CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

DEVELOPMENT OF NUTRITIONAL INFORMATION FOR THE CSUN VARSITY ATHLETE

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science in
Family Consumer Sciences

by

Ray Burigo

June 2006

TABLE OF CONTENTS

LISTS OF TABLES

LIST OF FIGURES

ABSTRACT

DEVELOPMENT OF NUTRITIONAL INFORMATION FOR THE

CSUN VARSITY ATHLETE

by

Ray Burigo

Master of Science in

Family Consumer Sciences

The purpose of this study was to assess the nutritional knowledge, behaviors, and concerns of the CSUN varsity athlete. The collected findings are to serve as a guideline for the development of nutrition education material to be utilized to enhance the nutritional knowledge and dietary intake of the CSUN athlete. A self-report questionnaire was completed by 109 athletes representing thirteen different sports teams. Subjects included 56 female (51.4%) and 53 male (48.6%) athletes. The mean age of the athletes was 19.7 (± 1.4) years. Athletes averaged 3.9 correct responses for the ten questions designed to assess nutritional knowledge. The top three sources of nutritional information for the athletes were “athletic trainers” (59.6%), “coaches” (54.8%), and “friends or teammates” (50.0%). Athletes selecting “classes” as the source of “most” of their information achieved the highest nutritional knowledge score of 6.0 (mean = 3.9). A majority of the athletes were interested in learning more about “nutrition programs for improved performance” (67%), “recipe ideas” (53.2%), and “tips on eating out” (51.4%). Significant differences existed for the personal goals of “decrease body fat” which was selected by 67.4% of female athletes and 16.7% of the males ($p = 0.001$), and the

personal goal of “gain muscle”, which was indicated by 73.8% of the males compared to 17.4% of the females ($p = 0.001$). The majority (75%) of CSUN athletes used “sports products” or “nutritional supplements” (e.g., sports drinks, energy bars), while 56% indicated that they took vitamin or mineral supplements. Significant differences were noted between genders for the usage of “protein powder or amino acids,” “high-protein meal replacement drinks” and “creatine.” Creatine usage by the men’s baseball team was found to be 100%. This study suggests that the CSUN varsity athlete could benefit from additional nutrition instruction, particularly regarding the understanding of the role of protein and the proper macronutrient content of pre-exercise meals. This information will be made available to coaches, athletic trainers, and nutrition practitioners for the purpose of supporting the dietary goals of the CSUN athletes.

CHAPTER I

INTRODUCTION

A correlation between athletic performance and nutrition has been well established (American Dietetic Association, 2000). Nutrition has been found to play a vital role in maximizing athletic performance, enhancing recovery, and maintaining overall health (Manore & Thompson, 2000; Maughan, 2002). Despite the advances made in the field of sports nutrition, limited research consistently reveals that the dietary habits of collegiate athletes are inadequate (Clark, Reed, Crouse, & Armstrong, 2003; Han-Markey, Elve, & Sutton, 1998; Hinton, Sanford, Davidson, Yakushko, & Beck, 2004) and that their nutritional knowledge is poor (Barr, 1987; Batson, Sease, Stanek, & Leski, 2004; Heredeen, 1999; Jacobson, Sobonya, & Ransone, 2001; Mandali, 2005; Rosenbloom, Jonnalagadda, & Skinner, 2002; Whitcombe, 1996; Zawila, Steib, & Hoogenboom, 2003). Speculation as to the reasons for the inadequate levels of nutritional knowledge and proper eating habits are plentiful. Many collegiate athletes are living on their own for the first time without domestic skills such as cooking and shopping (Rosenbloom, 2000), and the pressures of athletic competition and scholastic achievement have created hectic schedules for athletes who need to balance classes, practices, competition, and coursework (Shattuck, 2001; Vinci, 1998).

Pennsylvania State University was the first NCAA school to employ a full time sports nutritionist in the early 1990's (Clark, 1994). Since that time, a number of colleges and universities across the nation have begun developing various methods of nutrition education intervention (e.g., individual counseling, nutrition newsletters, seminars, lectures) to address the athlete's apparent lack of nutritional knowledge and inadequate

dietary intake, but these practices are not widespread (Vinci, 1998). Before such methods of intervention can be developed at CSUN, it is first necessary to obtain a more comprehensive understanding of the nutritional knowledge, behaviors, and concerns of the CSUN athlete.

Purpose

The purpose of this study was to assess the nutritional knowledge, behaviors, and concerns of the CSUN varsity athletes. The collected findings will serve as a guideline for the development of nutritional education materials that can be utilized to enhance the athlete's nutritional knowledge and, ultimately, improve dietary intake. The results of this study will provide insights into the attitudes, concerns, behaviors, and knowledge of CSUN varsity athletes. Important questions can be answered such as: (1) What is the level of nutritional knowledge of the CSUN athlete? (2) What are their sources of nutritional information, and (3) What do the athletes want to learn more about? Insights will be gained into the CSUN athlete's eating behaviors, goals, and concerns. This information will be available to assist coaches, athletic trainers, nutrition educators, and nutrition counselors in their quest to educate and inform the CSUN athletes.

Definitions

1. *Athlete*. A person possessing the natural or acquired traits, such as strength, agility, and endurance that are necessary for physical exercise or sports, especially those performed in competitive contexts (*Yourdictionary.com*).
2. *Collegiate/student athlete*. A student-athlete is a student whose enrollment was solicited by a member of the athletics staff or other representative of athletic interests with a view toward the student's ultimate participation in the intercollegiate athletics

program. Any other student becomes a student-athlete only when the student reports for an intercollegiate squad that is under the jurisdiction of the athletic department (*2001-02 NCAA Division I Manual*).

3. *Dietary supplement.* A product (other than tobacco) intended to supplement the diet that bears or contains one or more of the following dietary ingredients: (a) vitamin, (b) mineral, herb, or other botanical, (c) amino acid, (d) dietary substance for use by man to supplement the diet by increasing the total diet intake, and/or (e) a concentrate, metabolite, constituent, extract, or combination of any ingredient described in (a) – (f) (McArdle, Katch, & Katch, 1999).
4. *Ergogenic Aids.* Substances used to improve exercise and athletic performance by improving the production of energy (Manore & Thompson, 2000).
5. *Macronutrient.* Any of the nutritional components of the diet that are required in relatively large amounts: protein, carbohydrate, and fat (*Infoplease.com*).
6. *Micronutrient.* An essential nutrient, as a mineral or vitamin, that is required by an organism in minute amounts (*Infoplease.com*).
7. *Muscle glycogen.* The storage polysaccharide found in mammalian muscle, consisting of large irregular shaped, branched polysaccharide polymer (similar to amylopectin in plant starch) (McArdle et al., 1999).
8. *Professional athlete.* A professional athlete is one who receives any kind of payment, directly or indirectly, for athletic participation except as permitted by the governing legislation of the Association for the participation in athletics (*2001-02 NCAA Division I Manual*).

9. *Sports nutrition.* Nutrition that can help maximize athletic performance, prevent injury, enhance recovery from exercise, achieve and maintain optimal body weight, improve daily training workouts, and maintain overall good health (Manore & Thompson, 2000).
10. *Training table.* A table in a dining hall, as at a college, where athletes are provided with special meals to aid their conditioning (*Infoplease.com*).

Assumptions

The results of this study are based on the following assumptions:

- The subjects were representative of the athletes attending California State University Northridge (CSUN).
- The questionnaire was a suitable means of collecting information in regard to the knowledge, behaviors, and concerns of the CSUN athlete.
- The subjects understood the questions.
- Subjects responded truthfully and honestly to the questions.
- The information was coded, entered, and analyzed correctly.
- Data entry and data analysis were completed without error.

Limitations

This research has the potential to enhance the understanding of the nutritional knowledge, behaviors, and concerns of the CSUN athlete. However, certain limitations do exist:

- A cross-sectional design does not take into account changes over time.
- Answers may not represent actual behavior.

- Responses of collegiate athletes at CSUN cannot be generalized to other universities or other athletes in general.
- The study is limited to the number of athletes that completed the questionnaire.
- Answers to the questionnaire, although anonymous, may be biased due to social desirability.
- Questionnaires were completed in the training room before scheduled practices. Therefore subjects may be skewed toward athletes who were injured and those predisposed to receive precautionary treatments.

CHAPTER II

REVIEW OF LITERATURE

Overview of Sports Nutrition

The primary goal of sports nutrition is to achieve energy balance by ensuring an adequate caloric intake in the correct proportion of macronutrients (American Dietetic Association, 2000). These recommendations coupled with the need for quality training and adequate rest are the cornerstones for optimal athletic performance (Earnest, 2002). Achieving energy balance is crucial for the athlete's ability to consistently train at the intense levels needed for athletic success and continued well-being (Maughan, 2002). Nutritional recommendations for athletes are contingent on many factors, including gender, age, body type, and individual genetic variables. Adjustments in the general guidelines are recommended for different sporting events, positions played, fitness levels, and intensities of exercise. Environmental conditions such as heat, humidity, and altitude also factor into the dietary recommendations given to athletes (Rosenbloom, 2000).

In college athletics, nutrition is often the deciding factor between winning and losing. Recreational athletes can enhance athletic performance simply by increasing the time, duration, frequency, or intensity of their training. Collegiate athletes, however, are likely to be trained at similarly high levels with comparable physical talents leaving dietary intake as the deciding factor between winning and losing (Maughan, 2002).

In the past, sports nutrition in academia was covered within courses on applied nutrition or exercise physiology. More recently, classes dedicated solely to sports nutrition are offered at many colleges and universities. Although still in its infancy, the field of sports nutrition has established itself as an important subject worthy of serious

study (McArdle et al., 1999).

Areas of Sports Nutrition Relevant to the Collegiate Athlete

The nutritional issues that commonly affect the health and performance of collegiate athletes can be categorized within the general topics of body composition, the macro and micronutrient composition of meals, the timing of meals, hydration, and supplementation.

Body composition. According to Burke (1994), collegiate athletes often have misconceptions regarding body composition and weight loss (as cited in Rosenbloom, 2000). Sports nutrition emphasizes proper approaches to weight issues and body composition that can improve athletic performance and enhance health. Studies have revealed that female athletes often desire to lose weight (Batson et al., 2004; Hinton et al., 2004) The strong desire to win coupled with a preoccupation with appearance can increase the athlete's risk of disordered eating and subsequent poor health (Van de Loo & Johnson, 1995). Insufficient caloric intake can lead to inadequate percentages of body fat that can diminish health and performance (Dueck, Manore, & Matt, 1996). Furthermore, restricted energy diets together with intense training are associated with poor micronutrient intake that can compromise the body's immune functions jeopardizing the health and well-being of the athlete (American Dietetic Association, 2000; Pedersen, Helge, Richter, Rohde, & Kiens, 2000).

Macronutrient composition. College athletes have exhibited a poor understanding of the functions of carbohydrates, protein, and fat (Heredeen, 1999; Hinton et al., 2004; Jacobson et al., 2001; Mandali, 2005). Fundamental knowledge concerning the ideal composition of meals is needed to support the intense physical demands of athletes. It has

been established that the macronutrient needs of an athlete do not vary substantially from that of a non-athlete (Manore & Thompson, 2000). The Dietary Guidelines for Americans suggests that 55%-58% of the energy requirements come from carbohydrates, 12%-15% from protein, and 25%-30% from fat. Carbohydrates and fat are the main sources of energy for the athlete, with protein contributing less than 5% of total energy, providing carbohydrates are available (American Dietetic Association, 2000). Inadequate carbohydrate availability during training can increase the rate of protein catabolism causing lean muscle mass to be used as a fuel source, resulting in a decrease of strength and endurance (Lemon, 1998).

Micronutrients. Vitamin and mineral supplement use among collegiate athletes is high (Burns, Schiller, Merrick, & Wolf, 2004; Herbold, Visconti, Frates, & Bandini, 2004; Jacobson et al., 2001; Krumbach, Ellis, & Driskell, 1999), while their understanding of the functions of vitamins and minerals is low (Jacobson et al., 2001; Rosenbloom et al., 2002). It is generally believed by professionals that athletes can attain the recommended amounts of all micronutrients from a well-balanced diet (McArdle et al., 1999). Vitamin and mineral supplementation may improve performance for athletes with deficiencies, but there is insufficient evidence to support the general use of vitamin and mineral supplements for all athletes (Singh, Moses, & Deuster, 1992). It is recommended that athletes have a complete dietary analysis to determine their micronutrient needs and to determine whether the use of dietary supplements is warranted (Clark, 1997). Athletes at risk of micronutrient deficiency are those who are restricting energy intakes, using severe weight loss practices, eliminating one or more food groups, or consuming low micronutrient dense diets (American Dietetic

Association, 2000).

