THE ROLES, RESPONSIBILITIES, AND PERCEPTIONS OF REGISTERED DIETITIANS IN SPORTS NUTRITION

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The purpose of this study was to examine the role and perceptions of registered dietitians who work in sports nutrition. A survey was electronically distributed to the American Dietetic Association Sports, Cardiovascular, and Wellness Nutrition dietetic practice group of 5,894 members. Additionally, a survey was distributed to all the student athletes and coaches of two division I institutions, Kent State University and Indiana University, to gauge the perceptions of registered dietitians in these sample populations. However, there was very low response rate with these surveys, and the data was excluded from the study. There were 650 dietitians who participated in this study. Statistical analysis consisted of means, standard deviations, and frequencies. The findings conclude that the registered dietitians who work in sports nutrition perceive their roles to be largely similar, but the frequency of performing tasks as a part of their role in sports nutrition was not as widely reported among the sample population.
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CHAPTER I

INTRODUCTION

It has been proven that the performance of an athlete can be impaired or improved significantly based on the adequacy of their diet (Bedgood & Tuck, 1983; Clark, 2008; Dunford, 2006; Grandjean, 1989; Graves, Farthing, Smith, & Turchi, 1991; Lukaski, 2004; Rodriguez, DiMarco, & Langley, 2009). Nutrition plays a tremendous role in sport and competition and numerous studies and books have been published that discuss proper nutrition practices that lead to optimal performance (Bedgood & Tuck, 1983; Clark, 2008; Dunford, 2006; Grandjean, 1989; Graves et al., 1991; Lukaski, 2004; Rodriguez et al., 2009). Many elite athletes have utilized diets as a component of their training program, and have reaped the performance benefits (Clark, 2008; Dunford, 2006; Grandjean, 1997). Increasingly, more emphasis is being placed on which nutrients provide maximal energy output (Bedgood & Tuck, 1983; Clark, 2008). Also, there is a realization that choosing the wrong foods and having an inadequate diet hinders performance (Bedgood & Tuck, 1983; Clark, 2008). Athletes need a proper balance of macronutrients, micronutrients, and hydration to perform at their potential (Clark, 2008; Dunford, 2006; Rodriguez et al., 2009). Adamant training, energy balance, a nutrient dense diet, proper timing of nutrient intake, and adequate rest are crucial to enhancement of sport performance (Clark, 2008; Krieder et al., 2004; Rodriguez et al., 2009).

Proper nutrition is intrinsically linked to, and has been proven to enhance athletic performance (Clark, 2008; Dunford, 2006; Rodriguez, 2009). Adequacy of dietary carbohydrates, protein, and fat are all linked to an individual’s ability to physically
perform well (Clark, 2008; Dunford, 2006; Rodriguez, 2009). Carbohydrates are the main source of fuel during physical activity and it is recommended that athletes consume approximately 60-70% of their diet from carbohydrates (Burke et al., 2004; Clark, 2008; Dunford, 2006; Rodriguez et al., 2009). Fat, which is recommended to make up 20-25% of an athlete’s diet, is an equally important macronutrient for athletes in term of performance, and is largely utilized in well-trained athletes as the body’s fuel source in addition to muscle glycogen stores (Clark, 2008; Dunford, 2006; Horvath, Eagan, Fisher, Leddy, & Pendergast, 2000; Rodriguez, 2009). Additionally, athletes have higher recommendations for protein, 1.2 to 1.4 g/kg/day, and for strength athletes ranges from 1.6-1.7 g/kg/day, as protein accounts for 10-15% of energy requirements during prolonged exercise (Dunford, 2006; Rodriguez, 2009).

The question of who is responsible for disseminating nutrition resources in athletic settings is still unclear (Graves et al., 1991). In a study of the nutrition training, recommendations, responsibility, and resource utilization of high school coaches and trainers, the majority of high school coaches believe they are the main disseminators of nutrition information, while the majority of athletic trainers believe they and the coaches are both equally responsible for providing nutrition information (Graves et al., 1991). It is interesting to note that the athletes in this setting identified neither the coaches nor the trainers as important sources of nutrition information; most cited their parents as fulfilling this role (Graves et al., 1991).

In 2006, the Sports, Cardiovascular, and Wellness Nutrition dietetic practice group and Commission on Dietetic Registration (CDR) of the American Dietetic
Association (ADA) successfully approved credentials for registered dietitians (RDs) in sports nutrition. *Board Certification as a Specialist in Sports Dietetics Nutrition* (CSSD) is an exam-based credential offered for RDs who meet the sport dietitian requirements. Requirements include current RD status by the Commission on Dietetic Registration, and maintenance of RD status for a minimum of two years from the original examination date of the specialty examination. Initial certification requires 1,500 hours of specialty practice experience as an RD within the past five years, and recertification requires documentation of 1,000 hours of specialty practice experience as an RD in the past five years, by the date the application is due (“Board certification as a specialist in sports dietetics,” n.d.).

