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Nutrition Knowledge and Attitudes Among Clemson University Student-Athletes

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NUTRITION KNOWLEDGE AND ATTITUDES AMONG CLEMSON UNIVERSITY STUDENT-ATHLETES

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ABSTRACT

Participants in this study were 95 Clemson University student-athletes who were currently on the varsity men's and women's soccer, tennis, track and field, and swimming and diving who completed a survey on nutrition knowledge and attitudes.

The mean total point score on the survey was 17.48 $\pm$ 1.71. The mean score on knowledge questions on the survey was 11.59 + 3.14 or 46.3%. Females had a slightly higher mean score (12.3+ 3.03 or 49.2%) than males (10.9 + 3.13 or 43.6%) on the knowledge questions. The mean score on attitude questions was 5.89+ 1.67 or 58.9%. Females had a slightly higher mean score (6.19 + 1.53 or 61.9%) than the males (5.60 + 1.76 or 56%) on the attitude questions. A multiple regression analysis for impact of sport, gender, class rank, previous nutrition course, and eating situation on total score on the survey gave an overall R^2 of 0.174 ($F= 3.75$, $p= 0.004$). There was no significant unique effect of class rank ($p = 0.084$), sport ($p= 0.079$), and eating situation ($p= 0.079$) for this model. The unique effect of gender ($p= 0.003$) and taking a nutrition course ($p= 0.036$) were statistically significant. Even though the proposed model was statistically significant, it did not adequately predict performance on the survey. The model predicted that females were to score 2.5 points higher on the survey than males and that those who reported taking a nutrition course in the past were to score 1.7 points lower than those who had not taken a nutrition course. This most likely reflects the relatively small number who reported having taken a nutrition course. Additional studies should include additional attitude questions and further define the role of nutrition education on knowledge and attitudes of student-athletes.

ACKNOWLEDGMENTS

I would like to express my sincere appreciation and thanks to the entire thesis committee for all of their time, assistance, interest, and expertise in this study and its findings. In addition special thanks are extended to Dr. Beth Kunkel for encouraging me and providing numerous hours of help without which I would never have been able to finish. Special thanks are also extended to Dr. Gail Delicio for all the time she spent helping me run and understand the statistics. Lastly special thanks are extended to my family and friends for their continuous support.

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CHAPTER ONE

REVIEW OF LITERATURE

The sports environment can heighten body and weight related concerns because of factors such as pressure from coaches, social comparisons with teammates, team weigh-ins, performance demands, revealing uniforms, and judging criteria. Many athletes and coaches believe that lowering body fat composition will result in enhanced athletic performance. It is also not uncommon for athletes to have little or no idea of what normal eating habits or balanced meals are. The purpose of this study is to determine if gender or sport plays a role in the eating attitude and nutritional knowledge of NCAA Division One student-athletes. Soccer, swimming and diving, basketball, track and field, and tennis student-athletes will participate in this study. The information obtained is important to athletic trainers, strength and conditioning coaches, sport coaches, and other exercise professionals who strive to safeguard participation and maximize performance of athletes. It could also be helpful to student-athletes to understand the role of nutrition in performance. This chapter will review the literature in the areas of nutritional guidelines, hydration guidelines, energy systems, nutritional problems, effects of hydration, and athlete body image and attitude towards weight and food.

Nutritional Guidelines

Nutrition is becoming more of a concern for the general population throughout our country as rates of obesity and chronic disease increase. More and more people are becoming aware of the correlation between eating and health. There are many programs

available to make people more aware of their food choices and ways to choose healthier options.

The Healthy Eating Index

The U.S. Department of Agriculture (USDA) created The Healthy Eating Index (HEI) to help consumers adopt a balanced eating plan. The USDA assigned foods to five major groups: fruits, vegetables, grains, meat and legumes, and milk. Daily recommendations that would allow an individual to meet nutrient needs in all food groups were provided. Based on a 2,000 kcal diet, 2 cups of fruit, 2.5 cups of vegetables, 6 ounces of grains, 5.5 ounces of meat and legumes, 3 cups of milk, and 6 teaspoons of oil should be consumed to meet HEI guidelines (Guenther et al., 2007).

MyPyramid

Over the years the pyramid symbol has been used to signify food groups and the number of servings per group needed in a day. MyPyramid was adopted by the USDA to provide people a visual aid for learning how to adjust their eating patterns. The pyramid uses multiple colors to represent the five different food groups and reinforce the need for variety. The five food groups are grains, vegetables, fruits, milk, and meat and beans. Oils are also given a small sliver on the pyramid to indicate they can be used in moderation. Based on a 2,000 kcal diet an individual would need to consume 2 cups of fruit, 2.5 cups of vegetables, 6 ounces of grains, 5.5 ounces of meat and legumes, and 3 cups of milk every day to maintain a balanced diet. MyPyramid is a guide not only to healthier eating but also a healthier lifestyle. The pyramid is three dimensional so it includes a staircase to remind people to be physically active on a daily basis. The

physical activity pyramid has four levels of activity, from the top of the pyramid the levels are as follows: do seldom- limit sedentary activities, 2-3 days/week- engage in strength and flexibility activities and enjoy leisure activities often, 4-6 days/week- engage in moderate or vigorous activities regularly, and every day- be as active as possible.

Energy Systems

The human body supports physical activity through three main energy systems. These three energy systems are the (1) ATP-PCr system, (2) glycolytic system (also referred to as the anaerobic glycolysis system), and (3) oxidative system (also referred to as the aerobic system) (Wilmore, Costill, & Kenney, 2008).

In order to sustain physical activity proper nutrition is required to provide adequate levels of carbohydrate and fat to use as fuel and of protein to maintain and build lean tissue, vitamins and minerals to support energy metabolism and tissue building, and water to distribute the fuels and to dissipate the resulting heat and wastes.

Adenosine triphosphate (ATP) is the substance used for energy in all cells. Only by breaking down ATP is energy released to power all forms of biological work including muscle contraction (Hultman, 1967). The energy in the food we eat is extracted and used to regenerate ATP. However, the body contains only approximately 3 ounces of ATP. This ATP can provide energy for a limited amount of time. Gladden (1989) stated that ATP can only assist a person in sustaining an all out sprint for a few seconds before a system for regenerating ATP is needed.

Anaerobic Energy Systems

Anaerobic energy is created without the use of oxygen. Instead, this system relies on the release of energy that has been stored within the body. There are two anaerobic energy systems used for short bursts of intense activity such as sprinting, jumping and cutting. These two anaerobic energy systems are the adenosine triphosphate-phosphocreatine (ATP-PCr) system or alactic system and the glycolytic system (also called anaerobic glycolysis or lactic system) (Gladden, 1989; Hultman, 1967; and Wilmore et al., 2008).

ATP-PCr Energy System

This system can be referred to as the immediate energy system because it is used for short duration and high intensity performances such as a serve in tennis. This system does not require or produce oxygen. Energy is provided almost completely from the high-energy phosphate compounds ATP and PCr stored within the specific muscles that are activated during the exercise (Bangsbo et al., 1991). According to Hultman (1967), there are approximately 5 millimoles (mmol) of ATP and 15 mmol of PCr stored within each kilogram of muscle. As ATP is broken down it produces energy and ADP. When the ADP is combined with PCr it regenerates ATP which can later be used for energy. This system is only active for a very short amount of time due to the body's inability to store significant quantities of ATP and PCr.

Glycolytic System (Anaerobic Glycolysis Energy System)

The glycolytic system, often referred to as the anaerobic glycolysis system, is also known as the short-term energy system or lactic acid system. As with the ATP-PCr System, oxygen is not necessary for this system to operate. Glycogen, which is stored in

the skeletal muscles and liver, is the primary fuel source for the glycolytic system (Bangsbo et al., 1990). While this system provides a rapidly accessible form of energy it is not immediately activated. As the ATP-PCr system is depleted, the body begins to metabolize glycogen and form energy through this second anaerobic mechanism.

In order to continue to exercise at an intense level which goes beyond the brief period sustained primarily by the ATP-PCr system, ATP must be continually regenerated at a rapid rate to maintain performance. During intense bouts of exercise, the energy necessary to phosphorylate ADP in the skeletal muscle comes primarily from stored muscle glycogen through the anaerobic glycolysis system (Hultman, 1967). An advantage of this energy system is its ability to facilitate the rapid formation of ATP in the absence of oxygen and provide energy for activities lasting up to two minutes (Wilmore et al., 2008). A problem associated with the generation of energy through this system is the significant amount of lactic acid which is formed as a by-product. According to Wilmore et al. (2008),

> "lactic acid inhibits further glycogen breakdown because it impairs glycolytic enzyme function. In addition, the acid decreases the muscle fibers' calcium binding ability and thus may impede muscle contraction" (p. 53).

The glycolytic system performs the critical role of rapidly supplying energy beyond the available stored high-energy phosphates (Bangsbo et al., 1990). Because the glycolytic system and ATP-PCr system can only sustain activity of an intense nature for several minutes, a third energy system is necessary.