Hydration. The role of proper hydration is extremely important to the athlete for the enhancement of performance and the maintenance of good health. The metabolism of an athlete during exercise can be five to twenty times greater than resting levels (Manore & Thompson, 2000). During exercise, water absorbs the heat from the muscles which is then dissipated through sweat. It is not uncommon for an athlete to lose two to three liters of water per hour of exercise (Rosenbloom, 2000). Excessive sweat rates, without proper re-hydration, will lead to a state of dehydration which will have an adverse effect on athletic performance and overall well-being (Barr, 1999). Dehydration causes an increase in heart rate, core body temperature, blood osmolarity, and perceived exertion, while decreasing stroke volume and blood flow to the skin that is needed for the dissipation of heat (Rosenbloom, 2000). Severe consequences are associated with greater fluid loss. A reduction of 20-30% in athletic performance can result from fluid losses of 4-6% of total body weight, and losses greater than 6% could initiate heat exhaustion, heatstroke, coma, or death (Sleamaker & Browning, 1996).

Timing of meals. Many collegiate athletes have hectic schedules and often train two or more times per day (Rosenbloom, 2000) The hectic schedule coupled with the increased physical demands require that the athlete be knowledgeable in regard to the proper foods to eat before, during, and after practices. The pre-exercise meal has been shown to be beneficial in preventing physical and mental fatigue compared to training in the fasting state (Sherman, Peden, & Wright, 1991). The pre-exercise meal is normally moderate in protein, low in fat and fiber, and high in carbohydrates as well as being familiar to the athlete and well-tolerated (Manore & Thompson, 2000). During exercise,

the athlete experiences a decrease in blood glucose along with muscle and liver glycogen stores. Carbohydrate feeding during exercise has been shown to spare glycogen stores and prolong the time to fatigue during intense or prolonged exercise (Manore & Thompson). Carbohydrates are recommended immediately after exercise for the purpose of replenishing muscle glycogen and preparing the body for the next training session (Manore & Thompson).

Dietary supplements and ergogenic aids. There is an increasing need to educate the collegiate athlete in regard to the use of dietary supplements and ergogenic aids. The marketing of these products is currently a multi-million dollar industry aimed at impressionable athletes looking for a competitive edge. Supplements marketed for athletes often claim to improve athletic performance, recovery time, muscle gain, or fat loss. The manufacturing of dietary supplements is not subject to the strict regulations set by the United States Food and Drug Administration. The Dietary Supplement Health and Education Act (DSHEA) of 1994 allowed supplements to be marketed without scientific documentation of their often exaggerated claims. The contents of many of these supplements may contain impurities that may cause an athlete to test positive for a banned substance (Rosenbloom).

Collegiate Athletes

There is limited research on the nutritional behaviors and dietary intakes of college athletes. Moreover, much of the research conducted on professional athletes cannot be easily generalized to the collegiate athlete population. Collegiate athletes tend to be younger and less experienced than their professional counterparts. The majority of sports related research involves professional sports organizations that often have access

to facilities staffed with dietitians, chefs, and other health professionals. The ability to generalize past research is further exacerbated by the lifestyle of the typical collegiate athlete. Many are living on their own for the first time with a limited amount of shopping, cooking, and domestic skills (Rosenbloom). The adjustments to new living conditions are coupled with the pressures of scholastic achievement and athletic competition creating a hectic schedule that demands the juggling of classes, practice, homework, training, and competition (Shattuck, 2001; Vinci, 1998). In addition, limited financial resources often hamper many collegiate athletes adding to the challenge of attaining proper nutrition (Rosenbloom).

The dietary behavior of collegiate athletes was dramatically altered by National Collegiate Athletic Association (NCAA) legislation that placed restrictions on the amount of times an athlete was permitted to eat at a separate eating facility where athletes congregate for meals prepared specifically for them (*2001-02 NCAA Division I Manual*). Since this ruling, which went into effect during the summer of 1996, many male and female athletes have elected to eat off campus (Rosenbloom et al., 2002). In a study by Hinton et al. (2004), it was found that eating foods prepared away from home increased the likelihood that the athlete would exceed the recommended amounts for fat, saturated fat, cholesterol, and sodium. Conversely, a study by Fox (2004) suggests that the NCAA ruling has propelled collegiate athletes to take a more active role in their own dietary choices. The author found that athletes from schools that do not permit a separate eating facility for athletes, commonly referred to as the "training table," had (1) higher nutrition knowledge scores, (2) sought nutritional information more often, and (3) were more likely to read the label on foods before purchasing (Fox, 2004). Furthermore, it was

found in a study by Zawila et al. (2003) that athletes who prepared most of their own food scored significantly higher on the nutrition knowledge portion of the survey than athletes who normally had their food prepared for them. Likewise, testing of former collegiate athletes indicated that those who did not eat at a separate eating facility had higher scores for questions regarding general nutrition knowledge (Kaiser & Kunkel, 1996).

Title IX of the Education Amendments is a federal statute that was created to prohibit sex discrimination in education programs that receive federal financial assistance (*2001-02 NCAA Division I Manual*). Title IX was introduced in 1973, leveling the playing field for female athletes. This legislation called for equal number of male and female participants in all federally funded school activities. The ruling prompted an increase in the number of female collegiate athletes from fewer than 30,000 in 1972 to 202,500 in 2004, such that women now make up 41% of the varsity collegiate athletes in the United States (Porto, 2005). The increase in female participation is occurring without a complete understanding of the effects of intense training on developing female bodies (Van de Loo & Johnson, 1995). The demands put on female athletes increase the risk of suboptimal caloric intake leading to possible bone related abnormalities (Skolnick, 1993). Furthermore, studies have indicated that many female athletes are concerned with weight loss. One study found that over 70% of female athletes were trying to lose weight, while most male athletes wanted to gain or maintain their current weight (Batson et al., 2004). According to a study by Hinton et al. (2004), 62% of female athletes wanted to lose five or more pounds as compared to 23% of the male athletes. These body image concerns can lead to disordered eating patterns, increasing the risk of inadequate nutrition,

menstrual dysfunction, and premature osteoporosis (Bass, Daly, & Caine, 2002).

Nutritional Knowledge of the Collegiate Athlete

A survey of 243 Division I collegiate athletes reported that less than 40% had received nutritional information before entering college (Batson et al., 2004). These findings are consistent with a study conducted by Chapman, Toma, Tuveson, and Jacob (1997) who found that (1) only 26% of the high school female athletes received nutrition education in the classroom, and (2) their nutritional knowledge was found to be inadequate. Concurring results by Wiita and Stombaugh (1996) were found indicating that high school female athletes had misconceptions in regard to nutrition.

Jacobson et al. (2001) reported that 44.8% of the athletes surveyed "seldom or never" received nutritional counseling during their entire college careers and that their nutritional knowledge scores were inadequate. Studies evaluating the nutrition knowledge of collegiate athletes, although limited, consistently find the level of knowledge to be insufficient (Batson et al., 2004; Heredeen, 1999; Jacobson et al., 2001; Mandali, 2005; Rosenbloom et al., 2002; Whitcombe, 1996; Zawila et al., 2003).

A study comparing the nutritional knowledge of student-athletes with the general student population found scores comparable, with both groups averaging 34% correct responses. Additionally, both groups scored higher on general nutrition questions than on questions pertaining to sports nutrition (Barr, 1987). Rosenbloom et al. (2002) reported that only 63% of men and 54% of woman collegiate athletes knew that carbohydrates and fat are the main sources of energy; that 47% of men and 43% of women thought that protein was the main source of energy for muscles; that more than half of these subjects erroneously believed that vitamin and mineral supplementation would increase energy;

and that nearly 35% thought that protein supplements were needed in addition to dietary sources. This study consisted of eleven questions designed to test the nutritional knowledge of Division 1A athletes resulting in a mean score of 5.8 correct responses. Similar findings were reported by Mandali et al. (2005). They found that the majority of female athletes believed that vitamin, mineral, and protein supplements were needed in addition to food sources, and three-fourths thought that protein was the primary source of energy for the muscles. Other studies continually reported suboptimal nutrition knowledge levels for collegiate athletes. A study conducted by Heredeen (1999), found that vitamin and mineral supplements were believed to be good sources of energy by 80% of collegiate football players, and that 70% of these subjects believed that bread and potatoes should be avoided while trying to lose weight. Whitcombe (1996) found that the knowledge of collegiate athletes was quite poor with a mean score of 47.8% (possible range of 0% - 100%), concluding that nutritional education was warranted.

In a study by Jacobson et al. (2001), the nutritional knowledge of collegiate athletes was compared to data from a similar survey in 1992. It was found that only diminutive changes in the nutritional knowledge of athletes had occurred since the earlier study, despite recommendations to increase efforts to educate the athletes. The study concluded the following: (1) athletes were unaware of the correct recommended intake of carbohydrate, protein, and fat; (2) only 3% of the participants identified the correct recommended intake for protein; (3) over two-thirds thought that protein requirements should be 26% or more; (4) almost half of the athletes believed that fat intake should be less than 12%; and (5) male athletes were more likely than females to believe that protein was an immediate source of energy for the working muscles. Similar suboptimal findings

were found by Zawila et al. (2003), suggesting that the nutritional knowledge of female cross country runners was insufficient to prevent related health problems. Further education of the athletes was recommended, focusing on the importance of carbohydrates and the need to balance energy intake for the purpose of maximizing performance.

Dietary Intake of the Collegiate Athlete

There is limited research in regard to the actual eating practices of collegiate athletes. But the majority of available studies have found the dietary intake of collegiate athletes to be inadequate (Clark et al., 2003; Han-Markey et al., 1998; Hinton et al., 2004; Wiita & Stombaugh, 1996).

A recent study of the dietary intake of collegiate athletes conducted by Hinton et al. (2004) found that male athletes were 400 calories below the recommended daily energy requirements and that male and female athletes had inadequate intake of both carbohydrates and protein. The authors also found that only 15% of the athletes consumed the recommended intake of carbohydrates, that 26% achieved the recommended intake of protein, and that males were more likely then females to exceed the recommended intake of fat, saturated fat, cholesterol, and sodium (Hinton et al., 2004). A study at Eastern Michigan University was undertaken after poor eating behavior and fatigue were noted by the coaching staff of the men's basketball team. Dietary analyses of the team members established that intake was inadequate for milk/dairy, vegetables, and breads and grains. Further, the researchers found that the majority of the basketball team achieved the recommended levels of fruit by drinking fruit juices, and that the players exceeded the recommendation for fats, oils, and sweets. Furthermore, questions regarding proper hydration suggested that 33% of these athletes did not know

the importance of hydration in relation to athletic performance (Han-Markey et al., 1998). A study by M. Clark et al. (2003) analyzed the pre and post season dietary intake of female soccer players utilizing food records and 24-hour recalls. Results indicated that the intake of carbohydrates was inadequate for the replenishment of muscle glycogen and that the combined mean intake of several vitamins and minerals was found to be marginal, bordering on inadequate. A longitudinal study conducted by Wiita and Strombaugh (1996) tracked the nutritional knowledge and dietary intake of adolescent female runners. Over a three year period, the nutritional knowledge remained suboptimal (67%), while the quality of the diet declined.

Vitamin and mineral supplements are often used by athletes even though deficiencies among athletes for most micronutrients are not common (Haymes, 1991). A survey of 411 collegiate athletes found that 56.7% used vitamin/mineral supplements on a regular basis; that females were more apt to take calcium and iron, while males were likely to take vitamin A and B-12; and females were more likely to take vitamin/mineral supplements but the difference was not significant (Krumbach et al., 1999). Concurring results were found in a study by Herbold et al. (2004), citing that 65.4% of female athletes used dietary supplements one or more times per month and that the most popular (35.8%) supplement taken was a multivitamin/mineral supplement with iron. The authors also found that supplemental vitamin C was consumed by 31% of the athletes, herbal/botanical supplement usage was indicated by 17% of the athletes, and amino acid/protein supplements were reported to be used by 12% of the subjects. Similar use of supplements was cited in a study by Burns, Schiller, Merrick, and Wolf (2004) claiming that 88% of 236 student athletes used one or more nutritional supplements, while 58%

reported the use of two or more supplements. Furthermore, a study involving 163 Division I athletes found 75.8% using a vitamin/mineral supplements and 57.8% usage of dietary supplements (Ludwig, Wieman, Anding, & Moreland, 2005).