The International Society of Sports Nutrition (ISSN) offers certification in the form of CISSN or Certified Sports Nutritionist for the International Society of Sports Nutrition (“CISSN: Get certified now,” n.d.). Eligibility is based on the criteria of having a 4-year undergraduate degree in exercise science, kinesiology, physical education, nutrition, biology, or a related biological science (“CISSN: Get certified now,” n.d.). This accreditation is the loosest certification of the aforementioned credentials and should be noted that CISSN is not a replacement or accepted credential for any state laws governing the application of nutrition in a commercial setting (“CISSN: Get certified now,” n.d.). Although these credentials exist, they are not widely known to the general population. It is believed that a sports dietitian network is needed beyond the dietetic practice group of sports, cardiovascular, and wellness nutrition.
The Collegiate and Professional Sports Dietitians Association (CPSDA) was created on the basis of the need for athletes to have access to performance nutrition professionals (Ellis, 2010). It was formally launched in May 2010 with the essential message that athletes perform better with a sports dietitian on staff. The continual message of the CPSDA is that sport dietitians are the authorities on nutrition, and should be the source of this information for not only athletes, but coaches and trainers, too. At the 2010 conference, the Board of Directors of CPSDA loosely defined the vision and mission of the CPSDA and drafted guiding principles of the organization. CPSDA is made up of credible practitioners, support service directors, and ethical advisors that promote “food first” in athletic settings. They believe credentials alone have not elevated the cause for sports dietitians and are working towards creating a better network of respected, experienced nutrition experts (Ellis, 2010).

Sports nutrition is an increasingly growing field (Kreider et al., 2004; Vinci, 1998). This is largely due to the growing prevalence of athletes who desire to control the variables affecting performance (Burns, 2003; Rodriguez et al., 2009). A great deal of time and money is spent on new training theories, new coaching methods, new equipment, and/or performance-enhancing supplements; however, athletic programs are increasingly cognizant of the effectiveness of incorporating sports nutrition, a proven scientific benefit to performance (Shattuck, 2001). Competitive athletes may have a support system that includes a coach, sports psychologist, medical doctor, physical therapist, and possibly a massage therapist; however, many fail to have sports dietitians as a support service (Clark, 2008).
It has been argued that proper nutrition practices and nutrition guidance are as critical as good coaching and appropriate strength training to reduce the risk of athletic-related injury (Clark, 1999). Athletes equipped with more nutrition knowledge make better food choices that result in better health, well-being, and athletic performance (Quatromoni PA, 2008). Additionally, nutrition intervention enhances performance and can be a source for safe weight loss practices, counseling for eating disorders, and a protection for both athletes and athletic departments from hazards such as supplement abuse or overuse or other dangerous nutrition-related practices (Clark, 1999; Grandjean AC, 1997).

**Problem Statement**

Since the emergence of nutrition information and its connection to the enhancement of performance in this setting, professional and college athletic programs are increasingly showing interest in the acquiring and hiring of sports nutritionists to gain a competitive edge (Burns, Schiller, Merrick, & Wolf, 2004). The implications of the increasing volume of athletic intensity in competition and sport and the role of nutrition warrant the increased demand for registered dietitians in this field. High school age athletes are increasingly participating in preseason workouts, summer camps, and elective training sessions prior to their sport season in order to gain a competitive advantage and be prepared for their upcoming season (Denehy, 2006). Since nutrition is a daily concern for athletes, this implies that a dietitian should be more involved than just during the academic school year, and should be aware of the training practices of their athletes. Currently, there is a lack of research on the role and benefit of sports dietitians within...
athletic teams or on how dietitians in the field view their responsibilities (Clark, 1999).

In 2009, the ADA established the Standards of Practice (SOP) and Standards of Professional Performance for Registered Dietitians in Sports Dietetics to outline the scope of practice for RDs in this setting, which is fluid concept (ADA, 2009). Due to the lack of evidence-based research on the specific role of sports dietitians within the workings of athletic teams, additional research on this topic should be performed (Clark, 1999).

**Purpose Statement**

The purpose of this study is to examine the role and perceptions of sports dietitians who work in sports nutrition. The surveys will provide insight on the role and perceptions of RDs in sports nutrition.

**Definitions**

1. Sports nutrition: the study and practice of assisting athletes and teams in achieving optimal performance and long-term health benefits through the use of sound nutrition education and practices.

