results from the intention to perform a behavior. The TPB has shown success in predicting health behaviors related to drug use, sexuality, physical activity, smoking and nutrition (Armitage & Conner, 2001). Studies have utilized the TPB to predict dietary supplement usage amongst groups of adults, women, and female collegiate athletes (McDonald & Nicholson, 2006; Conner, Kirk, Cade, & Barrett, 2003; Housman, Dorman, Pruitt, Ranjita, & Perko, 2011). Limited research has been conducted to predict the intention to use or actual use of MVS amongst female college undergraduate students (Pawlak et al., 2008; Pawlak et al., 2005).

The TPB provides a framework for examining factors that may influence an individual's intention to engage in a behavior. While behavioral intention is most closely associated with actual behavior, the TPB proposes that three additional factors: attitudes towards the behavior, subjective norms, and perceived behavioral control (PBC) over the behavior influence behavioral intention. Salient beliefs of behavioral, control, and normative beliefs further influence such factors (Ajzen, 1991).

Attitudes towards a certain behavior stem from one's evaluation of the behavior and the consequences of engaging in that particular behavior. The theory postulates that if one perceives the outcomes of a behavior to be positive and assigns a high value to such consequences, then his or her attitude towards the behavior is favorable. This in turn is thought to influence the individual's intention to perform the given behavior, and subsequently his or her decision to engage in the behavior (Ajzen, 1991).

Social pressures to perform or not perform a given behavior constitute subjective norms. If an individual believes a behavior to be considered acceptable by his/her social group, the individual is more likely to report intention to perform the behavior (Ajzen, 1991).
PBC is defined as one's perceived ability to willfully engage in a particular behavior. In other words, how easy/convenient or difficult/inconvenient it is to perform a certain behavior. Situational factors, such as access to healthcare services and health information, as well as internal factors including knowledge of how to perform health behaviors affect perceived behavioral control. A high PBC is associated with behavioral intention and subsequent execution of that behavior when perceptions of control accurately reflect actual control (Ajzen, 1991; Armitage & Conner, 2001).

The TPB has been used to predict health behaviors including decision to consume MVS. Consistent with the TPB model, intention to use MVS supplements has shown to be the most important direct predictor of MVS use amongst Caucasian and African-American female college students (Pawlak et al., 2005; Pawlak et al., 2008). Use of the TPB to determine predictors of dietary supplement use in women over the age of 40 years found the odds of using supplements more than doubled for every single unit increase in intention score (Conner et al., 2003). Current research is inconclusive in stating which of the three salient beliefs; attitudes, subjective norms,

or PBC is most predictive of behavioral intention for use of MVS (Pawlak et al., 2005; Pawlak et al., 2008; Housman et al., 2011).

Analysis of TPB constructs in the context of MVS use amongst women provides insight as to the specific attitudes, subjective norms and PBC that prompt intention to use, and subsequent use of MVS. With respect to attitude amongst a population of Caucasian college-aged females, the belief that regular use of a MVS supplement would improve wellbeing had the greatest impact on decision to use a MVS. The belief that taking a daily MVS would make up for nutrients missed in ones' diet also showed significant influence on actual MVS use (Pawlak et al., 2008). Similar research conducted with a population of African American college-aged females found that positive beliefs about MVS use for improving health, nutrition and energy levels were evident for both MVS- and non-MVS users (Pawlak et al., 2005). Hence, while it may be drawn from these studies that college-aged females view use of MVS as important for health and well-being, such beliefs do not always result in the decision to use MVS.

Research on young adult females' attitudes to predict use of MVS indicates personal appearance is a factor in the intention and decision to use MVS. In populations of both Caucasian and African-American female college students, the expectancy that taking a MVS would help one to look better was reported significantly more from those who consume MVS versus those who do not (Pawlak et al., 2005; Pawlak et al., 2008). Such appearance-based behavioral belief is consistent with other research on health issues considered most important by young adults. Focus group findings by Dorfman (2004) found that women between the ages of 17 and 25 years considered body image and a concern for good looks as two of the top factors associated with their current health status. Herbold et al (2004) identified reasons for dietary supplement use amongst collegiate female athletes. "Good health," "improved athletic abilities,"

and "decreased body fat" were reasons reported most commonly by female athletes representing a variety of sports teams (Herbold et al., 2004).

MVS and Nutrition Status. Perceived nutrition and health statuses are associated with MVS use. It has been hypothesized that users of dietary supplements including MVS report improved health status compared to non-users. Interestingly, such is not attributed solely to the intake of supplements, but rather the sum of healthy lifestyle behaviors and preventative health actions that supplement users report in comparison to non-users. Primary consumers of MVS supplements report better nutrient intakes from food sources alone than those who do not take supplements (Foote et al., 2003). They also tend to engage in more physical activity and are less likely to smoke than non-users of supplements (Kirk et al., 1999; Touvier et al., 2009; Radimer et al., 2004; McNaughton et al., 2005; de Jong et al., 2003). Conner et al (2001) found that being conscious of one's dietary intake was a strong predictor of dietary supplement use. Such a finding helps to understand why MVS are commonly used by athletes. That is, athletes' attitudes towards nutrition as an important component of performance should theoretically lend to increased interest in diet and sports nutrition supplements. However this theory is not to be assumed. For example, it has been found that a lack of accurate knowledge in such areas as general nutrition, weight control and dietary supplements is common amongst collegiate athletes, particularly female athletes (Rosenbloom, Jonnaloagodd, & Skinner, 2002; Valliant et al., 2012).

Despite the fact that primary consumers of MVS are those in adequate nutrition and health status, such supplements are not indicated for use in healthy populations according to the American Academy of Nutrition and Dietetics, formerly the American Dietetic Association. Such organization states that"….the best nutrition-based strategy for promoting optimal health and reducing the risk of chronic disease is to wisely choose a wide variety of foods." (Ventura

Marra, & Boyar, 2009). Favorable health outcomes have been found to be more closely tied to dietary patterns, including the types and quantities of food consumed, rather than individual nutrient intake (Lichtenstein & Russell, 2005).

The Institute of Medicine (IOM) Dietary Reference Intakes (DRIs) may be used to estimate optimal nutrient intake. The DRIs include Recommended Dietary Allowances (RDAs), Adequate Intakes (AIs), Estimated Average Requirements (EARs), and Tolerable Upper Intake Levels (ULs). Micronutrient intakes for healthy individuals are to be based off of the RDAs and AIs (Institute of Medicine, 2000). At the population level, the United States Department of Agriculture and United States Department of Health and Human Services' 2010 Dietary Guidelines for Americans (DGA) provide dietary guidance to promote health and reduce risk of chronic disease (U.S. Department of Agriculture [USDA] & U.S. Department of Health and Human Services [US DHHS], 2010).

While a balanced diet can provide all nutrients necessary for adequate nutrition status, many Americans fail to consume the variety and quantities of foods required to meet recommended micronutrient intakes. It is estimated that a mere 3% to 4% of Americans adhere to the DGA and that widespread micronutrient inadequacy exists (King, 2007; USDA, 2010).

MVS Recommendations. For certain population subgroups, additional nutrients provided from dietary supplements may be warranted. Those with malnourishment, other specific health conditions such as sickle cell anemia, and those taking certain medications including methotrexate, may have modified micronutrient needs. The DGA state that "Supplements may be useful when they fill a specific identified nutrient gap that cannot or is not otherwise being met by the individual's intake of food" (USDA, 2010).