Oxidative System

The oxidative system, or aerobic energy system, is the long-term energy system for the human body. It is incapable of providing energy for activities that are of short duration and high intensity. Coggan et al. (1990) state that although glycolysis is rapid and requires no oxygen for producing energy, very little ATP is resynthesized. Therefore, it becomes necessary to turn to the oxidative system for activities of longer duration. Energy produced via the aerobic energy system is created by using oxygen to help metabolize the various food stores; carbohydrates, fatty acids and amino acids.

According to Wilmore et al. (2008), the oxidative system has the potential to generate 37 to 39 molecules of ATP for each molecule of muscle glycogen metabolized. In comparison, the glycolytic system has the capacity to create 2 or 3 ATP molecules for each molecule of glycogen metabolized (Wilmore et al., 2008). In short, the oxidative system has the capacity to create large amounts of energy and maintain physical activity for hours. Hickson et al. (1978) state that endurance events rely almost completely on aerobic metabolism because depletion of this system takes a longer amount of time.

Nutrient Use During Physical Activity

Physical activity requires carbohydrates and fats as fuel, protein to build and maintain lean tissues, vitamins and minerals to support both energy metabolism and tissue building, and water to help distribute the fuels and to dissipate the resulting heat and wastes. During intense activities the fuel mix used within the body is mostly glucose. During less intense or moderate activities the body will rely more on fat for fuel (Whitney & Rolfes, 2008).

Glucose

During physical activity the liver breaks down its glycogen and releases glucose into the bloodstream. The muscles use this glucose as well as their own glycogen stores to fuel activity. Glycogen supplies can easily support everyday activities but are limited to less than 2000 kcalories of energy, which is enough for approximately 20 miles of running (Whitney & Rolfes, 2008). When the muscles become depleted of glycogen they fatigue and limit the amount of physical activity an individual can complete. There are many factors that can influence the amount of glycogen the body stores. An individual's diet can affect the amount of glycogen stored. In one study runners were given one of three diets in order to compare a diet's effect on endurance. The runners fed a high carbohydrate diet were able to maintain strenuous activity far longer than the runners fed a high fat and protein diet (Tarnopolsky et al., 1995). The intensity of the physical activity will also factor into how long an individual's glycogen will last. The more intense the activity the quicker the glycogen will be depleted from the muscles. Another factor that can affect the use of glycogen is the duration of activity. Within the first 20 minutes of exercise an individual uses primarily glycogen for fuel. As the muscles use their own glycogen and start to demand more the liver will begin to breakdown its glycogen. After 20 minutes of moderate activity the individual will start to use less glycogen and start to utilize fat in addition to glycogen for fuel. If activity lasts long enough, glucose can be depleted (Tarnopolsky et al., 1995).

Fat

The body's fat stores can usually provide more than 70,000 kcalories and fuel hours of activity without being depleted (Whitney & Rolfes, 2008). During physical

activity fatty acids are taken from the internal fat stores (Jeukendrup et al., 1998). At the start of physical activity the fat level within the blood drops. As the activity continues for a few minutes epinephrine signals the fat cells to begin breaking down their stores of triglycerides and liberating fatty acids into the blood (Jeukendrup et al., 1998). After 20 minutes of activity the body starts to use fat stores as its major fuel. As the intensity of an activity increases fat use steadily decreases. The reason for this is fat needs to be aerobically metabolized (Whitney & Rolfes, 2008). Therefore if an individual is breathing heavily oxygen is not abundantly available making it harder to use more fat as fuel. Training is another factor that can affect an individual's ability to utilize fat as a primary fuel source. Individuals who are aerobically trained have produced adaptations that allow the body to draw more heavily on fat as a source of fuel as a result of increased ability of the heart and lungs to deliver oxygen to muscles during activity. Sports nutrition experts recommend that endurance athletes consume 20 to 30 percent of their energy from fat to meet nutrient and energy needs (Jeukendrup et al., 1998).

Protein

Protein is the third fuel source for the body during physical activity. However, protein is mainly used to build muscle and other lean tissues. Athletes retain more protein in their muscles and have the ability to use more protein as fuel than sedentary individuals. Muscles will increase their use of amino acids for energy during physical activity, however; protein still only contributes about 10 percent of the total fuel used both during rest and during activity (Whitney & Rolfes, 2008). The factors that affect the use of protein during physical activity are the same factors affecting the other fuel

sources. Individuals who consume diets adequate in energy and rich in carbohydrate will use less protein than those who eat diets rich in protein and fat. The reason for this is that carbohydrates spare proteins from being broken down to make glucose when needed. Physical activity requires glucose, therefore, a diet lacking in carbohydrate necessitates the conversion of amino acids to glucose. The intensity and duration of activity also affect the utilization of protein (Tipton & Wolfe, 2005). An endurance athlete training more than an hour a day has the ability to deplete glycogen stores by the end of a workout session. When this occurs the athlete will become more dependent on body protein for energy. During training, aerobic athletes are not using more protein as an energy source but instead using protein to build muscle. This shows that athletes do have an increased demand for protein, however, not nearly as much protein as the amount consumed by many athletes. As individuals train and their bodies slowly adapt to physical activity, whether it is endurance or strength training, their bodies start to use less protein during activity (Tipton & Wolfe, 2005).

The DRI committee does not recommend increased protein intakes for athletes (Dietary, 2009). The RDA for protein for adults is 0.8 g/kg/day (Dietary, 2009). The recommendation for a power (speed or strength) athlete is between 1.6- 1.7 g/kg/day (Nutrition, 2000). The recommendation for an endurance athlete is between 1.2-1.6 g/kg/day (Nutrition, 2000).

The Female Athlete Triad

One of the most common issues associated with athletes and their nutritional behavior is the female athlete triad. The female athlete triad consists of disordered

eating, amenorrhea, and osteoporosis. The female triad is caused by an energy deficit, in which poor eating habits or unhealthy eating practices make it impossible to meet the caloric needs of strenuous exercise in order to maintain optimal health and performance (Shimon, 2006). When there is a constant energy drain on body fat because of disordered eating patterns, eventually the menstrual cycle is disrupted (Shimon, 2006). A prolonged absence of menstruation lowers estrogen levels and reduces bone mass, which can lead to an increase of fractures, skeletal fragility, and verbally instability (Shimon, 2006). The female triad does not need to demonstrate all three aspects to be considered a threat to an individual's health and general well being.

Disordered Eating

Energy restriction is common in sport, and for many athletes it is necessary to achieve the sport specific body weight and composition that result in optimal performance (Loucks & Nattiv, 2005). When female athletes start to emphasize the importance of fat loss, they consume 30% less energy per unit of body weight than male athletes (Loucks & Nattiv, 2005).

The female triad does not designate one specific eating disorder such as anorexia nervosa or bulimia but rather includes a wide range of disordered eating behaviors which at its extremes includes anorexia nervosa, bulimia, and compulsive over-eating (Burney & Brehm, 1998). The athlete's eating pattern may begin with typical dieting behavior such as limiting caloric intake, occasionally skipping meals, and possibly using diet pills. However, it may then progress into compulsive abnormal behavior which will result in a clinically significant eating disorder (Burney & Brehm, 1998). Some of the medical

complications associated with disordered eating include depleted glycogen stores, decreased lean body mass, chronic fatigue, micronutrient deficiencies, dehydration, anemia, electrolyte and acid-base imbalances, gastrointestinal disorders, parotid gland enlargement, decreased bone density, and erosion of tooth enamel (Beals et al., 1999). There are also some psychological problems that have a tendency to accompany disordered eating which include decreased self-esteem, anxiety, depression, and death due to suicide (Beals et al., 1999).

The rate of disordered eating, including dietary restriction and purgative behaviors, in female athletes may be as high as 62% (Burney & Brehm, 1998). This rate is much higher than the estimated prevalence of 1-3% in the general population. (Kirchner & Cohen, 2002). Even though there is an increased prevalence of eating disorders among the athletic population, up to 50% of the cases may remain clinically undetected (Kirchner & Cohen, 2002).

The main risk factors that have been implicated in contributing to the development of disordered eating include societal pressures to be thin; chronic dieting; low self-esteem; family dysfunction; physical or sexual abuse; participation in sports that emphasize a low body weight or particular body shape; participation in individual sports; participation at an elite or highly competitive level; and traumatic life events such as illness or injury, a coach change, or relationship problem (Beals et al., 1999). Some of the potential warning signs of disordered eating include ritualized eating, food restriction, obsessive training, or other compulsive behavior (Kirchner & Cohen, 2002).

Amenorrhea

The standard definition of amenorrhea is the absence of a menstrual cycle for at least six consecutive months. Amenorrhea can refer to females who have started their menstrual cycle and then lost it for a period of time or it can be the delay of onset of menstruation. If a female reaches 16 years of age within beginning menstrual cycles, it is referred to as primary amenorrhea or delayed menarche (Beals et al., 1999).