2. Athlete: a person who is actively participating in high school, collegiate, professional sports or who is actively seeking national recognition or Olympic status as a competitive athlete.
CHAPTER II
REVIEW OF LITERATURE

Relationship of Macronutrients and Athletic Performance

Energy is stored in the chemical bonds of macronutrients, specifically carbohydrates, fats and proteins (Dunford, 2006). In humans, energy stores have been estimated to be approximately 400 kilocalories in liver glycogen, 1500 kilocalories in muscle glycogen, 30,000 kilocalories in muscle protein, and 80,000 kilocalories or more in adipose tissue with the actual values varying based on the individual (Dunford, 2006). The basic macronutrient fuel sources for athletes are glucose, derived from liver glycogen, triacylglycerol and glycogen molecules stored within muscle cells, free fatty acids that enter the bloodstream for delivery to active muscle, and intramuscular and liver derived carbon skeletons of amino acids (Dunford, 2006, notes). Therefore, macronutrients are crucial to support the energy expenditure of all athletes. At rest, 2-5% of fuel utilization is protein, 35% is glucose/glycogen, and 60% is fat. In light to moderate exercise, fuel utilization breakdown is 2-5% protein, 40% glucose/glycogen, and 55% fat. In high intensity-sprint, the breakdown is 2% protein, 95% glucose/glycogen, and 3% fat and in high intensity endurance exercise the breakdown is 5-8% protein, 70% glycogen, and 15% fats (Dunford, 2006).

Carbohydrates

Consuming adequate amounts of carbohydrates, given the type and duration of exercise, is one of the most important dietary recommendations for athletes in terms of performance benefit (Clark, 2008; Dunford, 2006; Grandjean, 1989; Jeukendrup, 2004).
Carbohydrates are the main source of fuel during physical activity (Burke et al., 2004; Clark, 2008; Dunford, 2006; Jeukendrup, 2004; Rodriguez et al., 2009). Specifically, muscle and liver glycogen and blood glucose are essential for optimal performance (Bergstrom, Hermansen, & Hultman, 1967; Burke et al., 2004; Costill & Hargreaves, 1992; Dunford, 2006; Jeukendrup, 2004; Rodriguez et al., 2009). In addition to being the primary fuel source for physical activity, carbohydrates in the diet spare protein as an energy source, preventing ketosis, and provide fuel for the central nervous system (Bergstrom, et al., 1967; Costill & Hargreaves, 1992; Dunford, 2006; Welsh, Davis, Burke, & Williams, 2002). Muscle glycogen depletion is intrinsically linked to fatigue and exhaustion (Bergstrom, et al., 1967; Burke, 2004; Costill & Hargreaves, 1992; Dunford, 2006; Welsh et al., 2002). Replenishing muscle glycogen stores is also critical for maximizing the muscle glycogen store potential, and preparing the muscles for the next exercise session (Burke, 2004; Clark, 2008; Dunford, 2006; Jeukendrup, 2004). In addition to timing of meals in order to fully replenish muscle glycogen stores, studies show optimal storage is also dependent on dietary intake needs being met, if dietary intake is not at recommended levels, muscle glycogen storage will be negatively impacted (Burke et al., 2004; Dunford, 2006; Jeukendrup, 2004).

Consuming carbohydrate during exercise can improve performance by maintaining blood glucose levels and carbohydrate oxidation (Bergstrom et al., 1967; Costill & Hargreaves, 1992; Welsh et al., 2002). The major source of carbohydrate in the body is muscle glycogen, followed by liver glycogen, and lastly blood glucose (Bergstrom et al., 1967; Costill & Hargreaves, 1992; Dunford, 2006). The amounts of
glycogen in these stores vary depending on factors of such as dietary intake and state of training (Dunford, 2006). In order to maintain a high level of intensity of exercise, muscle glycogen stores are critically important (Dunford, 2006). During the early stages of exercise is when muscle glycogen stores are most rapidly utilized and the amount of muscle glycogen available is exponentially related to exercise intensity (Bergstrom et al., 1967; Costill & Hargreaves, 1992; Dunford, 2006). There is also a strong relationship to the amount of muscle glycogen and the length of time exercise can be performed at 70% of VO_{2max}. The greater the muscle glycogen content, the more exercise potential that exists (Dunford, 2006).

Liver glycogen stores maintain blood glucose levels both at rest and during exercise in order to fuel muscle brain and the nervous system (Costill, & Hargreaves, 1967; Welsh et al., 2002). Increased exercise intensity leads to greater rate of liver glycogen release. Blood glucose is more difficult to control when liver glycogen is depleted (Dunford, 2006).

Muscle glycogen is a well-known limitation to endurance performance; muscle glycogen is converted to glucose fueling exercising muscles and with larger muscle mass, there is a greater potential for glycogen storage and glycogen need (Costill & Hargreaves, 1992). Studies of runners have shown that high carbohydrate diets replenished muscle glycogen levels and maintained performance, whereas low-carbohydrate diets for three successive days resulted in low muscle glycogen levels (Dunford, 2006). There has also been research on the benefit of carbohydrate supplementation during exercise bouts of one hour or more (Wright, Sherman, & Dernbach, 1991). In fact, the performance
benefits of carbohydrates prior to competition or training may be compounded with the addition of carbohydrate consumption during exercise (Wright et al., 1991). In one study, cyclists who received carbohydrate feedings before and during exercise were able to exercise longer than when receiving carbohydrate either only before exercise alone or during exercise alone (Wright et al., 1991).

