The Impact of Sports Dietitians on Nutrition Knowledge and the Prevalence of Relative Energy Deficiency in Sport (RED-S) in Collegiate Athletes

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THE IMPACT OF SPORTS DIETITIANS ON NUTRITION KNOWLEDGE AND THE PREVALENCE OF RELATIVE ENERGY DEFICIENCY IN SPORT (RED-S) IN COLLEGIATE ATHLETES

by

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ABSTRACT

Background: Nutrition plays a critical role in an athlete’s performance, recovery, and overall health, but previous research has shown that many athletes fail to meet their nutritional needs. Furthermore, the failure to meet energy needs may result in a condition known as relative energy deficiency in sport (RED-S). Current literature on RED-S highlights the adverse effects inadequate fueling can have on an athlete’s performance. Fortunately, there has been an influx in the number of registered dietitian nutritionists (RDNs) working in collegiate athletics, and it is hypothesized that sports RDNs can further support athletes by showcasing proper fueling strategies to minimize the risk of RED-S.

Objectives: To assess the relationship between sports nutrition knowledge, RED-S risk, and access to a sports RDN in collegiate athletes from NCAA Division I and Division III universities in Georgia.

Methods: Collegiate athletes and athletic staff were recruited to complete a web-based questionnaire. Nutrition knowledge was assessed using a 20-question sports nutrition knowledge questionnaire (SNKQ). Athletes were also asked to complete the six question disordered eating screen in athletes (DESA-6) to determine risk for RED-S.

Results: A total of 34 participants (n = 25 collegiate athletes, n = 9 athletic staff) completed the study. Mean total SNKQ score was 69.8 ± 16.5% for athletes and 70.6 ± 12.4% for athletic staff. Both athletes and staff scored the lowest in the supplement sub-section (66.7% (50.0), 66.7% (50.0), respectively) and the highest in the weight-management sub-section (80.0% (30.0), 80.0% (40.0), respectively). Four athletes scored ≥ 3 on the DESA-6, indicating disordered eating and elevated risk for RED-S. A significant negative correlation was found between DESA-6 scores and total SNKQ score (p = 0.01, r = -0.50), micro- and macronutrient sub-score (p < 0.05, r = -0.35), and weight management sub-score (p = 0.00, r = -0.55). No significant differences were found in SNKQ scores or DESA-6 scores between participants attending a university with a full-time sports RDN versus those without (p > 0.05). However, athletes and staff who reported previous nutrition education scored significantly higher than those who had not.

Conclusions: Collegiate athletes and athletic staff have overall inadequate sports nutrition knowledge, but improvements have been made, particularly in knowledge of hydration and weight-management. Relative energy deficiency in sport remains a concern in the athlete population, and inadequate knowledge may result in an increased risk due to lack of awareness of proper fueling strategies. Athletic departments may better support their athletes by hiring full-time sports RDNs who can educate and empower athletes to utilize nutrition as a means to improve health, better athletic performance, and gain a cutting edge over their opponent.

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ABBREVIATIONS

ACSM: American College of Sports Medicine
AT: Athletic Trainer
BEDA-Q: Brief Eating Disorder in Athletes Questionnaire
CSSD: Certified Specialist in Sports Dietetics
DESA-6: Disordered Eating Screen for Athletes
EDE-Q: Eating Disorder Examination Questionnaire
EDI: Eating Disorder Inventory
EHMC: Exercise Hypogonadal Male Condition
ESP: Eating Disorder Screening for Primary Care
FDA: Food and Drug Administration
FFM: Fat Free Mass
IOC: International Olympic Committee
IRB: Institutional Review Board
ISSN: International Society of Sports Nutrition
KSU: Kennesaw State University
LEA: Low Energy Availability
LEAF-Q: Low Energy Availability in Females Questionnaire
NCAA: National Collegiate Athletic Association
RDA: Recommended Daily Allowance
RDN: Registered Dietitian Nutritionist
RED-S: Relative Energy Deficiency in Sport
RED-S CAT: RED-S Clinical Assessment Tool
RST: RED-S Specific Screening Tool
SCS: Strength and Conditioning Specialist
SEAQ-I: Sport-Specific Energy Availability Questionnaire and interview
SD: Standard Deviation
SNKQ: Sports Nutrition Knowledge Questionnaire
TDEE: Total Daily Energy Expenditure
TFEQ: Three-Factor Eating Questionnaire
TPB: Theory of Planned Behavior
CHAPTER I

INTRODUCTION

Competing in varsity sports at the collegiate level is no easy task. Student-athletes are expected to balance high-level academics and athletics, while also facing social demands, financial challenges, and the underlying transition into adulthood.\textsuperscript{1} Through all of this, it is common for athletes to neglect their nutritional needs. It is well known that nutrition is imperative for peak athletic performance, but studies have shown that athlete sports nutrition knowledge is often inadequate.\textsuperscript{2-13} Furthermore, inadequate nutrition knowledge can be negatively associated with dietary intake.\textsuperscript{4,8,12} Athletes have increased energy and nutrient needs, and the failure to meet these needs through dietary measures may result in a condition now referred to as relative energy deficiency in sport (RED-S).\textsuperscript{14,15}

Consistent inadequate dietary intake can lead to a host of issues that can ultimately impair performance.\textsuperscript{15} Due to the correlations between athlete nutrition knowledge, dietary intake, and performance, researchers suggest that by increasing athletes’ nutrition knowledge, dietary intake will improve, and thus, lead to better performance. A 2021 narrative review by Riviere \textit{et al.}\textsuperscript{16} found that the presence of a registered dietitian nutritionist (RDN) is associated with improvements in dietary intake among student athletes. Though there has been a recent increase in the number of sport specific RDNs, these experts are currently only available at select universities. We hypothesize that the presence of a sports RDN is correlated with not only increased nutrition knowledge but also better dietary intake and a lower risk of RED-S. To test this hypothesis, we propose the following specific aims:
Specific Aim 1: Assess nutrition knowledge of collegiate athletes from NCAA Division I and Division III universities in Georgia. To achieve this aim, collegiate athletes were asked to complete a web-based sports nutrition knowledge questionnaire (SNKQ) developed by Dr. Torres-McGehee.³

Specific Aim 2: Determine the risk of RED-S among collegiate athletes from NCAA Division I and Division III universities in Georgia. To achieve this aim, athletes were asked to answer the Disordered Eating Screen for Athletes (DESA-6) questionnaire.

Specific Aim 3: Examine the relationship between sports nutrition knowledge, RED-S risk, and access to a sports RDN in collegiate athletes from NCAA Division I and Division III universities in Georgia. To achieve this aim, knowledge scores and DESA-6 scores were compared among multiple groups to determine correlations and differences in means.

Data obtained from this study was used to identify nutrition knowledge and the risk of RED-S among collegiate athletes to determine whether any correlations among these outcomes exist. Additionally, data was also used to evaluate the impact of a sports RDN on nutrition knowledge and the risk of RED-S. Given the proximity of athletes and their support staff, coaches, athletic trainers (ATs), and strength and conditioning specialists (SCSs) were also asked to complete the nutrition knowledge questionnaire. An understanding of the impact of sports RDNs and the relationship between nutrition knowledge and RED-S risk is suggested to help colleges and universities better support their teams and improve overall performance and sporting outcomes within the athletic department.
CHAPTER II

REVIEW OF THE LITERATURE

Collegiate athletes are faced with immense physical, mental, and emotional demands that necessitate proper nutrition for adequate fueling.\textsuperscript{1,14} Though dietary habits are known to play a critical role in athletic performance, recovery, and overall health, many athletes fail to meet their nutritional needs.\textsuperscript{17-20} Previous studies on athlete dietary intake and nutrition knowledge indicate a gap between research and practice.\textsuperscript{4,8,12,18} More athletes are exposed to the risks of RED-S, and it is imperative to provide the appropriate education and interventions to mitigate the prevalence of under fueling. The plethora of RDNs who are beginning to specialize in sports nutrition provides a unique opportunity to educate and empower athletes to fuel for their individual needs.\textsuperscript{16} This literature review aims to explore the barriers associated with proper fueling in the collegiate athlete population and how they have impacted dietary intake and nutrition knowledge. Additionally, the prevalence and risks of improper fueling and inadequate knowledge are highlighted along with the role of a RDN in minimizing these risks and improving overall athletic performance through enhanced dietary measures.

2.1 Collegiate Athletes

Nearly eight million students in the United States currently participate in high school athletics, but of those, only about 7\% make it to the collegiate level and only 2\% to the National Collegiate Athletic Association (NCAA) Division I level.\textsuperscript{21} Those who do compete at the NCAA Division I level spend a median of 33 hours a week practicing, training, and competing in their designated sport.\textsuperscript{21} In addition to physical demands, athletes are also required to maintain good academic standing and are encouraged to engage in an array of extracurricular activities to expand
their professional network and socialize amongst their peers. The demands placed on collegiate athletes make recovery and performance top priority. It is well-known that a healthy diet supports performance and recovery, yet many athletes still fail to meet their nutritional needs.\textsuperscript{17-20}

Brauman \textit{et al.}\textsuperscript{22} identified the five most significant barriers to healthy eating in collegiate student-athletes as time, cost, access to food, frequency of travel, and lack of nutrition knowledge. The most frequently cited barriers were easy access to unhealthy foods (56% of participants), lack of time (55% of participants), and high costs of healthy foods (46% of participants).\textsuperscript{22} In another study by Karpinski and Milliner\textsuperscript{23}, the constructs of the Theory of Planned Behavior (TPB) were used to identify barriers of healthful eating in Division II collegiate athletes. A similar result was found with primary barriers being easy access to low-quality, energy dense food and a demanding schedule that makes it challenging to find time to grocery shop and prepare healthy meals at home. Additionally, athletes identified social situations and newly found independence as having an influence on their food choices and dietary intake.\textsuperscript{23} Understanding the challenges collegiate athletes face is critical in providing beneficial education and interventions to improve nutrition knowledge and dietary intake.

\textit{2.2 Nutrition Intake}

It is evident that athletes have increased energy expenditure compared to the normal adult population. Energy balance is one of the primary goals of sports nutrition, and this occurs when energy input is equal to energy output.\textsuperscript{14,24} Basal metabolic rate, the thermic effect of food, and the thermic effect of activity all contribute to total daily energy expenditure (TDEE), and depending on the sport, season, and type of training, athlete energy output may vary considerably.\textsuperscript{24} In a 2021 study by Moon \textit{et al.},\textsuperscript{25} energy expenditure during scheduled daily activities was compared between NCAA Division II female basketball and lacrosse players. Total daily activity energy
expenditure was found to be significantly different between practices, games, conditioning, and off days in both sports. Overall, though, TDEE was greater in basketball players independent of the scheduled activity \((p = 0.00)\).

This is just one of many examples illustrating the differences in energy expenditure not only between different scheduled activities but also between athletes competing in different sports.

Significant associations have been found between adequate energy intake and performance, and the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine (ACSM) have highlighted the importance of proper nutrition in enhancing athletic performance and recovery from sporting activities. Nutritional strategies, such as the type, amount, and timing of food, fluids, and supplements can influence athletic performance and promote optimal growth, recovery, and injury risk reduction.

A recent study published in 2021 reviewed the literature on nutritional strategies for basketball players and suggested that sleep, protein, carbohydrates, and fluids are foundational components of performance that should be emphasized to promote recovery and minimize injury risk. Despite the known correlations between nutrition, performance, and recovery, there appears to be a gap between knowledge and practice.

Because sports nutrition is a constantly evolving field, the Journal of the International Society of Sports Nutrition (ISSN) works to identify emerging research and provide updated sports nutrition guidelines and recommendations for athletes. The ISSN currently highlights general dietary guidelines for active individuals and places adequate energy intake as top priority. Moderately active individuals engaging in less than 60 minutes of exercise a day three times per week may only need 25-35 kilocalories per kilogram of bodyweight \((\text{kcal/kg/BW})\), while an athlete engaging in 2-3 hours of moderate to high-intensity exercise on 5-6 days a week may need upwards...
of 70 kcal/kg/BW a day. Additional recommendations for protein, carbohydrate, and fat distribution are provided but vary depending on the type of athlete and what season of training they are in. Strength-based athletes, for example, may need 5-8 grams of carbohydrates per kg/bw while an endurance athlete may need 8-10 grams of carbohydrates per kg/BW. Protein needs are also elevated in athletes with the typical range falling between 1.2 and 2.0 g/kg/BW. Specific micronutrient needs and proper timing of ingestion are also important facets of sports nutrition that can play an integral role in athletic outcomes.