Professional sports nutrition organizations do not recommend use of dietary supplements, including MVS, by athletes who consume adequate energy to support weight maintenance from foods representing a varied diet. However recommendations vary for athletes who do not consume adequate energy and nutrients from their diets. It is the stance of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine that those athletes who "restrict energy intake or have severe weight loss practices, who eliminate one or more food groups from their diet, or who consume an unbalanced and low micronutrient-dense diet may benefit from a daily multivitamin/mineral supplement" (Rodriquez & DiMarco, 2009). Such a position is further supported by researchers studying the challenges faced by elite athletes in adhering to weight class restrictions; it is recommended that athletes consume a MVS supplement during period of weight loss to ensure sufficient micronutrient intakes (Sundgot-Borgen, & Garthe, 2011).

Weight-Class Athletics. Extreme weight-control practices have been reported by athletes participating in weight-class sports such as martial arts, boxing, wrestling and lightweight rowing (Terry et al., 1999; Oppliger et al., 2003). In these sports, athletes must meet strict weight requirements for competition. This has led athletes to intentionally manipulate body weight in order to participate in competition. Severe dietary restriction and fasting are examples of unsafe weight-control measures commonly employed by weight class athletes, as are the use of diuretics and laxatives, self-induced vomiting, and excessive exercise (Turocy et al., 2011; Oppliger et al., 2003; Nattiv et al., 2007; Karlson, Becker, & Merkur, 2001).

Rowing is a physically demanding sport for which high energy expenditure is an unavoidable product of training and competition (Hagerman F.C., 1984). Collegiate rowers are considered endurance athletes found to train at sub-maximal levels of approximately 75-85%

VO_{2max} (DellaValle & Haas, 2011). Female lightweight rowers are at risk for malnutrition related to an inadequate intake of calories and micronutrients necessary to match their increased energy output and metabolic requirements. Research conducted using the doubly-labeled water technique found the energy expenditure of elite female rowers to be approximately 4000 kcal per day during a period of heavy training. In comparison, such athletes' energy intakes as measured by self-reported four-day food record indicated significant inadequate energy intake at only 66% of expenditure (Hill & Davies, 2002).

Creation of a calorie deficit is a common goal amongst female lightweight rowers to achieve weight reduction. Female lightweight rowers are required to weigh no greater than 130 pounds (59 kg) for competition. While there is a lack of research to state the extent of weight lost by female lightweight rowers in order to meet weight requirements, research on other weight-classed athletes indicates wrestlers and boxers will commonly compete in a class 10-15% below their usual body weight (Brownell, Steen, & Wilmore 1987; Oppliger et al., 2003).

Extent of the Problem

Micronutrient Concerns. Dietary restriction as a means of weight loss may lead to micronutrient deficiencies, especially if the diet limits or excludes entire food groups. Research on micronutrient intakes of judo athletes engaging in food restriction to achieve weight loss for participation in weight class competition showed that athletes failed to consume recommended daily intakes of multiple micronutrients. Athletes' diets were found to be inadequate at both baseline, representative of regular eating habits, and following seven days of food restriction. Riboflavin (vitamin B2), niacin (vitamin B3), pantothenic acid (vitamin B5), pyridoxine (vitamin B6), cyanocobalamin (vitamin B12), magnesium, potassium and sodium were further reduced from baseline to post-food restriction period (Filaire, Maso, Degoutte, Jouanel, & Lac, 2001).

Such findings suggest that weight-class athletes are at increased risk for chronic dietary insufficiency and nutrient deficiency.

FCLR involved in intense training coupled with low energy and low micronutrient intakes are at an increased risk of developing chronic fatigue, injury, and reduced immunity to illness (Burke, Loucks, & Broad, 2006; Yanagawa et al., 2010). The belief that use of a MVS will prevent illness and reduce risk of injury is a potential reason as to why female collegiate lightweight rowers may use such dietary supplements. Research using the TBP to predict dietary supplement use by women found that subjects who supported the belief that dietary supplements are effective for reducing risk of colds/flu and anemia were more likely to use supplements (Conner et al., 2001; Conner et al., 2003).

Information on the use of MVS by female collegiate lightweight rowers is of importance in relation to intake of folic acid and prevention of neural tube defects (NTD). Adequate intake of folic acid has been shown to reduce risk of giving birth to an infant with NTD and it has been estimated that upwards of 50% of birth defects could be prevented if adequate folic acid is consumed by the mother prior to conception (Eichholzer, Tonz, & Zimmerman, 2006). Yet studies continue to show that college-aged females have lower intakes of folic acid-containing MVS than older females (CDC, 2005). This discrepancy has been attributed to young women's lack of awareness of the relationship between folic acid and prevention of NTD, rather than the lack of action in spite of knowledge (Fehr, Regr, & Protudjer, 2011). While college-aged females may not intend to conceive, this population has been shown to be at increased risk of unplanned pregnancy related to failure to use contraception (Walsh, Fielder, Carey, & Carey, 2012). Such factors place college-aged females at increased risk of giving birth to an infant with NTD.

FCLR with restricted dietary intake are at significant risk of iron deficiency, with and without anemia. Dietary iron intake has shown to have the greatest effect on body iron stores among females (McClung, 2012). Female athletes desiring weight loss may reduce or eliminate their intake of heme iron-rich foods such as red meat due to the association of meat and dietary fat. While vegetarian and vegan diets can provide sufficient dietary iron, the non-heme iron found in plant-based foods is not as well absorbed by the body (Hurrell & Egli, 2010). Iron losses from menstruation place females at further risk for iron deficiency, as do losses incurred from physical activity (Gropper, Smith, & Groff, 2009). Impact- and foot-strike- induced hemolysis, sweat and gastrointestinal iron losses, as well as inflammation resulting from high-intensity training can further increase female athletes' risk of developing iron-deficiency (Ehn, Carlmark, & Hoglund, 1980; Robertson, Maughan, & Davidson, 1987; DeRuisseau, Cheuvront, Haymes, & Sharp, 2002; Akabas & Dolins, 2005). In addition, collegiate populations can be expected to include female adolescent athletes, whose rapid growth patterns demand increased iron intake (Gropper et al., 2009). Due to iron's role in oxygen transportation and energy metabolism, sufficient iron stores are necessary for optimal athletic and academic performance, specifically endurance exercise activities (Hinton, Giordano, Brownlie, & Haas, 2000). Declines in both cognitive and physical function are evident with iron deficiency. In a study of 165 female collegiate rowers, 40% were found to be iron-deficient, with and without anemia, at the beginning of a training season. Performance measures indicated that iron-deficient rowers without anemia, whose serum ferritin levels measured 20 ug/L or less, were on average 21 seconds slower to finish a 2-km simulated race than those with sufficient iron stores, defined as greater than 20ug/L in this study (DellaValle & Haas, 2011). Addition research exists to confirm that iron-deficiency is prevalent among female endurance athletes of a variety of sports

(Constantini et al., 2000; Dubnov & Constantini, 2004; Zhu & Haas, 1998; Diehl, Lohman, Smith, & Kertzer, 1986).

In addition, as full-time students, it is imperative that collegiate female rowers have healthy iron stores to support cognitive health and academic performance. Impaired iron status is associated with reduced cognitive performance and increased time required to complete tasks in female undergraduate students (Murrary-Kolb & Beard, 2007). In addition, such research showed that supplementation with ferrous sulfate and subsequent improvement in iron status in previously iron-deficient students was associated with increased cognitive performance and reduced time required to complete learning-, memory-, & attention-based activities. The awareness of iron's important role in physical and cognitive performance as described above may influence female collegiate lightweight rowers' decision to use MVS.