About 2 to 5% of women in the general population have amenorrhea. However, within athletes the range is 3.4 to 66% (Burney & Brehm, 1998). The highest frequency of amenorrhea is among ballet dancers and runners (Kirchner & Cohen, 2002), with 65% of the runners on one team experiencing amenorrhea (Loucks & Nattiv, 2005).

Many factors can cause amenorrhea. Amenorrhea may be explained by the energy availability theory which states that, when the central nervous system detects that dietary energy intake is not sufficient to support both exercise and other physiologic functions; it reduces energy expenditure by suppressing reproductive function (Kirchner & Cohen, 2002). Other factors include strenuous training, low body fat, low body weight, genetic predisposition, pregnancy, psychological or emotional stress, and eating disorders (Burney & Brehm, 1998). The absence of a regular menstrual cycle is abnormal and unhealthy no matter the etiology.

There are some physicians who believe that amenorrhea is the body's normal training response in the female athlete and should not be a cause for concern. However, amenorrhea is a serious disorder because it may increase risk of osteoporosis (Burney & Brehm, 1998).

Osteoporosis

Female athletes who are experiencing amenorrhea have decreased estrogen levels which may lead to premature osteoporosis (Burney & Brehm, 1998). This type of osteoporosis is characterized by low bone mineral density; microarchitectural deterioration; increased skeletal fragility; and increased risk of minimal trauma fractures to the extremities, hips, and spine (Beals et al., 1999).

Bone mineral density loss as a result of amenorrhea may be completely or at least partly irreversible even with calcium supplementation, resumption of menses, and estrogen replacement therapy (Beals et al., 1999). Athletes who receive no treatments may have bone density equal to that of women in their 50's while still in their 20's (Burney & Brehm, 1998). Bone loss in an amenorrheic athlete is rapid and may not be reversible, which makes it very important for these athletes to understand they may be permanently impacting their skeletal structure (Burney & Brehm, 1998). Lumbar bone density in amenorrheic athletes was 14% less than that of eumenorrheic athletes and 27% less than that of sedentary women with normal cycles (Kirchner & Cohen, 2002). Mudd et al. (2007) found Division I varsity female runners, swimmers, and divers demonstrated some deficits in site specific bone mineral density compared to student-athletes in other sports. Of the 99 women who participated in their study, 23 were amenorrheic (Mudd et al., 2007). Runners had the lowest total body and site specific bone mineral density at all sites except the legs when compared with gymnasts and softball players. Swimmers and divers had significantly lower leg bone mineral density than athletes in every other sport except for runners (Mudd et al., 2007). The conclusion

that can be drawn from this study is that runners, swimmers and divers may be more susceptible to stress fractures than athletes in other sports.

Knowledge and Behavior

While much is known about the science of exercise and of nutrition, having that knowledge does not always impact behavior. Nelson et al. (2009) found that nutrition knowledge was positively associated with moderate physical activity and negatively associated with television viewing Nelson et al (2009) also found parental knowledge of nutrition was an overall predictor of adolescent knowledge. Clifford et al. (2009) found that even though participants in their study gained knowledge about nutrition and food by watching a television show their new knowledge had very little impact on dietary behaviors. Driskell et al. (2008) found that, after reading given nutrition labels for foods in the dining halls, 12% of women and 80% of men changed their food choices. When eating outside the dining hall 23% of women and 65% of men would change their food choices after reading the nutrition label (Driskell et al., 2008). The main reasons for reading nutrition labels were looking for the serving size, ingredients, or amounts of protein (Driskell et al., 2008). Ares et al. (2008) found that there might be a need for health claims to be placed on labels so consumers who lack nutritional knowledge are aware of the health benefits of specific foods. Even though various types of interventions have been able to improve the nutritional knowledge base, there is little evidence the knowledge is being used. Weijzen et al (2008) found a substantial discrepancy between healthful intentions and actual snack choice. In a study of athletes looking at college baseball players it was found that athletes' daily schedule and their perception of the

impact of a healthful diet on their focus and concentration had the biggest impact on intention to eat healthful food (Pawlak et al, 2009). There are many factors that influence decision making, especially in food behavior, so no single theory is able to fully explain eating behavior (Sobal & Bisogni, 2009).

Athlete Nutrition Knowledge

Many athletes adopt rigid training diets that predispose them to undernutrition, fatigue, and injury (Quatromoni, 2008). In many cases athletes who adopt rigid training diets find themselves under fueled, preoccupied with thoughts about food, and compromised in their athletic performance (Quatromoni, 2008). Though there appears to be increased interest in and availability of nutrition education, it is unclear if athletes are more knowledgeable about the role of nutrition on athletic performance (Rosenbloom et al., 2002). It is not uncommon for athletes to have misinformed beliefs about their nutritional needs (Quatromoni, 2008). Athletes value, seek, and participate in nutrition services that guide healthful eating and healthful weight control when available (Quatromoni, 2008). Nutritional intervention with athletes can increase nutrition knowledge and create positive dietary changes in the athletes who undergo the intervention (Abood et al., 2004). Frederick and Hawkins (1992) studied the nutritional knowledge and attitudes, dietary practices, and bone densities of four groups of women: postmenopausal women, college-aged dancers, college track athletes, and non athletic college women. They reported that the nonathletic group had a higher mean knowledge score than the track team members or the dancers. There was no significant difference in attitude scores among the groups (Frederick & Hawkins, 1992). Athletes are also prone

to misunderstandings regarding nutrition. Many athletes believe vitamin supplements are needed to improve performance and provide energy, protein supplements are necessary to build muscle, and protein is the primary energy source for muscle (Rosenbloom et al., 2002). Smart and Bisogni (2001) interviewed collegiate hockey players to determine influences on food choices. These athletes viewed low-fat foods as healthy and water and juice as healthier choices than caffeine-containing or carbonated beverages (Smart & Bisogni, 2001). Food choices were also influenced by phases of their season. During the off-season, athletes tend to worry less about nutrition than during their season because of the effect of nutrition on their athletic performance (Smart & Bisogni, 2001).

Rationale

Many researchers studying student-athletes have focused on eating disorders and the female athlete triad. The number of studies focusing the general nutrition knowledge and attitudes of student-athletes is very limited. Most of the research has been directed to determining the risk of developing eating disorders and educational strategies to minimize that risk. There is a need for additional studies focusing on general nutrition knowledge and attitudes among student-athletes.

This study was designed to assess the knowledge and attitude of collegiate athletes regarding specific nutrition principles and nutritional guidelines. The null hypotheses of the study are:

- There is no difference between genders in nutrition attitude.
- There is no difference between genders in nutrition knowledge.
- There is no difference between sports in nutrition attitude.

- There is no difference between sports in nutrition knowledge.

CHAPTER TWO

MATERIALS AND METHODS

This study was designed to assess the knowledge and attitude of collegiate athletes regarding specific nutrition principles and nutritional guidelines. The main concepts within this survey are:

- Vitamins are not a source of energy but supplements act comparably to naturally occurring vitamins in foods.
- Protein is found in many sources besides meat.
- Nutrient dense foods are foods that have a large amount of nutrients relative to the number of calories per serving.
- Energy dense foods are foods that have a large amount of calories per serving.
- Some types of serum cholesterol are beneficial.
- Fiber is found in many plant sources and has many positive health benefits.
- Water is the best way to rehydrate during physical activity and hydrating slowly throughout the event is better than drinking large amounts at one time.
- Losing weight is based on total calories in and calories out so eliminating a food group all together is not an effective weight management strategy.
- It is important to be aware of nutritional concepts in everyday life.

Based on the review of the literature, an instrument was designed with 25 knowledge statements and 10 attitude statements. The knowledge statements were items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, and 28

(Appendix B). The attitude statements were items 19, 24, 27, 29, 30, 31, 32, 33, 34, 35 (Appendix B).

Design of the Instrument

There was not an existing instrument that addressed the concepts associated with the design of the present study. Therefore, a new instrument was designed. Many of the statements were adapted from a previous survey by Zawilia et al. (2003) Those items were 2, 4, 6, 8, 12, 13, 16, 23, 24, 26, 33, 34, and 35 (Appendix B).

Validity

Once the survey tool was designed it was reviewed by fellow graduate students within the nutrition masters program. Two graduate students were emailed the survey and asked to review the survey for readability and basic knowledge concepts. A professor with a background in survey design was also given the survey to review. After receiving the feedback from these individuals, edits were made to simplify wording and to shift the proportion of positively and negatively worded items within the survey. At this point the survey was given to a class of graduate students from different masters programs. The purpose of this was to determine the need to simplify the survey or clarify any items. There were no changes made to the survey based on their responses.

This study protocol was reviewed by the Institutional Review Board (IRB) of Clemson University and received approval as an exempt protocol, since all participants were at least 18 years of age and the items in the instrument asked for no sensitive or personally identifying information. Approval was received within the month of

submitting the written proposal. Data collection began soon after IRB approval was granted. Data were collected during the months of January and February 2010.

