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# How Nutrition Knowledge of Coaches, Athletic Trainers, and Strength and Conditioning Specialists Translates to Their Athletes

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# How Nutrition Knowledge of Coaches, Athletic Trainers, and Strength and Conditioning Specialists Translates to Their Athletes

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ABSTRACT

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The basis of dietary habits is linked to an individuals' nutrition knowledge; for collegiate athletes this is the difference between optimal performance and falling short. To understand how nutrition information is disseminated to student-athletes, this research surveyed the athletes themselves and their sports staff (coaches, athletic trainers, and strength and conditioning specialists) on their current knowledge. Sport staff and student-athletes at East Tennessee State University were given the opportunity to participate in a 52-question online survey that tested both their general and sports-related nutrition knowledge. While the study sample size did not allow for statistical analyses required to address all three research questions, findings did indicate some variation between teams on measures of nutrition knowledge, and there was a statistically significant difference between sport staff and athletes' general and sport nutrition knowledge. This study aimed to understand if nutrition knowledge of sport staff directly affects that of their corresponding athletes.

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## Chapter 1. Introduction

Nutrition knowledge is regarded as concepts and processes related to diet and disease, diet and health, and food choices that represent important nutrients. Adequate nutrition knowledge can translate into positive dietary habits and food choices that affect overall health. It can vary significantly between age groups, genders, and cultures. Many factors contribute to the level of nutrition knowledge that college-aged adults acquire; including socioeconomic status, education level, and interest in health. Collegiate student-athletes must be regarded as their own sub-population when assessing dietary needs and nutrition knowledge. Collegiate athletes are expected to have better dietary habits due to the importance of proper nutrition and its correlation to optimal performance, although athletes rarely possess the nutrition knowledge expected of them. For this reason, they seek outside sources of information, from coaches, parents, athletic trainers or strength and conditioning specialists. If these outside sources are not educated adequately on the nutritional needs of athletes, then inaccurate information can be disseminated and could be detrimental to the health and/or performance of the athlete.

Most current studies on nutrition knowledge in athletes are conducted on Australian elite football players (Spronk et al., 2015) or Finnish endurance runners (Heikkila et al., 2018). There is no measurement tool directly related to assessing the nutrition knowledge of American collegiate athletes. This makes it difficult to understand the extent or lack of student-athletes' nutrition knowledge. Not only must the athletes' nutrition knowledge be assessed, but the sport staff's nutrition knowledge must be addressed as well. With this information, the gaps in education and knowledge of nutrition can be analyzed and substantiated. If student-athletes are looking to their sport staff for information, it is crucial to know the quality of nutrition knowledge that they seek. By introducing a measurement tool incorporating tested questions

from reliable and validated questionnaires, the adequacy of the sport staff and the athlete's nutrition knowledge can be measured and gaps between these two populations can be explored.

## Chapter 2. Literature Review

### Defining Sports and Its Athletes

There is often a misunderstanding when terminology like “sport”, “exercise” and “physical activity” are used interchangeably due to different nuances in their definitions. The first definition separating “exercise” and “physical activity” as their own entities came in 1985 from Caspersan, Powell & Christenson. It is important to know the differences between terminologies when conducting research, due to the potential for error among readers. Table 1 fully defines these terms.

**Table 1**

Key Definitions of Physical Activity and Athletes

| Term | Definition |
|---|---|
| Sport | “physical activity with a competitive nature” (Winter & Fowler, 2008) |
| Exercise | “any and all activity involving generation of force by the activated muscles that results in disruption of a homeostatic state” (Caspersan, 1985, as cited in Winter & Fowler, 2008, p. 448)<br><br>“body movement produced by skeletal muscles, resulting energy expenditure varying from low to high, very positively correlated with physical fitness, planned, structured, and repetitive bodily movement, the objective is to maintain or improve physical fitness” (Caspersan, 1985, as cited in Winter & Fowler, 2008, p. 449) |
| Physical Activity | “any body movement produced by muscles that results in energy expenditure” (Laquale, 2009, p. 12)<br><br>“A planned repetitive movement that is created to maintain or improve fitness level” (Laquale, 2009, p. 12)<br><br>“Contains three elements: movement of the body produced by skeletal muscle, resulting energy expenditure that varies from low to high, and a positive correlation with physical fitness” (Caspersan, 1985, as cited in Winter & Fowler, 2008, p. 449) |
| Recreational Athlete | “a person who is physically active but who does not train for competition at the same level of intensity and focus as a competitive athlete” (Laquale, 2009, p. 12) |

| | |
|---|---|
| Competitive/Elite Athlete | "an individual who participants in 'competitive physical activities' or sports/games that require physical strength, agility or stamina" (Laquale, 2009, p. 12) |

There is a threshold between the nutrient needs for an athlete versus general population, and how athlete requirements need further attention. Competitive athletes require a more detailed approach to recommendations regarding nutrition to optimize performance in their specific sport. Today, the National Collegiate Association of Athletes (NCAA, 2020) states there are over 460,000 student-athletes over a span of 24 competitive sports. These collegiate athletes require their own nutrition-specific requirements differing from those of recreational or elite athletes.

**Nutrition Recommendations for Athletes**

Laquale (2009) studied whether athletes require specific nutritional recommendations dependent upon their level of intensity and competitiveness. The purpose of sports nutrition is to "integrate the principles of exercise physiology and nutrition science in a practical way" (Woodruff, 2016, p. 3). It is important for athletes to understand that dietary habits are linked directly to "our physical capacity and how to optimize that capacity with proper nutrition and education" (Woodruff, 2016, p. 3). Sports performance, training and recovery is found to be directly linked to nutrition and dietary habits. The Academy of Nutrition and Dietetics (AND), Dietitians of Canada, and American College of Sports Medicine released a joint position statement in 2016 (p. 501) stating "the performance of, and recovery from, sporting activities are enhanced by well-chosen nutrition strategies." Energy, protein, and fluid needs are based upon specific individualized measures, such as intensity, goals and performance variables of the athlete. Since every aspect of "movement, muscular strength, agility, endurance, flexibility and

coordination require a complex interaction of energy and nutrients" (Woodruff, 2016, p. 3) it is crucial that athletes and their training staff are educated properly on their nutrition needs.

**Energy.**

As previously discussed, athletes are at higher risk for not meeting their caloric and protein needs because they are unaware of how much more they require. Understanding energy intake and energy expenditure are basic nutrition education points that all athletes need. Typically, athletes require higher amounts of energy and protein to replenish glycogen stores, maintain body weight, and repair or build muscle (Ray & Fowler, 2004). A lack of energy intake can lead to "persistent fatigue, poor recovery or unwanted weight loss" (Ray & Fowler, 2004, p. 864). Basic nutrition guidelines for athletes are individualized based upon their specific goals and physiological state.

*Carbohydrate.* Carbohydrate is a critical source of energy used as fuel by the body. It is necessary in both aerobic and anaerobic activity. As intensity of physical activity increases, greater amounts of carbohydrate are used (Campbell & Spano, 2011). Carbohydrates spare protein muscle being used to fuel the body in exercise and intense physical activity (Fogt, 2011). Typical requirements include carbohydrate intake to be 55-60% of their total daily calories (Gaines, 2006). The AND (formerly known as the American Dietetic Association) suggests carbohydrate intake for athletes is 6-10 g/kg, which could be dramatically low or more than the suggestion of 55-60% of total calories, dependent upon the body composition of the athlete (Gaines, 2006). During times of intense training, the National Strength and Conditioning Association (NSCA) recommends up to 10 g/kg of body weight of carbohydrate intake (Fogt, 2011). Adequate carbohydrate stores within muscle allow optimal performance and recovery for athletes during times of training and competition.

*Protein.* The main function of protein is to promote growth and repair the cells and damaged tissues within the body at a cellular level (Kreider, 2011). Its use is limited in energy production when compared to carbohydrates and fats (Campbell & Spano, 2011). A misconception of athletes is that higher protein intake will increase strength and endurance, though protein requirements can be met through diet alone (Rodriguez et al., 2009). There is debate regarding the proper amount of protein needs for athletes, with Gaines (2006) stating 15-20% of daily caloric intake, and Cotunga, Vickery and McBee (2005) stating 10-15% of daily calories is adequate. The AND statement reports 1.4-1.7 g/kg of protein as appropriate (Gaines, 2006), though, in more specific cases, endurance athletes are advised to consume 1.6-1.7 g/kg, and strength or resistance athletes should consume 1.2-1.4 g/kg (Ray & Fowler, 2004). The NSCA's recommendation for aerobic exercise is similar to AND's recommendation of 1.2-1.4 g/kg; however, for anaerobic exercise the NSCA's recommends up to 2.0 g/kg (Kreider, 2011). For the best outcome, it is crucial to monitor and evaluate the athlete frequently and adjust needs based on their goals (Gaines, 2006).