As collegiate athletes competing within the NCAA, female lightweight rowers are expected to avoid consuming substances banned by this organization. While MVS are permitted for use, the NCAA cautions student-athletes of the potential for contamination amongst dietary supplements. Athletes are advised to consult with athletics department staff before consuming dietary supplements (NCAA, 2012). Such messages of caution may elicit fear of producing a positive drug test among FCLR, subsequently affecting decision to use MVS.

In summary, FCLR are at increased risk of micronutrient deficiency related to inadequate oral intake secondary to dietary restriction and other extreme weight control practices. The presence of micronutrient deficiencies can have detrimental effects on athletic performance, academic work, and the athlete's overall health and wellbeing. Professional nutrition and medical organizations including the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine have stated that "...athletes severely restricting energy

intake, eliminating one or more food groups, consuming diets low in micronutrients, or engaging in severe weight loss practices may require vitamin and mineral supplementation" (Rodriquez & DiMarco, 2009). An awareness of the consequences of malnutrition is one reason why female collegiate athletes may decide to use MVS supplements; however other social, psychological and knowledge factors exist.

The purpose of this study was to examine the effects of salient beliefs and behavioral intention towards MVS use on the decision to use MVS among FCLR, using the constructs of the TPB. Female athletes from lightweight collegiate rowing programs participated in this study. The information obtained is important to sports nutritionists, athletic trainers, rowing coaches and other sports professionals who strive to support athletes in preparing for competition.

CHAPTER 3: Methodology

There is a lack of information about female lightweight collegiate rowers' decisions to use MVS. The purpose of this research project was to fill a gap in the current literature predicting behavioral intentions to use, and use of MVS, amongst the FCLR population utilizing constructs of the TPB. The sample population and instrumentation are described. A description of study design and procedure will follow.

Institutional Review Board Approval. This research protocol was reviewed and approved by the College of Health and Human Services Human Subjects Review Committee at Eastern Michigan University.

Subjects and Selection of Sample

Subjects were recruited from women's collegiate lightweight rowing programs within the United States and Canada. Participating academic institutions included Pennsylvania State University, University of California at Berkeley, Purdue University, Washington State University, University of Chicago, Stetson University, Lafayette College, Queens University, Brock University, Simon Fraser University, University of Western Ontario, University of Guelph, University of Montreal, McMaster University, and University of Ottawa.
Contact information for each of the aforementioned programs' head coaches was gathered from the respective school's athletic department web site. An invitation requesting permission of athlete participation in this study was sent to all head and assistant coaches of the women's lightweight rowing programs.

The subjects were female and competed in lightweight rowing at their academic institutions. The research did not discriminate between rowers and coxswains as both classifications of athletes face restrictions on body weight for participation in competition. It was

expected that the majority of subjects would be rowers as the ratio of rowers to coxswains on rowing teams tends to be large. The majority of subjects were expected to be between the ages of 18 and 23 years and be enrolled in undergraduate studies at their respective academic institution. Subjects must have reached the age of 18 years to participate in this study as specified within the informed consent document provided to subjects (Appendix C). Continued participation past the informed consent agreement was considered the equivalent of providing signature of agreement. Subjects were further asked to provide their age in years. Only the data of those subjects who responded with an age equal to or greater than 18 years were included in this research. Thus inclusion criteria included participation as a rower or coxswain on a collegiate women's lightweight rowing team, female sex, and age of 18 years or older.

Instrumentation

A self-administered, online questionnaire was used to measure constructs of the TPB related to the use of MVS (Appendix A). This study utilized an existing questionnaire for measurement of TPB constructs to ensure validity and reliability of the current research findings. Permission for use of the existing questionnaire was sought and granted from the original author. Survey questions were drawn from the *Survey of the Theory of Planned Behavior* (STPB) by Pawlak et al., (2008). The STPB is a questionnaire previously used in research to measure Caucasian and African-American college females' attitudes, subjective norms, PBC and behavioral intention with regard to MVS use. The 35-item STPB utilizes a seven-point Likert scale for which subjects rate their agreement with statements from -3 (disagree) to +3 (agree). Pawlak et al., (2005, 2008) analyzed such questionnaire for the individual reliability of intention, attitude, subjective norms and PBC. Cronbach alpha reliability scores were 0.95 for behavioral intention, 0.93 for attitude, 0.90 for subjective norms, and 0.84 for perceived behavioral control.

The STPB was tested for cognitive understanding by three female volunteers, and further tested for reliability during a pilot test with fifteen female college student volunteers with a mean age of 22.4 years (Pawlak et al., 2008). The finalized STPB questionnaire was administered to 100 female African American students with a mean age of 20.9 years, and later 96 Caucasian female students with a mean age of 21.5 years during regularly scheduled classes at one southern United States university (Pawlak et al., 2005; Pawlak et al., 2008).

This study utilized the STPB as such instrument has shown validity and reliability in measuring TPB constructs amongst a sample of female college students. Question 9 of the STPB was modified to specifically address the use of MVS supplements for the improvement of rowing performance. Both the original and modified questions aim to measure respondents' attitude towards MVS supplement use.

Original Item. "I think that my taking a multivitamin supplement each day next week would be smart."

Modified Item. "I think that my taking a multivitamin supplement each day next week would improve my rowing performance."

The STPB includes items to measure behavioral intention, attitudes, normative beliefs, behavioral beliefs, perceived behavioral control and control beliefs related to MVS use (Table 1).

Table 1

STPB Statements Per TPB Construct

TPB Construct	Number of Items Measuring Construct	Example of Statement
Behavioral intention	5	I intend to take a multivitamin supplement each day next week.
Attitude	5	I think that taking my multivitamin supplement each day would be healthy.
Subjective Norms	4	People who are important to me would think that I should take a multivitamin supplement each day next week.
Perceived behavioral control	4	It would be easy for me to take a multivitamin supplement each day next week.
Behavioral beliefs	8	Taking a multivitamin supplement each day next week would improve my health.
Normative beliefs	6	My family (e.g. parents, siblings) thinks that I should take a multivitamin supplement each day next week.
Control beliefs	3	It would be difficult for me to remember to take a multivitamin supplement each day next week.

Procedure

The head coaches of the aforementioned women's lightweight rowing programs were sent an initial email introducing the purpose and methodology of this study and request for their team's participation (Appendix B). Two weeks later, each head coach was sent a follow-up email containing a link to the online questionnaire. Coaches were asked to forward this email to members of their lightweight women's rowing team for participation in the study.

The sample of FCLR was assessed using an Internet-based questionnaire. An account with Survey Monkey, an online survey development program, was created by the researcher. The researcher possessed sole access to the Survey Monkey account, and login information (username and password) was not shared with other individuals. Items contained in the STPB

questionnaire were transcribed into Survey Monkey and used to create an online version of the STPB.

The online questionnaire maintained the anonymity and confidentiality of subjects. Subjects were not asked to provide identification information nor were respondents' IP addresses recorded.

The online survey was made available to athletes for a period of one month. Once athletes completed the online questionnaire, data was downloaded for analysis.

Design

This study utilized a non-experimental, cross-sectional, quantitative survey design to examine attitudes, subjective norms, perceived behavioral control and behavioral intentions towards MVS use by FCLR.