Participants

Participants in this study were 18-26 year old male and female student-athletes who attended Clemson University during the 2009-2010 academic year and who were participating in varsity soccer, swimming and diving, track and field, and tennis at the time of the study.

General Procedures

Participants were recruited for participation in this study verbally. With the assistance of Clemson's athletic training staff, the coaching staff for each team set up a meeting time for their athletes. During the meetings with each team the purpose of the study and what the athletes' participation would involve if they chose to participate were described Appendix A contains a copy of the informational letter which was provided to the student-athletes in addition to the verbal explanation of that letter. At this time the student-athletes were given the opportunity to ask any questions pertaining to the research and to decline participation. Student-athletes who chose to participate were given a copy of the informational letter and the survey. The athletes completed the survey during this meeting and returned it. Participants were instructed not to place their name or any identifying demographic information on the survey. Since the survey was administered in groups, it was not possible to link an individual to a specific survey. Completed surveys were stored in a cabinet within a locked lab. Only members of the research team had access to the data.

Data Analysis

SPSS 17.0 for Windows was used to perform all the statistical analysis for this study. Frequencies for demographic information, such as gender, class rank, sport, eating situation, and prior nutrition education were determined. Means were calculated for total scores on the survey and for the knowledge and attitude items on the survey.

Analysis of variance was used to compare groups of participants by their survey scores. The multiple regression analyses were based on the dependent variable of total score on the survey and independent variables of gender, class rank, sport, eating situation, and prior nutrition education. Statistical significance for these analyses was set at $P<0.05$.

CHAPTER THREE

RESULTS AND DISCUSSION

Response Rate

This survey, for which there were no incentives, garnered a 43.98% response rate. Ninety-five collegiate student athletes who currently attend Clemson University completed the survey used in this study. The rosters used to determine response rates for this study were the 2009-2010 official team rosters according to the Clemson University Athletic Department. The data for this study were collected during the spring semester of the 2009-2010 academic year.

Response rate differed among teams. Of the 37 women on the swimming and diving team roster, 26 (70.27%) completed the survey. The men's swimming and diving team has a roster of 23 athletes and 22 (95.65%) completed the survey. The women's track and field team has a total of 41 athletes and 3 (7.32%) completed the survey. The men's track and field team has a roster of 37 athletes and 4 (10.81%) completed the survey. The women's soccer team has a roster of 30 players and 11 (36.67%) completed surveys. The men's soccer roster has 26 players and 15 (57.69%) completed the survey. The tennis teams have a combined total of 22 athletes. Of the 12 players on the men's tennis team, 7 (58.33%) completed the survey. The women's tennis team has 10 players and 7 (70.00%) completed the survey.

Collecting data during the spring semester may have affected the response rates for some sports. The response rates for men's and women's soccer were lowered because their seniors appeared on the rosters but were most likely not participating in

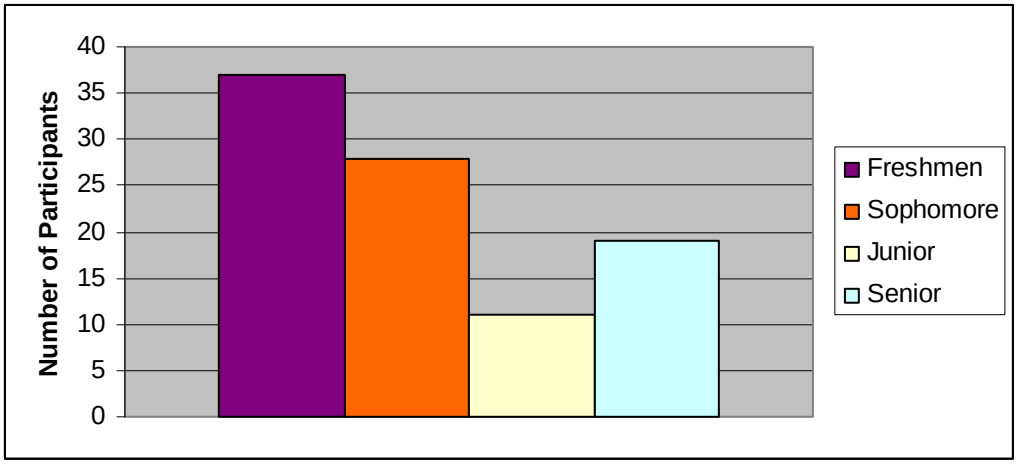
team meetings since their season was over. In some cases teams may have lost athletes at the beginning of the spring semester due to transferring or quitting the team. Another factor that could be responsible for lower participation could be athletes missing from the information meeting about the study due to class or other schedule conflict. These athletes would appear on the roster but not have been present at the team meeting when the opportunity to participate in the study was presented. Both of the track teams had particularly low response rates. This may reflect the large number of athletes, the disparate nature of the sports represented on these teams and the difficulty in gathering a large number of them together at the same time.

Demographics

When given the choice of freshmen, sophomore, junior, senior, and graduate for level of education, none of the participants marked the graduate level. Thirty-seven (38.9%) participants indicated freshmen, 28 (29.5%) indicated sophomore, 11 (11.6%) indicated junior, and 19 (20.0%) indicated senior. (Figure 3.1)

To describe which eating situation best describes their own eating situation, participants were given the choices of eating primarily in the dining halls, mainly buying and preparing own food at home, or a combination of these. Fifty (52.6%) of the participants reported eating primarily in the dining halls, 36 (37.9%) reported mainly

Figure 3.1: Class Rank



buying and preparing their own food at home, and the remaining 9 (9.5%) reported combining eating in the dining hall and preparing their food at home. (Figure 3.2). Many freshmen have meal plans since they are required to live on campus. In a previous study behavior adaptation of college students as a factor in weight gain and possible decision making behavior and patterns associated with gender were investigated (Cluskey & Grobe, 2009). Cluskey and Grobe (2009) found that one of the major challenges to healthy eating by college students was the perception of lacking healthy dining options. Smart and Bisogni (2001) investigated male college hockey players and their eating behaviors. In this study participants described their eating behaviors as changing throughout their four years at school (Smart & Bisogni, 2001). Coming in as freshman the participants ate the majority of their meals in dining halls and as they started to move off campus they started to buy and prepare more of their meals (Smart & Bisogni, 2001).

Of the 95 participants, 48 (50.5%) were swimmers and divers, 7 (7.4%) were track and field athletes, 14 (14.7%) were tennis players, and 26 (27.4%) were soccer players (Figure xx). Within the participants 48 (50.5%) were male and 47 (49.5%) were female. Of the swimmers 22 (45.8%) were males and 26 (54.2%) were females. Within the track and field athletes 4 (57.1%) were males while 3 (42.9) were females. Of the tennis players, 7 (50%) were males and 7 (50%) were females. Of the soccer players 15 (57.7%) were males and 11 (42.3%) were females.

When athletes were asked if they have previously taken a nutrition course 32 (33.7%) responded “yes” and 63 (66.3%) responded “no” (Figure 3.4) Thirteen (40.6%)

Figure 3.2: Eating Situation

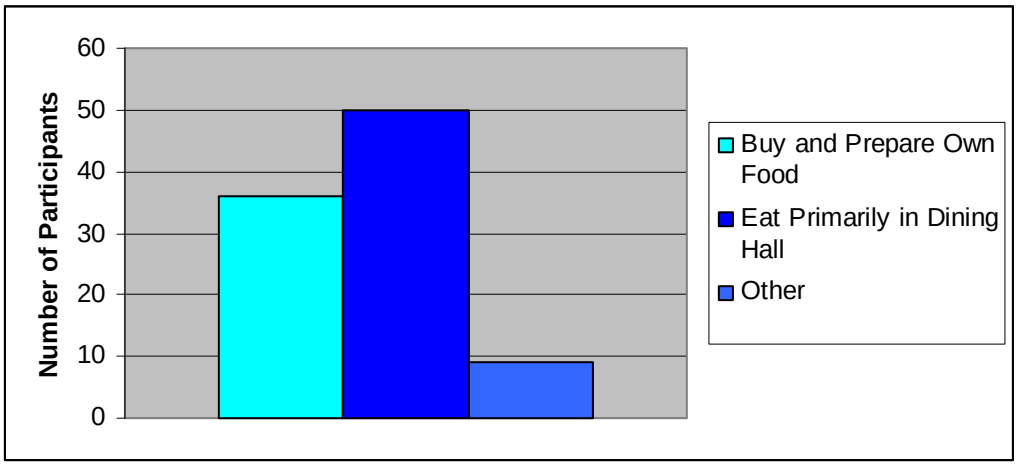
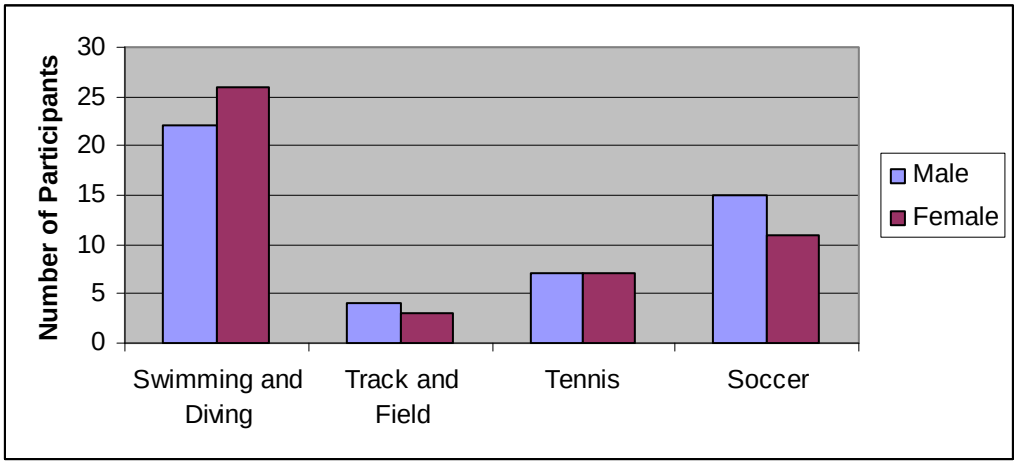