Sources of Nutritional Information

Burns et al. (2004) reported that the primary sources of nutritional information for athletes were athletic trainers (39.8%), strength and conditioning coaches (23.5%), and dietitians (14.4%), adding that many athletes (23.5%) were unaware that a dietitian was available. The authors recommended that dietitians increase their marketing effort towards the collegiate athlete and to work closely with athletic trainers to provide nutritional information. Jacobson et al. (2001) surveyed sixteen universities finding that the primary sources of nutritional information for male athletes were strength and conditioning coaches (21.9%) and athletic trainers (19.0%), while women listed university classes and nutritionists as their top sources. According to Zawila et al. (2003) only 17% of female athletes cited the athletic trainer as a source of nutrition information with the top choices being magazines, parents, coaches, and teammates. Similar findings reported by Cherundolo and Levine (1999), noting that friends, coaches, athletic trainers, parents, and magazines had the most influence on the athletes' dietary supplement choices. In a study by Krumbach et al. (1999), it was found that most athletes (40.6%) selected "self" as their top source of supplement information, followed by dietitians, family members or friends, coach or trainer, and physician or pharmacist. Herbold et al. (2004) reported that family members (53%) were the top source of dietary supplement information according to the 162 female collegiate athletes surveyed, followed by friends (24.6%), physician (18.7%), coaches (10.5%), and nutritionists (8.2%). Reasons stated

for the use of supplements were as follows: good health (60.1%), to improve performance (12%), to decrease body fat (6.1%), and to increase muscle mass (4.1%) (Herbold et al., 2004). Krumbach et al. (1999) found the top reasons for using supplements were "recommended by a family member or friend" and to "improve performance," with female athletes significantly more likely to list "recommended by a family member or friend" as their rationale for choosing supplements, while males were more likely to select "improve performance" as their motivation for supplement use. The often-cited reason of "improve performance" was also selected as the top choice reason for supplement use among athletes for the studies of Cherundolo and Levine (1999) and Jacobson et al. (2001).

Reliability of Information

The concern over misinformation being communicated to athletes was addressed in several studies. Shifflett, Timm, and Kahanov (2002) evaluated the nutritional knowledge of athletic trainers, coaches, and athletes by means of a survey. Scores indicated that athletic trainers were the most knowledgeable, followed by coaches and athletes. Athletic trainers responded with 74% correct answers, followed by coaches with 64% correct answers, and athletes with 55% correct responses. Scholastic coursework in the fields of health and nutrition was found to have a significant relationship to scores. The top two sources of information for the athletic trainers were academic journals and nutrition faculty. Coaches relied on athletic trainers and nutrition faculty as their top choices for information while athletes chose their parents. Questions posing the most difficulty for the group pertained to the protein needs of athletes and the percentage of fat needed in the diet. Athletes had additional trouble in the areas of hydration and weight

gain.

Smith-Rockwell, Nickols-Richardson, and Thye (2001) investigated the nutritional knowledge, opinions, and practices of college coaches and athletic trainers. The authors found that athletic trainers and coaches combined had a mean score of 67% (possible range of 0%-100%) on nutritional knowledge portion of the survey. Strength and conditioning coaches scored best along with participants with greater than fifteen years experience. In addition, subjects that trained or coached female athletes tended to have higher scores than those coaching or training male athletes. Athletic trainers and strength and conditioning coaches were the least knowledgeable responding to questions related to the micronutrient needs of athletes. Authors concluded that coaches and trainers were "knowledgeable about some appropriate nutritional recommendations," adding that registered dietitians should complement their efforts in the educational process.

The nutritional knowledge of coaches from North Carolina was determined by way of a mail survey (Corley, Demarest-Litchford, & Bazzarre, 1990). The coaches responded correctly to 70% of the questions, but only 33% responded with a high level of certainty. The authors found no correlation between nutrition knowledge scores and years of experience or scholastic coursework in nutrition. Coaches reported that junk food, poor eating habits, and consuming an unbalanced diet were the major dietary problems of their athletes.

Development of Sports Nutrition Education

The proliferation of sports nutrition information in recent years has prompted many institutions to implement nutrition education programs for their athletes. A number

of colleges and universities have developed programs utilizing various methods to increase the nutritional knowledge of their athletes (Vinci, 1998). A study conducted at Pennsylvania State University (Clark, 1994), reported that student athletes sought nutritional information to enhance performance, clarify supplement use, reduce or gain weight, and manage eating disorders. The role of the sports nutritionist is being recognized for both the individual counseling of athletes and in the development of education programs for teams, coaches, and trainers. Facilitating menu changes in dining facilities and creating workshops for weight loss or weight gain are examples of the increasing role of the sports nutritionist on campuses. However, a study by Potter and Wood (1991) indicates that there is a lack of research regarding the most effective methods in which to educate the athletes (as cited in Chapman, Toma, Tuveson, & Jacob, 1997).

The University of Florida implemented a nutrition education program following the NCAA ruling that restricted the use of separate eating facilities for athletes (Stahmer & Kratina, 1997). A monthly newsletter was developed targeting the student athlete along with a series of nutritional messages that were posted in the locker rooms. All incoming athletes were required to meet with a nutritionist at least once per year.

The University of Washington has developed a nutrition program as a component of the NCAA sponsored Department of Intercollegiate Athletics Total Student-Athlete Program that provides life skills to student athletes (Vinci, 1998). The NCAA conducts a number of programs that help prepare student-athletes for the hectic schedules and academic challenges of college athletic life. Their program emphasizes that an understanding of athletic culture and the physical and mental stresses faced by athletes

are needed to provide successful assistance. In their program, the sports nutritionists function as educators, counselors, and administrators. For female athletes, a multidisciplinary group including a nutritionist, physician, clinical psychologist, and athletic trainer are teamed to prevent and treat eating disorders.

A Total Student-Athlete Development (TSAD) program was instituted at Eastern Michigan University, after coaches witnessed poor eating behaviors of athletes (Han-Markey et al., 1998). The multi-disciplined team of professionals, including a psychologist, academic service center specialist, and dietitians worked together to develop a program that examined nutritional knowledge, body composition, and dietary intake of the student athletes.

Effectiveness of Sports Nutrition Programs

Various methods of nutrition education intervention have been successful with the majority of studies finding increased nutritional knowledge after the implementation of nutrition education programs (Abood, Black, & Birnbaum, 2004; Chapman et al., 1997; Keller-Grubbs, Landis, Lowe, & Finn, 1994; Kunkel, Bell, & Luccia, 2001; McReynolds, Cohen, Gambrell, & Dirks, 1993; Wiita, Stombaugh, & Buch, 1994). Other studies have delved into the question of whether nutritional knowledge correlates with improved dietary intake. According to a study by Zawila et al. (2003), 91.7% of the female athletes surveyed agreed with the statement, “Learning facts about nutrition is the best way to achieve favorable changes in food habits,” while 83.3% answered yes to the question, “Does your knowledge of nutrition affect how you eat?” Some studies claim a positive correlation between knowledge and intake (Abood et al., 2004; McReynolds et al., 1993; Wiita et al., 1994) others do not (Barr, 1987; Chapman et al., 1997; Keller-Grubbs et al.,

1994; Perron & Endres, 1985).

At Florida State University, Abood et al. (2004) evaluated the nutrition education intervention of female athletes. The intervention entailed a series of eight lectures on topics, shown in past studies, to be problematic for collegiate athletes (e.g., correct proportions of macronutrients, commonly deficient micronutrients, timing of meals, dining at restaurants). Efforts were made to conduct in-class activities for the purpose of having the athletes apply and tailor the information to meet their individual needs. The study demonstrated that the intervention increased not only nutrition knowledge, but also self-efficacy, and an improvement in overall dietary intake.

Texas A&M University developed a nutrition education program for their athletes focusing on weight control, the food groups, timing of meals, and eating disorders (McReynolds et al., 1993). The program included eleven sessions using handouts, films, posters, overheads, food models, and group discussions. Questionnaires were completed by the athletes before and after the sessions to evaluate dietary behaviors and nutrition knowledge. It was found that both nutrition knowledge and dietary behaviors improved after completion of the eleven sessions. Awareness of the services provided by the Health Center also increased.

A study at Clemson University (Kunkel et al., 2001) reported that peer nutrition education increased the nutrition knowledge and blood lipid levels of female athletes. Subjects met with a peer educator once a week for a period of seven weeks. The peer nutrition counselors focused the education process on weight management, the Food Guide Pyramid, serving sizes, healthy snacks, selecting foods from a variety of sources, making healthy choices, and guidelines to dining out. Individual counseling was

emphasized in this program because it allowed for the opportunity to tailor and modify the information to meet the individual needs and learning style of the athletes.

Another nutrition education program was designed for female cross-country runners to assess its impact on nutrition knowledge and dietary intake (Keller-Grubbs et al., 1994). The program consisting of three one-hour sessions, presentations, hand-outs, and group discussions was shown to significantly increase the nutrition knowledge of collegiate female runners. However, the 3-day food records, taken one month after the completion of the sessions, did not show a significant difference in the dietary intake of the subject.

A study by Burns et al. (2004) found athletic trainers and strength coaches to be the main sources of nutrition information for the collegiate athlete. For this reason, the authors suggest the collaboration of nutrition educators with athletic trainers and strength coaches. Nutrition educators were encouraged to offer seminars not only to athletes, but also to athletic trainers and coaches. Aggressive marketing strategies were also recommended for dietitians in order to play a more prominent role in the education of the student athlete.

Summary

This study will add to the body of knowledge and provide a better understanding of the nutritional knowledge and dietary behaviors of collegiate athletes. Past research has examined the nutritional knowledge and dietary intake of collegiate athletes and found them to be inadequate. The consequences of these inadequacies will negatively affect athletic performance and the health and well-being of the athletes. The findings of this study, coupled with the information gained from past research, will be utilized in the

development of nutritional information for the CSUN varsity athlete.

CHAPTER III

METHODOLOGY

This research was a cross-sectional study designed to assess the nutritional knowledge, concerns, and behaviors of CSUN varsity athletes. The study was approved by the department of Family and Consumer Sciences and by the Committee for the Protection of Human Subjects of the Office of Research and Sponsored Projects at CSUN (Appendix A).

Procedure

The athletic trainers of the CSUN Sports Medicine staff were contacted to solicit their participation for the collection of subject data. Permission was granted to distribute a self-report questionnaire (Appendix B) to varsity athletes in the training room before scheduled practices. Specific days and hours were designated during a two week period of time to ensure a cross-representation of athletic teams.

Athletes visiting the training room were asked to complete the three page questionnaire. Athletes were told that their participation was voluntary and anonymous. Those willing to complete the questionnaire were given a clipboard containing the Bill of Rights (Appendix C) for experimental subjects, an information form, and the questionnaire. Athletes completed the questionnaire while receiving treatment for injuries or precautionary procedures in preparation for practice. Others completed the questionnaire while waiting for treatment, therapy, or training sessions to begin. The training room environment provided the athletes with a comfortable area and ample time to thoroughly review and complete the questionnaire. Assistance from the athletic trainers, and their familiarity with the athletes, contributed to the high response rate. All

of the questionnaires were completed within a 10-15 minute time frame. A total of 109 questionnaires were collected.

Questionnaire

The majority of the self-report questionnaire used for this study was designed by the Georgia Tech Athletic Association with slight modifications and additional questions (Appendix D). Permission was given by the authors for the use of the Georgia Tech Athletic Association questionnaire (Appendix E). The survey underwent a qualitative review by a panel of three CSUN faculty members with expertise in sports nutrition and research design to establish content validity. Alterations were made to the questionnaire according to the recommendations made by the panel of experts.

The questionnaire contained 37 questions designed to elicit information regarding the demographics, concerns, behaviors, and nutritional knowledge of the CSUN varsity athletes. Athletes responded to various types of questions including fill-in-the-blanks, checklists, dichotomous (e.g., yes/no), categorical, and Likert response scales. The eleven questions developed at Georgia Tech University (Appendix D), pertaining to the assessment of nutrition knowledge, were used by Rosenbloom et al. (2002) in a past study. Ten of these eleven questions were used in the present study. One question was added, and the wording of another question was modified.

Data Analyses

Descriptive statistics including mean, standard deviations, and analyses of frequencies were analyzed using the Statistical Package for Social Sciences software (SPSS version 13.0). Differences between genders were detected by t-test and chi-square analysis. One way ANOVA calculated differences between the nutrition knowledge

scores of freshman, sophomore, junior, and senior classes. Differences were considered significant at $p < 0.05$.