Data Analysis

IBM SPSS Statistics version 15 software was used for data analysis. As performed in similar studies on TPB constructs to predict MVS use, multiple linear regressions evaluated the relation between attitude, subjective norms and perceived behavioral control, and intention to use MVS. A one-way analysis of variance (ANOVA) was performed to determine potential differences in behavioral intention score between current MVS users and non-users. Frequency distributions were used to determine information about subjects' age (mean), ethnicity (mode), position on rowing team (mode), and frequency of MVS use per week (mode).

CHAPTER 4: Results

The present study used a self-reporting questionnaire, specifically an online version of the *Survey of the Theory of Planned Behavior* (2005), to assess FCLR salient beliefs, attitudes, PBC, subjective norms, intention to use, and actual use of MVS. This chapter presents a demographic description of the subject sample, as well as the results of a series of statistical functions used to determine relationships between TPB constructs and MVS use.

Description of the Sample. An online version of the STPB was completed by 73 FCLR. Six subjects failed to meet the study inclusion criteria and were excluded from data analysis. The mean age of the 67 participants included in data analysis was 20.1 years (SD= 1.6), and 86.4 percent of subjects were between the ages of 18 and 21 years. A majority of participants (91.4%) reported of being of Non-Hispanic or Latino origin, and 91.1 percent reported being Caucasian. Rowers accounted for 88.1 percent of responses, while 8.9 percent reported as coxswains, and 3.0 percent reported being both a rower and coxswain for their team. Table 2 presents the demographic characteristics of study participants.

Table 2

Demographic Characteristics of Study Respondents (n=67)

Characteristics	Number	Percent
Age (years)	(n=67)	
18	7	10.4
19	24	35.8
20	15	22.3
21	12	17.9
22	6	9.0
23	1	1.5
24 and older	2	3.0
Racial/Ethnic Group	(n=62)	
White	54	93.1
Black or African American	1	1.7
Asian	4	6.9
Native Hawaiian or other Pacific Islander	0	0
American Indian or Alaska Native	1	1.7
Other	2	3.4
Position on Team	(n=67)	
Rower	59	88.1
Coxswain	6	8.9
Both rower and coxswain	2	3.0

Findings. The reported weekly usage of MVS ranged from zero to seven days. Overall, 50.8 percent of subjects reported MVS use at least one day per week. Daily MVS use was reported by 32.8 percent of subjects, while 49.2 percent of subjects reported no use of MVS. The TPB variables significantly correlated with each other with regard to intention to use MVS. The multiple correlation of attitude, subjective norms, and perceived behavioral control significantly correlated with measures of behavioral intention ($R=0.838$). The linear combination of attitude, subjective norms, and PBC together accounted for 70.3% (R squared) of the variance in behavioral intention ($F[3,58]=45.72$, $P<0.001$). Attitude had the greatest influence ($B=0.635$, $P<0.001$) followed by PBC ($B= 0.181$, $P<0.05$). Subjective norms did not significantly correlate with variance of behavioral intention to use MVS ($B=0.121$, $P>0.05$).

Thirty-four subjects reported use of MVS. A one-way analysis of variance was conducted to determine whether there was a difference in the mean scores of behavioral intention between MVS users and non-users. There was a significant difference in the mean scores of behavioral intention between these two groups ($F[20,41]=7.717$, $P <0.001$). MVS users reported moderately-high intention scores (mean 1.8 +/- 1.7), while non-users reported low intention scores (mean -2.1 +/- 1.4).

A separate multiple regression analysis was conducted with only those subjects who reported no use of MVS. For this sub-sample, the linear combination of attitude, subjective norms, and perceived behavioral control together accounted for 39.9% of the variance in ehavioral intention ($F[3,26]= 5.75$, $P <0.05$). Attitude, subjective norms and PBC were not found to predict behavioral intention. Beta coefficients were .351, P=.170 (attitudes), .292, P=.252 (subjective norms), and .069, P=.668 (PBC).

Logistic regression was performed with those subjects who reported use of MVS. Behavioral intention and PBC were entered into the first step of the analysis. Attitude and subjective norms were entered in the second step, and behavioral, normative, and control beliefs were entered in the third step of the analysis. Such order of entering these variables into the regression analysis is consistent with the TPB assumptions that behavioral intention and PBC are the strongest predictors of a behavior. Attitudes and subjective norms follow, as does salient beliefs in order of prediction strength. Overall, 87.9% of subjects were correctly classified as MVS users or nonusers. The Hosmer and Lemeshow test of model fit showed that the model adequately fits the data (Hosmer and Lemeshow Chi-Square = 14.95 (df=8) P<.080). The odds of using MVS more than quadrupled (4.113), (see Table 3) for every increase of one unit of

behavioral intention. The model accounted for 72.4% of the variance in the use of MVS (Nagelkerke R Square = 0.724).

Table 3

Impact of the variables of the TPB on behavior based on results of logistic regression analysis.

Variables	Odds Ratio	95% Confidence Interval	Significance
Step 1			
Intention	4.113	1.562-10.835	0.004
PBC	1.549	0.601-3.987	0.365
Step 2			
Attitude	0.715	0.207-2.467	0.595
Subjective norms	0.364	0.087-1.524	0.167
Step 3			
Control beliefs	0.781	0.330-1.850	0.575
Behavioral beliefs	0.736	0.167-3.244	0.686
Normative beliefs	4.012	0.659-24.407	0.132

Subjects' behavioral, normative, and control belief expectancy and value statements were analyzed to determine motivational factors leading to intention and use of MVS. Table 4 indicates the percentage of subjects who reported agreeing or strongly agreeing with each expectancy or value statement. Those factors found to be most important, as evidenced by greater than 80% of subjects agreeing or strongly agreeing with the specific belief statement include being healthy, getting all of the nutrients in one's diet, and looking and feeling good.

Table 4

Expectancy (beliefs) and corresponding value statements of behavioral, normative and control beliefs.

Belief/Value	Statements	Percent of Responses Scored 6 or 7 (Agree/Strongly Agree)
Behavioral Beliefs		
Expectancy	Taking a multivitamin supplement each day next week would improve my health.	41.4
Corresponding Value	Being healthy is important to me.	98.3
Expectancy	Taking a multivitamin supplement each day next week would help me to get the nutrients I do not get in my diet.	43.1
Corresponding Value	Getting all the nutrients I need is important to me.	86.2
Expectancy	Taking a multivitamin supplement each day next week would give me extra energy.	18.9
	Getting extra energy from multivitamin supplements is important to me.	18.9
Expectancy	Taking a multivitamin supplement each day next week would help me look and feel better.	22.4
Corresponding Value	Looking and feeling good is important to me.	94.8
Normative Beliefs		
Expectancy	My family (eg. parents, siblings) thinks I should take a multivitamin supplement each day next week.	34.5
Corresponding Value	It is important to me what my family thinks about my taking multivitamin supplements.	22.4
Expectancy	My peers approve of my taking a multivitamin supplement each day next week.	39.7
Corresponding Value	It is important to me what my peers think about my taking multivitamin supplements.	3.4
Expectancy	My doctor wants me to take a multivitamin supplement each day next week.	17.2
Corresponding Value	It is important to me what my doctor thinks about my taking multivitamin supplements.	51.8
Control Beliefs		
Expectancy	It would be difficult for me to remember to take a multivitamin supplement each day next week.	24.1
Corresponding Value	Remembering to take multivitamin supplements would make taking them more difficult.	31.0

Expectancy	I can afford buying multivitamin supplements.	58.4
Corresponding Value	The cost of multivitamin supplements would prevent me from taking them.	10.3

CHAPTER 5: Discussion and Conclusions

This is the first known application of the TPB to the use of MVS by a population of FCLR. The results of this study compare favorably with previous TBP studies on the use of MVS by collegiate females and collegiate female athletes.