When the body is adequately fueled with carbohydrate, the carbohydrate utilization has a protein sparing action (Dunford, 2006; Jeukendrup, 2004). The body doesn’t have to rely on protein from muscle or the diet for energy when enough carbohydrate is present (Dunford, 2006; Jeukendrup, 2004). Sparing protein is important because protein is needed during times of growth, for tissue maintenance and repair, as well as for synthesis of hormones and enzyme production (Dunford, 2006; Jeukendrup, 2004).

Greater intensities of exercise require greater amounts of carbohydrates (Costill & Hargreaves, 1992; Dunford, 2006). Other factors that may require more carbohydrates include climate extremes, the altitude level of training, and age of the individual (Dunford, 2006). Factors that decrease dependence on carbohydrates as a fuel source include increased level of fitness, and increased temperature adaptation (Dunford, 2006; Jeukendrup, 2004). When carbohydrates are lacking in the diet of athletes, individuals may feel sluggish, weak, slow their performance, or experience fatigue; this is often dubbed in the middle of exercise performance as “hitting the wall” (Dunford, 2006). Depletion of glycogen stores leads to an eventual decrease in blood glucose (Bergstrom et al., 1967; Burke, 2004; Costill & Hargreaves, 1992; Dunford, 2006; Welsh et al.,
When blood glucose falls too low, the body becomes unable to fuel the exercising muscle and eventually the nervous system starts shutting down (Welsh et al., 2002). Individuals may become confused, disoriented, irritable, and even hallucinogenic. Consuming carbohydrates delays this glycogen depletion (Welsh et al., 2002). Studies conclude that a high carbohydrate diet is the best recommendation for endurance athletes, and the goal is to maximize carbohydrate availability before, during, and after exercise (Bergstrom et al., 1967; Burke et al., 2004; Costill & Hargreaves, 1992; Dunford, 2006; Jeukendrup, 2004; Rodriguez et al., 2009). It is recommended that athletes consume approximately 60-70% of their diet from carbohydrates (Costill & Hargreaves, 1992; Dunford, 2006). It is recommended that 5 to 7 g carbohydrate/kg/day is recommended for general training needs and 7 to 10 g carbohydrate is recommended for endurance athletes (Dunford, 2006; Rodriguez et al., 2009). Athletes participating in ultra-endurance events, lasting four hours or more, have higher recommendations closer to 11g/kg/day or greater than 600 g/day (Dunford, 2006). One to four hours prior to exercise, athletes should consume 1 to 4 g carbohydrates/kg to ensure adequate muscle and liver glycogen needs are met (Dunford, 2006; Rodriguez et al., 2009). In events lasting up to and longer than one hour, athletes should consume 30 to 60 g carbohydrate per hour to maintain blood glucose levels and carbohydrate oxidation (Dunford, 2006; Rodriguez et al., 2009). After exercise lasting 90 minutes or longer, athletes should consume 1.5 g carbohydrate/ kg within 30 minutes, followed by an additional meal of 1.5 g carbohydrate/kg approximately two hours later (Dunford, 2006; Rodriguez et al., 2009). It is highly recommended that athletes consume sufficient energy for their needs in
combination with a high carbohydrate intake (Dunford, 2006; Jeukendrup, 2004). Replenishing muscle glycogen is particularly beneficial for athletes who are training more than once per day or have multiple competition events in one day (Dunford, 2006; Jeukendrup, 2004).

**Fat**

A diet adequate in fat balances the diet of athletes, and helps some athletes achieve calorie goals (Horvath, Eagan, Fisher, Leddy, & Pendergast, 2000; Rodriguez et al., 2009). Fat is the most calorie-dense food energy source, containing nine calories per gram (Dunford, 2006). Lipids play a role as energy reserves, protection of vital organs, thermal insulation, and transport of fat-soluble vitamins (Dunford, 2006).

The main types of fuel used by muscles for energy metabolism are glycogen, glucose, and free fatty acids (Dunford, 2006; Horvath et al., 2000). Energy availability during exercise has two components, the first is the rate of availability, which determines an individual’s power output; the second is the availability of substrate to supply energy over the period of exercise time (Horvath et al., 2000). Endurance performance depends on the rate of utilization of glycogen and fats and the quantity of their storage in the body’s muscle (Horvath et al., 2000). An important energy source for contracting muscles is intramuscular triacylglycerol stores (Dunford, 2006; Horvath et al., 2000). Free fatty acids are derived from circulation, very-low-density lipoproteins in the bloodstream or from triacylglycerol stored in adipocytes (Dunford, 2006). Fat, in addition to carbohydrate, is oxidized to supply energy to exercising muscles and the extent to which it is utilized depends on the duration and intensity of exercise (Dunford,
It has been shown that endurance exercise performed at 65-75% maximal heart rate is dependent on muscle glycogen stores, but after 15 to 20 minutes of endurance exercise, lipolysis is stimulated and free fatty acids and glycerol are released for energy utilization (Burke, Kien, & Ivy, 2004). Although fatty acid oxidation during endurance exercise yields more energy when compared to the energy yielded by carbohydrate, fatty acid oxidation requires more oxygen than carbohydrates, putting greater stress on the heart muscle (Dunford, 2006). Trained muscles have higher muscle lipoprotein lipase, muscle lipase, fatty acid acyl CoA synthetase and reductase, higher carnitine acyl transferase, and more 3-hydroxyl acyl CoA dehydrogenase activities, indicating that the more trained the athlete is, the more efficient the body is at utilizing fat as fuel (Dunford, 2006; Horvath et al., 2000).