CHAPTER IV

RESULTS

The self-report questionnaire was completed by 109 CSUN varsity athletes. Females athletes accounted for 51.4% (*n* = 56) of the subjects and males the remaining 48.6% (*n* = 53). The mean age of all athletes was 19.7 (±1.4).

The ethnicities of the athletes were as followed:

- White 47.7% (*n* = 52)
- Black/African-American 25.7% (*n* = 28)
- Hispanic 10.1% (*n* = 11)
- Asian 2.8% (*n* = 3)
- Other ethnicities 16.5% (*n* = 18)

Of the athlete respondents, 68.8% (*n* = 75) live off campus, and the remaining 31.2% (*n* = 34) live on campus. Those living with roommates totaled 72.5% (*n* = 79), 15.6% were living with their parent(s) or relative (*n* = 17), 9.2% lived alone (*n* = 10), and 1.8% live with their spouse or significant other (*n* = 2).

Thirteen CSUN varsity sports were represented in the study. The number of participating athletes for each sport is noted in Table 1.

The study consisted of 32 freshman (29.4%), 27 juniors (24.8%), 26 sophomores (23.9%), fifteen seniors (13.8%), and nine (8.2%) 5th year seniors.

Eating Habits

When asked to describe their eating habits, 34.0% of male athletes listed their eating habits as “good” compared to 28.4% of the females. An almost equal number of males and females listed their eating habits as “fair” (males 60.4%, females 60.7%).

Differences were noted between male and female athletes that listed their eating habits as "poor" (males 5.7%, females 16.1%). The differences were not significant ($p = 0.068$).

Table 1

Participants in Each Sport

Sport	**Frequency (*n*)**	**Percent (%)**
Men's Track & Field	17	15.6%
Women's Track & Field	16	14.7%
Women's Softball	15	13.8%
Men's Volleyball	11	10.1%
Men's Soccer	10	9.2%
Men's Basketball	8	7.3%
Men's Baseball	7	6.4%
Woman's Volleyball	7	6.4%
Women's Water Polo	6	5.5%
Women's Tennis	5	4.6%
Women's Basketball	4	3.7%
Women's Soccer	2	1.8%
Woman's Swimming	1	0.9%

The athletes were asked to list the three most common places that they would go to eat. The most common food establishments chosen by the athletes were: Subway® 43.2%, Chipotle® 25.7%, Mc Donald's® 19.2%, In & Out® 17.4%, Panda Express®

15.6%, and Taco Bell® 12%. The top selections of food establishments chosen by the athletes are listed in Table 2. The selections listed by the athletes were categorized into types of food by the author. The most common type of food establishments were "Fast Food/Hamburger," which was selected by 67% of the athletes, followed by "Mexican" (57.7%), "Sandwich Shop" (51.3%), "Chinese" (22%), and "Multi-menu Restaurant" (18.4%).

Table 2

Top Choices of Food Establishments

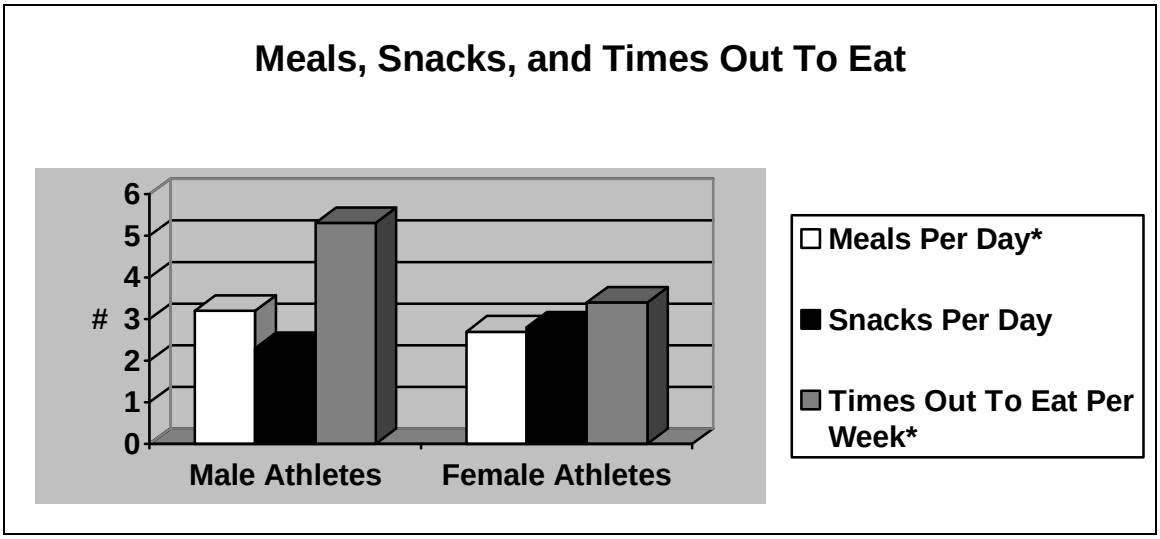
Food Establishment	**Percent (%)**
Subway®	43.2%,
Chipotle®	25.7%,
Mc Donald's®	19.2%,
In & Out®	17.4%,
Panda Express®	15.6%
Taco Bell®	12.0%.

T-test calculations showed a significant difference in the number of meals consumed per day by male and female athletes ($t = 2.811$, $p = 0.006$). The mean number of meals consumed by males was 3.2 meals per day as compared to 2.7 by the female athletes. No significant difference was found between genders in the number of snacks that the athletes consumed in one day ($t = -1.320$, $p = 0.190$). The male mean was 2.3 snacks per day as compared to 2.7 by the female athletes. A significant difference

between males and females was not found when athletes were asked if they frequently skipped meals. A significant difference was found between males and females in the number of times that the athletes went out to eat per week ($t = 2.374$, $p = 0.019$). The mean for male athletes was 5.3 times per week as compared to 3.4 times for the females. A summary of the differences between genders in the number of times they went go to eat per week, and the number of meals and snacks consumed each day are listed in Figure 1.

Figure 1

Number of Meals and Snacks Consumed Each Day by the Athletes and the Number of Times Going Out to Eat Each Week



* = $p < 0.05$ (males vs. females)

Tabulations found that 34.6% of males responded that they frequently skipped meals as compared to 39.3% of the females. The differences were not statistically significant. There was not a significant difference between the male and female athletes

in the amount of water that was consumed before, during, and after practice. The mean amount of water consumed before practice was 3.5 cups, during practice equaled 3.3 cups, and after practice the amount was 3.4 cups.

Types of Food Avoided

Chi-square calculations did not find significant differences in the types of food avoided by male and female athletes. A ranking of the foods avoided are listed in Table 3.

Table 3

Types of Food Avoided

Avoided Food	**Percent (%)**
Alcohol	47.7%
Fast Food	33.0%
Fats/oil	28.4%
Fried Food	26.6%
Sweets	24.8%
Fish	11.9%
Red Meat	10.1%
Breads	6.4%
Vegetables	4.6%
Dairy	2.8%
Grains	2.8%

Poultry	0.9%
Fruits	0.0%

Topics of Interest

Athletes were asked to place a check mark by the topics that they would like to learn more about. The percentage of athletes selecting each topic is depicted in descending order in Table 4.

Table 4

Topics That Athletes Wanted to Learn More About

Topics of Interest	**Percentage Selected by Athletes**
Nutrition programs for improved performance	67.0%
Recipe ideas	53.2%
Tips on eating out	51.4%
Cooking tips	46.8%
Shopping tips	39.4%
Weight control*	39.4%
Weight gain*	31.2%
Tips for reading the food label	30.3%
Cooking demonstrations*	22.9%
Grocery store tour	17.4%

* = $p < 0.05$ (males vs. females)

Chi-square tests detected significant differences for the topics “weight control,” “weight gain,” and “cooking demonstrations” when comparing male athletes to female athletes. Only 7.1% of the female athletes selected “weight gain” as a topic that they wanted to learn more about, as compared to 56.6% of the male athletes (*chi-square* = 31.037, $p = 0.001$). A majority of female athletes (51.8%) selected “weight control” as a topic of interest, compared to 26.4% of the male athletes (*chi-square* = 7.337, $p = 0.007$). Only 13.2% of male athletes had selected this “cooking demonstrations” as compared to 32.1% of the female athletes (*chi-square* = 5.524, $p = 0.019$).

Knowledge Scores

T-test did not find a significant difference for the total nutritional knowledge scores of the male and female athletes. Ten questions were asked resulting in a mean score of 4.1 correct answers for the male athletes and a mean score of 3.7 for the female athletes. An ANOVA analysis compared the nutritional knowledge scores between freshman, sophomores, juniors, and seniors (including 5^{th} year seniors). The top score was achieved by seniors (mean = 4.3), followed by sophomores (mean = 4.1), juniors (mean = 3.7), and then freshman (mean = 3.5). Differences were not statistically significant.

A question involving the effectiveness of sports drinks compared to water during exercises lasting less than one hour was eliminated due to conflicting results of current research and ambiguous nature of the question. The percentage of correct responses for each question pertaining to nutritional knowledge is listed in Table 5. A significant difference did exist between male and female athletes for the question, “Foods high in protein should be eaten prior to an athletic event,” with 35.3% of males providing correct

answers, while the females responded with 17.9% correct responses (*chi-square* = 4.200, $p = 0.040$). The question "Meals high in fat should be consumed two to three hours before an athletic event" also produced a significant difference with males having 45.8% correct answers and females 26.8% correct (*chi-square* = 4.091, $p = 0.043$).

Supplement Use

Chi-square analysis did not find a significant difference between genders for the question," Do you take vitamin or mineral supplements." The response "Yes, daily" was indicated by 17.9% of the athletes, while the response, "Yes, but not every day" was noted by 37.7% of the athletes. The number of athletes that did not take vitamin or mineral supplements equaled 44.3%.

Chi-square analysis did not find a significant difference between genders for the question, "Do you use any sports products or nutritional supplements?" The response "Yes, daily" was indicated by 9.4% of the athletes, while "Yes, but not every day" was selected by 66.0% of the athletes. Those not taking sports products or nutritional supplements equaled 24.5%. The types of sports products and nutritional supplements taken by the athletes are listed in Table 6.

Chi-square analysis found significant differences for "protein powder, drinks, or amino acids," with 41.0% of male athletes indicating usage, along with 11.9% of the female athletes (*chi-square* = 8.930, $p = 0.003$). The nutritional supplement "creatine" also produced a significant difference between the make and females athletes, with a usage rate of 10.3% for males athletes coupled with 0% usage for the females (*chi-square* = 4.531, $p = 0.033$). It was found that 100% of the men's baseball team used creatine. Creatine usage of 33.3% was found for the men's volleyball team along with 16.7% for

the men's track and field team. A significant difference occurred for "high-protein meal replacement drinks," with male athlete usage at 23.1% compared to 7.1% for female athletes (*chi-square = 4.068, p* = 0.044). Iron supplements, calcium supplements, and glutamine supplements were each specified once in the space provided for "other."

Table 5

Percentage of Correct Responses to Nutritional Knowledge Questions

Questions	**Correct (%)**	**Incorrect (%)**
Fluids should be replaced before, during, and after athletic events.	99.0%	1.0%
Carbohydrates and fats are the main source of energy for muscles.	64.2%	35.8%
Athletes can rely on thirst to ensure fluid replacement during and after an athletic event.	53.3%	46.7%
Meals high in fat should be consumed 2 to 3 hours before an athletic event.*	35.6%	64.4%
Protein supplements are needed in addition to diet for muscle growth and development.	31.8%	68.2%
Eating carbohydrates is known to increase body fat.	31.1%	68.9%
Foods high in protein should be eaten prior to an athletic event.*	26.2%	73.8%
Sweets should not be eaten prior to an athletic event.	24.5%	75.5%
Protein is the primary source of energy for muscles.	22.6%	77.4%

Vitamin and mineral supplements increase energy levels.	7.5%	92.5%

* = $p < 0.05$ (males vs. females)

Table 6

Sports Products and Nutritional Supplements Used by Athletes

Sports Product / Nutritional Supplement	**Percentage (%)**
Sports Drinks (e.g., Gatorade®, Powerade®)	91.4%
Energy Bars (e.g., Power Bar®, Clif Bar®)	60.5%
Protein powder, drinks, or amino acids*	25.9%
High-protein meal replacement drinks * (e.g., Met-Rx®, Myoplex®)	14.8%
Liquid meals (e.g., Slim-Fast®, Ensure®)	4.9%
Creatine*	4.9%
Weight-loss products / fat burners	0.0%

* = $p < 0.05$ (males vs. females)

Sources of Information

T-test did not find significant differences in the responses of male and female athletes when asked, “From what sources are you getting your nutritional information?” Athletes were able to select as many of the choices that applied. Table 7 provides a percent summary of the sources of information indicated by the athletes.