Approximately half of subjects reported use of MVS (50.8%). While frequency of use varied from one day to seven days per week, 65% of MVS users reported daily use. Such findings are similar in comparison to those reported by Herbold et al., (2004) on the frequency of MVS use by

Results of this study indicate that behavioral intention was a significant predictor of MVS use, with 87.9% of subjects correctly classified as MVS users or non-users. In the present study, the TBP model was able to explain 70.3 percent of variance for behavioral intention towards use of MVS. Such compares to 49.7 percent explanation of variance for intention as reported by Pawklak et al., 2008 in a study of the TPB to predict use of MVS among female undergraduate students. The present study compares favorably to that of Conner et al., (2001), in which 70 percent of intention variance was explained.

Attitude, subjective norms, and PBC together predicted behavioral intention to use MVS. However, only attitude and PBC were found to have significant correlation with behavioral intention when analyzed independently. Subjects who reported positive attitudes and/or high PBC were more likely to also report intention to use MVS. The non-significant relationship between subjective norms and behavioral intention does not support TPB assumptions, but does agree with previous studies utilizing the TPB to predict MVS by female undergraduate students (Pawlak et al., 2008). In such study, attitudes and PBC, but not subjective norms predicted behavioral intention towards use of MVS.

The results of this study are in contrast to other studies on the TPB to predict use of sport-related dietary supplements by female collegiate athletes. Housman et al. (2011) found that subjective norms most strongly predicted behavioral intention to use dietary supplements among NCAA division I female student athletes. Belonging to an identifiable group such as an athletic team is thought to mediate the effects of subjective norms through influence of peers and coaches (Armitage & Conner, 2001). However the results of the current study utilizing a population of FCLR do not support such assumptions.

Consistent with the TPB model, the results of this study indicate that behavioral intention most strongly predicted actual behavior. For each increase in behavioral intention score, the odds of using MVS more than quadrupled. Such result is consistent with previous research on MVS use by female college students. Pawlak et al. (2005, 2008) found that the odds of using MVS increased between 3- and 5-fold for every increase in behavioral intention among African-American and Caucasian subjects, respectively. The current study also found MVS users to report higher mean behavioral intention scores in comparison to non-users. Such finding is consistent with TBP assumptions and the researcher's hypothesis that high behavioral intention towards use of MVS will be associated with MVS use amongst the sample of FCLR.

A variety of factors important to female collegiate lightweight rowers were identified. Those factors found to be most important, as evidenced by greater than 80% of subjects agreeing or strongly agreeing with the specific belief statement include being healthy, getting all of the nutrients in one's diet, and looking and feeling good. In relation to MVS use, close to half of subjects believed that taking MVS would assist in being healthy (41%) and getting all of the nutrients in one's diet (43%). Significantly fewer subjects (22.4%) felt that an MVS would help them to look and feel better despite placing a high value on such outcome. Thus, while study

subjects value nutrition, being healthy, and appearance, they perceive MVS as influencing health and nutrition rather than appearance. Similar results were found to be true of female African American undergraduate students. In such study utilizing the original *Survey of the Theory of Planned Behavior* to study factors leading to use of MVS, getting all nutrients in one's diet and being healthy, but not looking and feeling good were found to be significant factors in decision to use MVS (Pawlak et al., 2005). Body image and appearance are considered important concerns for young women. Attempts at changing appearance have included dietary modifications, cosmetics, cosmetic surgery, anti-aging strategies, and the use of dietary supplements (Kanter, Agliata, & Tantleff-Dunn, 2001). Future efforts by sports nutritionists to encourage use of MVS by FCLR when deemed appropriate may be improved by promoting MVS as a means of improving health and nutritional intake. Messages aimed at educating FCLR on the relationship between optimal nutrition and wellbeing and appearance (skin, hair, nail health) may further improve MVS acceptance based on the high value FCLR in this study placed on looking and feeling good.

Study Limitations. Limitations must be considered when interpreting the results of this study. Voluntary participation by subjects may have led to over representation of those with strong beliefs and attitudes, both positive and negative, towards MVS use. Such may have influenced the frequency of reported MVS use and motivational factors for use of MVS. This research was based upon subject-self reporting and thus may have been subject to self-report bias. Subjects may have modified or withheld responses based on the concern that coaches or athletic department staff would have access to the results, potentially affecting their position on their rowing teams. In addition, the belief that MVS fall under NCAA banned substances may lead fewer FCLR to use and report use of MVS. The current study involved 67 subjects, less than

the number as recommended by Francis et al., (2004) for studies utilizing the TPB with multiple regression analysis. For such studies, a minimum of 80 subjects is recommended for achieving statistically significant results. In addition, the current study reflects the reports of a sample of FCL, and thus findings may not be generalized to all female, weight class, or rowing athletes.

Conclusion. FCLR are at increased risk of developing micronutrient deficiencies due to inadequate oral intake secondary to severe weight control practices such as restrictive eating. MVS may serve as one approach to preventing and correcting micronutrient deficiencies. In spite of such, a lack of literature exists on the motivational factors that lead FCLR to use MVS. The findings of this study indicate that strong positive attitudes and perceived behavioral control towards MVS are associated with intention and decision to use MVS. FCLR who are recommended to take MVS by sports nutritionists may be more likely to adhere to a supplement regimen if messages about MVS reflect perceived benefits. These perceived benefits include consumption of essential nutrients, looking and feeling good, and being healthy.

References

Ajzen, I. (1991). The theory of planned behavior. *Organisational Behavior and Human Decision Processes*, *50*, 179-211.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice Hall.

Akabas, S. R., & Dolins, K. R. (2005). Micronutrient requirements of physically active women: What can we learn from iron? *The American Journal of Clinical Nutrition*, 81(5), 1246S-1251S.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behavior: A meta-analytic review. *British Journal of Social Psychology*, *40*(Pt4), 471-499.

Bailey, R. L., Gahche, J. J., Lentino, C. V., Dwyer, J. T., Engel, J. S., Thomas, P. R., … Picciano, M. F. (2011). Dietary supplement use in the United States, 2003-2006. *The Journal of Nutrition*, *141*(2), 261-266.

Becker, C. B., McDaniel, L., Bull, S., Powell, M., & McIntyre, K. (2012). Can we reduce eating disorder risk factors in female college athletes? A randomized exploratory investigation of two peer-ed interventions. *Body Image*, 9(1), 31-42.

Brownell K. D., Steen S. N., & Wilmore J. H. (1987). Weight reduction practices in athletes: Analysis of metabolic and health effects. *Medicine and Science in Sports and Exercise*, 19, 546-556.

Burke, L. M., Loucks, A. B., & Broad, N. (2006). Energy and carbohydrate training and recovery. *Journal of Sports Science*, *24*,7, 675-685.