*Fat.* The final macronutrient to be monitored among athletes is fat. Fat, along with carbohydrate, is used as a fuel source within the body. An energy shift from carbohydrate to fat occurs during long, low-intensity exercise (Lowery, 2011). There is a consistent recommendation amongst sources stating that fat intake should be 20-25% of daily total caloric intake. The NSCA further defines these recommendations for athletes, with a regular daily intake of 30% fat, broken down into 10% increments of saturated fat, polyunsaturated fat and monounsaturated fat (Lowery, 2011). These macronutrient guidelines for athletes are considered broad but can become extremely specific when identifying nutrient timing, athletes' goals, periodization cycle and availability. The purpose of these recommendations is to reduce the issues caused by

insufficient dietary habits of athletes, like loss of lean tissue, compromised immune systems and diminished musculoskeletal function (Rodriguez et al., 2009).

*Hydration.* Fluid needs are crucial to the performance and recovery of the athlete due to the losses through perspiration. Water and sports drinks are important before, during and after the sporting event or training session, but proper amounts are variable dependent upon environmental conditions and types of physical activities occurring (Sawka et al., 2007). Without proper fluid balance, electrolytes within the body are affected and can cause symptoms of hyponatremia or hypokalemia (Seebohar, 2011). Dehydration can have serious consequences on the athlete and their physiologic functions, measured by core temperature, perceived exertion and heart rate (Sawka et al., 2007). Certain sports are at greater risk for dehydration because of the conditions they practice or compete in, their clothing type and equipment used for protection (Seebohar, 2011); these sports are American football, hockey and wrestling. The American College of Sports Medicine (ACSM) and NCSA both recommend an athlete drink about 5-7 mL/kg at least 4 hours before their exercise activity (Sawka et al., 2007). When participating in a training session or competition, athletes should aim to consume enough fluids to replace losses from sweat that is a deficit equivalent of <2% body weight of total body fluid (Thomas et al., 2016). Finally, when it comes to fluid intake after exercise, Seebohar (2011, p. 79) of NSCA recommends ingesting "20 to 24 ounces of fluids for every pound of body weight lost during exercise." ACSM recommendations differ by 1.5 liters of fluid for each kilogram of body weight lost. Improper fluid intake can be detrimental to the health and wellbeing to an athlete and should be taken seriously. Athletes should not wait until they feel thirsty to drink water.

*Dietary Supplements.* Dietary supplements are products available to the general public to be consumed in addition to diet, which include vitamins, minerals, amino acids and more; they

are believed to give favorable results (Knapik et al., 2015). Misinformation of the purposes and types of dietary supplements for athlete consumption is extremely prominent. Most athletes believe in order to perform, or recover better and faster, they need to take at least one type of supplemental aid (Parks et al., 2018). In a survey of Division I collegiate athletes and their eating habits and challenges, 70% responded they use at least one supplement (Parks et al., 2018). This statistic may indicate that athletes do not understand they can achieve adequate protein and energy amounts through a balanced diet alone. Common supplements, such as creatine, are designed to assist in increased strength, power and lean body mass (Wilborn & Campbell, 2011). Other supplements, not as widely known as creatine, have far less research and therefore safety and proper dosages are unknown. It is important for athletes to understand this and practice caution when aiding their diet with supplements. NCAA regularly screens athletes for drug use from performance-enhancing supplements, steroids, or even dietary supplements (NCAA, 2020). Student-athletes have lost their eligibility due to intake of dietary supplements contaminated with a steroid or stimulant that had been banned (NCAA, 2020). This is, in part, because most dietary supplements are not regulated or labeled properly, and mislead athletes (NCAA, 2020).

**Training and Nutrition Periodization**

Collegiate athletes follow training periodization plans for their sport dependent on which part of their competitive season they are in. Periodization is defined as a "framework for planned, systematic variation of training parameters, in a way that directs physiological adaptations to the training goals required of the sport" (Gamble, 2006, p. 56). These are comprised of cycles (macrocycle, mesocycle and microcycle) with each cycle having its own specific goal based upon what the athlete or trainer is hoping to achieve; this can be strength,

hypertrophy, power, injury prevention or metabolic conditioning (Gamble, 2006). Described in Table 2.

**Table 2**

Periodization Cycles

| Cycle | Definition | Goal of Periodization |
|---|---|---|
| Macrocycle | Consists of several months<br><br>Sometimes considered the "annual cycle"; includes preparatory, competition and transition periods (Issurin, 2008) | Weight Status, whether weight gain or loss is needed to achieve cycle goals (Gaines, 2006)<br><br>**Carbohydrates:** daily intake match several month trainings (Stellingwerff et al., 2019)<br><br>**Protein:** adjusting to training demands (~1.5 g/kg/day) (Stelllingwerff et al., 2019)<br><br>**Iron:** adequate iron in diet based on individual basis (Stellingwerff et al., 2019)<br><br>**Creatine:** usage during hypertrophy training block (Stellingwerff et al., 2019) |
| Mesocycle | Consists of several weeks<br><br>Mid-sized training cycles that is made up of multiple microcycles (Issurin, 2008). | Hypertrophy, maximum strength, explosive power, metabolic conditioning and injury prevention (Gamble, 2006).<br><br>**Carbohydrates:** focus of carbohydrate fueling during endurance sessions to "adapt the GI over several weeks for race day" (Stellingwerff et al., 2019, p. 142)<br><br>**Protein:** increase to around 2 g/kg/day over a "body composition phase to minimize muscle mass loss" (Stellingwerff et al., 2019, p. 142)<br><br>**Iron:** increase in intake from a supplement (Stellingwerff et al., 2019)<br><br>**Creatine:** "acute high-dose creatine loading phase to enhance a several week anaerobic short interval training" (Stellingwerff et al., 2019, p. 142) |

| | | |
|---|---|---|
| Microcycle | Consists of several days<br><br>Small sized, consisting of a few days, usually one week (Issurin, 2008) | **Carbohydrate:** short manipulation of CHO availability to increase recovery or decrease aerobic adaptations (Stellingwerff et al., 2019)<br><br>**Protein:** optimizing type, amount and timing enhance recovery (Stellingwerff et al., 2019)<br><br>**Iron:** optimizing iron bioavailability; including vitamin C and excluding calcium (Stellingwerff et al., 2019)<br><br>**Creatine**: "optimizing acute muscle creatine uptake by taking post training with carbohydrates" (Stellingwerff et al., 2019, p. 142) |

These cycles and specific goals also include nutrition periodization, or aligning training variables with appropriate nutrition guidelines to alter the performance outcomes (Gaines, 2006). Specific periodized nutrition requirements are meant to meet the demands of the sport, and claim athletes will be at "an optimal fuel level and body composition" (Gaines, 2006, p. 20). Periodized nutrition puts focus on the importance of "carbohydrate availability as a driver of training effects" to allow optimal output from the muscles and metabolic system (Jeukendrup, 2017, p. S53). During competitive seasons, athletes will be at their highest level of carbohydrate and caloric intake (Gaines, 2006). The strenuous work that collegiate athletes put their bodies through causes them to be at a higher risk for deficiencies in energy and protein.

Nutrient timing plays a vital role in how athletes are physiologically able to use the macronutrients and perform to optimally. Contugna et al. (2005) argues that the timing of food intake based on training and competition schedule is crucial. "The ability to perform and recover from exercise can be positively or negatively affected by dietary intake before, during and after the event" (Cotugna et al., 2005, p. 324). It is recommended that a pre-event meal be comprised of low fat, low fiber, minimal caffeine, moderate in protein, and high in complex

carbohydrates and fluid (Cotugna et al., 2005, p. 324). This meal should be consumed 3 to 4 hours before the event. During the event, the recommendation is 30-60 g of carbohydrates every hour, typically achieved through consumption of sport drinks (Cotugna et al., 2005).

Lastly, nutrient timing recommends after the event, athletes should consume a meal of adequate carbohydrate intake and moderate protein, with balanced meals every 2 to 4 hours for the rest of the day (Cotugna et al., 2005). Hydration and fluid status must always be addressed in athletes and should also be considered part of nutrient timing. Cotugna et al. (2005) recommend 12-20 oz of water should be consumed 2-3 hours before an event and 6-12 oz every 15-20 minutes during the event to remain properly hydrated. The purpose of nutrient timing is optimal performance of the athlete and can prepare other organs for competition through manipulation, such as, "improving stomach comfort by regularly drinking large volumes" (Jeukendrup, 2017, p. S53). The benefits provided by proper nutrition recommendations allow athletes to adjust their dietary habits to meet these requirements.