Inadequate energy, and more specifically, inadequate carbohydrate intake has been reported in several studies assessing collegiate athlete dietary intake. A study by Abbey et al. assessed dietary intake of NCAA Division III football players and found that over half of participants consumed starches, grains, meat, and dairy daily, but less than half consumed fruits and vegetables daily. Additionally, linemen consumed high amounts of total fat, saturated fat, cholesterol, sodium, and potassium, but low amounts of carbohydrates, fiber, and essential fat. In a similar study, Gomez-Hixson et al. found total energy, carbohydrates, and dietary fiber to be below recommended levels for NCAA Division III soccer players; however, added sugar and total fat were above recommended levels. Likewise, Beerman et al. found carbohydrate intake to be inadequate in 73% of the endurance runners studied, and Shirver et al. found 75% of female collegiate athletes from a NCAA Division I university failing to consume the minimum amount of carbohydrates needed to support their training.

In addition to inadequate energy and carbohydrate intake, athletes are also prone to inadequate micronutrient intake. Vitamin D, calcium, and iron are critical to athletic performance but are often found to be inadequate in the collegiate athlete population. Calcium and vitamin D play a significant role in bone health, and when deficient, can increase the risk of
fractures and other bone-related injuries. Condo et al. studied female Australian rules football players and found iron and calcium intakes to be inadequate in 100% and 65.5% of players, respectively, when compared to current athlete recommendations. Endurance runners from the Beerman et al. study were also found to have insufficient calcium and vitamin D intakes. Fifty percent of women and 24% of men did not meet the recommended daily allowance (RDA) for calcium, and 95% of all participants did not meet the RDA for vitamin D. In contrast, the RDA for iron was met in 100% of men and 75% of women, but this is likely a result of over half of the participants reporting use of an iron supplement.

Though supplements may be useful in times of deficiency, the widespread use of supplements in the athlete population is a growing topic of concern. Dietary supplements consist of any products that are taken by mouth and intended to supplement intake of whole foods. They may come in the form of vitamins, minerals, fatty acids, amino acids, herbs, and botanicals, or as substrates and enzymes. They may be found as tablets, powders, soft gels, or liquids, and they can be readily purchased at grocery stores, convenience stores, and specialty stores. One of the main concerns surrounding the use of supplements in the athlete population is that they may expose athletes to dangerous ingredients, banned substances, toxins, or contaminants. Unlike conventional foods and drug products, dietary supplements are not regulated under the same Food and Drug Administration (FDA) guidelines. Athletes choosing to use supplements are encouraged to look for products that are third-party tested to ensure no banned substances are found in the product. The International Olympic Committee (IOC) has taken a stand in response to supplement use in athletes and has agreed that supplements may enhance performance but only if they are utilized in a safe and healthy manner under expert knowledge.
In a 2020 cross-sectional study by Barrack et al.,\textsuperscript{32} habitual use of dietary supplements in NCAA Division I athletes was investigated and showed that 45.2% of athletes reported taking supplements at least two days a week over the past year. The most common supplements were vitamins, minerals, and protein/amino acids. In another study of NCAA Division I collegiate athletes, 100% of the athletes studied (n = 138) reported using a dietary supplement or sports food at least once within the last 12 months.\textsuperscript{33} Of even more concern, 66% of the athletes purchased and used supplements that were not provided by the athletic department, and only 57% of the athletes stated that the supplements they bought were third-party tested. In the same study, nutrition knowledge surrounding supplements was found to be poor with a median score of 25%.\textsuperscript{33} Likewise, a study by Froiland et al.\textsuperscript{34} reported supplement use in 89% of subjects. When asked about sources of information about supplements, female athletes were likely to report family members as a source of information, while male athletes reported store nutritionists, fellow athletes, friends, and coaches as their top sources.\textsuperscript{34}

\textbf{2.3 Energy Availability}

A major consequence of inadequate energy intake is low energy availability (LEA). Formerly known as the female athlete triad, RED-S is the syndrome experienced by both male and female athletes who have impaired physiological functioning resulting from relative energy deficiency.\textsuperscript{14} The foundation of the syndrome is LEA, which reflects the difference between energy intake and energy expenditure.\textsuperscript{35} There is no gold standard measure of LEA, but it is often diagnosed with the use of validated questionnaires or an energy intake of less than 30 kcal/kg of fat free mass (FFM) per day.\textsuperscript{35,36} The mismatch between energy intake and expenditure can occur intentionally to meet optimal or desired body mass or body composition, or it may occur unintentionally as a result of insufficient dietary intake.\textsuperscript{37} Regardless of the etiology, LEA is
associated with impairments in metabolic rates, menstrual function, bone health, immunity, protein synthesis, and cardiovascular health, all of which can contribute to impaired athletic performance.\textsuperscript{14,35,36}

As discussed previously, many athletes fall short of their recommended dietary needs. Most of the previous research involving RED-S has focused efforts on female athletes, but more recent research has included male athletes to highlight the effects in all athlete populations. Similar consequences are experienced by both sexes. While females often experience menstrual dysfunction with LEA, males may experience a similar suppression of reproductive function with a condition known as exercise hypogonadal male condition (EHMC).\textsuperscript{37} With EHMC, there is a decrease in luteinizing hormone and testosterone levels that can have an impact on libido and muscular strength and endurance. Though the triad consisting of LEA, decreased bone mineral density, and suppressed reproduction function was originally thought to primarily effect female athletes, new evidence suggests that the triad is prevalent in both sexes and results in similar impairments that have a significant negative association with physiological functioning, and thus, athletic performance.\textsuperscript{37}

Given the known consequences of LEA, it is imperative that athletes reverse the symptoms as soon as possible. Because there is no standardized assessment or diagnostic criteria for RED-S or LEA, various questionnaires have been developed with some validated in the athlete population. Unfortunately, though, many of the questionnaires are specific to female athletes and are unable to be applied to the broader population. Sim and Burns \textit{et al}.\textsuperscript{38} systematically reviewed the numerous questionnaires developed to measure RED-S or LEA risk in athletes, and 33 articles were reviewed with 13 total questionnaires identified. Only 8 of the questionnaires have been validated in athletes, and the most widely used questionnaires were the Low Energy Availability
in Females Questionnaire (LEAF-Q) and the Eating Disorder Examination Questionnaire (EDE-Q). Other validated questionnaires include the Brief Eating Disorder in Athletes Questionnaire (BEDA-Q), the Eating Disorder Inventory (EDI) – Drive for Thinness (DT) score, the Eating Disorder Screening for Primary Care (ESP), the RED-S Specific Screening Tool (RST), the Sport-Specific Energy Availability Questionnaire and Interview (SEAQ-I), the Three-Factor Eating Questionnaire (TFEQ), and most recently, the Disordered Eating Screen for Athletes (DESA-6).

In a 2020 review by Logue et al., the prevalence of LEA in various sports ranged from 22% to 58%. A similar result was found when investigating the risk of LEA with the prevalence ranging from 14% to 63%. In a 2020 study by Magee et al., 18 NCAA Division III collegiate female soccer athletes were assessed using a combination of the LEAF-Q and 3-day dietary records to determine prevalence of LEA. The LEAF-Q tool identified 53.7% of athletes at risk of LEA while the dietary recall found 67% of them to have LEA with a mean energy availability of 27.5 ± 8.9 kcal/kg FFM/day, which is below the threshold of 30 kcal/kg FFM/day that is used to classify those with LEA. In another study using the LEAF-Q to determine RED-S risk, collegiate long-distance runners from North Dakota State University were recruited for participation. Risk was determined by a score of 8 or higher on the LEAF-Q, and the mean score of all female participants was 8.38 ± 4.82. In addition to RED-S risk, the study also investigated injury risk and determined that athletes who are at risk for RED-S have a greater chance of reporting a higher number of injuries.

Compulsive exercise and disordered eating are leading causes of LEA and RED-S and are often more pronounced in athletes competing in aesthetic or weight-based sports, such as wrestling, cross-country, and figure skating. Psychological factors such as stress, anxiety, depression, and the pressure to perform may also contribute to disorderly eating and excessive
The reported prevalence of LEA in track and field athletes can range between 18% and 58% with the highest prevalence occurring in athletes competing in endurance and jump events. Impaired bone health, increased risk of injury, and hypothalamic amenorrhea are found to be common among female track and field athletes as evidenced by nearly 60% of elite middle- and long-distance athletes reporting menstrual dysfunction. In a study of disordered eating in female physique athletes, nearly half (46.6%) of participants identified with disordered eating through the use of validated questionnaires, such as the EDI and TFEQ. Male athletes are also susceptible to eating disorders, and in 2020, a scoping review by Karrer et al. indicated an eating disorder prevalence of up to 32.5% in elite male athletes with the highest prevalence occurring in weight-sensitive sports. Systematic reviews of disordered eating in athletes continue to highlight the risk associated with sports emphasizing leanness as a competing factor. Endurance, aesthetic, and weight-dependent sports, such as track, cycling, swimming, gymnastics, dance, figure-skating, and wrestling have shown significantly higher rates of eating disorders and an increased risk of RED-S and its accompanying consequences.

With the lack of a standard screening process, many of the symptoms of RED-S may get overlooked, increasing the risk of complications associated with energy deficiency. The lack of a standardized diagnostic procedure led the IOC to develop the RED-S Clinical Assessment Tool (RED-S CAT). This tool gives the sports medicine team guidance on how to evaluate athletes suspected of having RED-S and how to treat those who do to ensure safe and optimal return to play. Screening for RED-S is recommended to occur during annual physical examinations. Risk assessment for RED-S involves a combination of mixed modalities that may include, but are not limited to, questionnaires about eating disorders and compulsive exercise, intentional or unintentional weight loss, body fat percentage, bone mineral density, or other factors that may be
related to LEA. Once RED-S is suspected and diagnosed, athletes are expected and encouraged to work with a healthcare professional to regain normal physiological function and to achieve an energy balance consistent with their needs.\textsuperscript{14,46}

2.4 Nutrition Knowledge

Nutrition knowledge is a key modifiable risk factor that has the potential to significantly influence dietary intake. In 2011, Heaney \textit{et al.}\textsuperscript{2} systematically reviewed 29 studies assessing student athlete nutrition knowledge. Most of these studies were published before 2000 (n =17), and several examined knowledge between athletes and non-athletes. Athlete knowledge was found to be equal to or better than non-athletes but lower than that of nutrition students. Though a major limitation of studies assessing sports nutrition knowledge is that there is not a gold standard questionnaire, nearly all the studies in this review found nutrition knowledge to be inadequate according to their scoring methods.\textsuperscript{2}

One commonly used questionnaire is the one developed by Torres-McGehee \textit{et al.}\textsuperscript{3} It contains 20 questions that assess knowledge of basic nutrition, dietary supplements, weight management, and hydration. A score of 75% or greater indicates adequate nutrition knowledge, and a 10-point Likert scale (1 = not at all, 5 = fairly well, 10 = extremely well) is used to rank perceived nutrition knowledge. In the initial study by Torres-McGehee \textit{et al.},\textsuperscript{3} 579 athletes, ATs, and SCSs completed the questionnaire. The results found that 35.9% of coaches, 71.4% of ATs, 83.1% of SCSs, and 9% of athletes had adequate knowledge as indicated by a passing score of >75%. In another study by Abbey \textit{et al.},\textsuperscript{4} the same questionnaire was used to assess nutrition knowledge among NCAA Division III football players. Overall, nutrition knowledge was inadequate with a mean nutrition knowledge score of 55.2%. A similar result was found in a study by Andrews \textit{et al.}\textsuperscript{5} in which athletes from a mid-major Division I university achieved a mean
nutrition knowledge score of 56.9%. Only 12 out of the 128 student-athletes that completed the questionnaire received a passing score of >75%.