Figure 3.3: Gender



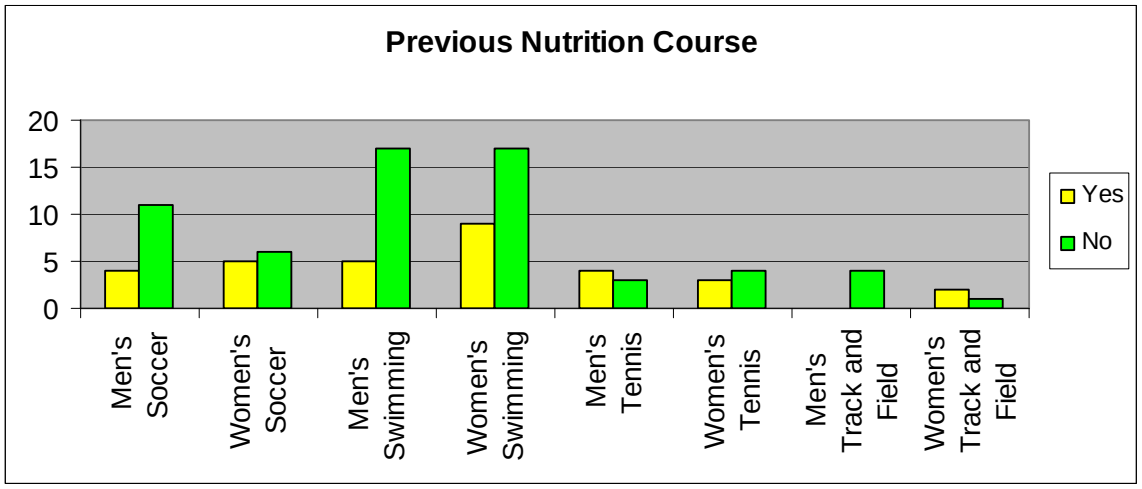
of the "yes" responses came from male athletes while 19 (59.4%) of the "yes" responses came from female athletes. Thirty-five (55.6%) of the "no" responses came from male athletes and 28 (44.4%) "No" responses came from female athletes. Of the males responding "no," 17 (48.6%) were swimmers and divers, 4 (11.4%) were track and field athletes, 3 (8.6%) were tennis players, and 11 (31.4%) soccer players. Of the females responding "no," 17 (60.7%) were swimmers and divers, 1 (3.6%) was a track athlete, 4 (14.3%) were tennis players and 6 (21.4%) were soccer players. Of the males responding "yes" to having previously taking a nutrition course, 5 (38.5%) were swimmers and divers, 0 (0.0%) were track and field athletes, 4 (30.8%) were tennis players, and 4 (30.8%) were soccer players. Of the females responding "yes" 9 (47.4%) were swimmers and divers, 2 (10.5%) were track and field athletes, 3 (15.8%) were tennis players and 5 (26.3%) were soccer players. During a previous study of former Clemson University student-athletes Kaiser (1997) found 56 of her total participants had not previously had a

nutrition course while 83 participants had taken a nutrition course. Within that study participants were asked if they felt a nutrition course would be helpful to the athlete population. All participants who had not previously taken a course felt it would be helpful while only 95% of those who had previously taken a course agreed with the need for a course (Kaiser, 1997).

Analysis of the Survey

The original survey asked participants to respond to the questions with a 1-5 Likert strongly agree to strongly disagree scale. The initial statistical examination of the survey responses revealed that the survey itself was not internally consistent and reliable.

Figure 3.4: Previous Nutrition Course



To bring the internal consistency and reliability statistics of the survey into acceptable ranges for surveys without random selection (KR-20 = 0.634), the 5-point scale was collapsed into a dichotomous scale with the correct responses given a score of 1 and the incorrect responses given a score of 0. For a pilot study without random selection, such as the present study, a KR-20 in the moderately high 0.6 range is acceptable.

The dichotomous scale gave the survey a total possible point score of 35. The mean total point score was 17.48 (SD= 1.71). The scores ranged from a high of 27 to a low of 7 correct answers. The high score of 27 was earned by a senior female swimmer who had taken a nutrition course in the past. She buys and prepares her own food. The lowest score was earned by a female soccer player who had not previously taken a nutrition course. She also buys and prepares her own food.

Knowledge and attitude scores

Twenty-five of the 35 items on the survey were knowledge questions (Table 3.1). The mean score on the knowledge questions was 11.59 (SD= 3.14), or 46.3%. The mean score of the females was 12.3 (SD= 3.03) (49.2%) while the mean score for the males was 10.9 (SD= 3.12) (43.6%).

The remaining ten items on the survey were attitude questions (Table 3.2). The mean score for the attitude items was 5.89 (SD= 1.67) (58.9%). The mean score for females was 6.19 (SD= 1.53) (61.9%) and for males was 5.60 (SD= 1.76) (56.0%).

While females had higher mean scores and both the highest and lowest scores, males had a wider range of variability within their responses.

Table 3.1: Knowledge Questions with Number of correct responses

Item		Total	Female	Male
1	Soft margarine contains less fat than butter.	25	11	14
2	Vitamins are a good source of energy.	21	9	12
3	There is more protein in a glass of whole milk than in a glass of skimmed milk.	35	20	15
4	Dark colored vegetables have more nutritional value than light colored vegetables	48	26	22
5	Hamburgers and French fries are nutrient dense.	73	37	36
6	Eggs, beans, nuts and milk are examples of protein sources other than meat.	91	45	46
7	Fruits and vegetables are nutrient dense.	82	39	43
8	Fresh, frozen, and canned vegetables all have similar nutrient values.	24	10	14
9	LDL is also known as the good cholesterol.	13	8	5
10	Decreasing intake of dietary carbohydrate poses no health risk.	69	38	31
11	Peanut butter is a good source of cholesterol.	26	15	11
12	Fiber in the diet may help to decrease blood cholesterol levels.	58	31	27
13	Bread and cereals is the only food group that is a good source of fiber	75	40	35
14	Increasing intake of dietary protein poses no health risk.	39	21	18
15	Obtaining between 50-60% of your daily calories from carbohydrate is recommended as part of a healthy diet.	45	23	22
16	Thirst is an adequate guide to the need for fluids.	42	22	20
17	Foods rich in omega-3 fatty acids help prevent heart disease.	64	35	29
18	Fruits and vegetables are energy dense.	21	11	10
20	Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods.	14	9	5
21	Obtaining about 20% of your daily calories from protein is recommended as part of a healthy diet.	57	31	26
22	Eating a variety of whole grain products ensures an adequate fiber intake.	70	36	34
23	Sports drinks are the best way to replace body fluids lost during exercise.	25	15	10
25	Hamburgers and French fries are energy dense.	16	7	9
26	Trans fat does not increase risk of chronic disease if consumed in moderation.	26	19	17
28	There is no health risks associated with lowering the amount of fat you eat every day	32	20	12

Table 3.2: Attitude Questions with number of correct responses

Item		Total	Females	Males
19	There is a relationship between good eating habits and good health	91	45	46
24	All physically active people should take vitamins.	11	6	5
27	Skipping meals is okay if you need to lose weight quickly.	86	46	40
29	The only time it is important to be aware of caloric intake is when you are trying to gain or lose weight.	74	41	33
30	Eating two meals or more per day will have a positive effect on mental and physical performance.	72	36	36
31	A key factor in weight loss is eating more protein.	26	8	18
32	The most effective weight loss method is to eat fewer calories per day.	45	28	17
33	Your daily diet can come from just a few food groups and still be nutritionally sound.	50	27	23
34	Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance.	28	13	15
35	During exercise it is better to drink lots of fluid all at once than to drink in small amounts over a period of time.	77	41	36

There were statistically significant correlations between gender of the athletes and total score on the survey (r= -0.243; p=0.003) and gender of the athletes and eating situation (r=0.290; p=0.002). Females consistently scored higher than their male counterparts and were more likely to buy and prepare their own food. There was no significant correlation between total score on the survey and sport (r= 0.204, p= 0.790).