**The Importance of Nutrition Knowledge on Dietary Habits**

Nutrition knowledge is regarded as a modifiable determinant in dietary behaviors. Adequate nutrition knowledge can translate into positive dietary habits and food choices that affect overall health. It can vary between age groups, genders and cultures, and a positive correlation between dietary habits and increased nutrition knowledge has been found (Jones et al., 2014). Previous research indicates that differences in nutrition knowledge exist based on gender, as shown by, elite Australian female athletes scoring 4% higher on a general nutrition knowledge questionnaire (Spronk et al., 2015) and university female athletes scoring significantly higher than their male counterparts on nutrition knowledge and attitudes (Dunn, 2007). Healthy food choices can promote improved health status, positive psycho-social and

mental functioning, as well as, optimal athletic performance in athletes (Ruano-Rodriguez et al., 2015).

Many factors contribute to the level of nutrition knowledge that college-aged adults acquire; including socioeconomic status, education level, and interest in health. Assessing a college student's general nutrition knowledge and dietary habits will allow for further education to increase confidence in dietary choices. Rosenbloom (2002) found that among Division I NCAA athletes, the lack of proper information regarding supplement use was widespread. To address the extent of nutrition knowledge deficits, proper assessment is necessary (Parmenter & Wardle, 1999) to improve nutrition strategies that will affect dietary habits and improve attitudes towards nutrition (Guadagnin et al., 2016). Without adequate nutrition knowledge, barriers regarding healthful dietary behaviors are more likely to occur (Jones et al., 2014). In order to better assess the relationship between nutrition knowledge and healthy habits, Parmenter & Wardle (1999) created a reliable and validated comprehensive questionnaire for college students.

**Dietary Habits of Athletes**

When it comes to the nutrition knowledge of collegiate athletes, the expectation is to have appropriate dietary habits that will enhance performance and maintain a physique best associated with their sport. A basic understanding of nutrition is pertinent to implement the principles of sports nutrition into their lives (Ozodogan, 2011). There are significant challenges that college students face when attempting to eat healthy, balanced meals. It has been found that college students do not meet nutritional guidelines because of "limited money, exposure to misinformation, insufficient access to healthy foods, inadequate cooking facilities, and inexperience in making personal food choices" (Parks et al., 2018, p. 117). Collegiate athletes meet even more difficulty when trying to achieve an ideal diet because of "increased nutrient

needs, busy practice schedules, frequent travels, body composition pressures, and misleading marketing of dietary supplements" (Parks et al., 2018, p. 117). Collegiate athletes lack the confidence to choose foods for themselves in order to achieve positive nutrition status.

**Nutrition Knowledge and its Effect on Diet**

The collegiate athlete population has been examined regarding the extent of their general nutrition knowledge, sports specific nutrition knowledge, and how it applies to every process in the body relating to recovery and energy production sources. A study to validate a reliable nutrition questionnaire among endurance athletes (ages 16-20) stated "athletes need adequate nutrition knowledge to better understand the importance of food choices on performance, recovery and health" (Heikkila et al., 2017, p. 873). Sports nutrition is a "relatively new discipline involving the application of nutritional principles to enhance athletic performance" (Ozodogan, 2011, p. 1). In a comparative study conducted by Dunn et al. (2007) researchers analyzed the level of nutrition knowledge of male and female college athletes and found that 51% was the average nutrition score. There is reasonable understanding that the nutrition knowledge scores of these athletes will have meaningful impact on their performance level and overall health (Dunn et al., 2007).

Since this population has different energy intake, micro/macronutrient and hydration requirements, it is deemed important that they are adequately educated on proper nutrition habits. Many athletes do not realize how much more energy they need and what types of foods to ingest; because of this, a food pyramid for athletes in Switzerland was constructed as an educational tool to reference when determining appropriate types and quantities of foods (Burke, 2008). Therefore, nutrition education is necessary to assist the athletes in making proper dietary decisions (Rosenbloom, 2002). The Rosenbloom (2002) study conducted on collegiate athletes,

reported that the common misconceptions surrounding nutrition (i.e. supplement use or high protein products) cause the athletes to choose foods based upon these misconceptions, which can lead to negative performance outcome.

## Sources of Nutrition Information Among Athletes

When assessing nutrition knowledge among athletes, it is helpful to identify where athletes are receiving their nutrition information. Identifying the sources athletes commonly use, will help to understand discrepancies, such as, their nutrition knowledge scores and related dietary habits, that is found in the data. A 2002 study by Shifflett, found that about 28% of athletes still use their parents as their main resource for nutrition information. A cross-sectional study by Torres-McGehee et al. (2012) reported athletes most commonly use their athletic trainers and strength and conditioning specialists for nutrition information due to the close relationships they build with everyday contact. This same study also reported how improper education and incorrect sports nutrition information "formulated on theory or unsupported research" can be disseminated to athletes by coaches, ATs and SCSs (Torres-McGehee, 2012, p. 206). Coaches have been known to suggest inappropriate nutrition recommendations to their athletes, such as, incorrect macronutrient intake, fluid restrictions and changes in weight (Cotugna et al., 2005).

### Sources of Nutrition Information Among Sport Staff

The nutrition knowledge and education of coaches was considered of "special interest" because they are considered an important resource of nutrition information for their athletes (Devlin, 2015). A systematic review of current sports nutrition knowledge in coaches and trainers by Trakman et al. (2016) state the difficulty to ascertain the nutrition knowledge in coaches and athletes. Proper nutrition education for athletes, coaches, ATs and SCSs is critical

to the performance of the athlete. It remains critical for ATs, coaches and SCSs to have received proper nutrition education, and up-to-date, evidenced-based information, when approached by their athletes.

Poor nutrition knowledge among sporting staff, can lead to a "ripple effect" of inaccurate information throughout teams (Shifflett et al., 2002). When tested on their knowledge using the Sports Nutrition Knowledge Questionnaire, Torres-McGehee et al. (2012) found that only 36% of coaches had adequate nutrition knowledge compared to ATs (77%) and SCSs (81%). The National Strength and Conditioning Association credentialing exam for Strength and Conditioning Specialists requires a full domain on nutrition topics, such as, nutrient timing and health factors associated with dietary choices (NSCA, 2021); this is indicative of the scores seen in the Torres-McGehee et al. (2012) study. The most misunderstood topics in coaches' nutrition knowledge are energy density, supplementation and the role protein play in physiological systems (Trakman et al., 2016). In order to improve the nutrition knowledge of athletes, the education and knowledge of coaches need to be addressed and corrected (Ozodogan, 2011).

**Sport Nutrition Knowledge Assessment Tools**

The need for a validated assessment tool to be integrated and implemented to test the nutrition knowledge of athletes and training staff is pertinent. Globally, there are inadequate measures regarding athletes and their access to nutrition information that are appropriate and relevant (Trakman et al., 2017). Without validated tools, it will be difficult to implement the education needed to positively affect the dietary behaviors of this population (Guadagnin et al., 2016). There are several versions of questionnaires to test the level of knowledge among athletic populations, but most only consider assessing general nutrition knowledge rather than sports-specific nutrition knowledge, such as, foods related to improved athletic performance, recovery,

fluid needs, weight management methods and supplement use. Currently, many of these tools address athletes outside of the United States in elite sports or in adolescents. This makes it difficult to establish similarities and differences among cultures, sports and genders. A systematic review of all current nutrition knowledge tools stated that "a tool should consider healthy literacy, cultural appropriation, and current consensus recommendations regarding nutrition for optimal athletic performance, and should undergo rigorous validation that includes techniques from within an item response theory network" (Trakman et al., 2016, p. 20).

*General Nutrition Knowledge Questionnaire (GNKQ).* The Parmenter and Wardle (1999) General Nutrition Knowledge Questionnaire was created to identify weak spots in people's knowledge of healthy eating and its relationship to overall health. The creation of this questionnaire was meant to pick up where previous tools were lacking; in both validity and reliability. Broad subjects, such as, understanding terms, awareness of recommendations, knowledge of nutrient sources in foods, practical food choices and awareness of diet and disease relations, were generated for the questionnaire with the assistance of a dietitian (Parmenter & Wardle, 1999). To assess construct validity and internal consistency the GNKQ was tested with undergraduate students in computer science and dietetics (Parmenter & Wardle, 1999). Original responses and retest answers underwent test-retest reliability, concluding that overall reliability was very high (Parmenter & Wardle, 1999). The GNKQ has become the cornerstone for many nutrition knowledge research studies.

In 2015 Spronk, Heaney, Prvan, and O'Connor examined nutrition knowledge using the GNKQ among Australian Football players and the average score was 58%. This study is particularly interesting considering the Australian athletes scored higher than athletes (ages 18-24) in the United States by over 6%. The Spronk et al. (2015) study is a clear example of how

college athletes in the United States need additional nutrition education to improve their nutrition knowledge.