**High-fat diets.** One prospective study of male runners, who had finished in the top 100 of a national duathlon, indicated no change in maximal power, maximal blood lactate concentration, or maximal heart rate on a low fat diet or on a high fat diet. No significant differences were observed between the performances of the runners on the two diets. The only significant changes associated with the high-fat diet were lower respiratory exchange ratios, and lower blood lactate concentrations at rest and at all sub-maximal exercise intensities. The study clarifies that the adaptations to the high-fat diet were not associated with change in performance in moderate- to high-intensity exercise lasting 20-90 minutes (Vogt et al., 2003).
**Low-fat diets.** It is common to find athletes experimenting with low-fat diets, particularly female endurance athletes and athletes in sports that perceive body image to be important in their sport (Dunford, 2006; Loosli, Benson, Gillien, & Bourdet, 1986).

Many believe that dietary fat increases adiposity and impairs health and/or performance. On the contrary, such low-fat diets have been shown to have negative health consequences and may hinder performance (Dunford, 2006). Associations have been reported between very-low-fat diets and exercise-associated amenorrhea, compromised immune function, and elevated serum triglycerides (Dunford, 2006). Additionally, low-fat diets have been reported to be low in essential fatty acids, zinc, calcium, and energy, in comparison to moderate-fat diets (Dunford, 2006; Horvath et al., 2000). Intramuscular fat stores, particularly those in contact with mitochondria, may be limited in athletes with low fat intakes due to either a low percentage of dietary fat or to low total caloric intakes (Dunford, 2006; Horvath et al., 2000). In the study performed by Horvath et al., on the effects of low, moderate, and high diets, runners on the low fat diets ate significantly fewer calories on the low fat diet than those on the moderate or high fat diets (Horvath et al., 2000).

The dietary fat intake patterns of athletes have been shown to vary considerably between sports, training, and performance level of athletes (Dunford, 2006). Excessive consumption of saturated fats and cholesterol can increase the risk of cardiovascular disease, a precursor to other chronic diseases (Dunford, 2006). Intakes above 35% of total calories have been associated with health problems and have also been shown to reduce endurance capacity (Bergstrom et al., 1967; Grandjean, 1989). Fat should consist
of approximately 30% or less of total energy and due to possible fat-soluble vitamin deficiencies such as vitamins E and D, very low fat diets are not recommended (Dunford, 2006; Rodriguez et al., 2009). It is recommended that dietary fat intake goals should be individualized to the athlete’s physical activity level, energy expenditure, nutritional needs, and food preferences (Dunford, 2006; Rodriguez et al., 2009). The recommended range for fat intake is 20-35% of total daily energy, and the proportion of fatty acids should approximate 10% saturated, 10% polyunsaturated, and 10% mono-unsaturated, including sources of essential fatty acids (Rodriguez et al., 2009).

**Protein**

The current Dietary Reference Intake (DRI) for protein is 0.8 g/kg/day for all individuals older than 18 years of age, irrespective of physical activity status (Dunford, 2006). The requirement for protein in sport is reflective of the need to offset protein losses to maintain nitrogen balance in the body (Tarnopolsky, 2004; Phillips, 2004). Protein in the body is continually being synthesized and degraded simultaneously, and because the body cannot reuse amino acids, there is a daily requirement to ingest protein (Dunford, 2006; Phillips, 2004). In order for muscles to be in a hypertrophic state, there needs to be a net positive protein balance (Phillips, 2004; Tarnopolsky, 2004).

Data suggests there are increased protein requirements for strength and endurance athletes; exercise intensity, duration, frequency, and training status dictate protein needs (Clark, 2008; Dunford, 2006; Tarnopolsky, 2004).

Protein after resistance exercise has been shown to increase muscle synthesis (Phillips, 2004). However, after initial phases of any resistance training program and the
initial adaptation to the performed exercise, the body adapts, and does not need an increased protein requirement (Phillips, 2004). Trained individuals likely require less protein than untrained individuals after exercising to support the maximal protein synthetic response to a given workout because prolonged-resistance training actually lessens the acute immediate response of muscle protein synthesis (Phillips, 2004). Protein supplements, though marketed heavily and convenient, are not necessary, and obtaining protein through dietary sources is widely recommended (Phillips, 2004). Energy requirements are emphasized as being equally important in muscle protein synthesis than protein alone, as insufficient energy can actually lead to a loss of lean body mass (Phillips, 2004).