Athletes were provided with the opportunity to “write-in” a source of nutritional information not listed on the questionnaire. Notably, 15.4% of the athletes wrote “family,

parents, mother, or father" in the space provided. All sources within the family were listed in the category of "family/parents."

Table 7

Sources of Nutritional Information

Sources of Information	**Percentage (%)**
Athletic trainers	59.6%
Coaches	54.8%
Friends and teammates	50.0%
Magazines and the media	34.6%
Classes	28.8%
Family/parents	15.4%
Books	11.5%

After indicating all the sources of nutritional information, the athletes were asked to select the source that provided "most" of the information. The athlete's selections for the source of the "most" nutritional information are shown in Table 8.

It should be noted that "family/parents" were selected by 15.4% of the athletes as a "write-in" in response to the source of "most" nutrition information making it the third highest choice of the athletes.

Athletes that chose "classes" or "books" as the source of "most" of their nutrition information had the highest mean nutrition knowledge scores. The mean score for those

selecting “classes” was 6.0 and those who selected “books” tallied a mean score of 5.0. The sources producing the lowest scores were “coaches” with a mean of 2.5 and “magazines and the media” with a mean score of 2.6. Athletes selecting “athletic trainers” as the source of most of their nutritional information had a mean score of 3.8, while those selecting “friends or teammates” had a mean score of 3.2. A mean score of 3.9 was achieved by athletes selecting “family/parents” as the source of “most” of their nutritional information. The relationship between the sources of information and the nutritional knowledge scores achieved by the athletes are presented in Figure 2.

Table 8

Sources where Athletes are Getting Most of Their Nutrition Information

Sources of Most Information	**Percentage (%)**
Athletic trainers	28.7%
Friends and teammates	19.1%
Family/parents	16.0%
Classes	12.8%
Magazines and the media	9.6%
Coaches	8.5%
Books	2.1%

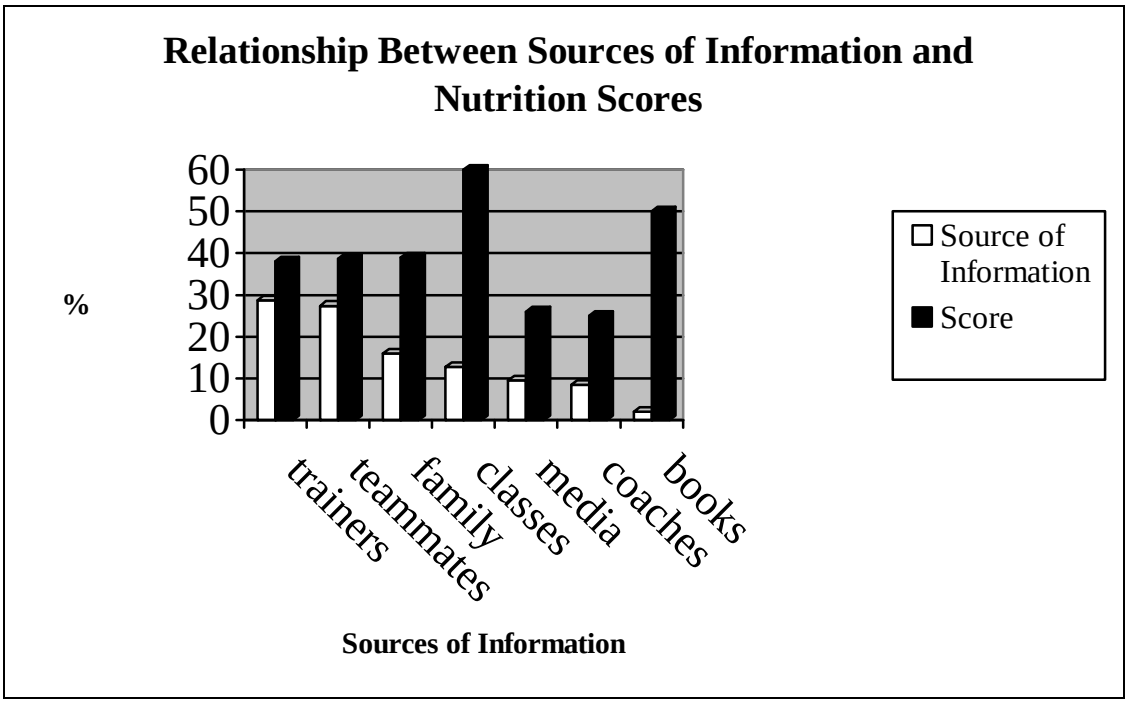
Goals and Concerns

Chi-square analysis detected a significant difference between male and female athletes when asked, “Do you think that your diet is nutritional adequate?” (*chi-square* = 6.529, $p = 0.038$). Males responded with “Yes” 40.0% of the time compared to 18.2% for

the female athletes. More female (41.8%) indicated that they did not know if their diet was nutritionally adequate compared to that of the males (26.0%). Female athletes (40.0%) responded "no" to this question regarding nutritional adequacy slightly more than their male (34.0%) counterparts.

Figure 2

Relationship Between Sources of Nutritional Information and Nutrition Knowledge Scores



Athletes were asked to rate their satisfaction with their cardiovascular endurance, muscular strength, and body fat percentage. T-test indicated a significant difference in regard to the satisfaction levels of cardiovascular endurance (t = -2.066, p = 0.041). When asked for their satisfaction level, 41.2% of the males indicated that they were "very satisfied" with their cardiovascular endurance compared to 18.2% of the female athletes.

More females (69.1%) indicated that they were “somewhat satisfied” compared to 47.1% of the males. “Somewhat dissatisfied” prompted an 11.8% respond from the male athletes compared to 10.9% of the females. Only 1.8% of the females and 0.0% of the males were “very dissatisfied” with their cardiovascular endurance. Significant differences were also found between male and female athletes in regard to the level of satisfaction with their body fat percentage (t = -2.019, p = 0.0046). More males (35.3%) were “very satisfied” with their percentage of body fat compared to 16.4% of the females athletes. There were no significant differences between male and female athletes when asked to respond about their satisfaction with their “muscular strength” (t = 0.505, p = 0.614). T-test did not show a significant difference between the male and female athletes for the perceived difficulty of maintaining their in-season weight. The average mean score of 2.0 indicated that the athletes thought that the ability to maintain their in-season weight was “somewhat easy.”

A high percentage of males (84.6%) and females (83.9%) had personal goals for body composition. A significant difference was found between the male and female athletes using chi-square calculations (*chi-square* = 29.419, p = 0.001). The personal goal of “gain muscle mass” was indicated for 73.8% of male athletes compared to only 17.4% of the females. The personal goal of “decrease body fat” was indicated by 67.4% of the female athletes and 16.7% of the males. The goal of “maintain current body weight” was selected by 15.2% of the females and 9.5% of the male athletes.

CHAPTER V

DISCUSSION

The purpose of this study was to assess the nutritional knowledge, behaviors, and concerns of the CSUN varsity athlete. The collected findings are to serve as a guideline for the development of nutritional education material that will be utilized to enhance the athlete's nutritional knowledge and ultimately improve dietary intake. This information will be available to assist coaches, athletic trainers, and nutrition counselors in their quest to provide nutritional information and guidance to the CSUN athlete.

Nutritional Knowledge

In this study, the nutritional knowledge of the CSUN varsity athlete was found to be inadequate. These results are in agreement with past studies examining the nutritional knowledge of collegiate athletes (Batson et al., 2004; Heredeen, 1999; Jacobson et al., 2001; Mandali, 2005; Rosenbloom et al., 2002; Whitcombe, 1996; Wiita et al., 1994; Zawila et al., 2003). The development of nutritional education materials is warranted as evidenced by the mean score of 3.9 correct responses out of ten questions on the portion of the questionnaire pertaining to nutritional knowledge of the athletes. The athletes had particular difficulty with questions regarding to the functions of protein in the diet, the content of pre-exercise meals, and the role of vitamin/minerals. Significant differences were not found comparing the scores of male and female athletes, concurring with the findings of Rosenbloom et al. (2002), but not Whitcombe et al. (1996) who found female scores to be significantly higher than males. Differences, although not significant, were found in the nutrition knowledge scores comparing freshman, sophomores, juniors, and seniors. Scores tended to improve as the athletes matured from freshman to seniors.

The results of one question from the knowledge portion of the survey, was not calculated into the findings. Specifically, the question regarding the effectiveness of sports drinks in exercises lasting less than one hour was not calculated into the results due to the conflicting results of numerous studies. The position of the American College of Sports Medicine does not support the claim that the use of sports drinks will enhance performance for exercises lasting less than one hour (Convertino et al., 1996). However, these findings are not supported by recent studies finding improved performance when carbohydrates, in the form of sports drinks, were consumed (Below, Mora-Rodriguez, Gonzalez-Alonso, & Coyle, 1995; Wilber & Moffatt, 1992).

The remaining ten nutritional knowledge questions are discussed in the following sections.

Question #1- Fluids should be replaced before, during, and after athletic events.

CSUN athletes were aware of the importance of replacing fluids before, during, and after athletic events. Ninety-nine percent of the CSUN athletes answered this question correctly. The majority of athletes (95%) surveyed by Rosenbloom et al. (2002) were also aware of the importance of hydration. Similarly, a study by Zawila et al. (2003) found over 70% of the female athletes responding correctly to questions pertaining to hydration. Adhering to the guidelines of proper hydration is especially critical to the CSUN athlete, due to the increased sweat rates associated with the warm environment of Southern California. Excessive sweat rates, without proper re-hydration, will lead to a state of dehydration which will have an adverse effect on athletic performance and overall well-being (Manore & Thompson, 2000). These findings in regard to the athlete's knowledge of hydration concur with their reported behavior. When CSUN athletes were

asked to indicate the amounts of water consumed before, during, and after practice, the mean scores were 3.5 cups, 3.3 cups, and 3.4 cups respectively. This question was designed to assess the general behavior of the athletes and was not suitable in ascertaining whether intake was adequate due to the multi-factorial nature of proper hydration.

Question #2- Athletes can rely on thirst to ensure fluid replacement during and after an athletic event.

Only 53% of the athletes knew that they couldn't rely on thirst to ensure proper fluid replacement. In contrast, nearly 80% of the athletes from the study conducted by Rosenbloom et al. (2002) answered this identical question correctly. A similar question, "Thirst is the best indicator of dehydration" was asked in a study by Nichols, Jonnalagadda, Rosenbloom, and Trinkaus (2005), and responded to correctly by 64% of the athletes at a southeast Division I institution. This question is of considerable importance because the thirst mechanism is unreliable and an athlete may lose 1% of his or her body weight in fluids before thirst is signaled. The amount of 1% is equivalent to 24 oz. for a 150 lb. athlete, and its loss requires the heart to beat an additional 3-5 beats per minute, adding additional stress to the body (Casa et al., 2000).

Question #3- Carbohydrates and fats are the main source of energy for muscles.

Nearly 65% of the athletes responded correctly to this question acknowledging that carbohydrates and fats are the main source of energy for muscles. In the study by Rosenbloom et al. (2002), this exact question was answered correctly by 58% of the athletes. The importance of carbohydrates and fats as the primary sources of fuel is critical for the collegiate athlete. Contributions from carbohydrates and fats are

significant during moderate exercise. However, collegiate athletes are required to train at high intensities that increase the reliance on carbohydrates as fuel. Carbohydrates are needed for the replenishment of muscle glycogen that is depleted at accelerated rates during intense exercise (Brooks & Mercier, 1994). Collegiate athletes often train twice a day, making the replenishment of glycogen an important consideration. Diets lows in carbohydrates are also known to increase the potential for injury and the susceptibility to minor infectious illnesses (Nieman & Pedersen, 1999). There is also a legitimate concern that athletes may be influenced by the popularity of low carbohydrate diets. Nearly 70% of CSUN athletes responded incorrectly to question #6, believing that the consumption of carbohydrates is associated with increased body fat. The results indicate that CSUN athletes would benefit from information regarding the primary sources of fuel and the importance of carbohydrates as a fuel source.

Question #4- Meals high in fat should be consumed 2 to 3 hours before an athletic event.