In 2017, a nutrition knowledge questionnaire was developed by Heikkila, Valve, Lehtovirta, and Fogelholm, which targeted a population of young endurance athletes in Finland and their coaches. This questionnaire became a reliable and validated questionnaire, but a limitation is that the food beliefs, education and understanding are different in Finnish individuals when compared to American collegiate athletes (Heikkila et al., 2017).

*Sports Nutrition Knowledge Questionnaire (SNKQ).* In 2017, Trakman, Forsyth, Hoye and Belski discovered that previous sports nutrition knowledge questionnaires were not adequately valid. Their goal was to develop and implement a new questionnaire validated using robust methodology, assessing knowledge of current sports nutrition recommendations, knowledge of all relevant aspects of sports nutrition, generalizable to multiple sports, and understood by individuals from various cultural backgrounds (Trakman et al., 2017). They addressed the limitations in previous questionnaires for athletes including heterogeneity, which made it difficult to quantify the correlation between nutrition knowledge and dietary intake (Trakman et al., 2017). This revised questionnaire was tested to be relevant and applicable to all athletes of multiple sports and understandable across various. Reliability of the SNKQ, included over 400 participants with 188 usable responses. Though reliability was high, it was investigated among Australian athletes (Trakman et al., 2017). There is a need for implementing an appropriate, relevant and reliable sports nutrition knowledge questionnaire aimed at measuring the influence of coaches and sports staff towards their athletes and nutrition knowledge.

With the lack of sport nutrition knowledge assessment tools aimed towards collegiate athletes in the United States, current tools can be utilized to ascertain the knowledge of this

population. There is a need for implementing an appropriate, relevant and reliable sports nutrition knowledge questionnaire aimed towards collegiate athletes to measure the influence that coaches, ATs and SCSs have on their collegiate athletes' nutrition knowledge. To better understand how nutrition knowledge is disseminated to collegiate athletes, primary sources of nutrition information and current nutrition knowledge need to be analyzed and substantiated. The purpose of this study is to identify gaps in sports nutrition knowledge among collegiate athletes, coaches, ATs, and SCSs.

**Research Questions**

The research questions posed by researchers aims to be explore the following:

RQ1: Does the nutrition knowledge of coaches, ATs and SCSs have significant impact upon the knowledge of their athletes?

RQ2: Will there be a difference between team (athletes, coaches, ATs and SCSs) mean scores in comparison to others?

RQ3: Is there a need for nutrition education for collegiate coaches, ATs, and SCSs based on their nutrition knowledge scores?

# Chapter 3. Methods

## Survey Design

Two online surveys were developed to assess both general nutrition knowledge and sports nutrition knowledge of student-athletes and athletic program staff at East Tennessee State University (ETSU). The 52-question survey included 20 questions from the previously validated General Nutrition Knowledge Questionnaire (Parmenter & Wardle, 2000) and Sports Nutrition Knowledge Questionnaire (Trakman et al., 2016), and 9 questions from the Nutrition Knowledge of Collegiate Athletes regarding Dietary Practices Related to Performance study (Rosenbloom et al., 2002). These tools were selected because the first two questionnaires had previously been through validity and reliability testing processes; both questionnaires have undergone a test-retest scenario among different populations. These populations include Division I collegiate athletes (Rosenbloom et al., 2002), collegiate athletes, coaches, ATs and SCSs (Torres-McGehee et al., 2012), and Australian university athletes and sports dietitians (Trakman et al., 2016).

Once selected, each question chosen was re-worded to reflect an American English eighth-grade reading level. The two surveys differed in the questions collecting demographic data of the student-athletes and athletic program staff. For athletes, the demographic questions included hours spent training, which sport(s) they participate in, their major program of study, if they have ever completed Principles of Nutrition Science (NTFD 2420, a nutrition course specific to ETSU), and where they eat most of their meals. For program staff, the demographic questions included how many hours they spent training athletes, their job title (i.e., athletic trainer, strength and conditioning specialist, or coach), sports team(s) they manage, and participation in formal nutrition education.

## Survey Implementation

An email containing the link to the Qualtrics survey to the athletic program staff questionnaire was sent to Dr. Michael Stone, graduate coordinator of the ETSU Sports Science and Performance program. This program encourages its students to get their Strength and Conditioning certification because they must lead or assist the strength program of one of the ETSU athletic teams. There are currently eight male sports teams and nine female sports teams for them to be involved with at ETSU. Dr. Stone then disseminated the email to all current and recently graduated (within the past year) students of the program. An email containing the Qualtrics link to the questionnaire for athletes was sent to the ETSU Athletic Academic Advisor to disperse to all student-athletes, since direct contact with the athletes was prohibited. Participants were notified of the potential risks and benefits of the study and were provided and signed an electronic informed consent document. This study was approved by the East Tennessee State University Institutional Review Board on August 14, 2020. Both surveys were distributed on September 8, 2020, and participants were allowed up to six weeks to complete the surveys, with the surveys closed for participation on October 20, 2020. A total of 33 sport staff and 30 student-athletes participated in the study.

## Data Collection, Coding, and Cleaning

After the two surveys closed, data were downloaded from Qualtrics as Excel files, coded then imported into IBM SPSS Statistics version 27. Responses to the General Nutrition and Sport Nutrition Knowledge questions were coded as either correct or incorrect, with correct answers receiving one (1) point per the original questionnaire answer keys (Appendix A). A total score for each questionnaire was then calculated. Demographic questions were also coded to allow for comparisons between groups. Variables for testing were based upon the research

questions provided and interest in further discoveries of these groupings. The chosen variables for statistical analysis are provided in Tables 3 and 4. Questionnaires from participants that were incomplete were included in the coding process but were disregarded in the ANOVA statistical analysis process.

**Table 3**

Variable Selection: Athletes

| Variable | Descriptor/Category |
|---|---|
| Age | 6 levels (18-25, 26-35, 36-45, 46-55, 56-65, 66 and older) |
| Class | 5 levels (Freshman, Sophomore, Junior, Senior, Graduate Student) |
| Gender | 3 levels (Male, Female, Other) |
| Weight Perception | 4 levels (Underweight, At a healthy weight, Overweight, Obese) |
| Training Hours | Reported as a continuous variable |
| Sport Played | 8 levels (Track & Field/Cross Country, Triathlon, Soccer, Volleyball, Baseball, Softball, Football, Cheer/Dance) |
| Diet Quality | 3 levels (Below average, Average, Above average) |
| Formal Nutrition Studies | 3 levels (Yes, No, NTFD2420) |
| Source of Nutrition Information | 9 levels (Academic courses, Magazines/books, Scientific journals/articles, Dietitians, Physician or other healthcare providers, Other athletes, Coaches, athletic trainers, strength and conditioning specialists, Sports organizations, Internet/media) |
| Height/Weight/BMI | Reported as a continuous variable |

**Table 4**

Variable Selection: Sports Staff

| Variable | Descriptor/Category |
|---|---|
| Age | 6 levels (18-25, 26-35, 36-45, 46-55, 56-65, 66 and older) |
| Job Title | 4 levels (Coach, Athletic trainer, Strength and Conditioning Specialist, Other) |
| Gender | 3 levels (Male, Female, Other) |
| Weight Perception | 4 levels (Underweight, At a healthy weight, Overweight, Obese) |
| Training Hours | Reported as a continuous variable |
| Sport Trained | 12 levels (Triathlon, Track & Field/Cross Country, Soccer, Volleyball, Baseball, Softball, Football, Cheer/Dance, Weightlifting/Olympic sport, Basketball, Swimming, Golf) |
| Diet Quality | 3 levels (Below average, Average, Above average) |
| Level of Education | 5 levels (High School, College, Graduate, Doctorate, Other) |
| Formal Nutrition Studies | 3 levels (Yes, No, NTFD2420) |
| Source of Nutrition Information | 9 levels (Academic courses, Magazines/books, Scientific journals/articles, Dietitians, Physician or other healthcare providers, Other athletes, Coaches, athletic trainers, strength and conditioning specialists, Sports organizations, Internet/media) |
| Height/Weight/BMI | Reported as a continuous variable |

## Statistical Analyses

Data analyses were performed using the IBM Statistical Package for Social Sciences (SPSS): Statistics version 27. An analysis of covariance (ANCOVA) test was performed to establish the relationship between nutrition knowledge of athletes and sports staff throughout every sport. Descriptive statistics were reported for demographic information, self-reported levels of training hours, diet quality, weight perception and formal nutrition education. Analysis

of variance (ANOVA) tests were used to determine the differences in total scores of general nutrition, sports nutrition, and overall total nutrition knowledge scores between groups (sports staff and athletes).