Strength athletes may have higher requirements due to the levels of chronic increases in net muscle protein synthesis, stimulated by habitual training (Tipton & Wolfe, 2004). Strength athletes often see protein as a way to increase muscle mass and strength or power and it is believed that eating increased amounts of protein exponentially increases muscle hypertrophy after resistance exercise, but evidence does not support this claim (Dunford, 2006; Phillips, 2004). Evidence indicates that amino acids not only function as precursors for protein synthesis, but also act as regulatory molecules to stimulate net muscle protein synthesis and that the rate of synthesis of new muscle proteins has a ceiling; the consumption of protein beyond a certain level does not stimulate protein synthesis further (Phillips, 2004; Tipton & Wolfe, 2004). The amount of protein that needs to be consumed to maximally stimulate muscle protein synthesis for an individual is not known, and therefore should be evaluated on an individual basis.
Optimal protein intake will vary depending on the training and competition goals of each athlete (Dunford, 2006; Tipton & Wolfe, 2004). It is known that excess protein is not beneficial to muscle protein synthesis, and will ultimately lead to increased urea production in the case of excess protein (Phillips, 2004). Maintaining energy balance at recommended levels often allows for protein goals to be easily met, and is presumed to have a greater affect on protein requirements for muscle building as muscle protein synthesis may be more limited by total energy consumption than protein requirements alone (Phillips, 2004; Tipton & Wolfe, 2004).

The ADA position stand states that athletes do not need a substantially different diet than the standard American recommendations: a diet of 55-58% carbohydrates, 12-15% protein, 25-30% energy from fat (Phillips, 2004; Rodriguez et al., 2009). While protein recommendations for low- and moderate-intensity endurance exercise do not differ significantly in terms of normal dietary protein requirements, recommendations may differ for elite endurance athletes (Tarnopolsky, 2004). Endurance athletes have an increased requirement due to increased amino acid turnover (Tarnopolsky, 2004). Protein recommendations for endurance athletes are approximately 1.2 to 1.4 g/kg/day (Dunford, 2006). Protein accounts for 10-15% of energy requirements during prolonged exercise (Dunford, 2006). Approximately 5% of energy for endurance athletes comes from protein, especially when blood glucose and glycogen stores are low (Clark, 2008). Protein intake should be carefully monitored; excess protein can cause high urea excretion, gout, strain on the liver and kidneys, calcium losses, bloating, and diarrhea (Wolfe, 2000). Studies indicate that the vast majority of athletes are receiving adequate
protein through their levels of energy intake; thus negating the necessity to independently increase protein levels in their diet (Lemon, 1991; Phillips, 2004; Tipton & Wolfe, 2004). There is also a notion that requiring protein intake to be a certain percentage of the diet may inhibit or limit the intake of fat and/or carbohydrates in the diet (Tipton & Wolfe, 2004).

An increasingly important factor in the diets of athletes is the component of the timing of protein. After endurance exercise, it would appear that timing of nutrient ingestion also may be important for the response of net muscle protein balance. It has been shown that supplementation of protein, carbohydrate, and fat immediately after exercise showed a greater amino acid uptake when ingested immediately after cycling exercise than three hours after cycling (Levenhagen et al., 2001; Tipton & Wolfe, 2004). Due to the combination of the above factors, it is recommended that determination of appropriate protein intake must take into account the demands of the individual goals and training regimen of each athlete (Dunford, 2006; Tipton & Wolfe, 2004). Each requirement should be tailored to the functional needs of the particular sport and perhaps even more specifically, to the particular positional requirements within a sport (Dunford, 2006; Tipton & Wolfe, 2004).

**Importance of Fluid and Hydration in Athletes**

**Fluid Balance**

Fluid balance is one of the most crucial components to performance and health and well-being (Clark, 2008; Dunford, 2006). Fluid balance is pivotal for the body’s thermoregulation, cell rigidity and function, and absorption of micronutrients (Dunford,
For individuals who participate in vigorous physical activity, and in special environmental conditions such as hot and humid environments, cold environments, or high altitudes, the concepts of hydration and electrolyte balance become even more critical (Clark, 2008; Dunford, 2006; Rodriguez et al., 2009). Activity increases the need for the body to regulate fluids more readily, thus increasing the need for fluids in active individuals. Sweating also causes body mineral and trace element losses, thus perpetuating the need for electrolyte replacement (Dunford, 2006). When athletes are completing multiple daily workouts or competing in multiple events during the course of a day, it is important to monitor weight changes and replenish fluid losses throughout the day; ideally weight lost during the training session should be regained by the next day’s workout (Oppliger & Bartok, 2002).