Another popular method of assessing nutrition knowledge is through the use of the SNKQ that was developed by Zinn, Schofield, and Wall in 2005. This 84-question questionnaire comprises five main knowledge sub-categories: general nutrition concepts (46 questions), recovery (7 questions), fluids (5 questions), weight control (15 questions), and supplements (11 questions). The questions were developed by an expert panel consisting of six practicing sports dietitians, and a validation study indicated that the questionnaire is both valid and reliable for use in measuring sports nutrition knowledge. A study by Holden et al. utilized this questionnaire to assess sports nutrition knowledge of 77 collegiate volleyball players, and the mean score was 46% with no athlete scoring above the established passing score of 70%. Condo et al. also used the SNKQ to assess the knowledge of female Australian rules football players, and the median score was 54.5%, which is consistent with previous results indicating inadequate nutrition knowledge among athletes. The SNKQ has also been used to assess the nutrition knowledge of coaches, and a 2015 study by Botsis and Holden found a mean score of 55% in college coaches, indicating inadequate nutrition knowledge. Similarly, a study of varsity coaches at a Canadian University determined low nutrition knowledge based on scores on the SNKQ, but despite low nutrition scores across all categories, coaches still reported giving athletes sports nutrition advice.

The availability of resources is thought to be a major factor contributing to athlete nutrition knowledge, and Division I universities often have far more resources than Division II or III schools. It is expected that schools with more resources have more opportunities to educate athletes on the importance of nutrition in overall health and performance. Werner et al. sought to compare nutrition knowledge in revenue versus non-revenue sports, and it was hypothesized that revenue
sports, such as football and basketball, would have higher knowledge scores given their greater resources. Despite these advantages, the non-revenue sports were found to have higher knowledge scores. The study also found that males had lower knowledge scores than females, therefore, it is possible that the difference in revenue and non-revenue sports is attributed to the fact that the most revenue is generated from male sports.\textsuperscript{11} A recent 2021 study by Klein \textit{et al.},\textsuperscript{12} found that NCAA Division III athletes also have poor nutrition knowledge. Though these results may be due to a lack of resources and limited access to a sports RD, it is difficult to make conclusions given the consistent low nutrition knowledge scores across athletes from all levels. A positive conclusion of the study was that despite low knowledge scores, athletes reported adequate dietary habits in line with recognized sport nutrition guidelines.\textsuperscript{12}

To date, no such studies have found overwhelming evidence suggesting adequate sports nutrition knowledge among collegiate athletes. Common misconceptions about sports nutrition among all studies in the Heaney \textit{et al.}\textsuperscript{2} review were about the roles of nutrients and their energy content, the use of protein as an energy source, and the need for supplements to achieve peak performance. Abbey \textit{et al.}\textsuperscript{4} found similar misconceptions with the addition of the functions of specific nutrients and the safety and regulation of supplements. In contrast, Torres McGehee \textit{et al.}\textsuperscript{3} found that the section on supplements and performance had the highest average scores among all participants. Questions about micronutrients and macronutrients had the lowest scores, followed by questions about weight management and eating disorders.\textsuperscript{3} Though athletes had many misconceptions in regard to nutrition, most were knowledgeable about the importance of hydration. In general, athletes knew that dehydration impaired performance and that fluids need to be replaced before, during, and after exercise.\textsuperscript{4,5,11,13} Based on the current literature, it is evident
that educational interventions are needed to increase sports nutrition knowledge and encourage its translation into practice.

2.5 Sources of Nutrition Knowledge

One major factor contributing to athlete nutrition knowledge is the source of their information. Collegiate athletes live very structured lives, and between class, training, and practice, athletes are constantly being told where to be and what to do, leaving little time for their own research and decision-making. When it comes to nutrition, many athletes look for a quick source of information. Due to the proximity of coaches, ATs, and SCSs, athletes often turn to these convenient and seemingly trustworthy sources when they seek nutrition advice. Though coaches and trainers are experts in their given field, they often lack the education to properly educate athletes on the importance of nutrition and how to implement healthful eating practices into their daily lives.

Several studies have assessed where student-athletes receive their nutrition information.\cite{Torres-McGehee2017, Abbey2019, Jacobsen2019, Abbott2018, Torres-McGehee2016, Sills2017, Vida2017} Torres-McGehee et al.\cite{Torres-McGehee2017} found that athletes primarily turn to ATs, SCSs, and coaches for nutrition information. This is consistent with the findings of Jacobsen et al.\cite{Jacobsen2019} and Abbey et al.\cite{Abbey2019}; however, some athletes also reported turning to magazines, websites, and friends and family for nutrition information. In a study of 77 collegiate volleyball players, coaches (n = 51) were found to be the main source of nutrition information followed by ATs and RDNs (n = 34), the internet (n = 26), personal trainers (n = 19), physicians (n = 16), and television (n = 16).\cite{Sills2017} In another study of NCAA Division III athletes that was published in 2021, social media was among the top 3 choices of nutrition information, followed by coaches and ATs.\cite{Vida2017} A review by Trackman et al.\cite{Trackman2017} also showed internet as a top source of nutrition information, which highlights the growing influence of online digital media as a source of information for the collegiate
population. Though RDNs are considered the experts in nutrition, no study has reported an overwhelming majority of athletes choosing them as their main source of knowledge.

Because athletes often choose coaches and ATs as a source of nutrition information, several studies have also assessed the knowledge of coaches, ATs, and SCSs and who they turn to for nutrition education.\textsuperscript{3,49,50} In the same study by Torres-McGehee et al., 35.9\% of coaches, 71.4\% of ATs, and 82.1\% of SCSs were found to have adequate nutrition knowledge. Similar to these results, other studies by Smith-Rockwell et al.\textsuperscript{49} and Shifflet et al.\textsuperscript{50} found 66\% and 75\% of ATs, respectively, to have adequate nutrition knowledge. To address the prior issue of inadequate nutrition knowledge among ATs, the National Athletic Trainer Association (NATA) updated its curriculum in 2006 to include additional educational competencies covering nutrition.\textsuperscript{51} Though ATs may be required to complete nutrition education, there are no requirements for coaches. In the study by Danaher and Curley,\textsuperscript{10} none of the participating coaches had undergone any formal nutrition training. Despite lack of training and inadequate knowledge scores, athletes put an immense amount of trust in their support staff and still turn to them for key information that may be out of their area of expertise.\textsuperscript{10}

Aside from acquiring nutrition knowledge from trusted individuals, information can also be obtained from nutrition coursework. In the study of Division III football players by Abbey et al.,\textsuperscript{4} only 11.5\% of the 77 participants had taken a nutrition course in college, but those that had scored significantly higher on the knowledge questionnaire compared to those who had never taken a nutrition course (71.2\% vs. 53.6\%; p <0.001). Similarly, a study by Zawila et al.\textsuperscript{52} found that 22\% (13 of 60) of the collegiate runners studied had taken a nutrition course in college, and they, too, had significantly higher scores than those who had never taken a nutrition course. In contrast, Holden et al.\textsuperscript{7} found no significant difference in knowledge scores in the 33\% of participants who
had taken a nutrition course. A similar result was found in the study of NCAA Division III athletes, in which no athlete scored above a 42% even when having a history of taking a nutrition course.\textsuperscript{12} Based on these findings, it is suggested that nutrition coursework may be beneficial to an athlete’s understanding of sports nutrition, but it is likely insufficient to provide all necessary knowledge and motivation to put nutritional strategies into practice.

2.6 Registered Dietitian Nutritionists

Providing optimal nutrition education and interventions for collegiate athletes will likely require the employment of an RDN. Registered dietitian nutritionists are experts in nutrition who can assess, diagnose, and treat issues related to nutrition.\textsuperscript{53} More specifically, a Board-Certified Specialist in Sports Dietetics (CSSD) is a RDN who has obtained an additional certification to verify their expertise in sports nutrition, specifically.\textsuperscript{54} According to the Academy of Nutrition and Dietetics Commission on Dietetic Registration, the minimum eligibility requirements to become a CSSD include maintaining current RDN status for at least two years after the original examination date and documentation of 2,000 hours of sports dietetics practice experience as a RDN within the past five years.\textsuperscript{54} The first full-time sports RDN was hired in 1994, and since then, the number of sports RDNs in the collegiate setting has grown.\textsuperscript{16} Despite this, there is still a lack of sports RDNs in the collegiate setting, especially among Division II and Division III universities.

In a 2021 review by Riviere \textit{et al.},\textsuperscript{16} the impact of sports RDNs on health and performance in student-athletes was assessed. Sports RDNs were found to have a positive impact on nutrition knowledge and dietary intake. In a study of 30 NCAA Division I baseball players, a nutritional education intervention led by a RDN resulted in increased energy, protein, and carbohydrate intake as well as a decrease in fat mass and body fat percentage and a greater improvement in a 5-10-5 shuttle test.\textsuperscript{55} Another study of Division I baseball players compared the results of a dietary habits
questionnaire between three universities. Two of the universities had a RDN on staff while the third did not, and the results of the study suggested that athletes at schools with a RDN have better daily eating habits and better knowledge of fueling and refueling around workouts and game days. Two additional studies examined the impact of a RDN on LEA in female athletes. Valliant et al. found that a RDN can improve nutrition knowledge and macronutrient intake in NCAA Division I volleyball players. Likewise, Syed-Abdul et al. performed a case study of a track and field athlete with energy deficiency and menstrual irregularities and suggested that professional nutrition programming can help track and field athletes recover from energy deficits and symptoms of the female athlete triad.

Despite these findings, further studies are warranted to assess the association between sports RDNs, nutrition knowledge, RED-S risk, and sports performance outcomes. The goal of the current study is to assess the impact of sports RDNs on collegiate athlete nutrition knowledge and the risk of RED-S. Ultimately, the study aims to develop the data to support the idea that full-time sports RDNs can improve athletic performance outcomes through increased nutrition knowledge, better dietary intake, and a reduced risk of LEA and RED-S.
CHAPTER III

METHODS AND PROCEDURES

3.1 Participants

Following approval by the Institutional Review Board (IRB), recruitment of collegiate athletes, coaches, ATs, and SCSs was conducted via email. Additionally, an email was sent to the Associate Director of Student-Athlete Development at each of the participating universities to encourage participation. Recruitment was limited to seven Division I and Division III universities in the State of Georgia: 1) Georgia Institute of Technology (Georgia Tech), 2) Georgia State University, 3) Kennesaw State University (KSU), 4) Mercer University, 5) University of Georgia, 6) Georgia Southern University, and 7) Emory University. Inclusion criteria for all participants included an eligible athlete or current employee at one of the aforementioned universities that was over the age of 18 years and actively participating in the Fall 2021 and Spring 2022 sports season. Athletes who were not eligible for intercollegiate competition were excluded from the study.

3.2 Participant Contact

The research team had a minimum of three contact points. Due to the nature of the study, additional contact points were made in response to participants questions or concerns. The research team contacted participants for the following reasons:

- Initial recruitment of student-athletes through a blast email to coaches, assistant coaches, ATs, and SCSs employed at Georgia Tech, Georgia State University, Kennesaw State University, Mercer University, Georgia Southern University, Emory University, and the University of Georgia.

- A follow-up email one month later to all coaches, assistant coaches, ATs, and SCSs.
• Individual emails to the Associate Director of Student-Athlete Development at each of the participating universities

3.3 Nutrition Knowledge Assessment

Nutrition knowledge was assessed using a web-based SNKQ. As discussed in the literature review, there are several available methods for assessing sports nutrition knowledge, but in this study, we chose to use the questionnaire developed by Torres-McGehee et al.3 This is a validated questionnaire that consists of 20 multiple choice questions covering several domains of sports nutrition, including macro- and micronutrients, supplements, weight management, eating disorders, and hydration. Individual questions were graded for correctness, and adequate knowledge was then characterized by answering at least 75% of the questions correctly. Each question was followed by a standardized question asking about the participant’s confidence in their answer choice. In addition to the knowledge assessment, the questionnaire also included questions about demographics, sources of nutrition information, and previous nutrition education. The second part of the questionnaire differed slightly based on current occupational status, but the same survey link was used for all participants. The survey was distributed through an anonymous link to Qualtrics.com, an online survey application provided by Georgia State University. The exact questionnaire can be seen in Appendix B.