Centers for Disease Control and Prevention [CDC]. Department of Health and Human Services, Centers for Disease Control and Prevention. (2006). *National health and examination*

survey data. Retrieved from website: http://www.cdc.gov/nchs/nhanes/nhanes2005-2006/nhanes05_06.htm

Centers for Disease Control and Prevention [CDC]. (2005). Use of dietary supplements containing folic acid among women of childbearing age-United States, 2005. *Mortality and Morbidity Weekly Report*, 57(1), 5-8.

Conner, M., Kirk, S., Cade, J., & Barrett, H. (2003). Environmental influences: Factors influencing a woman's decision to use dietary supplements. *The Journal of Nutrition*, *133*(6), 1978S-1982S.

Conner, M., Kirk, S. F. L., Cade, J. E., Barrett, J. H. (2001). Why do women use dietary supplements? The use of the theory of planned behavior to explore beliefs about their use. *Social Science and Medicine*, 52, 621-633.

Constantini, N., Eliakim, A., Zigel, L., Yarron, M., & Falk, B. (2000). Iron status of highly active adolescents: Evidence of depleted iron stores in gymnasts. *International Journal of Sport Nutrition and Exercise Metabolism*, 10(1), 62-70.

DellaValle, D. M., & Haas, J. D. (2011). Impact of iron depletion without anemia on performance in trained endurance athletes at the beginning of a training season: a study of female collegiate lightweight rowers. *International Journal of Sport Nutrition and Exercise Metabolism*, 21(6): 501-506.

de Jong, N., Ocke, M. C., Branderhost, H. A., & Friele, R. (2003). Demographic and lifestyle characteristics of functional food consumers and dietary supplement consumers. *British Journal of Nutrition*, *89*(2), 273-281. doi: 10.1079/BJN2002772

DeRuisseau, K. C., Cheuvront, S. N., Haymes, E. M., & Sharp, R. G. (2002). Sweat iron and

zinc losses during prolonged exercise. *Int J Sport Nutr Exerc Metab*, 12(4):428-437.

Diehl, D., Lohman, T., Smith, S., & Kertzer, R. (1986). Effects of physical training and competition on the iron status of female hockey players. *International Journal of Sports Medicine*, 7(5), 264-270.

Dorfman, R. (2004). Developing a folic acid campaign for women in eastern North Carolina: A social marketing research project. Unpublished manuscript.

Dubnov, G., & Constantini, N. (2004) Prevalence of iron depletion and anemia in top-level basketball players. *International Journal of Sport and Exercise Metabolism*, 14(1), 30-37.

Earnest, C., Cooper, K. H., Marks, A., & Mitchell, T. L. (2002). Efficacy of a complex multivitamin supplement. *Nutrition*, 18(9), 738-742.

Ehn, L., Carlmark, B., & Hoglund, S. (1980). Iron status in athletes involved in intense physical activity. *Medicine and Science in Sports and Exercise*, 12(1), 61-64.

Eicholzer, M., Tonz, O., & Zimmerman, R. (2006) Folic acid: a public health challenge. *Lancet*, 326(9519):1352-1361.

Fehr, K. R., Fehr, K. D., & Protudjer, J. L. (2011). Knowledge and use of folic acid in women of reproductive age. *Canadian Journal of Dietetic Practice and Research*, 72(4),197-200. Doi: 10.3148/72.4.2011.197.

Filaire, E., Maso, F., Degoutte F., Jouanel P., & Lac, C. (2001). Food restriction, performance, psychological state and lipid values in judo athletes. *International Journal of Sports Medicine*, 22(6), 454-459.

Foote, J. A., Murphy, S. P., Wilkin, L. R., Hankin, J. H., Henderson, B. E., & Kolonel, L. N. (2003). Factors associated with dietary supplement use among healthy adults of five ethnicities. *American Journal of Epidemiology*, *157*, 888-897.

Frances, J. L., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, R.…Bonetti, D. (May 2004). *Constructing questionnaires based on the theory of planned behavior: A manual for health services researchers*. Retrieved from http://pages.bangor.ac.uk/~pes004/exercise_psych/downloads/tpb_manual.pdf

Froiland, K., Koszewski, W., Hingst, J., & Kopecky, L. (2004). Nutrition supplement use among college athletes and their sources of information. *International Journal of Sport Nutrition and Exercise Metabolism*, 2004, 14, 104-120.

Gropper, S. S., Smith, J. L., & Groff, J. L. (2009). *Advanced nutrition and human metabolism*. (5 ed., Vol. 485). Belmont, CA: Wadsworth.

Hagerman, F.C. (1984). Applied physiology of rowing. *Sports Medicine*, 1(4), 303-326.

Herbold, N. H., Visconti, B. K., Frates, S., & Bandini, L. (2004) Traditional and nontraditional supplement use by collegiate female varsity athletes. *International Journal of Sport Nutrition and Exercise Metabolism,* 14(5), 586-593.

Hill, R. J., & Davies, P. S. W. (2002). Energy intake and energy expenditure in elite female rowers. *Medicine and science in sports and exercise*, 34(11), 1823-1829. Doi:10.1249/01.MMS.0000035370.25209.96

Housman, J., Dorman S., Pruitt B., Ranjita, M., & Perko, M. (2011). Consumption of Sport-Related Dietary Supplements Among NCAA Division 1 Female Student Athletes. *American Journal of Health Behavior*, 35(4), 438-446.

Huang, H. Y., Caballero, B., Chang, S., Alberg, A., Semba, R., S., Schneyer, C.,…& Bass, E. B. (2006). Multivitamin/mineral supplements and prevention of chronic disease. *Evidence Report/Technology Assessment,* 139, 1-117.

Hurrell, R., & Egli, I. (2010). Iron bioavailability and dietary reference values. *Am J Clin Nutr*.

91(5),1461S-147S.

Institute of Medicine, Food and Nutrition Board. (2000). *Dietary reference intakes; applications in dietary assessment*. Washington, DC: National Academies Press.

Kanter, A., Daniel, A., & Tantleff-Dunn, S. (2001). College students' attitudes towards age-related changes in physical appearance. Paper presented at the Annual Conference of the American Psychological Association, 2001.

Karlson, K. A., Black Becker, C., & Merkur, A. (2001). Prevalence of eating disordered behavior in collegiate lightweight rowers and distance runners. *Clinical Journal of Sport Medicine,* 11(1), 32-37.

King, J. C. (2007). An evidence-based approach for establishing dietary guidelines. *Journal of Nutrition*, 2007, 137(2), 480-483.

Kirk, S. F. L., Cade, J. E., Conner, M., & Barrett, J. (1999). Characterizing dietary supplement use in women. *Proceedings of the Nutrition Society*, *58*, 11A.

Lichtenstein, A. H., & Russell, R. M. (2005). Essential nutrients: Food or supplements: Where should the emphasis be? *Journal of the American Medical Association*, 294(3), 351-358.

Jasti, S., Siega-Riz, A. M., & Bentley, M. E. (2003). Dietary supplement use in the context of health disparities: cultural, ethnic and demographic determinants of use. *The Journal of Nutrition, 133(Suppl),* 2010S-2014S.

McClung, J. P. (2012). Iron status and the female athlete. *J Trace Elem Med Biol*. 26(2-3):124-126.

McDonaldson, D. D., & Nicholson, N. R. (2006). Dietary information and intention to continue and recommend supplements. *International Journal of Nursing Studies,* 43:51-57.

McNaughton, S. A., Mishra, G. D., Paul, A. A., Prynne, C. J., & Wadsworth, M. E. (2005).