Survey Items Most Frequently Answered Incorrectly

The items for which the student-athletes most frequently provided an incorrect response and the percentage who provided this incorrect response were

2. Vitamins are a good source of energy. (71.58%)

16. Thirst is an adequate guide to the need for fluids. (52.63%)

24. All physically active people should take vitamins. (72.63%)

25. Hamburgers and French fries are energy dense. (62.11%)

34. Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance. (56.84%)

Two of these items missed by the majority of the participants pertained to vitamins. The knowledge statement, "Vitamins are a good source of energy" was answered incorrectly by 71.58% of participants. The attitude statement, "All physically active people should take vitamins" was answered incorrectly by 72.63% of participants. This finding agrees with other researchers who reported that athletes believe that vitamin and mineral supplements increase energy levels (Jonnalagadda et al., 2001).

The attitude statement "Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance" was answered

incorrectly by 56.84% of participants. Hiza and Gerrior (2002) reported that, even though college students are aware of good nutrition and are a healthy population as whole, they often develop poor eating habits during their years in college. Most students see weight gain as the sole consequence of unhealthy eating (Belaski, 2001).

The knowledge statement, "Thirst is an adequate guide to the need for fluids", was answered incorrectly by 52.63% of participants. Jonnalagadda et al. (2001) found more than 90% of the athletes in their study recognized the importance of maintaining proper hydration status.

Survey Items Most Frequently Answered Correctly

The items that were most frequently answered correctly with the percentage of the respondents providing this correct response were

5. Hamburgers and French fries are nutrient dense. (76.84%)
6. Eggs, beans, nuts, and milk are examples of protein sources other than meat. (95.79%)
7. Fruits and vegetables are nutrient dense. (86.32%)
10. Decreasing intake of dietary carbohydrate poses no health risk. (72.63%)
13. Bread and cereals is the only food group that is a good source of fiber. (78.95%)
17. Food rich in omega-3 fatty acids help prevent heart disease. (67.37%)
19. There is a relationship between good eating habits and good health. (95.79%)
22. Eating a variety of whole grain products ensures an adequate fiber intake. (73.68%)

27. Skipping meals is okay if you need to lose weight quickly. (90.53%)

29. The only time it is important to be aware of caloric intake is when you are trying to gain or lose weight. (77.89%)

30. Eating two meals or more per day will have a positive effect on mental and physical performance. (75.79%)

35. During exercise it is better to drink lots of fluids all at once than to drink in small amounts over a period of time. (81.05%)

The knowledge statement, "Eggs, beans, nuts, and milk are examples of protein sources other than meat," was correctly answered by 95.79% of participants. This finding indicates that athletes understand there are many different food sources of protein. According to Jonnalagadda et al. (2001) 50% of the athletes in their study believed that protein supplements were necessary for muscle growth and development and that protein was the primary source of energy for muscle.

Items 13 ("Bread and cereals is the only food group that is a good source of fiber.") and 22 ("Eating a variety of whole grain products ensures an adequate fiber intake.") were general nutrition knowledge of fiber intakes. The athletes know not only different sources of fiber but how to ensure they receive enough fiber within their daily diets. Another general nutrition knowledge item was item 17 ("Foods rich in omega-3 fatty acids help prevent heart disease."). This item asks about the importance of omega-3 fatty acids. The participants were knowledgeable about omega-3 fatty acids and how they help prevent heart disease.

Many of the participants answered the general attitude items correctly. These responses indicated that athletes understand the relationship between good eating habits and good health, that eating two meals or more per day will have a positive effect on mental and physical performance. They also appear to have an awareness of basic weight management strategies such as skipping meals does not help to lose weight quickly and that they need to be aware of caloric intake at all times and not just when they are trying to gain or lose weight.. An understanding of basic hydration principles was demonstrated by the responses to the negatively worded item, "During exercise it is better to drink lots of fluids all at once than to drink in small amounts over a period of time.").

There appears to be a lack of understanding of the basic concepts of nutrient and energy density, Most participants understood that fruits and vegetables are nutrient dense while hamburgers and French fries are not; however, most of them did not understand that hamburgers and French fries are energy dense. . There is a lack of information on this type of knowledge within prior studies and should be looked into further.

Survey Items Most Frequently Answered Undecided

The items for which respondents answered undecided and the percentage providing that response were

9. LDL is also known as the good cholesterol. (70.53%)
20. Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods. (43.58%)
31. A key factor in weight loss is eating more protein. (45.26%)

There were a few items on the survey that the majority of the participants were clearly unsure of the correct answer. The knowledge statement, "LDL is also known as the good cholesterol" was answered as undecided by 70.53% of participants. It is unclear if the participants were unsure of the meaning of LDL or if they just didn't have knowledge of cholesterol. Another knowledge statement, "Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods," was answered as undecided by 43.58% of participants. Jonnalagadda et al. (2001) found that athletes have misconceptions about vitamins in general. It is possible that this could lead to their uncertainty how the vitamins are used within the body. The knowledge statement, "A key factor in weight loss is eating more protein," would have been correctly answered "strongly disagree." However the responses varied and fell mainly in the undecided category (45.26 %). These data agree with Jonnalagadda, et al. (2001) who reported that 50% of their participants believed that protein supplements were necessary for muscle growth and development and protein was the primary source of energy for muscle.

Regression Analysis

In order to examine the effect of class rank, eating situation, taking a nutrition course, sex and sport on the score on the nutrition survey, multiple regression analyses were conducted. In these analyses, total Nutrition Survey score was modeled with five independent variables (class rank, eating situation, taking a nutrition course, sex, and sport).

Preliminary Analysis

The preliminary analysis was conducted to identify outlying cases that had the potential to exert excessive influence on the regression line. Large studentized residuals, high leverage values and large Cook's Distances typically are used to identify outliers. Five outliers were identified, each with studentized residuals over 2.0. Three of the five outliers also had leverage values over the value of 0.12, the threshold set for high leverage in this analysis by the formula (Keith, 2006). Four cases had Cook's distance means of 0.06. (See Figure 3.5).

Sensitivity Study

A sensitivity study was conducted to determine whether the four outliers would adversely influence the analysis. In the first step of the sensitivity study (Model 1), a multiple regression analysis was conducted on the full set of data (95 cases). In the second step, the four outlying cases were dropped from the dataset and the regression analysis was conducted again to determine if an improvement occurred in estimation of regression coefficients and in R^2.

Model 1: The Preliminary Model with All 95 Cases in the Dataset

The first multiple regression analysis, with all 95 cases in the dataset, produced an R^2 of 0.211, $F(9, 85) = 2.525$, $p = 0.013$. The adjusted R^2 was 0.127 and the standard error of estimate was 3.837.

The unique contributions (effect estimates) of the independent variables on the Total Nutrition Test Score are summarized in Table 3.3. The effect of Sex was statistically significant ($t = -2.802$, $p = 0.006$).