3.4 RED-S Risk Assessment

There is no gold standard method for measuring RED-S risk in athletes. Validated questionnaires include, but are not limited to, the Brief Eating Disorder in Athletes Questionnaire (BEDA-Q), the Eating Disorder Examination Questionnaire (EDE-Q), the Eating Disorder Inventory (EDI) – Drive for Thinness (DT) score, the Eating Disorder Screening for Primary Care (ESP), the Low Energy Availability in Females Questionnaire (LEAF-Q), and the RED-S
Screening Tool (RST). Though these questionnaires have been validated, they are limited to the population in which they were validated in. Another recently validated questionnaire is the Disordered Eating Screen for Athletes (DESA-6). Because the DESA-6 only contains six questions and has been validated in both male and female athlete populations, we chose to include it in our study to assess RED-S risk. A score greater than or equal to three was positive, indicating disordered eating and risk for RED-S. The DESA-6 questionnaire and score sheet can be seen in Appendix C.

3.5 Medical History

Participants who indicated that they were a student-athlete were led to a group of questions asking about their personal medical and health history. Questions inquired about past or current injuries, illnesses, surgeries, and allergies.

3.6 Physical Activity Assessment

Participants who indicated that they were a student-athlete were also led to an additional group of questions asking about their level of physical activity. Questions assessed the number of times participants trained in a week, as well as the intensity, frequency, and duration of these sessions. The questions also aimed to identify athletes that engaged in additional physical activity outside of their regular sport-specific training.

3.7 Ethical Considerations

Research participants were not subject to harm in anyway throughout the study. Participant information remained confidential and stored under a unique participant identification number provided by the Qualtrics survey system. Participants were required to acknowledge and accept the consent form (see Appendix A) prior to beginning the survey. Throughout the duration of the study, participants were able to discontinue the survey under their own discretion.
3.8 Data Management

Participant’s data were de-identified and assigned unique numbers. The data was collected from an online survey, and it was stored digitally in excel files and statistical analysis software. The digital data are stored on Georgia State University’s secure OneDrive account to prevent data degradation or loss. Only the PI, and the student PI have access to the stored data.

3.9 Data Analysis

Descriptive statistics and frequencies were calculated for all variables. Normality was determined using Shapiro-Wilk tests. Data are reported as mean ± standard deviation (SD) for normally distributed variables and median and interquartile range (IQR) for non-normally distributed variables. Independent sample t-tests were used to compare the means of normally distributed variables, and Mann-Whitney U tests were used to compare the means of nonparametric variables. Point-biserial correlations were used to measure the association between nutrition knowledge and having a full-time sports RDN and having received any form of nutrition education during collegiate years. One-way analysis of variance (ANOVA) was used to compare differences between participants from Division I and Division III schools and between participants who had access to a full-time sports RDN and those who did not. A Kruskal-Wallis test was used to determine differences between non-parametric variables in participants from different universities. For all analyses, statistical significance was defined as $p \leq 0.05$. Data analyses were performed using IBM SPSS Statistics for Mac version 28.0 (IBM Corp., Armonk, N.Y., USA).
CHAPTER IV

RESULTS

4.1 Participants

A total of 34 participants (15 males and 19 females) completed the survey questionnaire in its entirety. Twenty-five participants classified themselves as student-athletes (9 males and 16 females) while the additional nine were characterized as either a coach, AT, or SCS for their respective university (6 males and 3 females). Eighteen (52.9%) participants were affiliated with Emory University, while the remaining 17 were from Georgia State University (n = 5), Georgia Southern University (n = 6), Georgia Tech (n = 2), Kennesaw State University (n = 2), and Mercer University (n = 2). All athletes denied history of high blood pressure, high cholesterol, type 1 or type 2 diabetes mellitus, hypoglycemia, and liver or renal complications. Additionally, no athlete reported history of skeletal or joint disorders, and all athletes denied smoking.

4.2 Sports Nutrition Knowledge Scores

A score of 75% or greater indicated adequate sports nutrition knowledge.\(^1\) Table 1 provides mean or median percentage scores for athletes and athletic staff on the SNKQ, as well as sub-scores on each of its four domains. There were no statistically significant differences between athletes and staff in total nutrition knowledge score (69.8 ± 16.5% vs. 70.6 ± 12.4%, respectively). Athletes earned the highest scores in the weight management (80.0% (30.0)) and hydration (80.0% (20.0)) sub-sections and the lowest scores in the supplements sub-section (66.7% (50.0)). Similarly, staff earned the highest scores in the weight management sub-section (80.0% (40.0)) and the lowest scores in the supplements sub-section (66.7% (50.0)).
Table 1. Sports Nutrition Knowledge Scores

<table>
<thead>
<tr>
<th></th>
<th>Athlete Score (%) (n = 25)</th>
<th>Staff Score (%) (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sports Nutrition Knowledge Score*</td>
<td>69.8 ± 16.5</td>
<td>70.6 ± 12.4</td>
</tr>
<tr>
<td>Micro- and Macronutrients Sub-Score*</td>
<td>67.4 ± 17.8</td>
<td>69.9 ± 11.2</td>
</tr>
<tr>
<td>Supplements Sub-Score**</td>
<td>66.7 (50.0)</td>
<td>66.7 (50.0)</td>
</tr>
<tr>
<td>Weight Management Sub-Score**</td>
<td>80.0 (30.0)</td>
<td>80.0 (40.0)</td>
</tr>
<tr>
<td>Hydration Sub-Score**</td>
<td>80 (20.0)</td>
<td>71.1 ± 17.6</td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation of the mean or median (interquartile range).

Participants were divided based on whether or not their university provides access to a sports RDN. Of the six participating universities, only three employ a full-time sports RDN (i.e., Georgia Southern University, Georgia Institute of Technology, and Kennesaw State University). Knowledge scores were compared, and no statistically significant differences were found between participants from a university with a full-time sports RDN compared to those without. Knowledge scores were also compared between Division I and Division III universities, and athletes from Division III universities were found to have a significantly higher total sports nutrition knowledge score than athletes from Division I universities (76.1 ± 13.0% vs. 61.8 ± 17.5%; respectively, p = 0.01). Despite this, staff from Division I universities had a significantly higher score than staff from Division III universities on the hydration sub-section (80.0 ± 14.1% vs. 60.0 ± 16.3%; respectively, p < 0.05). No other significant differences were found between athletes or staff from Division I or Division III universities. Table 2 illustrates knowledge scores by access to a full-time sports RDN and university division.
<table>
<thead>
<tr>
<th></th>
<th>Total Knowledge Score (%)</th>
<th>Micro/Macro Sub-Score (%)</th>
<th>Supplement Sub-Score (%)</th>
<th>Weight Management Sub-Score (%)</th>
<th>Hydration Sub-Score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ath.</td>
<td>Staff</td>
<td>Ath.</td>
<td>Staff</td>
<td>Ath.</td>
</tr>
<tr>
<td>Sports RDN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Yes</td>
<td>65.0 ± 18.3</td>
<td>82.5 ± 3.5</td>
<td>65.7 ± 20.5</td>
<td>78.7 ± 10.3</td>
<td>50.0 (66.7)</td>
</tr>
<tr>
<td>- No</td>
<td>73.0 ± 15.0</td>
<td>67.1 ± 11.9</td>
<td>68.5 ± 16.4</td>
<td>67.4 ± 14.3</td>
<td>100.0 (33.3)</td>
</tr>
<tr>
<td>Division</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Division I</td>
<td>61.8 ± 17.5</td>
<td>74.0 ± 13.4</td>
<td>61.1 ± 22.2</td>
<td>74.3 ± 12.0</td>
<td>66.7 (66.7)</td>
</tr>
<tr>
<td>- Division III</td>
<td>76.2 ± 13.0</td>
<td>66.3 ± 11.1</td>
<td>72.4 ± 11.9</td>
<td>64.3 ± 8.2</td>
<td>100.0 (33.3)</td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation or median (interquartile range). Abbreviations: Ath – athlete, RDN – registered dietitian nutritionist, micro – micronutrient, macro – macronutrient.

To further examine the potential factors impacting nutrition knowledge, correlation statistics were run between knowledge scores and previous nutrition education. A significant positive correlation ($p = 0.03, r = 0.40$) was found between knowledge scores and athletes who have taken at least one college health course. Positive correlations were also found between knowledge score and staff who have taken at least one college nutrition course ($p = 0.05, r = 0.589$) or who have attended a nutrition program ($p = 0.02, r = 0.67$) in the past. Lastly, there were no statistically significant differences in knowledge scores between any of the participating universities. Table 3 illustrates the mean or median knowledge scores of participants from each university.
Table 3. Sports Nutrition Knowledge Scores by University

<table>
<thead>
<tr>
<th>University</th>
<th>Total Knowledge Score (%)</th>
<th>Micro/Macro Sub-Score (%)</th>
<th>Supplement Sub-Score (%)</th>
<th>Weight Management Sub-Score (%)</th>
<th>Hydration Sub-Score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ath.</td>
<td>Staff</td>
<td>Ath.</td>
<td>Staff</td>
<td>Ath.</td>
</tr>
<tr>
<td>Georgia State University</td>
<td>60.0</td>
<td>70.0</td>
<td>66.8</td>
<td>21.9</td>
<td>78.6</td>
</tr>
<tr>
<td>(n = 3, n = 2, resp.)</td>
<td>± 21.8</td>
<td>± 21.2</td>
<td>± 21.9</td>
<td>± 10.1</td>
<td></td>
</tr>
<tr>
<td>Georgia Southern University</td>
<td>58.0</td>
<td>80.0</td>
<td>57.1</td>
<td>26.7</td>
<td>71.4</td>
</tr>
<tr>
<td>(n = 5, n = 1, resp.)</td>
<td>± 21.1</td>
<td></td>
<td>± 21.9</td>
<td>± 10.1</td>
<td></td>
</tr>
<tr>
<td>Georgia Tech</td>
<td>67.5</td>
<td>n/a</td>
<td>50.0</td>
<td>10.1</td>
<td>n/a</td>
</tr>
<tr>
<td>(n = 2, n = 0, resp.)</td>
<td>± 3.5</td>
<td></td>
<td>± 10.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KSU</td>
<td>75.0</td>
<td>85.0</td>
<td>85.7</td>
<td>86.0</td>
<td>66.7</td>
</tr>
<tr>
<td>(n = 1, n = 1, resp.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercer University</td>
<td>n/a</td>
<td>65.0</td>
<td>n/a</td>
<td>57.1</td>
<td>n/a</td>
</tr>
<tr>
<td>(n = 0, n = 1, resp.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emory University</td>
<td>76.1</td>
<td>66.2</td>
<td>72.4</td>
<td>11.9</td>
<td>64.3</td>
</tr>
<tr>
<td>(n = 14, n = 4, resp.)</td>
<td>± 13.0</td>
<td>± 11.1</td>
<td>± 11.9</td>
<td>± 8.2</td>
<td></td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation or median (interquartile range). Abbreviations: Ath – athlete, micro – micronutrients, macro – macronutrients

4.3 Sources of Nutrition Knowledge

Participants were asked to select the top three sources from which they receive nutrition information. They were also asked to select the top three sources that they would recommend to others who may be seeking nutrition information. Tables 4 and 5 illustrate the number of times each nutrition source was selected for self-use or to recommend to others. The most selected nutrition source to use for athletes was RDN (n = 13) followed by internet (n = 11) and friends (n
Eight out of the nine staff members selected RDN as a top source for nutrition knowledge. Other common sources were academic journals and ATs with five selections each. Both athletes (n = 20) and coaches (n = 8) recommended RDNs the most to others looking for nutrition information. Strength and conditioning coaches and ATs were also common sources of nutrition information that participants recommended.