Supplement use is associated with health status and health-related behaviors in the 1946 British birth cohort. *Nutritional Epidemiology*, *135*(7), 1789-1890.

Murray-Kolb, L. E., & Beard, J. L. (2007). Iron treatment normalizes cognitive functioning in young women. *Am J Clin Nutr*, 85(3):778-787.

National Collegiate Athletic Association. (2012, April 10). *NCAA banned drug list*. Retrieved from http://www.ncaa.org/wps/wcm/connect/public/NCAA/Health and Safety/Drug Testing/Resources/NCAA banned drugs list

Nattiv, A., Loucks, A. B., Manore, M. M., Sanborn, C. F., Sundgot-Borgen, J., & Warren, M. P. (2007). American College of Sports Medicine position stand: The female athlete triad. *Medicine and Science in Sports and Exercise*, 39(10), 1867-1882.

Oppliger, R. A., Steen, S. A., & Scott, J. R. (2003). Weight loss practices of college wrestlers. *International Journal of Sports Nutrition and Exercise Metabolism*, 13 (1), 29-46.

Pawlak, R., Connell, C., Brown, D., Meyer, M. K., & Yadrick, K. (2005). Predictors of multivitamin supplement use amongst African-American female students: A prospective study utilizing the theory of planned behavior. *Ethnicity & Disease*, 15, 540-547.

Pawlak, R., Brown, D., Meyer, M. K., Connell, C., Yadrick, K., Johnson, J. T., & Blackwell, A. (2008). Theory of planned behavioral and multivitamin supplement use in Caucasian college females. *Journal of Primary Prevention*, 29, 57-71.

Radimer, K., Bindewald, B., Hughes, J., Ervin, B., Swanson, C., & Picciano, M. F. (2004). Dietary supplement use by us adults; data from the national health and examination survey, 1990-2000. *American Journal of Epidemiology*, *160*(4), 339-349. doi: 10.1093/aje/kwh207

Robertson, J. D., Maughan, R. J., & Davidson, R. J. (1987). Fecal blood loss in response to

exercise. *Br Med J (Clin Res Ed)*, 295(6593):303-305.

Rodriguez, N. R., & DiMarco, N. M (2009). Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. *Journal of the American Dietetic Association*, *109*, 509-527. doi: 10.1016/j.jada.2009.01.005

Rosenbloom, C. A., Jonnalagadda, S. S., & Skinner, R. (2002). Nutrition knowledge of collegiate athletes in a division I National Collegiate Athletic Association institution. *Journal of the American Dietetic Association*, 102(3):418-420.

Sundgot-Borgen, J., & Garthe, I. (2011). Elite athletes in aesthetic and Olympic weight-class sports and the challenge of body weight and body composition. *Journal of Sports Sciences*, 29(S1):S101-S114.

Terry, P. C., Lane A. M. & Warren, L. (1999). Eating attitudes, body shape perceptions and mood of elite rowers. *J Sci Med Sport*, 2(1):67-77.

Touvier, M., Niravong, M., Volatier, J., Lafay, L., Lioret, S., Clavel-Chapelon, F., & Boultron-Ruault, M. C. (2009). Dietary patterns associated with vitamin/mineral supplement use and smoking among women of the e3 n-epic cohort. *European Journal of Clinical Nutrition*, *63*(1), 39-47.

Torres-McGehee, T. M., Green, J. M., Leaver-Dunn, D., Leeper, J. D., Bishop, P. A., & Richardson, M. T. (2011). Attitude and knowledge changes in collegiate dancers following a short-term, team-centered prevention program on eating disorders. *Perceptual and Motor Skills*, 711-725.

Turocy, P. S., DePalma, B. F., Horswill, C. A., Laquale, K. M., Martin, T. J., Perry, A. C., & Somova, M. J. (2011). National Athletic Trainers' Association position statement: Safe

weight loss and maintenance practices in sport and exercise. *Journal of Athletic Training*, 46(3), 233-336.

U.S. Department of Agriculture and U.S. Department of Health and Human Services, (2010). *Dietary guidelines for Americans, 2010*. Retrieved from U.S. Government Printing Office website: http://www.health.gov/dietaryguidelines/dga2010/dietaryguidelines2010

U.S. Department of Agriculture, Agricultural Research Service. (2010). *Report of the dietary guidelines advisory committee on the dietary guidelines for Americans, 2010, to the secretary of agriculture and the secretary of health and human services*. Retrieved from website: http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/DGAC/Report /2010DGACReport-camera-ready-Jan11-11.pdf

United States Department of Health and Human Services, Food and Drug Administration (FDA). (2010). Dietary supplements. Retrieved from http://www.fda.gov/Food/Dietary Supplements

Valliant, M. W., Pittman, H. P., Kieckhaefer Wenzel, R., & Hilson Garner, B. (2012). Nutrition education by a registered dietitian improves dietary intake and nutrition knowledge of a NCAA female volleyball team. *Nutrients*, 4:506-516.

Ventura Marra, M., & Boyar, A. P. (2009). Position of the American Dietetic Association: Nutrient supplementation. *Journal of the American Dietetic Association*, *109*(6), 2073-2085. doi: 10.1016/j.jada.2009.10.020

Vinci, D. M. (1998). Effective nutrition support programs for college athletes. *International Journal of Sport Nutrition,* 8(3), 308-320.

Walsh, J. L., Fielder, R. L., Carey, K. B., & Carey, M. P. (2013). Changes in women's condom use over the first year of college. *J Sex Res*, 50(2):128-138.

Yanagawa, Y., Morimura, T., Tsunekawa, K., Seki, K., Ogiwara, T., Kotajima, N., Machida, T., Matsumoto S., & Murakami, M. (2010). Oxidative stress associated with rapid weight reduction decreases circulating adiponectin concentrations. *Endocrine Journal*, 57 (4), 339-345.

Zhu, Y. I., & Haas, J. D. (1998). Altered metabolic response of iron-depleted nonanemic women during a 15-km time trial. *Journal of Applied Physiology*, 84(5), 1768-1775.

Appendices

Appendix A- Instrumentation

SURVEY OF THE THEORY OF PLANNED BEHAVIOR

A multivitamin is a popular supplement used daily by a substantial number of people in the United States. **Regardless of whether or not you are currently taking multivitamin supplements**, please complete the following questions related to a multivitamin supplement.

Are you a female involved in lightweight rowing at your academic institution?

Yes No

Are you at least 18 years old?

Yes No

With regard to your position, are you a rower or coxswain?

Rower Coxswain Both rower and Coxswain

How many days per week do you take a multivitamin supplement?

0 1 2 3 4 5 6 7

Please answer all questions listed below.