# Chapter 4. Results

## Study Population

The study population consisted of individuals older than 18 years of age, associated with ETSU as either students, athletes or sport staff. Currently, ETSU has eight male sports teams (basketball, football, soccer, golf, track & field, cross country, baseball, tennis) and nine female sports teams (volleyball, soccer, softball, track & field, cross country, golf, tennis, basketball, triathlon). The study respondents included a convenience sample of 33 sport staff and 30 student-athletes across sports, as shown in Table 5. Of these, 26 males (sport staff, n=20; athletes, n=6) and 28 women (sport staff, n=6; athletes, n=22) completed the survey and were included for statistical analysis.

**Table 5**

Numbers of Participants by Sport and Group

| Sport | Sport Staff N | Athlete N |
|---|---|---|
| Track/ Cross Country | 1 | 5 |
| Triathlon | 3 | 3 |
| Soccer | 3 | 5 |
| Volleyball | 4 | 3 |
| Baseball | 3 | 3 |
| Softball | 1 | 2 |
| Football | 1 | 1 |
| Cheer/Dance | 1 | 6 |

| | | |
|---|---|---|
| Olympic Weightlifting | 4 | 0 |
| Basketball | 3 | 0 |
| Swim | 1 | 0 |
| Golf | 1 | 0 |

## Inclusion/Exclusion Criteria

Study respondents were male, female or other gender identification specified that met the following inclusion criteria: (1) 18 years of age or older; (2) ETSU athlete, coach, athletic trainer or strength and conditioning specialist; (3) willing and able to participate in the online survey. Exclusion criteria included (1) younger than 18 years of age; (2) not an ETSU athlete, coach, athletic trainer or strength and conditioning specialist.

## Descriptive Statistics

Mean scores and standard deviations were determined across three categories (General Nutrition Knowledge, Sport Nutrition Knowledge, and Total Scores) for individual sport staff and athletes in each sport that participated in this study. This is shown in Tables 6, 7, and 8 below.

**Table 6**

Mean General Nutrition Knowledge Scores by Sport and Status

| Sport | Sport Staff | | Athlete | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Group Scores | 12.178 | 2.21 | 9.143 | 2.59 |

| | | | | |
|---|---|---|---|---|
| Track/ Cross Country | 12.0 | * | 10.40 | 2.40 |
| Triathlon | 12.67 | 1.53 | 9.00 | 2.00 |
| Soccer | 12.00 | 3.46 | 8.60 | 2.60 |
| Volleyball | 13.25 | 0.96 | 10.00 | 2.00 |
| Baseball | 10.00 | 4.36 | 7.00 | 2.65 |
| Softball | 8.00 | * | 8.00 | 2.83 |
| Football | 11.00 | * | 11.00 | * |
| Cheer/Dance | 12.00 | * | 9.33 | 3.50 |
| Olympic Weightlifting | 13.50 | 0.58 | - | - |
| Basketball | 12.67 | 0.58 | - | - |
| Swim | 13.00 | * | - | - |
| Golf | 9.00 | * | - | - |

*****indicates only one Sport Staff or Athlete in data

**Table 7**

Mean Sport Nutrition Knowledge Scores by Sport and Status

| Sport | Sport Staff | | Athlete | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Group Scores | 15.385 | 2.93 | 10.000 | 4.21 |
| Track/ Cross Country | 18.00 | * | 12.60 | 3.05 |
| Triathlon | 15.33 | 0.58 | 8.33 | 3.51 |

| | | | | |
|---|---|---|---|---|
| Soccer | 15.33 | 3.06 | 8.80 | 3.70 |
| Volleyball | 16.50 | 3.87 | 9.67 | 3.06 |
| Baseball | 13.33 | 5.51 | 10.00 | 6.00 |
| Softball | 12.00 | * | 9.50 | 4.95 |
| Football | 13.00 | * | 17.00 | * |
| Cheer/Dance | 13.00 | * | 8.83 | 5.27 |
| Olympic Weightlifting | 17.33 | 1.15 | - | - |
| Basketball | 14.67 | 2.31 | - | - |
| Swim | 18.00 | * | - | - |
| Golf | 14.00 | * | - | - |

*indicates only one Sport Staff or Athlete in data

**Table 8**

Mean Total Knowledge Scores by Sport and Status

| Sport | Sport Staff | | Athlete | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Group Scores | 27.500 | 4.9 | 19.142 | 6.29 |
| Track/ Cross Country | 30.00 | * | 23.00 | 5.10 |
| Triathlon | 28.00 | 2.00 | 17.33 | 5.51 |
| Soccer | 27.33 | 6.43 | 17.40 | 6.19 |

| | | | | |
|---|---|---|---|---|
| Volleyball | 29.75 | 4.79 | 19.67 | 4.62 |
| Baseball | 23.33 | 9.87 | 17.00 | 8.54 |
| Softball | 20.00 | * | 17.50 | 7.78 |
| Football | 24.00 | * | 28.00 | * |
| Cheer/Dance | 25.00 | * | 18.17 | 7.73 |
| Olympic Weightlifting | 31.00 | 1.00 | - | - |
| Basketball | 27.33 | 2.89 | - | - |
| Swim | 31.00 | * | - | - |
| Golf | 27.50 | * | - | - |

*indicates only one Sport Staff or Athlete in data

## Results

While the study sample did not allow for statistical analyses required to address all three research questions, (RQ1, Does the nutrition knowledge of coaches, ATs and SCSs have significant impact upon the knowledge of their athletes?; RQ2, Will there be a difference between team (athletes, coaches, ATs and SCSs) mean scores in comparison to others?; RQ3, Is there a need for nutrition education for collegiate coaches, ATs and SCSs based on their nutrition knowledge scores?) findings did indicate some variation between teams on measures of nutrition knowledge, and there was statistically significant difference between sport staff and athlete knowledge on measures of general and sport nutrition knowledge.

An analysis of covariance (ANCOVA) was attempted to determine whether the mean scores on knowledge measures (dependent variables (DVs)) were equal across categories of

athletes/sport staff and specific sports (categorical independent variable (IV)) statistically controlling for the effects of formal nutrition education (covariates (CV)). Unfortunately, the number of participants within each of these categories was limited, and therefore statistical analysis was not feasible.

A one-way ANOVA was conducted to evaluate the relationship between the status of athlete or coach on performance on each knowledge subscale and for the total scale score. These results are shown in Table 9 and described below.

**Table 9**

Results of ANOVA Comparisons

| | Sport Staff | | Athlete | | *F* | $\eta^2$ |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | | |
| Nutrition Knowledge | 12.178 | 2.21 | 9.143 | 2.59 | 22.221*** | .29 |
| Sport Knowledge | 15.385 | 2.93 | 10.000 | 4.21 | 29.367*** | .36 |
| Total Knowledge Score | 27.500 | 4.9 | 19.142 | 6.29 | 29.041*** | .36 |

***p < .01

## General Nutrition Knowledge

A one-way ANOVA was conducted to evaluate the relationship between the status of athlete or coach on performance on a nutrition knowledge subscale. The independent variable included two levels: athlete or sports staff. The dependent variable was the score on the nutrition knowledge scale. The ANOVA was significant, $F$ (1, 54) = 22.221, $p$ = .000. The strength of the relationship between status and knowledge scores was strong, as assessed by $\eta^2$ with the

status accounting for 29% of the dependent variable. Post hoc testing was not completed as there are only 2 groups.

### Sport Nutrition Knowledge

A one-way ANOVA was conducted to evaluate the relationship between the status of athlete or coach on performance on a sports knowledge subscale. The independent variable included two levels: athlete or sports staff. The dependent variable was the score on the scale. The ANOVA was significant, $F$ (1, 52) = 29.041, $p$ = .000. The strength of the relationship between status and knowledge scores was strong, as assessed by $\eta^2$ with the status accounting for 35% of the dependent variable. Post hoc testing was not completed as there are only 2 groups.

### Total Nutrition Knowledge

A one-way ANOVA was conducted to evaluate the relationship between the status of athlete or coach on performance on a nutrition and sports knowledge test. The independent variable included two levels: athlete or sports staff. The dependent variable was the total score on the scale. The ANOVA was significant, $F$ (1, 52) = 29.041, $p$ = .000. The strength of the relationship between status and knowledge scores was strong, as assessed by $\eta^2$ with the status accounting for 35% of the dependent variable. Post hoc testing was not completed as there are only 2 groups.

### Other Findings

Though the study sample did not allow for statistical analysis of some variables, there were some other findings of interest. Figure 1 below depicts variations in average total nutrition knowledge scores by sport categories. This includes the combined scores of athletes and sport staff for each sport. Swimming had the greatest total average (x=31) with soccer scoring the

lowest overall ( $\bar{x}$ =17), though data for swimming participants only included one. All teams that participated scored at least 15 of the total possible 36 points. This graph shows how each sport team adequately answered all nutrition knowledge questions in comparison to one another.