Table 4. Nutrition Sources Selected for Self-Use

<table>
<thead>
<tr>
<th>Nutrition Source</th>
<th>Athletes (n = 24)</th>
<th>Staff (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDN</td>
<td>13 (54.2%)</td>
<td>8 (88.9%)</td>
</tr>
<tr>
<td>Internet</td>
<td>11 (45.8%)</td>
<td>4 (44.4%)</td>
</tr>
<tr>
<td>Coaches</td>
<td>9 (37.5%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Friends</td>
<td>8 (33.3%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Athletic Trainers</td>
<td>7 (29.2%)</td>
<td>5 (55.6%)</td>
</tr>
<tr>
<td>Academic Journal</td>
<td>6 (25%)</td>
<td>5 (55.6%)</td>
</tr>
<tr>
<td>Nutrition Courses</td>
<td>6 (25%)</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>Strength Staff</td>
<td>6 (25%)</td>
<td>3 (33.3%)</td>
</tr>
<tr>
<td>Parents</td>
<td>3 (12.5%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Physician</td>
<td>1 (4.2%)</td>
<td>1 (11.1%)</td>
</tr>
</tbody>
</table>

RDN – registered dietitian nutritionist

Table 5. Nutrition Sources Recommended to Others

<table>
<thead>
<tr>
<th>Nutrition Source</th>
<th>Athletes (n = 24)</th>
<th>Staff (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDN</td>
<td>20 (83.3%)</td>
<td>8 (88.9%)</td>
</tr>
<tr>
<td>Internet</td>
<td>9 (37.5%)</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>Nutrition Courses</td>
<td>9 (37.5%)</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>Strength Staff</td>
<td>9 (37.5%)</td>
<td>8 (88.9%)</td>
</tr>
<tr>
<td>Academic Journal</td>
<td>8 (33.3%)</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>Athletic Trainers</td>
<td>7 (29.2%)</td>
<td>6 (66.7%)</td>
</tr>
<tr>
<td>Coaches</td>
<td>6 (25.0%)</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>Physician</td>
<td>3 (12.5%)</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>Friends</td>
<td>1 (4.2%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Parents</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
</tr>
</tbody>
</table>

RDN – registered dietitian nutritionist
4.4 DESA-6 Scores

Participants who identified as a student-athlete (n = 25) were led to a series of six questions from the Disordered Eating Screen in Athletes questionnaire (DESA-6). The section was not labeled, and participants were simply asked to respond to each of the six multiple-choice questions. Twenty-five athletes responded to the DESA-6 questionnaire. A score of three or higher indicated disordered eating and an elevated risk for RED-S and its consequences. Out of the 25 athletes who completed the DESA-6 questionnaire, four participants scored above the threshold for risk.

A significant difference in total nutrition knowledge score was observed between athletes scoring at low- versus high-risk on the DESA-6 (p = 0.01). The mean knowledge score for individuals scoring less than a three on the DESA-6 was 73.3 ± 15.4%, whereas the mean score for individuals scoring a three or higher was 51.3 ± 0.06%. Additionally, a significant difference in scores on the weight management section was found between the two groups (p = 0.01). Athletes falling in the low-risk category had a mean score of 79 ± 17.2% on the weight management sub-section while athletes deemed high-risk had a mean score of 40 ± 23.1%. Point-biserial correlation tests found significant negative correlations between DESA-6 scores and total knowledge score (p = 0.01, r = -0.50), micro- and macronutrient sub-score (p = 0.05, r = -0.35), and weight management sub-score (p = 0.00, r = -0.55). No significant differences were found in any of the other sub-sections.

No statistically significant differences were found in DESA-6 score between athletes with access to a sports RDN versus those without. The mean score for athletes with access to a sports RDN was 1.50 ± 1.65, while the mean score for athletes without access was a 0.93 ± 0.96. Given that the reported threshold for risk is indicated as three or higher, our results suggest that the majority of participating athletes were at low-risk for disordered eating and RED-S at the time of
survey completion. Of the four athletes who scored a three or higher on the DESA-6, three reported access to a sports RDN while only one did not.

4.5 Confidence

For each sports nutrition knowledge question, participants were asked to specify their confidence in the correctness of their answers by selecting the appropriate level of confidence from a 4-point Likert scale (1 = not at all confident, 2 = not very confident, 3 = somewhat confident, 4 = very confident). The survey questionnaire was graded for correctness, and confidence levels were computed for both correct and incorrect answer choices. **Table 6** provides the average confidence levels for athletes and staff. Overall, athletic staff tended to have slightly higher confidence in their answer choices than athletes. Though confidence for incorrect answers was lower for both groups in all categories, the averages suggest that many participants still have some confidence in incorrect answers.

<table>
<thead>
<tr>
<th>Table 6. Confidence Scores (Likert Scale, 1-4) Among Athletes and Staff</th>
<th>Athletes (n = 25)</th>
<th>Staff (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Questions</td>
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Values are means ± standard deviation of the mean.
CHAPTER V

DISCUSSION

The first objective of this study was to examine sports nutrition knowledge of collegiate athletes, coaches, and ATs to determine if they portrayed adequate knowledge. We found that both athletes and staff scored below the 75% threshold for adequacy in their total nutrition knowledge score. When score was subdivided into its four domains, we found that athletes and staff both achieved adequate scores in the weight management category (80.0 (30.0), 80.0 (40.0), respectively, and athletes also scored adequately in the hydration sub-section (80.0 (20.0)), which is an improvement from previous studies assessing sports nutrition knowledge.\textsuperscript{3-5,7-10} In the 2012 study by Torres-McGehee,\textsuperscript{3} athletes averaged 54.9\% ± 13.5 with coaches, ATs, and SCSs scoring slightly higher with averages of 65.9\% ± 14.3, 77.8\% ± 10.3, and 81.6\% ± 10.3, respectively. Similarly, in a study by Andrews et al.\textsuperscript{5} that used the same SNKQ, the mean average of athletes from a mid-major Division I university was 56.9\%. To date, no study has shown consistent adequate nutrition knowledge in collegiate athletes. The results from the present study offer a positive outlook though and suggest that athletes and athletic staff have increased their nutrition knowledge over the recent years. Despite this, it still remains slightly below the threshold for adequacy in the majority of subjects.\textsuperscript{3-5,7-10}

Both athletes and staff earned the lowest scores in the supplement sub-section. Previous studies have also reported low supplement knowledge, which is of significant concern due to the lack of federal regulations surrounding dietary supplements. A 2020 study by Vento and Wardenaar\textsuperscript{60} examined supplement knowledge in 138 university student-athletes which yielded a median correct knowledge score of 25\%. All participants reported using a dietary supplement or
sports food at least once in the last 12 months, and even though over 90% believed it was important to know if a supplement was third-party tested, only 57% stated that the supplements bought and utilized were labeled as such. Another study assessing supplement use in NCAA Division I athletes found that 45.2% of participating athletes reported taking supplements. Though these studies are limited by the self-report nature of supplement use, it is clear that athletes would benefit from further education on safe and effective supplement use.

To examine the numerous factors that influence nutrition knowledge, we compared knowledge scores among several groups. No significant differences were found between participants from individual universities, but there was a significant difference between participants from Division I versus Division III universities. Our results indicated that athletes from Division III schools had higher overall scores than athletes from Division I schools. Given the discrepancy in resources between divisions, these results are surprising, and they contrast previous studies that found inadequate knowledge among athletes from Division III schools. Klein et al. assessed NCAA Division III athletes from the mid-Atlantic and Midwest regions and found a mean correct score percentage between 35% and 40%. Similarly, Abbey et al. examined Division III football players and found a mean score of 55.2%. Both of these studies reported averages lower than the typical range of 45%-65% that has been reported among studies focusing on Division I athletes.

Further analyses focused on history of nutrition and health education to potentially explain the difference in knowledge scores between divisions. Only three athletes from Division I universities and three athletes from Division III universities reported taking a collegiate nutrition course; however, health courses were more common with two athletes from Division I and 10 athletes from Division III having taken at least one. A positive correlation was found between
SNKQ scores and athletes who had taken at least one health course \((p = 0.03, r = 0.40)\). Likewise, Klein et al.\(^{12}\) and Abbey et al.\(^4\) concluded that athletes who had previously taken a collegiate nutrition or health course scored significantly higher \((p < 0.05)\) on the knowledge assessment compared to those who did not. Though there were not significant differences between total SNKQ score and attending a nutrition program, our results indicate that only 20% of athletes \((n = 2)\) from Division I schools attended a nutrition education program while 92.9% \((n = 14)\) of athletes from Division III schools reported that they had attended a nutrition education program. A 2020 systematic review by Sanchez-Diaz et al.\(^{63}\) examined the effects of nutrition education interventions on team sport players and found improvements in eating habits, nutrition knowledge, and body composition with educational programs. Therefore, it is probable that our participants from a Division III university scored higher on the SNKQ because of their prior nutrition and health education.

Similar to previous studies, we also sought to examine what resources athletes and staff use to obtain nutrition information. Approximately half of athletes and the majority of staff selected RDNs as a top source of nutrition information. Furthermore, most athletes and staff selected RDNs as a top source they would recommend to others seeking nutrition advice. Given that RDNs are board certified specialists in nutrition counseling and education, it is a positive improvement to see athletes and staff utilizing RDNs to obtain information. Unfortunately, RDNs are not readily available and employed by all athletic departments, and therefore, athletes and staff often turn to other sources for nutrition information. Athletes selected the internet and coaches as frequent resources while coaches often turned to ATs and academic journals. These results coincide with previous results showing ATs and coaches as common sources for nutrition information, which is likely attributed to the close proximity in which athletes, coaches, and ATs
work in. Though some coaches and ATs may have adequate knowledge, they lack the formal education and qualifications to provide appropriate nutrition counseling or medical nutrition therapy to athletes. In a study by Moulton et al., ATs were surveyed about their involvement in counseling for athletes, and they admitted to frequently exceeding their scope of practice, especially in regard to nutrition and eating disorders. Though ATs may provide general recommendations, it is not fair, nor safe, to have a non-nutrition expert providing individualized or group nutrition education.

Another aim of the present study was to examine risk of RED-S and its correlation with nutrition knowledge. Disordered eating plays a large role in the development of RED-S due to the imbalance of energy input and output. The DESA-6 is a validated questionnaire used in the athlete population to determine risk of disordered eating, and thus, RED-S. All student-athlete participants completed the DESA-6 with few participants scoring at or above the threshold for risk. This aligns with previous research indicating a high prevalence of disordered eating and LEA among athletes. In addition to the four athletes flagged by the DESA-6, three participants also reported irregular or absent menstrual cycles. Menstrual dysfunction is a hallmark of the female athlete triad and is a strong predictor of energy deficiency in female athletes. Though these athletes may not recognize their implicit underfueling, it is likely that they are. In a 2022 narrative review of the contributing factors to LEA in female athletes, nutrition knowledge, training demands, energy expenditure, and body image ranked among the top predictors of underfueling. Education on RED-S and its characteristics could help athletes become better aware of their fueling and when they may unintentionally fall into an energy deficient state. A 2019 study by Keay et al. examined this idea by randomly allocating competitive male cyclists at risk for RED-S to an educational intervention aimed to maintain adequate energy availability. The study found positive
changes in nutrition and skeletal loading after six months, which highlights the benefits and need for educational interventions in populations at risk for energy deficiency.62

Lastly, a significant negative correlation was found between DESA-6 scores and total SNKQ score, micro- and macronutrient sub-score, and weight management sub-score. These results suggest that athletes with low nutrition knowledge are at a greater risk for developing disordered eating and RED-S. Because RED-S is not always a by-product of disordered eating, we cannot assume that all participants scoring at or above a three on the DESA-6 have RED-S. None of the participants that scored at high-risk reported any other symptoms of RED-S, such as excess exercise, bone fractures, menstrual dysfunction, fatigue, or rapid weight loss. To date, this is one of the first studies to examine the relationship between RED-S and nutrition knowledge. Further studies are warranted to determine the degree in which nutrition knowledge plays a role in RED-S. Additionally, given the known consequences of RED-S, future studies may compare teams and/or individual athletes to determine the direct performance outcomes associated with nutrition knowledge and RED-S.

5.1 Limitations

The first limitation is the relatively small number of participants completing the survey questionnaire. A greater number of participants would have likely contributed to more representative averages and comparisons between the variables. Other studies similar in nature often have anywhere between 50-300 participants. Though our recruitment strategies were well versed, we were only able to recruit in a virtual format. Our primary recruitment method was via email to coaches, ATs, SCSs, and athletic directors. Because we were unable to contact athletes directly, we relied on athletic staff to forward the survey link and encourage participation from athletes.
Another limitation of the study was the survey length. Many participants began the survey, stopped mid-way, and never returned to complete it. The SNKQ itself was only 20 questions, but each question also asked about confidence in the answer choice, and then, there were additional sections asking about demographics, health history, physical activity, and more. Athletes and their staff are very busy, and though the survey was only estimated to take 15-20 minutes, it may have been too long for many participants hoping for a quicker survey. Of the validated SNKQs, though, this was among the shortest. Increased participation and completion may require an in-person recruitment strategy that allows the researcher to physically guide athletes and staff through the survey and answer any questions they may have throughout.