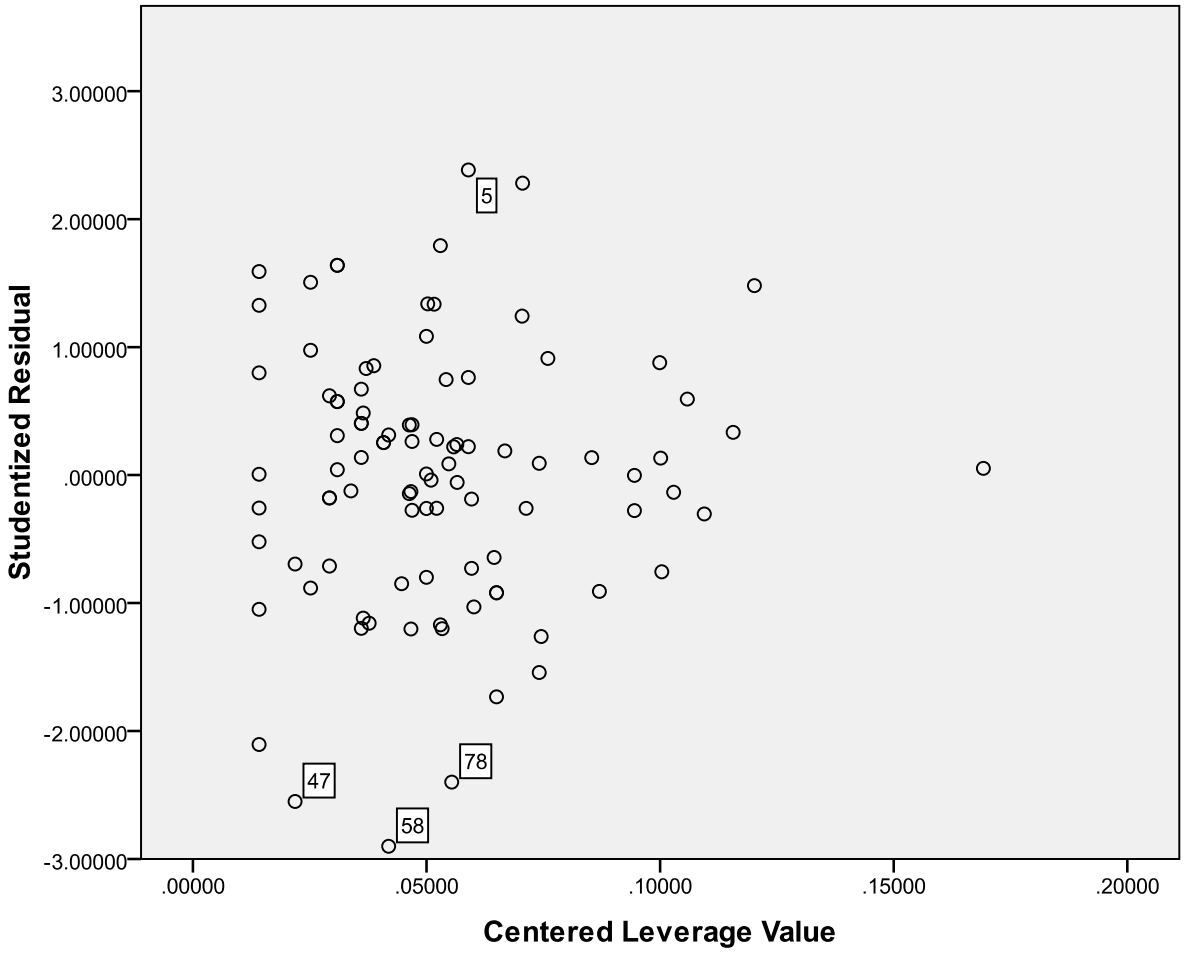


Figure 3.5. Studentized residuals plotted against centered leverage values identify cases 5, 78, 47, and 58 as exerting excessive influence on R^2 .

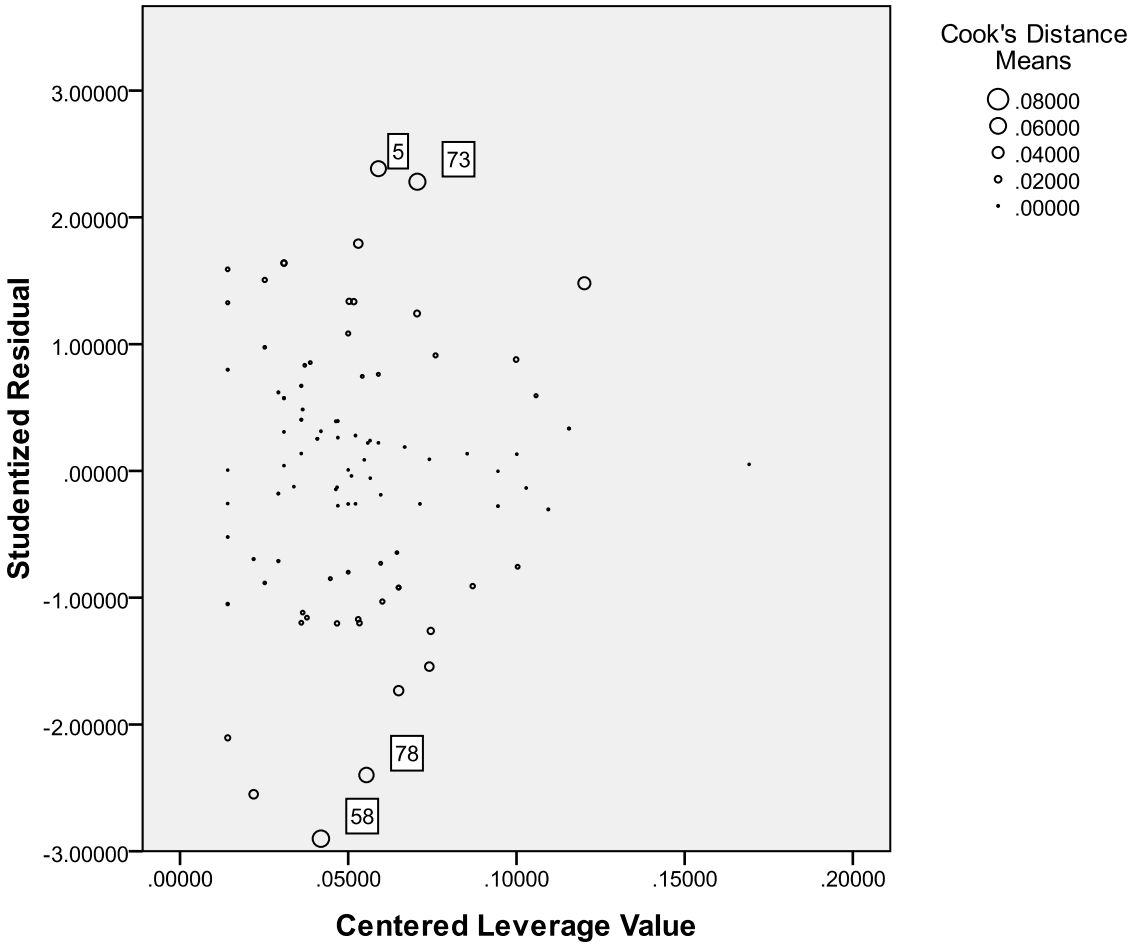


Figure 3.6. Cook's Distances are measures of the total influence of specific cases on the whole regression equation, and indicate that cases 5, 73 78, and 58 are affecting R^2.

Table 3.3 Results Summary for Model 1 (Full dataset, n=95 cases)

Variable	Effect Estimate	ΔR^2
Class Rank	--	0.045
Eating Situation	0.993	0.017
Sex	-2.404	0.073*
Took Nutrition Course	-1.731	0.035
Sport	--	0.061

The ΔR^2 is the proportion of variability explained by an independent variable, given the other independent variables.
* Significant at the 0.05 level

To test the global effect of the dummy coded categorical variable, Sport, the change in R^2 or (ΔR^2) was tested by forcing all categories in as a block. Further analysis of pairwise comparisons between categories were not conducted because the global effect of Sport ($\Delta R^2 = 0.061$) was not significant (F Change (3, 88) =2.134, p=0.102.

To test the global effect of the dummy coded categorical variable, Class Rank, the change in R^2 or (ΔR^2) was tested the same way. Pairwise comparisons between categories were not conducted because the global effect of Class Rank ($\Delta R^2 = 0.045$) was not significant (F Change (3, 85) =1.604, p=0.194.

Model 2: The Final Model with 91 Cases in the Dataset

A second multiple regression analysis, conducted with 4 outliers removed from the dataset (n=91 cases) produced an R^2 of 0.249, F (9, 81) =2.98, p=0.004. The adjusted R^2 was 0.166, and the standard error of estimate was 3.362. Model 2, with four outliers removed, predicted 24.90% (or conservatively 16.60%) of the respondents' total Nutrition Survey score.

The global effect of Sport, again, was not significant, so further pairwise comparisons were not conducted. The effect of Sex was significant (t= -3.400, p=0.001), and indicated that, on average, female athletes were predicted to score 2.6 points higher than males on the Nutrition Survey.

Athletes who reported taking a nutrition course were predicted to score about 2 points *lower* than those who did not (t= -2.072, p = 0.010). This result is counterintuitive, and should be interpreted with caution; it is most likely a result of inadequate sampling. The sample size number of athletes who reported not taking a course is approximately double (n=61) that of those who reported taking a course (n=30).

Table 3.4 Results Summary for Model 2 (Four outliers removed, n=91 cases)

-Variable	**Effect Estimate**	**ΔR^2**
Class Rank	--	0.034
Eating Situation	0. 957	0.021
Sex	-2. 586	0.107*
Took Nutrition Course	-2. 072	0.650*
Sport	--	0.048

The ΔR^2 is the proportion of variability explained by an independent variable, given the other independent variables.
* Significant at the 0.05 level.

CHAPTER FOUR

CONCLUSIONS

The most obvious and consistent result of the survey was the general lack of nutritional knowledge among Clemson University student-athletes. The total possible score was a 35 while the mean total point score was only 17.48 (SD= 1.71). The scores ranged from a high of 27 to a low of 7 correct answers. The total point score was broken into knowledge and attitude questions. There were a total of 25 knowledge questions and 10 attitude questions. The student-athletes scored poorly in both of these categories. The knowledge mean score was 11.59 (SD= 3.14) (46.3%) while the attitude mean score was 5.89 (SD= 1.67) (58.9%).