**Figure 1**

Mean Total Knowledge Score by Sport

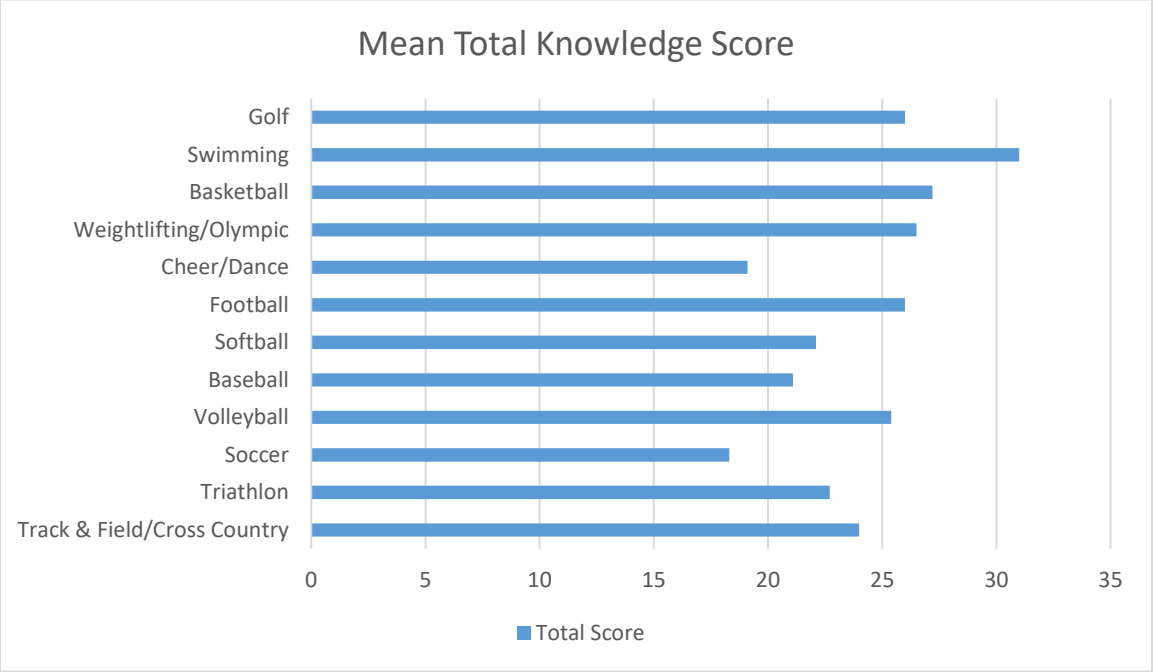
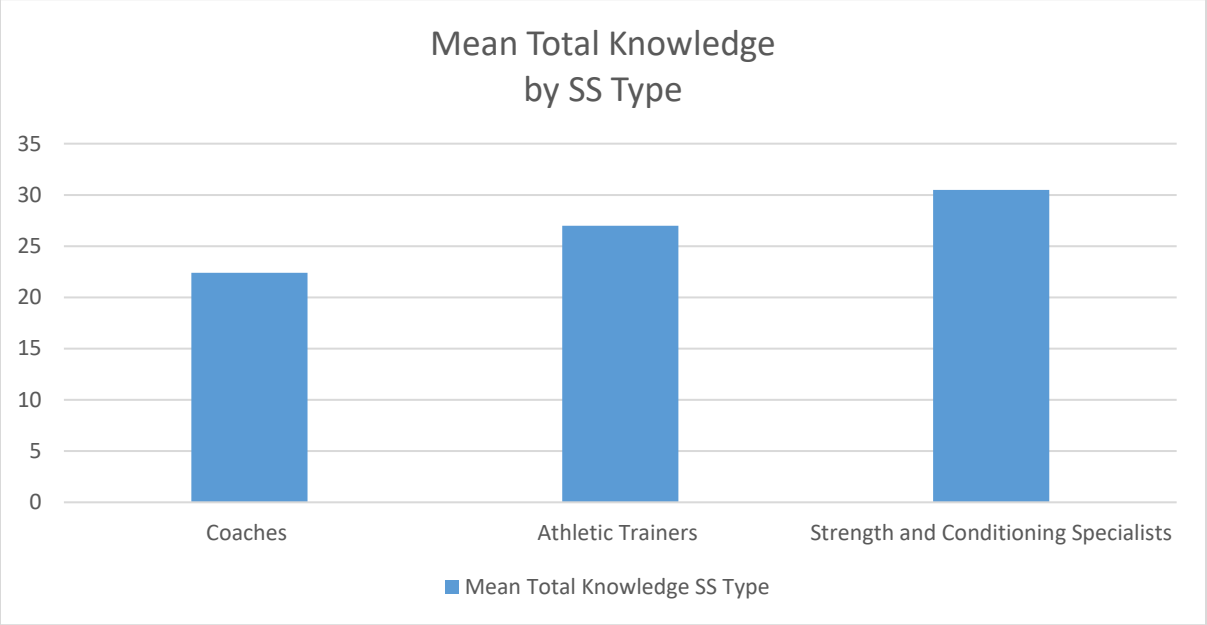



Figure 2 below shows that Strength and Conditioning Specialists scored greater overall (x=30) compared to the other two groups (ATs, x=26; coaches, x=22). The results, shown in this graph, from coaches may not adequately reflect coaches overall because only two coaches fully completed the questionnaire.

**Figure 2**

Mean Total Knowledge by Sport Staff Classification




The final research question was whether results indicate a need for nutrition education for collegiate coaches, ATs, and SCSs based on their nutrition knowledge scores. While overall this is seemingly the case, only SCSs scored at a passing rate greater than 75%. Final mean scores of sports staff came in as 61% from coaches, 72% from ATs and 83% from SCSs, indicating the need for further nutrition education for both coaches and athletic trainers.

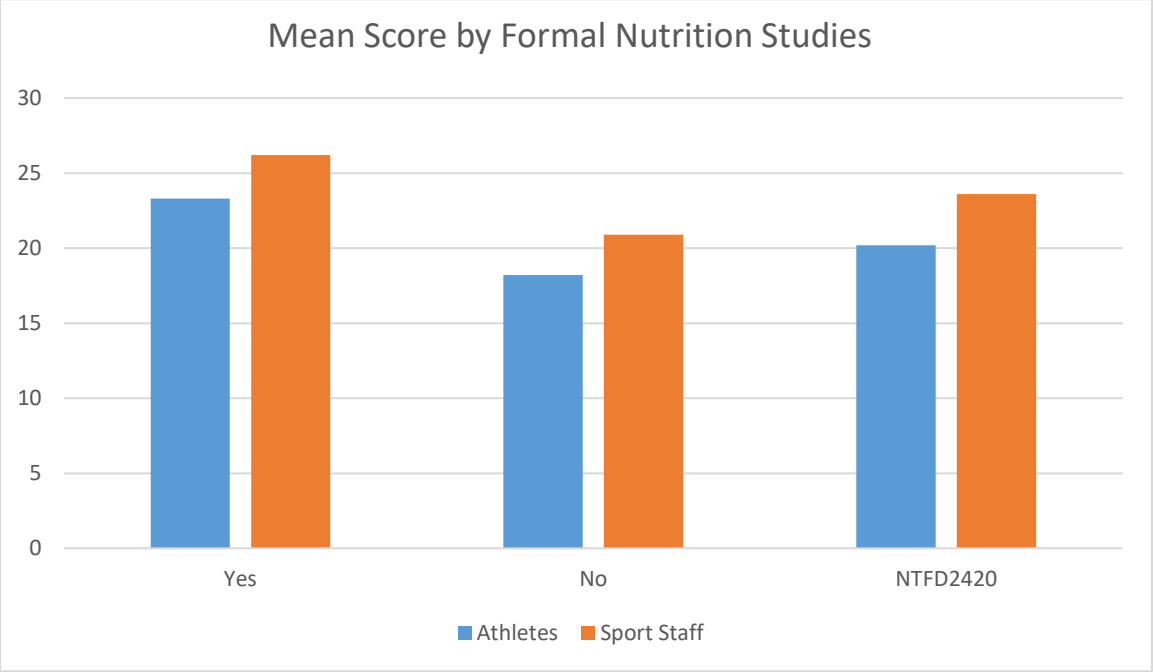
Other interesting similarities among variables were found. A demographic question about self-perceived weight was considered of interest to study staff, due to how sport staff viewed themselves and how student-athletes did. From self-reported height and weight, body mass index (BMI) was calculated for each participant. Only one of twenty-eight student-athlete participants considered themselves "underweight" and only three considered themselves "overweight." Athletes that have BMI's that would technically be considered "underweight" or "overweight/obese" reported they perceived themselves as "at a healthy weight." When

comparing this to sport staff (n=30), eight considered themselves “overweight” and none considered themselves “underweight”. Only one sport staff participant responded as considering themselves “obese.” This is interesting because like athlete participants, those with a BMI considered to be underweight, overweight or obese, regarded themselves “at a healthy weight.” This could be considered a result of a positive outlook in the world of sports, when most athletes feel the need to be “bigger”, “stronger”, “thinner” or “more toned.”