Lastly, dietary intake was unable to be assessed. An initial aim of the study was to compare nutrition knowledge to dietary intake, but the lack of participation resulted in the removal of this objective from the study. Three-day food records or 24-hour dietary recalls would have given insight into how the athletes fuel on a daily basis. The results could have been compared to current nutrition recommendations to determine nutrition adequacy and the potential for energy deficiency. With appropriate calorie and nutrient calculations, the researchers may have been able to catch more athletes with RED-S who may not have carried other notable symptoms. RED-S is a multifaceted problem that is not just a result of disordered eating, and therefore, our methods are not all encompassing of the characteristic traits of RED-S.

5.2 Conclusions

The study supports overall inadequate nutrition knowledge among the collegiate athlete population, but it illustrates positive improvements in several categories, such as hydration and weight management. Furthermore, the study highlights the impact of nutrition knowledge on the risk of RED-S. Given the known consequences of RED-S on athletic performance, it is imperative
that athletes and their staff are aware of the characteristic traits of energy deficiency and how to overturn it if and when it presents in athletes. Sports RDNs can play a major role in nutrition education and counseling to help athletes gain a competitive edge over their opponents. Though our results did not show significant differences in nutrition knowledge among schools with and without a full-time sports RDN, it was evident that nutrition and health education results in increased knowledge. Staffing a sports RDN can increase the prevalence and development and delivery of nutrition programs within an athletic department, and thus increase nutrition knowledge, leading to a lower risk of RED-S and a greater chance of improving performance outcomes.
REFERENCES


APPENDICES

Appendix A

Georgia State University
Informed Consent

Title: “The Impact of Nutrition Knowledge on the Prevalence of Relative Energy Deficiency in Sport (RED-S) in Collegiate Athletes”
Principal Investigator: Dr. Rafaela G. Feresin, PhD
Co-Investigator: Jessica P. Danh, MS, RD
Student Principal Investigator: Sarah Katz

Introduction and Key Information
You are invited to take part in a research study. It is up to you to decide if you would like to take part in the study. The purpose of this study is to assess the sports nutrition knowledge of student athletes, coaches, and athletic trainers/strength and conditioning coaches and compare the results between universities with and without a registered sports dietitian (SD). Additionally, we will assess the risk of relative energy deficiency in sport (RED-S) among athletes and whether it correlates with nutrition knowledge and exposure to a SD.

The total estimated time to complete the survey is 20 minutes for athletes and 10-15 minutes for coaches, athletic trainers, and strength and conditioning specialists. Though the survey link is the same for all participants, individuals characterized as a student-athlete will undergo a series of additional questions about their diet and training habits.

Taking part in this study will not expose you to any more risks than you would experience in a typical day. This study is not designed to benefit you; however, by providing applicable information on sports nutrition knowledge and RED-S risk, you may help to improve sports performance and overall student health.

Purpose
The purpose of the study is to assess the sports nutrition knowledge of student athletes, coaches, and athletic trainers/strength and conditioning coaches and compare the outcomes between universities with and without a registered SD. Additionally, the risk of RED-S will be assessed in athletes to determine whether it correlates with nutrition knowledge and exposure to a SD. You are invited to take part in this research study because you are a student athlete 18 years of age or older, a coach, or an athletic trainer/strength and conditioning coach at a university in the state of Georgia. A total of 2,500 people will be invited to take part in this study.

Procedures
If you decide to take part, you will be asked to complete an online questionnaire with two parts. The first part will consist of your background information (age, occupation, years of experience, education level, etc), health history, and physical activity. The second part is centered on sport nutrition, more specifically on: 1) macro & micro nutrients, 2) hydration, 3) supplements and
performance, and 4) weight management. Completing the two-part questionnaire will take approximately 15-20 minutes. Some of the questions asked are about eating disorders. However, the purpose of this study does not involve diagnosing these disorders; we are just identifying your knowledge of the topic and potential risk of energy deficiency.

**Future Research**
Researchers will remove information that may identify you and may use your data for future research. If we do this, we will not ask for any additional consent from you.

**Risks**
In this study, you will not have any more risks than you would in a normal day of life. No injury is expected from this study, but if you believe you have been harmed, contact the research team as soon as possible. Georgia State University and the research team have not set aside funds to compensate for any injury.

**Benefits**
We hope that the results of this study will help to assess your nutritional knowledge so the health professionals who work with you can provide improved nutrition education to enhance athletic performance. Additionally, we will be happy to go over individual results with you, but only if you request that we do so.

**Alternatives**
The alternative to taking part in this study is to not take part in the study.

**Voluntary Participation and Withdrawal**
You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time.

You may refuse to take part in the study or stop at any time. This will not cause you to lose any benefits to which you are otherwise entitled.

**Confidentiality**
We will keep your records private to the extent allowed by law. The following people and entities will have access to the information you provide:

- Dr. Rafaela G. Feresin, PhD, Jessica-Kim Danh, MS, RD, and Sarah Katz
- GSU Institutional Review Board
- Office for Human Research Protection (OHRP)

We will not use your name on study records. The information you provide will be stored on password- and firewall-protected computers with double-authentication factors. Note that IP Address information will be collected as a way to uniquely identify each submission.

When we present or publish the results of this study, we will not use your name or other information that may identify you.
Contact Information
Contact Sarah Katz at 337-502-3034 or skatz14@gsu.edu, or Dr. Rafaela G. Feresin, PhD at 404-413-1233 or rferesin@gsu.edu
- If you have questions about the study or your part in it
- If you have questions, concerns, or complaints about the study

The IRB at Georgia State University reviews all research that involves human participants. You can contact the IRB if you would like to speak to someone who is not involved directly with the study. You can contact the IRB for questions, concerns, problems, information, input, or questions about your rights as a research participant. Contact the IRB at 404-413-3500 or irb@gsu.edu.

Consent
We will email you a copy of this consent form to keep.

If you are willing to volunteer for this research, please click continue and proceed to the questionnaire.
Appendix B

Sports Nutrition Knowledge Survey

Thank you for viewing our Sports Nutrition Knowledge Survey!

By continuing this survey, you agree and consent to be a part of this study.

To view the informed consent document, please click here.

☐ I accept

Please provide your university email address.

____________________________________
Sports Nutrition - Question 1

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident

An athlete's diet should consist of approximately ___ protein, ___ fat, and ___ carbohydrates

- 12-15%, 25-30%, 55-70%
- 8-10%, 40-45%, 45-55%
- 25-35%, 55-65%, 70-90%
- 40-50%, 10-20%, 30-40%

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat Confident
- Very Confident

Sports Nutrition - Question 2

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
A mega dose of which of the following vitamins is potentially very dangerous?

- Thiamin
- Vitamin B6
- Vitamin C
- Vitamin A

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat Confident
- Very Confident

Sports Nutrition - Question 3

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
From a sports performance perspective, which is the most significant and/or detrimental dietary deficiency?

- Iron
- Zinc
- Calcium
- Vitamin C

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat Confident
- Very Confident

Sports Nutrition - Question 4

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
When dining at a fast food restaurant, a healthier low fat food selection would be:

- Crispy chicken sandwich
- Green salad with ranch and cheese
- Grilled chicken sandwich
- Medium french fry

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 5

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
The optimal timing for consuming a post exercise meal to restore glycogen (muscle carbohydrates) would be:

- Immediately after exercise
- Wait until you feel hungry
- 1-3 hours post-exercise
- 4 hours post-exercise

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 6

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
Which of the following is not a physiological effect of caffeine?

- Decreases the metabolic rate
- Stimulates the central nervous system
- Increases the secretion of epinephrine
- Increases heart rate and force of contraction

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 7

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
When following a modified carbohydrate-loading program for endurance athletes, what should the athlete do the day prior to competition?

- Eat a moderately high-carbohydrate meal and perform light exercise
- Eat a low-carbohydrate meal and participate in a regular amount of exercise
- Eat a high-carbohydrate meal and participate in an intense amount of exercise
- Eat a low protein diet and participate in a regular amount of exercise

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 8

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
What is wrong with an athlete eating a 12- to 16-ounce ribeye steak, baked potato with butter, green beans and soda 2 hours prior to an event?

- Sugar in the soda may take as long as 3 hours to metabolize
- The high fat meal will take longer to digest and hinder performance
- Nothing; the pre-event meal should be at least 500 calories or more
- Nothing; the athlete should eat what makes him or her feel comfortable

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 9

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
Recent research has suggested that creatine supplementation may enhance performance in which of the following types of physical performance tasks?

- High-intensity, anaerobic exercise such as powerlifting
- Cross Country competition event lasting about 30 minutes
- Marathon running (26.2 miles)
- Ultra marathons, such as Iron Man type triathlons

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 10

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
Which of the following statements regarding ergogenic aids is false?

- Use of any aid that enhances sport performance is illegal and is grounds for disqualification.
- Although most nutritional ergogenic aids are safe, some dietary supplements pose significant health risks.
- Endorsement of a nutritional ergogenic by a professional athlete does not necessarily mean that it is effective as advertised.
- Some nutritional supplements marketed as ergogenics may contain prohibited drugs.

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 11

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
The recommended guideline for safe and health weight loss:

- 3-5 pounds per week
- 1-2 pounds per week
- 8-10 pounds per week
- 15 pounds a month

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 12

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
An athlete has been diagnosed with bulimia and has a known history of laxative abuse. Complications of chronic laxative use include which of the following?

- Electrolyte imbalance and dehydration
- Hyperactivity
- Vomiting Blood
- Chronic nasal congestion

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 13

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
To safely increase muscle mass, it is recommended to increase both ______ and ______.

- Fat intake, carbohydrate intake
- Resistance training, caloric intake
- Resistance training, protein only
- Protein, water intake

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 14

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
The female athlete triad describes the simultaneous presence of which of the following?

- Low energy availability, menstrual cycle dysfunction (irregular), decreased bone mineral density
- Depression, premenstrual syndrome (PMS), and osteoporosis
- Menstrual cramping, under eating, and decreased iron levels
- Eating disorders, menstrual cycle loss, and osteoporosis

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 15

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
All of the following are methods of measuring body composition (specifically body fat %) except:

- Body Mass Index (BMI)
- Underwater "Hydrostatic" weighing
- Bioelectrical impedance analysis
- Measuring skin-fold thickness

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 16

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
After three weeks of exercise in the heat, the body's ability to adapt more efficiently is supported by all of the following EXCEPT:

- Increased sweat production during exercise
- A rapid drop in blood pressure with response exercise
- A drop in heart rate with response to exercise
- An increased sodium loss per liter of sweat

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 17

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
What measure is the best method to determine the amount of fluid loss due to sweat during an exercise session in which the athlete did not drink or go to the bathroom?

- Monitoring urine color
- Pre-post practice weigh-ins
- Thirst
- Urination frequency

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 18

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
During prolonged endurance exercise in the heat, excessive intake of water and inadequate intake of salt may lead to a life-threatening health condition called:

- Hypertension (high blood pressure)
- Dehydration (fluid loss)
- Hyponatremia (water intoxication)
- Hyperkalemia (high potassium)

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Sports Nutrition - Question 19

Below each of your answers, please specify your confidence in the correctness of your response by choosing the appropriate level of confidence. Please use the following scale to indicate your level of confidence:

1 = Not at All Confident
2 = Not Very Confident
3 = Somewhat Confident
4 = Very Confident
If an athlete loses one pound of fluid during an exercise session, what recommended ounces of fluid should he/she drink after post-exercise?

- 16-24 fl. oz
- 7-10 fl. oz
- 24-36 fl. oz
- 6-8 fl. oz

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident
Significant losses of electrolytes (such as sodium, chloride, potassium, or magnesium) during heavy exercise may lead to symptoms such as _____ or _____.

- Drop in blood pressure, increased production of urine
- Stress fracture, swelling
- Dyspnea (difficult or labored breathing), indigestion
- Muscular cramps, heat illness

Please specify your confidence in the correctness of your response by selecting the appropriate level of confidence.

- Not at All Confident
- Not Very Confident
- Somewhat confident
- Very Confident

Demographic Form

Name of your University or College

- Georgia State University
- University of Georgia
- Georgia Southern University
- Georgia Tech
- Kennesaw State University
- Mercer University

Age

________________________________________
Sex

- Male
- Female
- Prefer not to disclose

Ethnicity

- African American
- Asian American
- Hispanic American
- Caucasian
- Indian/Native American
- Other ________________________________________________

What is your current occupational status?