Nearly 65% of the CSUN athletes answered incorrectly and were not aware that meals high in fat should not be consumed 2 to 3 before an athletic event. There was a significant difference with males having 45.8% correct responses while females responding correctly 26.8% of the time. A smaller percentage (30%) of athletes answered this question incorrectly in the previous study by Rosenbloom et al. (2002). The wording of this question may have confused some athletes. Some athletes may have known that high fat meals should not be consumed directly preceding an event, but inadvertently believed that two to three hours were sufficient for complete digestion. The low percentage of correct answers for this question, and questions #7 and #8, demonstrate that more information is needed for the athletes concerning the appropriate macronutrient

makeup of pre-exercise meals.

Question #5- Protein supplements are needed in addition to diet for muscle growth and development.

Only 31.8% of the athletes answered this question correctly. Similar inadequate levels of knowledge in relation to protein have been found in previous studies (Jacobson et al., 2001; Mandali, 2005; Rosenbloom et al., 2002). The popularity of high protein diets and the aggressive marketing of protein products in the media and magazines may have contributed to the erroneous belief that protein supplementation is needed for the collegiate athlete. Increased protein needs may be warranted for some athletes, but are generally provided by diet alone, without supplementation, if energy needs are met (Rosenbloom, 2000). Athletes should be made aware that additional protein intake above the recommended levels will not support the development of additional muscle growth due to the limited rate in which muscle tissue can be accrued (American Dietetic Association, 2000).

Question #6- Eating carbohydrates is known to increase body fat.

A similarly low score of 31.1% correct answers was found in response to this question. These findings were consistent with a study of collegiate football players in which 70% believed that bread and potatoes should be avoided while trying to lose weight (Heredeen, 1999). In contrast, 75% of the athletes from the study by Rosenbloom et al. (2002) correctly responded to this question. Once again, the popularity of the low carbohydrate diet may be having an influence on the collegiate athlete. The belief that carbohydrates can make you fat is a concern for the high percentage of female athletes interested in weight loss considering carbohydrates are the main source of energy for the

athlete. As previously stated, the avoidance of carbohydrates can have an adverse effect on athletic performance and the overall health of the athlete.

Question #7- Foods high in protein should be eaten prior to an athletic event.

Athletes responded with only 26.2% correct answers for this question, demonstrating the athlete's misconceptions in regard to the proper timing and content of pre-exercise meals and the functions of protein. A large majority of CSUN athletes were unaware that pre-exercise meals should be moderate in protein, low in fat, and high in carbohydrates to enhance gastric emptying while maximizing blood glucose and glycogen stores (Manore & Thompson, 2000). Similar misconceptions were seen in questions #4 and #8, suggesting the need of nutritional instruction in this area.

Question #8- Sweets should not be eaten prior to an athletic event.

A majority of the athletes (75.5%) believed that "sweets" should be avoided prior to an athletic event. This corresponds with the study by Rosenbloom et al. (2002) that found roughly two-thirds of the athletes responding incorrectly. The high percentage of incorrect responses may be attributed to research from the late 1970's suggesting that the consumption of 75 grams of glucose 30 minutes before exercise accelerated the depletion of muscle glycogen while causing hypoglycemia and elevated insulin levels. Subsequent research has since contradicted these claims while others have shown enhanced performance when carbohydrates beverages were consumed one hour before exercise, especially if the athlete has fasted overnight (Rosenbloom, 2000). The overnight fast is responsible for the lowering of liver glycogen levels that are subsequently replenished by the carbohydrates or sweets ingested before exercise, providing the athlete with additional fuel and delaying the onset of fatigue (Manore & Thompson, 2000). Most

athletes can tolerate the consumption of sweets, even a candy bar, before exercise without any adverse effects (Clark, 1997).

Question #9- Protein is the primary source of energy for muscles.

More than 75% of CSUN athletes answered this question incorrectly, responding that protein is the main source of energy for the muscles. Conversely, in a study by Jacobson et al. (2001), protein was incorrectly identified as an immediate source of energy by only 21% of the athletes. Furthermore, nearly 54% of the athletes in the study by Rosenbloom et al. (2002) answered this question incorrectly. These findings further illustrate the need for nutrition education on clarifying the functions of protein. As noted earlier, the popularity of high protein diets and the aggressive marketing of protein products may be contributing to the athlete's infatuation with protein. It is estimated that protein contributes less than 5% of the body's energy needs when dietary requirements are met (Lemon, 1998). The consumption of protein above the recommended levels may be replacing carbohydrates or fats that are needed as the primary sources of energy. Unfortunately for the athlete, under these conditions, muscle protein will be used as a source of energy (American Dietetic Association, 2000). Therefore, the consumption of adequate carbohydrates will have a sparing effect on muscle protein during bouts of intense or prolonged exercise (Manore & Thompson, 2000).

Question #10- Vitamin and mineral supplements increase energy levels.

Nearly 93% of the CSUN athletes responded incorrectly to this question. Most of the athletes (63%) in the study by Rosenbloom et al. (2002) mistakenly believed that supplementation of vitamins and minerals would increase energy. In the study by Jacobson et al. (2002), roughly 30% responding incorrectly thinking that vitamins could

supply energy. The somewhat ambiguous wording of the question may have contributed to the low scores. Some athletes may have been aware that vitamins and minerals are not a direct source of energy but rather play an integral role as catalysts in the metabolic processes that produce energy. This line of reasoning could certainly support the claim that vitamin and mineral supplements assist in the production of energy, but any statement assuming a direct correlation between the intake of vitamin and mineral supplements and increased energy levels would be incorrect. “No evidence to date shows that vitamin supplementation improves athletic performance in people who are adequately nourished” (Clark, 1997, p.24).

Sources of Information

Nearly 29% of CSUN athletes had chosen “athletic trainer” as the source of most of their nutritional information. The selection of “athletic trainer” by nearly 29% of the CSUN athletes as the source of most nutritional information was in agreement with the findings of (1) the 40% reported in the study by Burns et al. (2004), and (2) the 22% reported in the research of Jacobson et al. (2002). The selection of “friends/teammates” (19.1%) and “family/parents” (16%) were the second and third top selections of the athletes. It should be noted that the selection of “family/parents” as a source of nutritional information was received as a write-in answer and was not listed as a category to be simply checked by the athlete. The percentage of athletes selecting “family/parent” as a source of information would in all likelihood been higher had the “family/parent” category been listed as a choice on the questionnaire. Parents were also selected as the top choice of nutrition information in the study Shifflet et al. (2002). It is recommended that “family/parent” be listed as a category in future studies.

The possibility exists that the athletes may be receiving inaccurate, misleading, or potentially dangerous information. Sources of nutritional information such as "family/parents," "friends/teammates," and "coaches" typically have limited nutrition education. Shifflett et al. (2002) found that scholastic coursework in the field of health and nutrition had a significant relationship in nutrition knowledge scores of athletic trainers, coaches, and athletes. Trainers who are required to take nutrition coursework demonstrated superior nutritional knowledge compared to that of coaches and athletes. Research found that the two top sources of information for the athletic trainers were academic journals and the nutrition faculty (Shiffett et al. 2002). In contrast, a study involving coaches from North Carolina found no correlation between nutrition knowledge and scholastic coursework in nutrition (Corley et al., 1990). Athletes perceived the information attained from athletic trainers to be reliable (Burns et al., 2004). Their ranking as the top source of nutrition information and their level of nutritional knowledge coupled with their daily contact and familiarity with the athletes make them a potential conduit for the future development and dissemination of nutritional materials. Interestingly, CSUN athletes that chose "classes" as the source of most of their nutritional knowledge had the highest knowledge scores, although the difference was not significant. Athletes who obtained most of their information from classes averaged a score of 6.0 compared to the mean of all athletes which was 3.9. Previous studies also cited higher knowledge scores for athletes taking nutrition related coursework (Barr, 1987; Zawila et al., 2003).

Topics of Interest

Athletes were asked to select topics that they were interested in learning more

about. They indicated a desire to learn about various "topics of interest" suggesting that the CSUN athletes would be receptive to the implementation of nutrition education programs. The topic selected the most by the athletes was "improved performance," which was of interest to 67% of the CSUN athletes. Improved performance is a common motivation of athletes (Cherundolo & Levine, 1999; Jacobson et al., 2001; Ludwig et al., 2005). It is suggested that nutritional counselors utilize this information when assessing the athlete's motivation and their counseling strategies. Interest in "recipe ideas" was the second most popular choice being chosen by 53% of the athletes, followed by "tips on eating out" (51%), "cooking tips" (47%), and "shopping tips" (39%). Interestingly, there was not a significant difference between male and female athletes for these topics which dealt mostly with the preparation of meals. However, a significant difference was found between males and females in their interest in "cooking demonstrations." Significantly more females (32.1%) than males (13.2%) indicated interest in this topic. The high percentage of male and female athletes wanting to learn about domestic skills may be correlated to the large percentage of athletes who are living on their own without the domestic skills necessary to prepare suitable meals on a daily basis. These findings suggest that domestic skills such as cooking and shopping be an integral part of nutritional information developed for the athletes.

Gender Differences

Significant differences in the concerns and attitudes of female athletes compared to male athletes were demonstrated in this study. The topic of "weight control" was of interest to 51.8% of the female athletes as opposed to 26.4% of the males. Similar discrepancies were found for the topic of "weight gain." More than half (56.6%) of the

males had selected “weight gain” as a topic that they wanted to learn more about as compared to only 7.1% of the females. Significant differences were indicated for the topic of “cooking demonstrations.”

Similar questions relating to body composition found significant differences between male and female athletes. High percentages of both males (84.6%) and females (83.9%) had goals for body composition. However, the personal goal of “gain muscle mass” was indicated by 73.8% of the male athletes as opposed to 17.4% of the females. A significantly higher percentage of females (67.4%) were more concerned with the goal of “decrease body fat” as compared to male athletes (16.7%). Furthermore, more males (35.3%) were “very satisfied” with their percentage of body fat as compared to females (16.4%). Batson et al. (2004) reported similar concerns among female athletes, finding that 70% wanted to lose weight while the majority of males were interested in weight gain. These finding, were also consistent with a study by Hinton et al. (2004), indicating that 62% of female athletes wanted to lose at least five lbs. Concerns regarding body composition may entice some athletes to contemplate the use of supplements or to alter their diet in order to achieve their personal goals. The high percentage of athletes with goals concerning body composition suggests that nutritional information regarding the altering of body composition would be a welcomed addition to the education materials developed for the athletes.

Significant differences between males and females were also exhibited in the perceived adequacy of their dietary intake. Significantly more males (40%) perceived their diets to be adequate as compared to 18.2% of the females. When asked to describe their “eating habits,” no significant differences were found. However, more females

(16.1%) listed their habits as “poor” as compared to males (5.7%). Additionally, males (41.2%) were significantly more satisfied with their cardiovascular conditioning than females (18.2%).

The gender differences related to body composition goals, adequacy of diet, eating habits, and cardiovascular conditioning were determined by the self-reported perceptions of the athletes. The questions only measured the perception of the athlete. The adequacy of the athlete’s diets, body composition, and their cardiovascular fitness levels were not measured as part of this study. Further studies are needed to determine whether there is a correlation between the perceived and actual measures of body composition, dietary intake, and fitness levels.

Significant differences also existed when comparing the number of times that males and females went out to eat. Males dined away from home 5.3 times per week as compared to 3.4 times per week for the females. Hinton et al. (2004) produced a similar finding, noting that males were likely to eat away from home. The question was not designed to determine the reasons for this discrepancy. These findings could impact the dietary intake of males. Studies have shown that eating out is related to the consumption of increased calories, total fat, and saturated fat (Hinton et al., 2004). Not only did males eat out more often, but they also consumed significantly more meals per day than the female athletes. Males consumed 3.2 meals per day, while the females managed to eat 2.7 meals per day. The amount of snacks eaten each day by the athletes was not significantly different with meals consuming 2.3 snacks per day compared to 2.7 by the females. The general eating pattern of CSUN athletes consists of the consumption of approximately 5 meals or snacks per day. The recommendation of eating smaller more frequent meals

during the day is considered an advantage to the athlete whose hectic training schedule often doesn't allow sufficient time for the full digestion of meals before exercise (Clark, 1997).

Eating out

Results regarding the eating establishments chosen most frequently by the athletes can aid in the development of nutritional information. Valuable information is obtained regarding the likes and dislikes of the athletes, even though their choices were undoubtedly influenced by the proximity of the eating establishment. The number one choice of Subway® (43.2%) was likely due to its location on the CSUN campus. The top choice of Subway® was followed by Chipotle® and McDonald's®. Education materials can be developed informing the athlete of the better menu selections of these popular eating establishments. Management of these popular places may also be persuaded to prepare menu selections designed specifically to the needs of the athlete. Athletes can also be instructed as to the best food choices, and according for the principles of meal timing.