Formal nutrition education was also found to be of interest in the findings of this study. Comparisons of any type of nutrition education versus none at all showed significance between score outcomes as shown below in Figure 3. Also, those that took NTFD 2420 (an introductory, Principles of Nutrition course taught at ETSU) were grouped separately from those that did not. Their scores were intermediate between those with other types of nutrition education and those without any. Athletes and coaching staff with nutrition education scored higher overall than both categories.

**Figure 3**

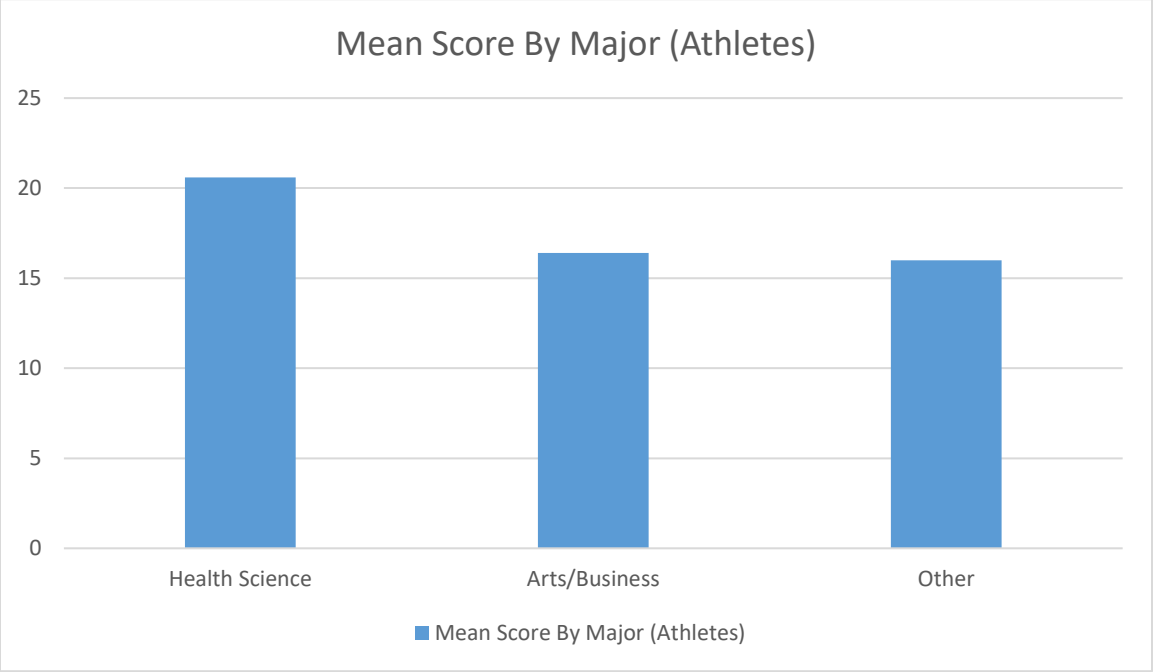
Mean Score by Formal Nutrition Studies: Sports Staff and Athletes




Like formal nutrition education, groupings found from student participants in a health science-related major of study compared to those that are not were deemed interesting. Those in a health science-related major on average scored (x=20.5) greater than those in Arts and Business majors (x=16). This can be seen in Figure 4.

**Figure 4**

Mean Scores by Major- Athletes




The total nutrition knowledge of sport staff and athletes was compared and showed significant correlation between the two groups to be 35%. Separately, general nutrition knowledge and sport nutrition knowledge had a strong correlation of 29% and 35%, respectively. Mean scores between teams and the need for nutrition education for sport staff were statistically evaluated but due to sample size, were unable to be found significant. Study staff is unable to determine whether sport staff nutrition knowledge directly affects that of their athletes.

Implementing a combined questionnaire consisting of parts of the General Nutrition Knowledge Questionnaire (Parmenter & Wardle, 1999), Sports Nutrition Knowledge Questionnaire (Trakman et al., 2016), and the Nutrition Knowledge of Collegiate Athletes regarding Dietary Practices Related to Performance study (Rosenbloom et al., 2012) to include collegiate athletes in the United States, allowed researchers to fill gaps in previous research. Based on past questionnaires (Dunn et al., 2007), where male and female athletes' mean scores

were recorded as average, this study found that the average score among athlete participants was slightly higher, at 53%. Though, this is higher than past studies, there is still room for improvement on the nutrition education and knowledge of student-athletes.

This study strived to show better nutrition knowledge of the sports staff at ETSU than those in other studies. Torres-McGehee et al. (2012) reported higher nutrition knowledge scores between coaches, strength and conditioning specialists and athletic trainers. From our research, coaches scored an average of 61%, ATs scored 72% and SCSs scored highest at 83%. Our study did follow the trend of SCSs scoring the highest, coaches scoring the least and ATs falling somewhere in the middle, though ATs did not perform as well on this study, compared to previous studies.

## Chapter 5. Conclusions

This study was conducted to explore the nutrition knowledge levels of student-athletes and sport staff. Rosenbloom in 2002 reported that athletes had common nutrition misconceptions that further impacted their dietary choices. Even though the athletes that participated in this study scored above average, there is still uncertainty of the impact it has on their performance. Researchers were able to conclude that knowledge among sports staff did not adequately translate to their athletes' scores, as evidenced by athletes scoring much lower than their staffing counterparts. One survey question asked if the participant would be interested in receiving further nutrition education and of the 26 sport staff participants, 22 stated they would. This shows that although sport staff scored adequately overall, they still feel they need additional nutrition education. This may indicate that sport staff understand the importance of their nutrition knowledge and the potential for how it impacts their athletes' performance.

### Limitations

This study was limited in participants due to the inability for study staff to personally reach out to both potential participant populations. The COVID-19 pandemic disrupted typical research study protocols by reducing in-person contact with student-athletes and coaching staff. Initially, the survey was meant to be distributed in early August 2020 in order to give participants ample time to complete. The restrictions of COVID-19 did not allow us to contact athletes until August 15$^{th}$ which decreased the survey completion time by two weeks. The recruitment strategy changed as well. Previously, study coordinators planned to speak to students on the importance of nutrition in sports and ask them to complete the 52-question survey. Because ETSU COVID-19 restrictions prevented direct contact, study staff was unable

to recruit as many participants as hoped. Due to this, the study sample size was much smaller and did not allow statistical significance to be tested.

Survey results were varied due to both athletes and sports staff exiting the questionnaire before completion and preventing complete results to be reported. By only filling out the demographic information and none or few of the nutrition knowledge questions, the study sample size was decreased. Though this is typical among online survey studies, it is considered a limitation to this study because of its detriment to the statistical testing of the data.

## Future Research

If this study were to be replicated in the future, there would need to be some alterations. First, the sample size would need to be larger to heed more significant results and to allow the results to be generalizable. This can be easily achieved with the study staff's ability to contact participants to explain the importance and benefits of participating in the study. Implementing this study at a larger university with a sports dietitian on staff would be interesting to test if athlete nutrition knowledge scores would be greater than at a smaller university without a sports dietitian on staff. Implementing the study at different universities in various geographical regions and athletic conferences could possibly report some interesting findings. Future research with modifications to this study could provide a clearer understanding of whether student athletes receive nutrition advice or information from the same sport staff.