**Dehydration**

Every year severe dehydration results in the injury and death of many athletes, including the death of a prominent football player in 2001 and in the same week, a collegiate football player who died of the same cause, and the deaths of three collegiate wrestlers during a 5-week span in 1997 (Oppliger & Bartok, 2002). At the time of their deaths, each wrestler was reported to be using dehydration techniques to rapidly lose weight necessary to reach a lower weight class for competition (Oppliger & Bartok, 2002). Dehydration, which is preventable, increases the risk of potentially life-threatening heat injury such as heat stroke and for this reason, it is critically important for athletes to strive for euhydration before, during, and after exercise (Dunford, 2006; Rodriguez et al., 2009). Dehydration, even as little as >2% of body weight, can adversely
affect aerobic exercise performance, especially in hot weather, and may impair mental/cognitive performance (Dunford, 2006; Rodriguez et al., 2009). Position statements by the American College of Sports Medicine (ACSM), the American Dietetic Association (ADA), the Canadian Dietetic Association (CDA), and the National Athletic Trainers’ Association (NATA) have been written to warn athletes, coaches, and athletic trainers about the dangers of dehydration and many recommendations for fluid requirements exist (Dunford, 2006; Rodriguez, 2009). Monitoring of athletes during training or competition to ensure health and safety is pivotal (Coris et al., 2004; Oppliger & Bartok, 2002; Rodriguez, 2009).

Knowledge about the negative effects of dehydration on exercise performance has spurred the use of isotonic sports drinks, which are widely available (Gilbert, 2008). There are some criticisms, however, with the use of sports drinks including reported dental erosion, and female groups in particular blame their use for episodes of weight gain (Gilbert, 2008). Each individual will vary in their need and desire for sports drinks due to several factors including work rate, sweat rate, sodium losses, environmental conditions, and food intake, thus perpetuating the need for RDs to be present in sport settings (Coyle, 2004; Gilbert, 2008; Rodriguez et al., 2009).

**Fluid Recommendations**

Currently, there are over five different positions statements that exist surrounding the recommendations for fluid intake and physical activity and a table of recommendations can be found in Appendix B. The joint position stand of the American College of Sports Medicine, American Dietetic Association, and Dietitians of Canada...
provides recommendations to maintain hydration status before, during and after exercise. At least four hours before exercise, individuals should drink approximately 5-7 mL/kg, 0.3-2.4 L during exercise depending on conditions, and 16-24 oz for every pound (0.5 kg) of body weight lost during exercise (Rodriguez et al., 2009). Additionally, consuming rehydration beverages and salty foods at meals and snacks help in replacing fluid and electrolyte losses (Rodriguez et al., 2009). Many athletes fail to return to a euhydrated state on a daily basis due to the fact that the thirst mechanism may not be enough to encourage proper restoration of body water in most individuals; this condition has been termed ‘involuntary dehydration’ (Oppliger & Bartok, 2009). Therefore, maintaining fluid balance is a learned behavior, not an intrinsic impulse (Dunford, 2006; Oppliger & Bartok, 2009).

**Heat Illness**

Heat illness is the third leading cause of death in US high school athletes (Coris, Ramirez, & Van Durme, 2004). There are five common types of heat illness including heat edema, heat cramps, heat syncope, heat exhaustion, and heat stroke. Heat edema is the mildest form of heat illness, characterized by dependent edema in individuals who are not acclimatized in extreme heat. Heat cramps consist of painful muscle cramps and may be accompanied by palpable muscular spasm. Heat syncope involves a loss of consciousness, typically with prolonged standing or with sudden rise from a seated or lying position in the heat. Heat exhaustion is the most common form of heat illness and is characterized by the inability to continue exercising in the heat, with classic symptoms of mild confusion, profuse sweating, headache, weakness, vertigo, heat cramps, chills,
tachycardia, vomiting, and nausea. Lastly, heat stroke, the most serious heat illness, is defined as a condition in which body temperature is elevated to a level that causes damage to body tissues giving rise to pronounced mental status changes, fatigue, nausea, and vomiting with possible syncope. What is most dangerous in terms of heat illness is the mentality that persists in some athletic cultures where fluid restriction during athletic training is practiced and deemed necessary to ‘toughen up’ athletes (Coris et al., 2004). This could be extremely detrimental to athletes who obtain and trust hydration practices solicited by their misinformed coaches or peers.