The types of foods enjoyed most by the athletes were determined to be "fast food/hamburger" selected by 67% of the athletes, followed by "Mexican" (57.7%), "sandwich shop" (51.3%), and "Chinese" (22%). Knowledge of the types of foods enjoyed by the athletes can assist nutrition educators in the designing of recipe ideas, shopping tips, cooking demonstrations, grocery store tours, and developing tips for eating out.

Avoidance of Foods

Much of the information in relation to the type of foods avoided by the athletes

can be construed as positive. However, definitive statements regarding the possible benefits of avoiding certain foods cannot be made without a comprehensive dietary analysis of the athlete. Positive implications can be applied to the low percentage of athletes avoiding fruits (0.0%) and vegetables (4.6%), considering they are excellent sources of vitamins, minerals, and fiber. Low percentages of avoidance were shown for breads (6.4%) and grains (2.8%). Fortunately, the message to avoid these foods by the advocates of the low carbohydrate diets has been largely ignored by the CSUN athlete. This is encouraging due to the importance of carbohydrates in the diet of athletes. The relatively low avoidance percentages of fish (11.9%), red meat (10.1%), and dairy (2.8%) can also be viewed as positive since they are excellent sources of protein, essential fats, iron, and calcium. The athlete's high avoidance percentage of alcohol (47.7%), fast foods (33.0%), and fried foods (26.6%) can generally be considered advantageous to the health of the athletes. Future research involving the dietary intake of the athletes is needed to ascertain whether these foods were successfully avoided or if athletes were inclined to give socially desirable answers.

Supplement Use

Vitamin or mineral supplements were taken on a daily basis by 17.9% of the CSUN athletes. An additional 37.7% took vitamin or mineral supplements but not on daily basis. These percentages were consistent with a study by Cherundolo and Levine (1999), who found 45% usage of vitamin and mineral supplements among the athletes surveyed, Krumbach et al. (1999), finding usage to be 56.7%, and Herbold et al. (2004), who found a 36% usage. These findings are in contrast with a study by Jacobsen et al. (2001), who found vitamin and mineral usage at only 18%. Misconceptions regarding the

functions of vitamin and minerals were found in this and other studies (Jacobson et al., 2001; Rosenbloom et al., 2002). Research has not suggested evidence to support the general use of vitamin and mineral supplements for athletes (Singh et al., 1992). However, supplementation with vitamins and minerals may improve athletic performance for those with deficiencies (Clark, 1997). Future research pertaining to the dietary intake of CSUN athletes will provide a better understanding of their nutritional status and the potential effectiveness of vitamin and mineral supplementation.

In this study, supplementation with "sports products" or "nutritional supplements" was evaluated separately from vitamins and minerals. Comparisons with other studies are difficult because many studies included vitamins and minerals in the grouping of nutritional supplements. Other studies didn't consider "sports drinks" or "energy bars" as nutritional supplements, further complicating the ability to compare studies. Nevertheless, the use of nutritional supplements is reported as high in most studies (Burns et al., 2004; Cherundolo & Levine, 1999; Herbold et al., 2004; Jacobson et al., 2001; Krumbach et al., 1999). Approximately 75% of the CSUN athletes indicated that they used "sports products" or "nutritional supplements," with the majority (66.0%) of the athletes indicating that their usage was not on a daily basis. Recorded usage for sports drinks (91.4%) and energy bars (60.5%) were the top choices of the CSUN athletes. There were no significant differences when comparing male and female athletes. The use of sports drinks was similarly high according to a study by Cherundolo and Levine (1999) and Herbold et al. However, Jacobson et al. reported usage at only 28% for drinks containing carbohydrate or electrolytes combined. Significant differences did exist between male and female athletes CSUN athletes for the usage of "protein powder,

drinks, or amino acids," "high-protein meal replacement drinks," and "creatine." Forty-one percent of male athletes consumed "protein powder, drinks, or amino acids," as compared to 11.9% of the females. More males (23.1%) than females (7.1%) used "high protein meal replacement drinks." These findings were in contrast to Herbold et al. who found only 12% of the athletes used amino acid/protein supplements. Creatine use among CSUN male athletes was at 10.3% compared to 0.0% usage by females. It was found that 100% of the men's baseball team had reported using creatine along with 33.3% of the men's volleyball team, and 16.7% of the men's track and field squad. Creatine usage was reported at 27% in a study by Cherundolo and Levine and 31.4% by Burns et al. In a study by Jacobson et al. (2001), men were significantly more likely to use creatine than women, who found that creatine was used by 38.9% of the males as compared to 9.8% of the females. Usage of creatine by baseball and football players was significantly higher than other sports (Jacobson et al.). Some studies have shown creatine to have a positive effect on high intensity intermittent exercise but the effects of long term use have not been studied (Rosenbloom, 2000). Researching the most current literature for creatine and other supplements is recommended as part of the process of developing nutritional information for the CSUN athletes. A high percentage of athletes have report the goal of improved performance as the reason they tried supplements (Cherundolo & Levine; Krumbach et al.). Nutrition educators can assist athletes in determining which supplements are beneficial and which are ineffective, banned, or potentially dangerous.

Conclusion and Recommendations

The purpose of this study was to assess the nutritional knowledge, concerns, and behaviors of the CSUN varsity athletes. These findings provide a foundation for the

development of nutrition education materials to be used to enhance the nutritional knowledge and ultimately improve the dietary intake of the CSUN varsity athlete. These findings may also serve as a catalyst for further research providing nutrition educators with a fuller understanding of the dietary needs of CSUN athletes.

The findings of the present study suggest that the need for the development of nutritional information for the CSUN athlete is warranted. The nutritional knowledge of the athletes was shown to be inadequate, particularly in relation to the role of protein in the diet and the principles of meal timing, and the functions of vitamins and minerals.

A large majority of athletes were found to have personal goals relating to body composition. Females were concerned with the loss or control of weight and the male athlete's concerns were related to muscle gain. Gender differences emerged in regard to supplement use, eating behaviors, and the perceived adequacies of their dietary intake. These differences need to be taken into consideration in the development of nutritional information.

CSUN athletes were shown to have high interest levels in many health related topics, especially concerning athletic performance and domestic skills related to meal preparation. It is recommended that these topics be emphasized in the educational process.

Further research is recommended to determine the dietary intake of the athletes. Dietary analyses can add to these findings and provide a more comprehensive evaluation of the diet of the athletes and would be beneficial in determining the necessity of nutritional supplementation. Additional research is warranted to evaluate the correlation between nutritional knowledge and actual dietary intake. Provisions should be made to

ascertain whether the anticipated increase in nutrition knowledge will have a positive impact on the athlete's dietary behavior.

Determining barriers to change would also add to the body of knowledge needed to successfully intervene in the dietary choices of athletes. The development of nutrition information can be better formulated if the barriers of change can be identified. An athlete's quest to consume an improved diet may be hampered by a variety of obstacles including a lack of knowledge, time, money, domestic skills, or a combination of these or others barriers. Developing research to explore potential barriers to change is recommended.

Research is also needed to determine the proper means for the dissemination of the nutritional information. Various methods of instruction have been utilized by other institutions such as newsletters, pamphlets, posters, brochures, lectures, and individual counseling. The effectiveness of various methods needs to be analyzed to determine their suitability for the conditions specific to CSUN.

Findings from this and other studies (Burns et al., 2004; Jacobson et al., 2001; Smith-Rockwell et al., 2001; Zawila et al., 2003) suggest that the dissemination of information be a combined effort involving athletic trainers and coaches. Athletic trainers are currently the number one source of nutritional information for the CSUN athlete. The rapport that they have established with the athletes can be utilized by nutrition educators. Athletic trainers should be looked upon as a valuable means of determining the concerns of the athletes and a valuable asset in the development of nutritional information. It is also recommended that nutritional information be developed specifically for the athletic trainers to better enable them to support the dietary concerns of the athletes.

It is recommended that the athletes' parents be involved in the educational process. This study indicates that many athletes rely on their parents as source of nutritional information. Nutritional information materials (e.g., newsletters) can be developed specifically for the parents, giving them the tools to better communicate proper nutritional information to the athlete.

Future research is needed to further evaluate the positive correlation that was found between "classes" as a source of nutritional information and nutrition knowledge scores. This study as well as others have shown improved nutritional knowledge scores for those having completed a nutrition based class (Barr, 1987; Jacobson et al., 2001; Zawila et al., 2003). The validation of these findings could lead to the justification of curriculum changes for the purpose of making a nutrition based class a required course for student athletes.

The findings from this study, coupled with the information gained from past research, can serve as the foundation on which to build and develop nutritional information for the CSUN athlete.

REFERENCES

2001-02 NCAA Division I Manual. Retrieved April 6, 2006, from http://www.ncaa.org/library

Abood, D. A., Black, D. R., & Birnbaum, R. D. (2004). Nutrition education intervention for college female athletes. *Journal of Nutrition Education & Behavior, 36*(3), 135-137.

American Dietetic Association. (2000). 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, 100*(12), 1543-1556.

Barr, S. I. (1987). Nutrition knowledge of female varsity athletes and university students. *Journal of the American Dietetic Association, 87*(12), 1660-1664.

Barr, S. I. (1999). Effects of dehydration on exercise performance. *Canadian Journal of Applied Physiology, 24*(2), 164-172.

Bass, S., Daly, R., & Caine, D. (2002). Intense training in elite female athletes: Evidence of reduced growth and delayed maturation? *British Journal of Sports Medicine, 36*(4), 310.

Batson, J. P., Sease, T., Stanek, M., & Leski, M. J. (2004). Sports nutrition in collegiate athletes. *Medicine & Science in Sports & Exercise, 36*(5), S348.

Below, P. R., Mora-Rodriguez, R., Gonzalez-Alonso, J., & Coyle, E. F. (1995). Fluid and carbohydrate ingestion independently improve performance during one hour of intense exercise. *Medicine & Science in Sports & Exercise, 27*(2), 200-210.

Brooks, G. A., & Mercier, J. (1994). Balance of carbohydrate and lipid utilization during

exercise: the "crossover" concept. *Journal of Applied Physiology, 76*(6), 2253-2261.

Burns, R. D., Schiller, M. R., Merrick, M. A., & Wolf, K. N. (2004). Intercollegiate student athlete use of nutritional supplements and the role of athletic trainers and dietitians in nutrition counseling. *Journal of the American Dietetic Association, 104*(2), 246-249.

Casa, D. J., Armstrong, L. E., Hillman, S. K., Montain, S. J., Reiff, R. V., Rich, B. S., et al. (2000). National Athletic Trainers' Association position statement: Fluid replacement for athletes. *Journal of Athletic Training, 35*(2), 212-224.

Chapman, P., Toma, R. B., Tuveson, R. V., & Jacob, M. (1997). Nutrition knowledge among adolescent high school female athletes. *Adolescence, 32*(126), 437-446.

Cherundolo, L. A., & Levine, A. M. (1999). Knowledge, attitudes, and use of dietary supplements in collegiate division hi student athletes. *Journal of the American Dietetic Association, 99*(9S), A39.

Clark, K. (1994). Working with college athletes, coaches, and trainers at a major university. *International Journal of Sport Nutrition, 4*(2), 135-141.

Clark, M., Reed, D. B., Crouse, S. F., & Armstrong, R. B. (2003). Pre- and post-season dietary intake, body composition, and performance indices of NCAA division I female soccer players. *International Journal of Sport Nutrition and Exercise Metabolism, 13*(3), 303-319.

Clark, N. (1997). *Nancy Clark's sports nutrition guidebook* (2nd ed.). Champaign, IL: Human Kinetics.

Convertino, V. A., Armstrong, L. E., Coyle, E. F., Mack, G. W., Sawka, M. N., Senay, L.

C., Jr., et al. (1996). American College of Sports Medicine position stand. Exercise and fluid replacement. *Medicine & Science in Sports & Exercise, 28*(1), i-vii.

Corley, G., Demarest-Litchford, M., & Bazzarre, T. L. (1990). Nutrition knowledge and dietary practices of college coaches. *Journal of the American Dietetic Association, 90*(5), 705-709.

Dueck, C. A., Manore, M. M., & Matt, K. S. (1996). Role of energy balance in athletic menstrual dysfunction. *International Journal of Sport Nutrition, 6*(2), 165-190.