- Head Coach
- Assistant Coach
- Athletic Trainer
- Strength and Conditioning Specialist
- Student Athlete
DESA-6 (Student Athletes ONLY)

Have you had 3 or more injuries that have inhibited your ability to train in the past season OR did your past season end early due to injury?

- Yes
- No

During the off season or when you are not able to train, do you worry about gaining weight?

- I never worry about gaining weight.
- I worry about gaining weight occasionally.
- I worry about gaining weight regularly.
- I worry about gaining weight constantly.

Are you happy with your current weight?

- Yes
- No

To be at your best performance weight, how many pounds do you think you need to gain/lose?

- None
- Lose 1 to 10 pounds
- Lose 11 to 15 pounds
- Lose more than 15 pounds
- Gain 1 to 10 pounds
- Gain more than 10 pounds
Are you intentionally restricting specific food groups to lose weight?

- Yes
- No

Has anyone other than a health professional (e.g. team physician, athletic trainer, registered dietitian) recently told you to lose weight?

- Yes
- No

Head Coach/Assistant Coach Information (Display if occupational status = head coach/assistant coach)

Highest Level of Education

- High School Graduate
- Some college
- Bachelors Degree
- Masters Degree
- Doctoral Degree
Years of Experience in Your Occupation (Coaching)

- 0-5 years
- 5-10 years
- 10-15 years
- 15-20 years
- 20 or More years

What sport are you coaching?

- Men's Basketball
- Women's Basketball
- Cheerleading
- Color Guard
- Men's Cross country
- Women's Cross country
- Dance Team
- Equestrian
- Football
- Men's Golf
- Women's Golf
- Gymnastics
- Ice Hockey
- Men's Lacrosse
- Women's Lacrosse
- Majorettes
- Rowing
- Men's Soccer
- Women's Soccer
- Men's Swimming and Diving
- Women's Swimming and Diving
- Men's Tennis
- Women's Tennis
- Men's Track and Field
- Women's Track and Field
- Baseball
- Softball
☐ Volleyball
☐ Wrestling
☐ Other (please specify)  

How many college nutrition courses have you taken? Please identify what course(s).

__________________________________________________________________________

How many college health courses have you taken? Please identify what course(s).

__________________________________________________________________________

Have you ever attended an educational program on sport nutrition?

☐ Yes
☐ No

When did you last attend a sport nutrition program?

☐ Within the last 6 months
☐ Within the last year
☐ 2-3 years ago
☐ 4-5 years ago
☐ 5 or More years ago

Was the sport nutrition program sponsored by the Athletic Department?

☐ Yes
☐ No
If "Yes," was the attendance mandatory?

- Yes
- No

If "No," who sponsored the program?

________________________________________________________________

In the past year, did your ATHLETES attend an educational program on sport nutrition?

- Yes
- No

If "Yes," was the attendance mandatory?

- Yes
- No
What educational resources does the Athletic Department/Sports Medicine Department make available for coaches/teams regarding nutrition? Mark all that apply.

- [ ] Videos
- [ ] Nutritional Literature (Pamphlets, Journals, etc.)
- [ ] Sponsored Programs
- [ ] Registered Dietitian
- [ ] Nutritionist
- [ ] None at this time
- [ ] Other (please specify)

Does your Athletic Department have access to a Registered Dietitian/Nutritionist for your athletes?

- [ ] Yes
- [ ] No

If "Yes," is the Registered Dietitian/Nutritionist:

- [ ] Full-time through Athletics
- [ ] Part-time with Athletics
- [ ] Full-time with Student Health Center
- [ ] Part-time with Student Health Center
- [ ] Off-Campus (private)
If "No," who do you utilize to give nutritional advice/counseling to your athletes?

________________________________________________________________

Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information **YOU** rely on regarding nutrition and diet.
- Academic Journals
- Athletic Trainer
- Coaches
- Registered Dietitian/Nutritionist
- Friends
- Parents
- College Nutrition Courses
- Magazines
- Strength and Conditioning Specialist
- Team Physician
- Internet
- Other (please specify)

Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information you would RECOMMEND your athletes to utilize. (Only use answers you have available or access to at your institution)
- Academic Journals
- Athletic Trainer
- Coaches
- Registered Dietitian/Nutritionist
- Friends
- Parents
- College Nutrition Courses
- Magazines
- Strength and Conditioning Specialist
- Team Physician
- Internet
- Other (please specify)
Indicate below how well you understand athlete's nutritional needs.

- Extremely well
- Very well
- Moderately well
- Slightly well
- Not well at all

Please indicate below how important you think it is for your athletes to adhere to a healthy diet.

- Extremely Important
- Very Important
- Moderately Important
- Slightly Important
- Not Important at all

Please indicate the quality of your present eating habits.

- Excellent
- Good
- Average
- Poor
- Terrible
Athletic Trainer Information (Display if occupational status = athletic trainer)

Highest Level of Education

- High School Graduate
- Some College
- Bachelors Degree
- Masters Degree
- Doctoral Degree

Years of Experience in Your Occupation

- 0-5 Years
- 5-10 Years
- 10-15 Years
- 15-20 Years
- 20 or More Years
What sport(s) are you providing health care?

- Men's Basketball
- Women's Basketball
- Cheerleading
- Color Guard
- Men's Cross Country
- Women's Cross Country
- Dance Team
- Equestrian
- Football
- Men's Golf
- Women's Golf
- Gymnastics
- Ice Hockey
- Men's Locrosse
- Women's Lacrosse
- Majorettes
How many college nutrition courses have you taken? Please specify which one(s).
How many college health courses have you taken? Please specify which one(s).

________________________________________________________________

Have you ever attended an educational program on sport nutrition?

○ Yes

○ No

If Yes, please answer the following questions.

When did you last attend a sport nutrition program?

○ Have not attended

○ Within the last 6 months

○ Within the last Year

○ 2-3 Years Ago

○ 4-5 Years Ago

○ 5 or More Years Ago

Was the sport nutrition program sponsored by the Athletic Department?

○ Yes

○ No

If Yes, was the attendance mandatory?

○ Yes

○ No
If No, who sponsored the program?

________________________________________________________________

In the past year, did your ATHLETES attend an educational program on sport nutrition?

☐ Yes

☐ No

If Yes, was the attendance mandatory?

☐ Yes

☐ No

What educational resources does the Athletic Department/Sports Medicine Department make available for coaches/teams/athletic trainers regarding nutrition? Mark all that apply.

☐ Videos

☐ Nutritional Literature (Pamphlets, Journals, etc.)

☐ Sponsored Programs

☐ Registered Dietitian

☐ Nutritionist

☐ None At This Time

☐ Other ________________________________________________
Does your Athletic Department have access to a Registered Dietitian/Nutritionist for your athletes?

- Yes
- No

If Yes, is the Registered Dietitian/Nutritionist:

- Full-Time through Athletics
- Part-Time with Athletics
- Full-Time with Student Health Center
- Part-Time with Student Health Center
- Off-Campus (Private)

If No, who do you utilize to give nutritional advice/counseling to your athletes?

__________________________________________________________________

Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information YOU rely on regarding nutrition and diet.

_____ Academic Journals
_____ Athletic Trainer
_____ Coaches
_____ Registered Dietitian
_____ Friends
_____ Parents
_____ College Nutrition Courses
_____ Magazines
_____ Strength and Conditioning Specialist
_____ Team Physician
_____ Internet
_____ Other
Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information YOU would RECOMMEND to your athletes to utilize. (Only use answers you have available or access to at your institution)

_____ Academic Journals
_____ Athletic Trainer
_____ Coaches
_____ Registered Dietitian
_____ Friends
_____ Parents
_____ College Nutrition Courses
_____ Magazines
_____ Strength and Conditioning Specialist
_____ Team Physician
_____ Internet
_____ Other

Indicate below how well you understand athletes' nutritional needs. Use the following scale:

○ Extremely well
○ Very well
○ Moderately well
○ Slightly well
○ Not well at all

Please indicate how important you think it is for your athletes to adhere to a health diet. Use the following scale:

○ Extremely important
○ Very important
○ Moderately important
○ Slightly important
○ Not at all important
Please indicate the quality of your present eating habits. Use the following scale:

- Excellent
- Good
- Average
- Poor
- Terrible

Strength & Conditioning Specialist Information (Display if occupational status = strength and conditioning specialist)

Highest Level of Education

- High School Graduate
- Some College
- Bachelors Degree
- Masters Degree
- Doctoral Degree

Years of Experience in Your Occupation

- 0-5 Years
- 5-10 Years
- 10-15 Years
- 15-20 Years
- 20 or More Years
What sport(s) are you providing strength and conditioning programs for?

☐ Men's Basketball
☐ Women's Basketball
☐ Cheerleading
☐ Color Guard
☐ Men's Cross Country
☐ Women's Cross Country
☐ Dance Team
☐ Equestrian
☐ Football
☐ Men's Golf
☐ Women's Golf
☐ Gymnastics
☐ Ice Hockey
☐ Men's Lacrosse
☐ Women's Lacrosse
☐ Majorettes
Rowing
Men's Soccer
Women's Soccer
Men's Swimming and Diving
Women's Swimming and Diving
Men's Tennis
Women's Tennis
Men's Track and Field
Women's Track and Field
Baseball
Softball
Volleyball
Wrestling
Other (please specify)

How many college nutrition courses have you taken? Please specify which one(s).
How many college health courses have you taken? Please specify which one(s).

________________________________________________________________

Have you ever attended an educational program on sport nutrition?

○ Yes

○ No

If Yes, please answer the following questions.

When did you last attend a sport nutrition program?

○ Have not attended

○ Within the last 6 months

○ Within the last Year

○ 2-3 Years Ago

○ 4-5 Years Ago

○ 5 or More Years Ago

Was the sport nutrition program sponsored by the Athletic Department?

○ Yes

○ No

If Yes, was the attendance mandatory?

○ Yes

○ No
If No, who sponsored the program?

________________________________________________________________

In the past year, did your ATHLETES attend an educational program on sport nutrition?

○ Yes

○ No

If Yes, was the attendance mandatory?

○ Yes

○ No

What educational resources does the Athletic Department/Sports Medicine Department make available for coaches/teams/athletic trainers regarding nutrition? Mark all that apply.

☐ Videos

☐ Nutritional Literature (Pamphlets, Journals, etc.)

☐ Sponsored Programs

☐ Registered Dietitian

☐ Nutritionist

☐ None At This Time

☐ Other ________________________________________________
Does your Athletic Department have access to a Registered Dietitian/Nutritionist for your athletes?

- Yes
- No

If Yes, is the Registered Dietitian/Nutritionist:

- Full-Time through Athletics
- Part-Time with Athletics
- Full-Time with Student Health Center
- Part-Time with Student Health Center
- Off-Campus (Private)

If No, who do you utilize to give nutritional advice/counseling to your athletes?

____________________________________________

Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information YOU rely on regarding nutrition and diet.

- Academic Journals
- Athletic Trainer
- Coaches
- Registered Dietitian
- Friends
- Parents
- College Nutrition Courses
- Magazines
- Strength and Conditioning Specialist
- Team Physician
- Internet
- Other
Please rank order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information you would recommend to your athletes to utilize. (Only use answers you have available or access to at your institution)

____ Academic Journals
____ Athletic Trainer
____ Coaches
____ Registered Dietitian
____ Friends
____ Parents
____ College Nutrition Courses
____ Magazines
____ Strength and Conditioning Specialist
____ Team Physician
____ Internet
____ Other

Indicate below how well you understand athletes' nutritional needs. Use the following scale:

- Extremely well
- Very well
- Moderately well
- Slightly well
- Not well at all

Please indicate how important you think it is for your athletes to adhere to a health diet. Use the following scale:

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important
Please indicate the quality of your present eating habits. Use the following scale:

- Excellent
- Good
- Average
- Poor
- Terrible

**Student Athlete**

**Level of Education**

- Freshman
- Sophomore
- Junior
- Senior
- 5th Year Senior

What is your **MAJOR** (degree) at your institution?

________________________________________________________

What is your **MINOR** (degree) at your institution?