Disagree Neither Agree

No.	Behavioral Statements	*Circle one*						
1.	I intend to take a multivitamin supplement each day next week.	1	2	3	4	5	6	7
2.	I think that my taking a multivitamin supplement each day next week would be healthy.	1	2	3	4	5	6	7
3.	I could easily take a multivitamin supplement each day next week.	1	2	3	4	5	6	7
4.	I will try to take a multivitamin supplement each day next week.	1	2	3	4	5	6	7
5.	I think that my taking a multivitamin supplement each day next week would be beneficial.	1	2	3	4	5	6	7
6.	People who are important to me think I should take a multivitamin supplement each day next week.	1	2	3	4	5	6	7
7.	Factors outside of my control could prevent me from taking a multivitamin supplement each day next week.	1	2	3	4	5	6	7
8.	I plan to take a multivitamin supplement each day next week.	1	2	3	4	5	6	7
9.	I think that my taking a multivitamin supplement each day next	1	2	3	4	5	6	7

	week would improve my rowing performance.	
10.	It would be easy for me to take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
11.	I want to take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
12.	People whose opinion I value think I should take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
13.	I can afford buying multivitamin supplements.	1 2 3 4 5 6 7
14.	It is very likely that I will take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
15.	I think that my taking a multivitamin supplement each day next week would be pleasant.	1 2 3 4 5 6 7
16.	My family (e.g. parents, siblings) thinks I should take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
17.	I will have the opportunity to take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
18.	I think that my taking a multivitamin supplement each day next week would be favorable.	1 2 3 4 5 6 7
19.	My peers approve of my taking a multivitamin supplement each day next week.	1 2 3 4 5 6 7
20.	It would be difficult for me to remember to take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
21.	I am very confident I could take a multivitamin supplement each day next week.	1 2 3 4 5 6 7
22.	Taking a multivitamin supplement each day next week would improve my health.	1 2 3 4 5 6 7
23.	Being healthy is important to me.	1 2 3 4 5 6 7
24.	It is important to me what my family thinks about my taking multivitamin supplements.	1 2 3 4 5 6 7
25.	The cost of multivitamin supplements would prevent me from taking them.	1 2 3 4 5 6 7
26.	Taking a multivitamin supplement each day next week would help me to get nutrients I do not get in my diet. Getting all nutrients I need is important to me.	1 2 3 4 5 6 7

27.		1	2	3	4	5	6	7
28.	My doctor wants me to take a multivitamin supplement each day next week.	1	2	3	4	5	6	7
29.	It is important to me what my doctor thinks about my taking multivitamin supplements.	1	2	3	4	5	6	7
30.	Remembering to take multivitamin supplements would make taking them more difficult.	1	2	3	4	5	6	7
31.	Taking a multivitamin supplement each day next week would give me extra energy.	1	2	3	4	5	6	7
32.	Getting extra energy from multivitamin supplements is important to me.	1	2	3	4	5	6	7
33.	It is important to me what my peers think about my taking multivitamin supplements.	1	2	3	4	5	6	7
34.	Taking a multivitamin supplement each day next week would help me look and feel better.	1	2	3	4	5	6	7
35.	Looking and feeling good is important to me.	1	2	3	4	5	6	7

Please indicate your age:

Younger than 18 18 19 20 21 22 23 24 or older

Please indicate your ethnicity:

Hispanic or Latino origin Not of Hispanic or Latino origin Prefer not to answer

Please indicate your race:

American Indian or Alaskan Native Asian White African American

Native American or Pacific Islander Prefer not to answer

Provide your height in feet/inches: **Provide your weight in pounds:__**

Appendix B - Initial Invitation to Participate in Research

Dear (insert coach's name),

I am emailing to invite your lightweight women's rowing team's involvement in a study conducted by Heather Petraszko, RD of Eastern Michigan University on female collegiate lightweight rowers' decision to use multivitamin supplements.

This study will determine the extent to which female collegiate lightweight rowers' attitudes, beliefs and intentions predict use of multivitamin supplements. It is a multi-campus study involving eight women's lightweight rowing programs within the United States. The results of this study will assist the researcher and others working with athletes involved in weight-class sports to better understand the factors which influence athletes' decision to use multivitamin supplements. An analysis of such will provide sports nutritionists, athletic trainers, and physicians with improved knowledge of how to best recommend use of multivitamin supplements by weight-class athletes when use is warranted.

This research project is being administered via Internet-survey. The survey will take student-athletes approximately 10 minutes to complete. On January 28th, you will receive an email providing a link to the online survey. You are asked to forward this email to members of your lightweight women's rowing team, including both rowers and coxswains.

This research has been approved by the Eastern Michigan University Human Subjects Review Committee through the College of Health and Human Services. This extensive review process is to ensure the safety of participants in this research. There are no foreseeable risks or harm for the participants. Additionally, participation in this study is entirely voluntary and the strictest confidentiality will be maintained. Neither your institution nor your student-athletes will be identifiable in any reports because all of the information collected will be aggregated and the data of the respondents analyzed together. One report of the major findings will be written for presentation in educational settings and at professional conferences. The results may be published in a professional journal in the field of health education.

For more information, please contact Faculty Advisor Dr. Kay Woodiel at dwoodiel@emich.edu.

Thank you for your consideration.

Sincerely,

Heather Petraszko, RD
M.S. Health Education Candidate
Eastern Michigan University

Appendix C- Informed Consent

Eastern Michigan University
School of Health Promotion and Human Performance

INFORMATION OF RISK

Description of the Study:

This study is being conducted by a researcher in Eastern Michigan University's School of Health Promotion and Human Performance to better understand female collegiate lightweight rowers' decision regarding use of multivitamin/mineral supplements. In particular, the researcher is interested in how attitudes and beliefs about using multivitamin/mineral supplements relate to intention to use such supplements and actual use. You can participate in this research study by responding to the following questionnaire. It should take approximately 10 minutes to complete and no additional participation is required beyond the questionnaire.

Benefits and Risks:

As a participant in this study, you will not benefit personally, however, you will be helping to better understand athletes' decision to use multivitamin/mineral supplements. In addition, you will be providing valuable information for future research. The risks are minimal. Because this study addresses the issue of social pressures as well as physical health concerns, you may experience some anxiety while completing the questionnaire. If you feel uncomfortable with a question, you can skip that question or withdraw from the study altogether. If you decide to quit at any time before you have finished the questionnaire, your answers will NOT be recorded.

Voluntary Participation:

Your participation is voluntary; you are free to withdraw your participation from this study at any time without penalty or loss of benefits. If you do not want to continue, you can simply leave this website. If you do not click on the "submit" button at the end of the survey, your answers and participation will not be recorded. You also may choose to skip any questions that you do not wish to answer.

Confidentiality:

Your responses will be kept completely confidential. Be assured that your name will in no way be associated with this study. Response information will be maintained in an Internet survey site. Access to data is password protected and the researcher will have sole access to this information.

How the findings will be used:

Study data will be aggregated, and the results of the study will be used for scholarly purposes only. The results from the study will be presented in educational settings and at professional

conferences, and the results might be published in a professional journal in the field of health education and/or nutrition.

Contact information:

If you have concerns or questions about this study or your rights as a participant, please contact:

Kay Woodiel, Ph.D
Faculty Sponsor
Health Education Program
Eastern Michigan University
Phone: 734.487.7120, ext. 2698
Email: dwoodiel@emich.edu

Gretchen Reeves, Ph.D
Chair, University Human Subjects Review Committee, College of Health and Human Services
Phone: 734.487.3236
Email: greeves@emich.edu

This research protocol and informed consent document has been reviewed and approved by Eastern Michigan University Human Subjects Review Committee (UHSRC) for use from _____ to _____ (date). If you have questions about the approval process, please contact the UHSRC at human.subjects@emich.edu or call 734-487-0042.

CONSENT TO PARTICIPATE:

I understand my rights as a research participant and I voluntarily consent to participate in this study and follow its requirements. I additionally understand the purpose, intent, and necessity of the present study. I am able to print out a copy of this consent form for my future reference if I desire.

If you have read all of the above and would like to take part in this study, click the "submit" button below. By doing so, you are giving informed consent for use of your responses in this study. If you do not wish to take part in this study, please close this browser window.