Earnest, C. (2002). Preventing nutritional disorders in athletes: Focus on the basics. *Current Sports Medicine Reports, 1*(3), 172-178.

Fox, M. (2004). *Nutrition knowledge, behavior and attitude of division I track and field athletes,* from http://cehs07.unl.edu/cehsabstracts/

Han-Markey, T. L., Elve, S., & Sutton, M. (1998). Total student-athlete development (TSAD): A partnership between health services, athletics, and the coordinated program (CU) in dietetics. *Journal of the American Dietetic Associatio, 98*(9S), A81.

Haymes, E. M. (1991). Vitamin and mineral supplementation to athletes. *International Journal of Sport Nutrition, 1*(2), 146-169.

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.

Heredeen. (1999). Nutrition knowledge of college football lineman: implications for nutrition education. *Journal of the American Dietetic Association, 99*(9S), A38.

Hinton, P. S., Sanford, T. C., Davidson, M. M., Yakushko, O. F., & Beck, N. C. (2004). Nutrient intakes and dietary behaviors of male and female collegiate athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 14*(4), 389-405.

Jacobson, B. H., Sobonya, C., & Ransone, J. (2001). Nutrition practices and knowledge of college varsity athletes: A follow-up. *The Journal of Strength and Conditioning Research, 15*(1), 63-68.

Kaiser, A. S., & Kunkel, M. E. (1996). Nutrition knowledge and attitudes of former university athletes. *Journal of the American Dietetic Association, 96*(9S), A86.

Keller-Grubbs, G. A., Landis, W., Lowe, J., & Finn, A. (1994). Differences in nutrition knowledge and dietary intake among female runners upon completion of a nutrition education program. *Journal of the American Dietetic Association, 94*(9S), A86.

Krumbach, C. J., Ellis, D. R., & Driskell, J. A. (1999). A report of vitamin and mineral supplement use among university athletes in a division I institution. *International Journal of Sport Nutrition, 9*(4), 416-425.

Kunkel, M. E., Bell, L. B., & Luccia, B. H. (2001). Peer nutrition education program to improve nutrition knowledge of female collegiate athletes. *Journal of Nutrition Education, 33*(2), 114-115.

Lemon, P. W. (1998). Effects of exercise on dietary protein requirements. *International Journal of Sport Nutrition, 8*(4), 426-447.

Ludwig, K. A., Wieman, C. M., Anding, R. H., & Moreland, K. (2005). Athletic scholarship and sports competition anxiety as predictors of nutritional ergogenic

aid use in athletes. *Journal of the American Dietetic Association, 105*(8), 62.

Mandali. (2005). Perceived knowledge of protein and vitamin nutrition among female student athletes in a division II university. *Journal of the American Dietetic Association, 105*(8), 62.

Manore, M., & Thompson, J. (2000). *Sport nutrition for health and performance*. Champaign, IL: Human Kinetics.

Maughan, R. (2002). The athlete's diet: nutritional goals and dietary strategies. *Proceedings of the Nutrition Society, 61*(1), 87-96.

McArdle, W. D., Katch, F. I., & Katch, V. L. (1999). *Sports & exercise nutrition*. Philadelphia: Williams & Wilkins.

McReynolds, C. J., Cohen, J. W., Gambrell, K. M., & Dirks, K. R. (1993). Nutrition education with Texas A&M University athletes. *Journal of the American Dietetic Association, 93*(9S), A56.

Nichols, P. E., Jonnalagadda, S. S., Rosenbloom, C. A., & Trinkaus, M. (2005). Knowledge, attitudes, and behaviors regarding hydration and fluid replacement of collegiate athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 15*(5), 515-527.

Nieman, D. C., & Pedersen, B. K. (1999). Exercise and immune function: Recent developments. *Sports Medicine, 27*(2), 73-80.

Pedersen, B. K., Helge, J. W., Richter, E. A., Rohde, T., & Kiens, B. (2000). Training and natural immunity: Effects of diets rich in fat or carbohydrate. *European Journal of Applied Physiology, 82*(1-2), 98-102.

Perron, M., & Endres, J. (1985). Knowledge, attitudes, and dietary practices of female

athletes. *Journal of the American Dietetic Association, 85*(5), 573-576.

Porto, B. L. (2005, Fall 2005). Changing the game plan: A participation model of college sports. *Phi Kappa Phi Forum, 85*, 28-31.

Rosenbloom, C. A. (2000). *Sports nutrition : A guide for the professional working with active people* (3rd ed.). Chicago: The American Dietetic Association.

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.

Shattuck, D. (2001). Sports nutritionists fuel the competitive edge. *Journal of the American Dietetic Association, 101*(5), 517-518.

Sherman, W. M., Peden, M. C., & Wright, D. A. (1991). Carbohydrate feedings one hour before exercise improves cycling performance. *American Journal of Clinical Nutrition, 54*(5), 866-870.

Shifflett, B., Timm, C., & Kahanov, L. (2002). Understanding of athletes' nutritional needs among athletes, coaches, and athletic trainers. *Research Quarterly for Exercise and Sport, 73*(3), 357-362.

Singh, A., Moses, F. M., & Deuster, P. A. (1992). Chronic multivitamin-mineral supplementation does not enhance physical performance. *Medicine & Science in Sports & Exercise, 24*(6), 726-732.

Skolnick, A. A. (1993). Female athlete triad risk for women. *Journal of the American Medical Association, 270*(8), 921-923.

Sleamaker, R., & Browning, R. (1996). *Serious training for endurance athletes* (2nd ed.). Champaign, IL: Human Kinetics.

Smith-Rockwell, M., Nickols-Richardson, S. M., & Thye, F. W. (2001). Nutrition knowledge, opinions, and practices of coaches and athletic trainers at a division I university. *International Journal of Sport Nutrition and Exercise Metabolism, 11*(2), 174-185.

Stahmer, H. M., & Kratina, K. (1997). Development of a nutrition education program for athletes in a university setting. *Journal of the American Dietetic Association, 97*(9S).

Van de Loo, D. A., & Johnson, M. D. (1995). The young female athlete. *Clinical Sports. Medicined, 14*(3), 687-707.

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

Whitcombe, D. (1996). Relationship between nutrition knowledge and gender, ethnic background, and year in school in varsity athletes. *Journal of the American Dietetic Association, 96*(9S), A87.

Wiita, B. G., & Stombaugh, I. A. (1996). Nutrition knowledge, eating practices, and health of adolescent female runners: a 3-year longitudinal study. *International Journal of Sport Nutrition, 6*(4), 414-425.

Wiita, B. G., Stombaugh, I. A., & Buch, J. A. (1994). Nutrition knowledge and nutrient intakes of female high school and college runners. *Journal of the American Dietetic Association, 94*(9S), A89.

Wilber, R. L., & Moffatt, R. J. (1992). Influence of carbohydrate ingestion on blood glucose and performance in runners. *International Journal of Sport Nutrition, 2*(4), 317-327.

Yourdictionary.com. Retrieved April 6, 2006, from http://www.yourdictionary.com

Zawila, L. G., Steib, C. S., & Hoogenboom, B. (2003). The female collegiate cross-country runner: nutritional knowledge and attitudes. *Journal of Athletic Training, 38*(1), 67-74.

APPENDIX A

HUMAN SUBJECTS APPROVAL FORM

APPENDIX B

QUESTIONNAIRE

1. Gender: 1. ____Male 2. ____ Female

2. Age: _____

3. Sport: _____

4. Which one of the following best describes your ethnic background?
   1. ___ White/Caucasian
   2. ___ Hispanic
   3. ___ Black/African-American
   4. ___ Asian or Pacific Islander
   5. ___ other; please specify_____

5. What year in college are you? (check one)
   1. ____ freshman
   2. ____ sophomore
   3. ____ junior
   4. ____ senior
   5. ____ 5th year senior

6. Do you live on campus? 1. ____Yes 2. ____ No

7. With whom do you live? (check one)
   1. ____ with roommate(s)
   2. ____ with spouse or significant other
   3. ____ with parent(s) or relative
   4. ____ alone

8. How would you describe your eating habits? (check one)
   1. ____ good 2. ____ fair 3. ____ poor

9. How many times per week do you eat out? _____

10. When you go out to eat, what are the three most common places that you go?
    1. _____
    2. _____
    3. _____

11. Do you avoid any of the following foods? (check all that apply)
    1. ___ red meat
    2. ___ sweets (candy, desserts)
    3. ___ poultry (chicken, turkey)
    4. ___ alcohol
    5. ___ fish
    6. ___ dairy (milk, cheese)
    7. ___ fats/ oils (mayonnaise, butter, salad dressing)
    8. ___ fruits
    9. ___ vegetables
    10. ___ fried foods
    11. ___ fast foods
    12. ___ breads
    13. ___ grains (pasta, rice)

12. How many meals (e.g., breakfast, lunch, dinner) do you eat per day? _____

13. How many snacks (e.g., candy bars, sport bars, chips, piece of fruit) do you eat per day? _____

14. Do you frequently skip meals? 1. ____Yes 2. ____ No

15. Please put a check after the topics that you would like to learn more about.

1. nutrition programs for improved performance ____
2. weight control ____
3. weight gain____
4. shopping tips____
5. grocery store tour____
6. cooking tips ____
7. cooking demonstrations ____
8. recipe ideas____
9. tips on eating out ____
10. tips for reading the food label ____

Please list any additional topics that you would like to learn more about in the spaces below.
_____
_____
_____

16. Approximately how many cups (8 ounces = 1 cup) of water, juice, or sports drink do you drink **before** your workout? _____
17. Approximately how many cups of water, juice, or sports drink do you drink **during** your workout?_____

18. About how many cups of water, juice, or sports drink do you drink **after** your workout? _____

19. How easy or difficult is it for you to maintain your in-season weight? (check one)
1. ___ very easy 2. ___ somewhat easy 3. ___ somewhat difficult 4. ___ very difficult

20. Do you have any personal goals for body composition? 1. ____Yes 2. ____ No

If yes, please specify. (check one)
1. ___ gain lean mass/ gain weight
2. ___ decrease body fat / lose weight
3. ___ maintain current body weight

21. Please indicate whether you agree, disagree, or don't know, in regard to the following statements by placing a check in the appropriate column. Please do not guess. If you are not sure, check "Don't Know."

	Agree	Disagree	Don't Know
Carbohydrates and fats are the main source of energy for muscles.	*		
Eating carbohydrates is known to increase body fat.		*	
Sweets should not be eaten prior to an athletic event.		*	
Fluids should be replaced before, during, and after athletic events.	*		
Sports drinks are better than water for replacing lost fluids for workouts lasting less than one hour. (question omitted)			
Foods high in protein should be eaten prior to an athletic event.		*	
Protein is the primary source of energy for muscles.		*	
Meals high in fat should be consumed 2 to 3 hours before an athletic event.		*	
Athletes can rely on thirst to ensure fluid replacement during and after an athletic event.		*	

Protein supplements are needed in addition to diet for muscle growth and development.		*	
Vitamin and mineral supplements increase energy levels.		*	

* = correct response

22. Do you take vitamin or mineral supplements?
1. ___ Yes, daily 2. ___ Yes, but not every day 3. ___ No

23. Do you use any sports products or nutritional supplements?
1. ___Yes, daily 2. ___ Yes, but not every day 3. ___ No

If yes, please indicate the products or supplements that you use. (check all that apply)

1. ___ energy bars (e.g., Power Bar, Clif Bar)
2. ___ sports drinks (e.g., Gatorade, Powerade)
3. ___ high-protein meal replacement drinks (e.g., Met-Rx, Myoplex)
4. ___ liquid meals (e.g., Slim-Fast, Ensure)
5. ___ creatine
6. ___ weight-loss products/ fat burners
7. ___ protein powder, drinks, or amino acids
8.___ others (please list) _____
_____
_____

24. Do you think that your diet is nutritionally adequate? 1. ____ Yes 2. ____ No
3. ____Don't know

From what source(s) are you getting your nutritional information? Please check all that apply.
1. ____ magazines and the media
2. ____ coaches
3. ____ athletic trainers
4. ____ classes
5. ____ friends or teammates
6. ____ books
7. ____ other (please specify) _____

25. For the previous question, **circle** the source where you are getting most of your nutritional information.

26. Please rate your satisfaction with the following factors. (e.g., How satisfied are you with…)

	Very satisfied	Somewhat satisfied	Somewhat dissatisfied	Very dissatisfied
Your cardiovascular endurance				
Your muscular strength				
Your body fat percentage				

APPENDIX C

APPENDIX D

APPENDIX E