________________________________________________________

How many college nutrition courses have you taken? Please specify which one(s).

________________________________________________________

How many college health courses have you taken? Please specify which one(s).

________________________________________________________
What sport are you participating in?

☐ Men's Basketball
☐ Women's Basketball
☐ Cheerleading
☐ Color Guard
☐ Men's Cross Country
☐ Women's Cross Country
☐ Dance Team
☐ Equestrian
☐ Football
☐ Men's Golf
☐ Women's Golf
☐ Gymnastics
☐ Ice Hockey
☐ Men's Lacrosse
☐ Women's Lacrosse
☐ Majorettes
Rowing
Men's Soccer
Women's Soccer
Men's Swimming and Diving
Women's Swimming and Diving
Men's Tennis
Women's Tennis
Men's Track and Field
Women's Track and Field
Baseball
Softball
Volleyball
Wrestling
Other _______________________________
Years of Experience Participating in Your Sport

- 0-5 Years
- 5-10 Years
- 10-15 Years
- 15-20 Years
- 20 or More Years

Have you ever attended an educational program on sport nutrition?

- Yes
- No

If Yes, please answer the following questions.

When did you last attend a sport nutrition program?

- Within the last 6 Months
- Within the last Year
- 2-3 Years Ago
- 4-5 Years Ago
- 5 or More Years Ago
- Did not attend

Was the sport nutrition program sponsored by the Athletic Department?

- Yes
- No
If Yes, was the attendance mandatory?

- Yes
- No

If No, who sponsored the program?

_____________________________________________________

In the past year, did you attend an educational program on sport nutrition?

- Yes
- No

If Yes, was the attendance mandatory?

- Yes
- No
What educational resources does the Athletic Department/Sports Medicine Department make available for athletes regarding nutrition? Mark all that apply.

☐ Videos

☐ Nutritional Literature (Pamphlets, Journals, etc)

☐ Sponsored Programs

☐ Registered Dietitian

☐ Nutritionist

☐ None At This time

☐ Other ____________________________

Does your Athletic Department have access to a Registered Dietitian/Nutritionist for athletes?

☐ Yes

☐ No

If Yes, is the registered Dietitian/Nutritionist:

☐ Full-Time Through Athletics

☐ Part-Time with Athletics

☐ Full-Time with Student Health Center

☐ Part-Time with Student Health Center

☐ Off-Campus (Private)
If No, who is utilized to give nutritional advice/counseling for athletes?

Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information YOU RELY on regarding nutrition and diet.

- Academic Journals
- Athletic Trainer
- Coaches
- Registered Dietitian/Nutritionist
- Friends
- Parents
- College Nutrition Courses
- Magazines
- Strength and Conditioning Specialist
- Team Physician
- Internet
- Other

Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information YOU feel most COMFORTABLE approaching for nutrition information and diet.

- Academic Journals
- Athletic Trainer
- Coaches
- Registered Dietitian/Nutritionist
- Friends
- Parents
- College Nutrition Courses
- Magazines
- Strength and Conditioning Specialist
- Team Physician
- Internet
- Other
Please Rank Order (1=First Choice, 2=Second Choice, 3=Third Choice) the top three sources of information YOU would RECOMMEND to other athletes.

______ Academic Journals
______ Athletic Trainer
______ Coaches
______ Registered Dietitian/Nutritionist
______ Friends
______ Parents
______ College Nutrition Courses
______ Magazines
______ Strength and Conditioning Specialist
______ Team Physician
______ Internet
______ Other

Indicate below how well you understand athlete's nutritional needs. Use the following scale:

- [ ] Extremely well
- [ ] Very well
- [ ] Moderately well
- [ ] Slightly well
- [ ] Not well at all

Please indicate how important you think it is for athletes to adhere to a health diet. Use the following scale:

- [ ] Extremely important
- [ ] Very important
- [ ] Moderately important
- [ ] Slightly important
- [ ] Not at all important
Please indicate the quality of your present eating habits. Use the following scale:

- Excellent
- Good
- Average
- Poor
- Terrible

Body Composition (Student Athletes ONLY)

What is your height (feet and inches)?
________________________________________________________________

What is your current weight (pounds)?
________________________________________________________________

Do you know your percent body fat?
- Yes
- No

What is your percent body fat?
________________________________________________________________

What method was used to determine percent body fat?
________________________________________________________________

When was your percent body fat last tested [MM/DD/YYYY]?
________________________________________________________________
Physical Activity Questionnaire (Display if occupational status = student athlete)

How many training/practice sessions did you attend in the past week?
________________________________________________________________________

Of those sessions, how many were:

- Intense sessions (a lot of sweating and heavy breathing)
  _______________________________________________________________________

- Moderate sessions (sweating and heavy breathing but quick to recover)
  _______________________________________________________________________

- Easy sessions (light sweating)
  _______________________________________________________________________

How long was practice/training on average?
________________________________________________________________________

What kind of training was involved? E.g. Sprints, long-distance runs, weights/resistance, skill-work.
________________________________________________________________________

Did you workout outside of training/practice sessions this past week?

- Yes

- No

How many times did you workout outside of training/practice?
________________________________________________________________________
Did any of your workouts fall on the same day as training/practice? If yes, how many?

Please provide any additional information about your physical activity (e.g., information from an activity tracker, such as average daily steps or activity minutes on weekdays vs. weekends, resting heart rate, heart rate variability, etc.)

Personal Health History (Display if occupational status = student athlete)

Have you ever been hospitalized or had surgery?

- Yes
- No

Please state the reason for hospitalization or operation, the duration, and the age you were when this occurred.

Are you currently seeing a doctor or other health care provider for any reason outside of normal check-ups?

- Yes
- No

When was your last menstrual cycle? [MM/DD/YYYY]

________________________________________________________
Have you ever been diagnosed as having any of the following? Check all that apply.

☐ High Blood Pressure
☐ High Cholesterol/Triglycerides
☐ Type 1 Diabetes
☐ Type 2 Diabetes
☐ Hypoglycemia (Low Blood Sugar)
☐ Liver or Renal Disease/Complications

Are you currently taking any medications?

☐ Yes
☐ No

Please list your medications.

__________________________________________________

Do you have any neurological disorders including fainting, dizziness, headaches or seizures?

☐ Yes
☐ No

Do you have any orthopedic or other health problems that may affect your ability to perform exercise?

☐ Yes
☐ No
Please explain how your orthopedic or other health problems affect your ability to exercise.

________________________________________________________________

Are you allergic, sensitive or intolerant to any foods or medications?

○ Yes
○ No

Please explain what foods or medications you are allergic, sensitive, or intolerant to.

________________________________________________________________

Have you made any changes to your diet in the last six months?

○ Yes
○ No

Please explain what dietary changes you have made and why.

________________________________________________________________

Do you smoke or use smokeless tobacco (e.g. vape)?

○ Yes
○ No

How many cigarettes per day?

________________________________________________________________
Have you had a physical exam in the past 2 years?

- Yes
- No

Please describe your assessment of your overall health.

________________________________________________________________________________________

Skeletal and Joint Health (Display if occupational status = student athlete)

Do you have a history of skeletal and/or joint disorders?

- No, I have not had any skeletal and/or joint disorders.
- Yes, but it's uncontrolled (i.e., you do not have an active treatment for it).
- Yes, and I am/have been treating it.

How has this condition affected your activity?

________________________________________________________________________________________

What joint(s) is afflicted? Please indicate left, right, or both.

________________________________________________________________________________________

Please describe how frequent pains occur.

________________________________________________________________________________________

Please describe how severe the pain is from a scale of 1-10 with 10 being the most severe. You are free to include more detail.

________________________________________________________________________________________
Please indicate which treatments you have undergone. Select all that apply.

☐ Medications
☐ Exercise Program
☐ Modified Diet
☐ Surgery

Do you have a family history of skeletal/joint disorders?

☐ Yes
☐ No

Thank You!

We'd like to give you a big THANK YOU for participating in this survey!
Appendix C

DESA-6 Version II Score Guide

1. Injury
   a. Yes = 1
   b. No = 0

2. Lose weight
   a. Never = 0
   b. Occasionally = 0
   c. Regularly = 1
   d. Constantly = 2

3. Happy with weight
   a. Yes = 0
   b. No = 1

4. Amount of weight loss
   a. None = 0
   b. Lose 1-10 pounds = 0
   c. Lose 11-15 pounds = 0
   d. Lose 15+ pounds = 1
   e. Gain 1-10 pounds = 0
   f. Gain 10+ pounds = 0

5. Restricting
   a. Yes = 1
   b. No = 0

6. Told to lose weight
   a. Yes = 1
   b. No = 0

Positive Score = 3 or greater
Appendix D

Dear Coaches, Athletic Trainers, and Strength & Conditioning Specialists,

You are invited to take part in a research study to assess the sports nutrition knowledge of collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. We will also assess dietary intake and the risk of relative energy deficiency in sport (RED-S) among athletes to determine whether it correlates with nutrition knowledge and access to a registered sports dietitian.

The study involves completing an online questionnaire that takes approximately 20 minutes to complete. It will begin with questions about sports nutrition, more specifically on: 1) macro & micronutrients, 2) hydration, 3) supplements and performance, and 4) weight management. Additional questions may ask about occupational experience, education, and health history. After completion of the questionnaire, athletes only will be provided with a login to the Automated Self-Assessment 24-Hour Recall System (ASA24). This is an online multi-pass method for assessing 24-hour dietary intake. The estimated completion time for the dietary recall is 20 minutes.

The study will not expose you to any more risks than you would in a normal day of life, and we hope the results of the study will help to assess nutrition knowledge and RED-S risk so that health professionals can provide nutrition education and other additional resources to enhance athletic performance.

If your teams agree to participate, please forward the next email to your student-athletes.

Attached to this email are printable flyers to display in locker rooms, weight rooms, and any other common spaces for varsity athletes.

We also invite all varsity coaches, assistant coaches, athletic trainers, and strength and conditioning specialists to complete the questionnaire. Clicking the link below will redirect you to the survey website.

CLICK HERE TO ANSWER THE SPORTS NUTRITION KNOWLEDGE QUESTIONNAIRE

If you have any questions about the study, please contact Sarah Katz at skatz14@student.gsu.edu or Dr. Rafaela G. Feresin, PhD at rferesin@gsu.edu.
Dear Collegiate Athlete,

You are invited to take part in a research study to assess the sports nutrition knowledge of collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. We will also assess dietary intake and the risk of relative energy deficiency in sport (RED-S) among athletes to determine whether it correlates with nutrition knowledge and access to a registered sports dietitian.

The study involves completing an online questionnaire that takes approximately 20 minutes to complete. It will begin with questions about sports nutrition, more specifically on: 1) macro & micronutrients, 2) hydration, 3) supplements and performance, and 4) weight management. Additional questions may ask about occupational experience, education, and health history. After completion of the questionnaire, you will be provided with a login to the Automated Self-Assessment 24-Hour Recall System (ASA24). This is an online multi-pass method for assessing 24-hour dietary intake. The estimated completion time for the dietary recall is 20 minutes.

The study will not expose you to any more risks than you would in a normal day of life, and we hope the results of the study will help to assess nutrition knowledge and RED-S risk so that health professionals can provide nutrition education and other additional resources to enhance athletic performance.

CLICK HERE TO ANSWER THE SPORTS NUTRITION KNOWLEDGE QUESTIONNAIRE
Appendix E

ATHLETES, COACHES & TRAINERS NEEDED
FOR RESEARCH STUDY
assessing sports nutrition knowledge, dietary intake, and the risk of relative energy deficiency in sport (RED-S)

Requirements

Collegiate athlete, coach, athletic trainer, or strength & conditioning specialist for a NCAA Division I school in the state of Georgia

• Complete an online survey questionnaire
• Total estimated time: 20 min.

Questions? Please email skatz14@student.gsu.edu

IRB #H22207

Georgia State University
ATHLETES, COACHES & TRAINERS NEEDED

FOR RESEARCH STUDY
assessing sports nutrition knowledge, dietary intake, and the risk of relative energy deficiency in sport (RED-S)

Requirements

Collegiate athlete, coach, athletic trainer, or strength & conditioning specialist for a NCAA Division III school in the state of Georgia

• Complete an online survey questionnaire
• Total estimated time: 20 min.

Questions? Please email skatz14@student.gsu.edu

IRB #H22207