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# APPENDICES

## Appendix A: Survey—Sports Staff

**Demographics**

1. What is your age?
    a. 18-25
    b. 26-35
    c. 36-45
    d. 46-55
    e. 56-65
    f. 66 or older

2. What is your job title?
    a. Coach
    b. Athletic Trainer
    c. Strength and Conditioning Coach
    d. Other: _____

3. What is your sex?
    a. Male
    b. Female
    c. Other:_____

4. What is your height (inches)? _____

5. What is your weight (pounds)? _____

6. Do you consider yourself to be:
    a. Underweight
    b. At a healthy weight
    c. Overweight
    d. Obese

7. Rate your overall diet quality:
    a. Below average
    b. Average
    c. Above average

8. On average, how many hours per week do you work with athletes?

9. What sport(s) do you manage?

10. What is your highest level of education?
    a. High school
    b. College
    c. Graduate
    d. Doctorate
    e. Other:

11. Have you ever completed any formal studies of nutrition?
    a. Yes; list/describe:_____
    b. No

12. Have any of these individuals ever asked you for advice in regards to nutrition? Circle all that apply.
    a. Athletes
    b. Other coaches/trainers
    c. Students
    d. Other:_____

13. Does the organization you are part of provide you with any access to nutrition information or nutritionists/dietitians?
    a. Yes, nutrition info only
    b. Yes, nutrition info and access to nutritionists/dietitians
    c. Neither of the above

14. Are you following a special diet or eating pattern?
    a. Yes; list/describe_____
    b. No

15. Where do you receive most of your nutrition/diet information? (Select all that apply)
    a. Academic courses
    b. Magazines/books
    c. Scientific journals/articles
    d. Dietitian
    e. Physician or other healthcare providers
    f. Other athletes
    g. Coaches, athletic trainers, strength and conditioning specialists
    h. Sports organizations
    i. Internet/media

**General Nutrition Knowledge Questions**

16. Carbohydrate and fat are the body's main energy source.
    a. True
    b. False

c. Not sure

17. Eating carbohydrates makes you fat.
    a. True
    b. False
    c. Not sure

18. Protein is the main energy source for the muscle
    a. True.
    b. False
    c. Not sure

19. Glycogen is carbohydrate stored in the muscle.
    a. True
    b. False
    c. Not sure

20. Fats have important roles in the body.
    a. True
    b. False
    c. Not sure

21. Alcohol consumption can affect absorption and utilization of nutrients.
    a. True
    b. False
    c. Not sure

22. Skipping meals is justifiable if you need to lose weight quickly.
    a. True
    b. False
    c. Not sure

23. One gram of carbohydrate provides _____ calories?
    a. 4
    b. 5
    c. 7
    d. 9
    e. Not Sure

24. One gram of protein provides _____ calories?
    a. 4
    b. 5
    c. 7
    d. 9
    e. Not Sure

25. One gram of fat provides ____ calories?
    a. 4
    b. 5
    c. 7
    d. 9
    e. Not Sure

26. Vitamins and minerals provide energy (calories).
    a. True
    b. False
    c. Not sure

27. The only sources of protein are animal sources.
    a. True
    b. False
    c. Not sure

28. All supplements are tested to make sure they are safe and do not have contamination.
    a. True
    b. False
    c. Not sure

29. Iron in meat is absorbed at the same rate as iron in a plant food.
    a. True
    b. False
    c. Not sure

**Sport Nutrition Knowledge Questions**

30. Hydration status has an impact on athletic performance.
    a. True
    b. False
    c. Not sure

31. Sports drinks are better than water.
    a. True
    b. False
    c. Not sure

32. Athletes should replace fluids before, during and after an event.
    a. True
    b. False
    c. Not sure

33. An athlete should rely on thirst to ensure fluid replacement.
    a. True
    b. False

c. Not sure

34. Increasing protein in the diet is the main dietary change needed when only muscle gain is desired.
    a. True
    b. False
    c. Not sure

35. Which is the best recovery meal option for an athlete who wants to put on muscle?
    a. A "mass gainer" protein shake
    b. Pasta with lean beef and vegetable sauce, plus a piece of fruit, yogurt and nuts
    c. A large piece of grilled chicken with a side salad (lettuce, cucumber, tomato)
    d. A large steak and fried eggs
    e. Not sure

36. Which do you think is the best lunch option for an athlete trying to lose weight? Assume they are eating an appropriate breakfast and dinner.
    a. A side salad with no dressing (lettuce, tomato, cucumber)
    b. A pure whey protein isolate shake made with water
    c. A mixed meal that includes a small to moderate serving of meat and carbohydrate (e.g. small bowl of pasta with lean meat and vegetable sauce) plus a large side salad

37. Eating extra protein foods or taking amino acid supplements will help make bigger and stronger muscles.
    a. True
    b. False
    c. Not sure

38. Vitamin supplementation is recommended for all physically active people.
    a. True
    b. False
    c. Not sure

39. A physically fit person eating a nutritionally adequate diet can improve performance by eating more vitamins and minerals.
    a. True
    b. False
    c. Not sure

40. Iron tablets should be taken when an athlete feels extremely tired and is pale.
    a. True
    b. False
    c. Not sure

41. Creatine reduces perceived effort of exercise by acting on the central nervous system.

a. True
b. False
c. Not sure

42. Before competition, athletes should eat foods that are high in:
    a. Fluids, fat and carbohydrates
    b. Fluids, fiber and carbohydrates
    c. Fluids and carbohydrates
    d. Not sure

43. Athletes should consume high-fat meals 2 to 3 hours before a competition:
    a. True
    b. False
    c. Not sure

44. Males and females of the same age burn equal amounts of calories during the same exercise.
    a. True
    b. False
    c. Not sure

45. Basic sugars like table sugar, jam, and honey are the most suitable energy sources for athletes.
    a. True
    b. False
    c. Not sure

46. In events lasting 60-90 minutes, 30-60g of carbohydrates should be consumed per hour.
    a. True
    b. False
    c. Not sure

47. Protein is the main source of energy used by muscles during exercise:
    a. True
    b. False
    c. Not sure

48. Athletes should not consume more than 20g of fat per day.
    a. True
    b. False
    c. Not sure

49. When exercising at low intensities, fat provides almost all the energy needs.
    a. True
    b. False
    c. Not sure

50. Which is the best snack to have during an intense 90-minute training session?
    a. A ripe banana
    b. 2 boiled eggs
    c. A handful of nuts
    d. Not sure

51. After a competition, athletes should aim to consume foods that are high in which macronutrient/s?
    a. Protein, carbohydrate and fat
    b. Only protein
    c. Only carbohydrate
    d. Carbohydrate and protein
    e. Not sure

Would you be interested in participating in any nutrition education courses?
    a. Yes
    b. No

Appendix B: Survey—Athletes

**Demographics**

1. What is your age?
    a. 18-25
    b. 26-35
    c. 36-45
    d. 46-55
    e. 56-65
    f. 66 and older

2. What is your current classification?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Graduate Student

3. What is your sex?
    a. Male
    b. Female
    c. Other:_____

4. What is your height (inches)? _____

5. What is your weight (pounds)? _____

6. Do you consider yourself to be:
    a. Underweight
    b. At a healthy weight
    c. Overweight
    d. Obese

7. How many hours per week do you train? _____

8. What sport do you play? _____

9. Where do you eat most of your meals?
    a. On campus
    b. At home; either self-made, parent, or significant other
    c. Fast food/take-out
    d. Other:_____

10. Rate your overall diet quality:
    a. Below average
    b. Average
    c. Above average

11. What is your major or program of study? _____

12. Have you ever completed any formal studies of nutrition?
    a. Yes;
    b. If yes; list/describe:_____
    c. NTFD2420
    d. No

13. Have any of these individuals ever given you nutrition advice? (Select all that apply)
    a. Team-mates/other athletes
    b. Coaches, Athletic Trainers, Strength and Conditioning Specialists
    c. Dietitian/nutritionist
    d. Physician or other healthcare provider
    e. Friends
    f. Family
    g. Online (websites, social media)
    h. Other: _____

14. Does the organization you are part of provide you with any access to nutrition information or nutritionists/dietitians?
    a. Yes, nutrition info only
    b. Yes, nutrition info and access to dietitians/nutritionists
    c. Neither of the above

15. Are you following a special diet or eating pattern?
    a. Yes; list/describe_____
    b. No

16. Where do you receive most of your nutrition/diet information? (Select all that apply)
    a. Academic courses
    b. Magazines/books
    c. Scientific journals/articles
    d. Dietitian
    e. Physician or other healthcare providers
    f. Other athletes
    g. Coaches, athletic trainers, strength and conditioning specialists
    h. Sports organizations
    i. Internet/media

**General Nutrition Knowledge Questions**

17. Carbohydrate and fat are the body's main energy source.
    a. True
    b. False
    c. Not sure

18. Eating carbohydrates makes you fat.
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Would you be interested in participating in any nutrition education courses?
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    b. No

# VITA

## ALEXA CARBONE

| | |
|---|---|
| Education: | M.S. Clinical Nutrition, East Tennessee State University, Johnson City, Tennessee, 2021 |
| | Didactic Program in Dietetics (DPD), Lipscomb University, Nashville, Tennessee, 2019 |
| | B.S. Family and Child Sciences, Florida State University, Tallahassee, Florida, 2016 |
| Professional Experience: | Dietetic Intern, East Tennessee State University, Johnson City, Tennessee, 2019-2021 |
| | Graduate Assistant, East Tennessee State University, College of Health Sciences, 2019-2020 |