Within the scope and limitations of this investigation, it seems reasonable to conclude that:

- The unique effect of class rank, controlling for all other variables other variables, was statistically non-significant (p=.084).
- The unique effect of Sport, controlling for all other variables was statistically non-significant (p=.079).
- The unique effect of Eating Situation, controlling for all other variables was statistically non-significant (p=.079).
- The unique effect of Sex, controlling for all other variables was statistically significant (p=.003).
- The unique effect of Taking a Nutrition Course, controlling for all other variables was statistically significant (p=.036).

Recommendations for Further Research:

The following recommendations for further study are warranted based on the data obtained and questions that surfaced throughout the course of the investigation.

- Future investigations should seek to select a larger sample size which reflects the larger population of college student-athletes.
- Future research could include student-athletes from additional colleges.
- A study examining the effects of nutrition seminars or lectures on the nutritional knowledge of student-athletes.
- A study examining the differences between the general student population's nutritional knowledge to the student-athlete population.
- Future investigations should find where student-athletes obtain the majority of their nutritional knowledge.

APPENDICES

Appendix A

Informational Letter

Information for Participation in a Research Study
Clemson University

Assessment of nutrition knowledge and attitudes among Clemson University student-athletes

You are invited to participate in a research study conducted by Dr. Beth Kunkel along with Ashley Dunnigan. The purpose of this research is to further understand the level of nutritional knowledge Division I college athletes have and their attitudes toward eating. This study will also allow researchers to gain a better understanding of athletes' attitude and approach towards eating and to design programs that may benefit student-athletes.

Your participation will involve filling out a survey about your knowledge of and attitudes toward nutrition. This survey will take approximately 15 minutes for you to complete.

There are no known risks associated with this research. There are also no known benefits directly to you that would result from your participation in this research. However, results of this research may benefit student-athletes in the future.

We will do everything we can to protect your privacy. Please do not place your name or other identifying information on the survey. The survey process will take place in groups so once the survey is collected we will be unable to specifically link data to an individual.

In rare cases, a research study will be evaluated by an oversight agency, such as the Clemson University Institutional Review Board or the federal Office for Human Research Protection, which would require that we share the information we collect from you. If this happens, the information would only be used to determine if we conducted this study properly and adequately protected your rights as a participant.

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Beth Kunkel at Clemson University at 864-656-5690. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Institutional Review Board at 864.656.6460.

Appendix B

Survey

Some statements concerning nutrition are given below. Please indicate your reaction to each statement by selecting the number that best describes how you feel about the statement.

1 - If you strongly agree (SA)
2 - If you agree (A) but do not feel strongly about the statement
3 - If you are undecided (U) or neither agree or disagree
4 - If you disagree (D) but do not feel strongly about the statement
5 - If you strongly disagree (SD)

	SA	A	U	D	SD
Soft margarine contains less fat than butter.	1	2	3	4	5
Vitamins are a good source of energy.	1	2	3	4	5
There is more protein in a glass of whole milk than in a glass of skimmed milk.	1	2	3	4	5
Dark colored vegetables have more nutritional value than light colored vegetables	1	2	3	4	5
Hamburgers and French fries are nutrient dense.	1	2	3	4	5
Eggs, beans, nuts and milk are examples of protein sources other than meat.	1	2	3	4	5
Fruits and vegetables are nutrient dense.	1	2	3	4	5
Fresh, frozen, and canned vegetables all have similar nutrient values.	1	2	3	4	5
LDL is also known as the good cholesterol.	1	2	3	4	5
Decreasing intake of dietary carbohydrate poses no health risk.	1	2	3	4	5
Peanut butter is a good source of cholesterol.	1	2	3	4	5
Fiber in the diet may help to decrease blood cholesterol levels.	1	2	3	4	5
Bread and cereals is the only food group that is a good source of fiber.	1	2	3	4	5
Increasing intake of dietary protein poses no health risk.	1	2	3	4	5
Obtaining between 50-60% of your daily calories from carbohydrate is recommended as part of a healthy diet.	1	2	3	4	5
Thirst is an adequate guide to the need for fluids.	1	2	3	4	5

Foods rich in omega-3 fatty acids help prevent heart disease.	1	2	3	4	5
Fruits and vegetables are energy dense.	1	2	3	4	5
There is a relationship between good eating habits and good health.	1	2	3	4	5
Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods.	1	2	3	4	5
Obtaining about 20% of your daily calories from protein is recommended as part of a healthy diet.	1	2	3	4	5
Eating a variety of whole grain products ensures an adequate fiber intake.	1	2	3	4	5
Sports drinks are the best way to replace body fluids lost during exercise.	1	2	3	4	5
All physically active people should take vitamins.	1	2	3	4	5
Hamburgers and French fries are energy dense.	1	2	3	4	5
Trans fat does not increase risk of chronic disease if consumed in moderation.	1	2	3	4	5
Skipping meals is okay if you need to lose weight quickly.	1	2	3	4	5
There is no health risks associated with lowering the amount of fat you eat every day.	1	2	3	4	5
The only time it is important to be aware of caloric intake is when you are trying to gain or lose weight.	1	2	3	4	5
Eating two meals or more per day will have a positive effect on mental and physical performance.	1	2	3	4	5
A key factor in weight loss is eating more protein.	1	2	3	4	5
The most effective weight loss method is to eat fewer calories per day.	1	2	3	4	5
Your daily diet can come from just a few food groups and still be nutritionally sound.	1	2	3	4	5
Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance.	1	2	3	4	5
During exercise it is better to drink lots of fluid all at once than to drink in small amounts over a period of time.	1	2	3	4	5

Please provide information as indicated:

1. Are you:
    a. Male
    b. Female

2. What is your education level?
    a. Freshmen
    b. Sophomore
    c. Junior
    d. Senior
    e. Graduate

3. What sport do you participate in?

    _____

4. Which best describes your eating situation?
    a. I buy and/or prepare most of my own food.
    b. I eat the majority of my meals at the dining hall.
    c. Other

    _____

5. Have you ever taken a nutrition course (in high school or college)?
    a. yes
    b. no

Appendix C

Questions with the Correct Response Rate

		Total	Female	Male
1	Soft margarine contains less fat than butter.	25	11	14
2	Vitamins are a good source of energy.	21	9	12
3	There is more protein in a glass of whole milk than in a glass of skimmed milk.	35	20	15
4	Dark colored vegetables have more nutritional value than light colored vegetables	48	26	22
5	Hamburgers and French fries are nutrient dense.	73	37	36
6	Eggs, beans, nuts and milk are examples of protein sources other than meat.	91	45	46
7	Fruits and vegetables are nutrient dense.	82	39	43
8	Fresh, frozen, and canned vegetables all have similar nutrient values.	24	10	14
9	LDL is also known as the good cholesterol.	13	8	5
10	Decreasing intake of dietary carbohydrate poses no health risk.	69	38	31
11	Peanut butter is a good source of cholesterol.	26	15	11
12	Fiber in the diet may help to decrease blood cholesterol levels.	58	31	27
13	Bread and cereals is the only food group that is a good source of fiber	75	40	35
14	Increasing intake of dietary protein poses no health risk.	39	21	18
15	Obtaining between 50-60% of your daily calories from carbohydrate is recommended as part of a healthy diet.	45	23	22
16	Thirst is an adequate guide to the need for fluids.	42	22	20
17	Foods rich in omega-3 fatty acids help prevent heart disease.	64	35	29
18	Fruits and vegetables are energy dense.	21	11	10
19	There is a relationship between good eating habits and good health	91	45	46
20	Vitamins in fortified foods are not used by the body as well as naturally occurring vitamins from foods.	14	9	5
21	Obtaining about 20% of your daily calories from protein is recommended as part of a healthy diet.	57	31	26
22	Eating a variety of whole grain products ensures an adequate fiber intake.	70	36	34
23	Sports drinks are the best way to replace body fluids lost during exercise.	25	15	10
24	All physically active people should take vitamins.	11	6	5
25	Hamburgers and French fries are energy dense.	16	7	9
26	Trans fat does not increase risk of chronic disease if consumed in moderation.	26	19	17

27	Skipping meals is okay if you need to lose weight quickly.	86	46	40
28	There is no health risks associated with lowering the amount of fat you eat every day	32	20	12
29	The only time it is important to be aware of caloric intake is when you are trying to gain or lose weight.	74	41	33
30	Eating two meals or more per day will have a positive effect on mental and physical performance.	72	36	36
31	A key factor in weight loss is eating more protein.	26	8	18
32	The most effective weight loss method is to eat fewer calories per day.	45	28	17
33	Your daily diet can come from just a few food groups and still be nutritionally sound.	50	27	23
34	Physically active people need to be more concerned with nutrition than non-active individuals because of its effect on performance.	28	13	15
35	During exercise it is better to drink lots of fluid all at once than to drink in small amounts over a period of time.	77	41	36

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