**Relationship of Micronutrients and Athletic Performance**

Vitamins and minerals are necessary for many metabolic processes in the body; in many reactions involved with exercise and physical activity, such as energy, carbohydrate, fat and protein metabolism, oxygen transfer and delivery, and tissue repair (Dunford, 2006; Lukaski, 2004). Micronutrients become an important component in the diet of athletes that who have micronutrient deficiencies as these deficiencies have been found to negatively impact performance (Dunford, 2006; Lukaski, 2004). Individuals who have been found to be most at risk for micronutrient deficiencies are athletes who are restricting energy intake, often found in populations of wrestlers and female gymnasts (Dunford, 2006; Loosli et al., 1986). Clinical vitamin and mineral deficiencies are rare in the general population when a balanced diet is consumed (Dunford, 2006; Lukaski, 2004). Micronutrient recommendations for vitamins and minerals do not differ between healthy, moderately active people, and athletes; dietary reference intakes (DRIs) have been shown to be sufficient (Dunford, 2006). Micronutrient supplementation may be
most beneficial and necessary for athletes who are deficient in any particular micronutrient (Bernadot et al., 2001; Dunford, 2006). Some athletes may have increased requirements due to excessive losses in sweat and urine, factors that need to addressed individually (Dunford, 2006). However, obtaining micronutrients through diet is recommended foremost above supplements, as dietary sources of micronutrients have been found to be the most beneficial (Bernadot et al., 2001; Dunford, 2006).

**Vitamins**

In general, vitamins play two roles in the scope of performance, providing antioxidant functions, and facilitating energy transfer (Dunford, 2006).

Thiamin is a micronutrient known to play a key role in carbohydrate and protein metabolism. Competitive female gymnasts and collegiate wrestlers have been found to be two populations that are at risk for low thiamin levels, due to the low energy intake and restriction that is common in these populations (Chen et al., 1989; Lukaski, 2004; Loosli et al., 1986; Steen & McKinney, 1986). Brief thiamin restriction can cause pyruvate accumulation and increase circulating lactate during work, which may promote fatigue, impair training, and thus have a negative impact on performance (Chen et al., 1989; Lukaski, 2004).

Vitamin C is important in biological functions that influence performance; it is thought to indirectly benefit physical performance by enhancing physiologic functions (Dunford, 2006; Lukaski, 2004). In one study, men who were supplemented daily with 250 or 500 mg of Vitamin C for 10 days and exposed to controlled exercise in the heat had decreased body temperature as compared with men treated with placebo (Kotze, van
der Walt, & Rodgers, 1977; Lukaski, 2004). Additionally, Vitamin C may enhance immune function in individuals (Dunford, 2006; Lukaski, 2004). A study of male runners running in a marathon race received 600 mg of Vitamin C or a placebo for 21 days before a race. After 14 days post-race, the runners supplemented with Vitamin C had fewer upper respiratory tract infections than did men receiving the placebo, 33% versus 68% (Peters, Goetzshe, & Grobbelaar, 1993). Although evidence remains unclear, Vitamin C is thought to have beneficial effects on physiologic functions that facilitate recovery from intense training and thus, concurrently promote performance (Dunford, 2006; Lukaski, 2004).

Vitamin A, in contrast to the water-soluble vitamins, can be toxic in large amounts that are consumed, resulting in complications such as nausea, anorexia, hair loss, and kidney and liver damage (Dunford, 2006; Lukaski, 2004). While many populations of athletes such as endurance runners, professional ballet dancers, female collegiate heavy weight rowers, and male cross country runners have been shown to indicate sufficient vitamin intakes, adolescents and young adults in wrestling, ballet, and gymnastics tend to consume less than 70% of the RDA for vitamin A (Loosli et al., 1986; Steen et al., 1986). This deficiency may not be solely accounted for by dietary energy restriction, some deficiencies reported were the result of high-fat diets, and poor food selection in women (Dunford, 2006; Lukaski, 2004).

Vitamin E, another fat-soluble vitamin, is thought to play a role in type I muscle fibers, the muscle fibers believed to have greater catalase activity (Dunford, 2006; Lukaski, 2004). Vitamin E deficiency adversely affects skeletal muscle and may lead to
muscle degradation in humans (Dunford, 2006; Lukaski, 2004). However, generalized supplementation with vitamin E has not been shown to enhance performance (Dunford, 2006; Lukaski, 2004; Sherman, Down, & Norgan, 1976).

Minerals

Minerals support the building and maintenance of cell structure, tissue synthesis, muscle contractility, support acid base balance, and regulate metabolism (Dunford, 2006).

Iron is a key mineral that is required for the delivery of oxygen to tissues and the use of oxygen in the body (Dunford, 2006; Lukaski, 2004). Iron is a functional component in hemoglobin, myoglobin, cytochromes, and specific iron-containing enzymes and plays a critical role in energy use during exercise (Dunford, 2006; Lukaski, 2004). In one study that examined the adequacy of iron in diets of physically active people found that males generally consume at least the RDA for iron, but female athletes tend to consume somewhat less than the recommended 18 mg/d (Haymes, 1987). Inadequate intake is the primary cause of iron deficiency in women, and is common in women’s sports of field hockey, cross-country skiing, rowing, basketball, and softball (Haymes, 1987). In particular, female runners exhibit the most depletion of iron in tissues, with 25%-44% of normal values found (Haymes, 1987). Studies performed conclude iron’s significance in oxygen uptake during performance; individuals with the lowest hemoglobin concentrations in one study had the shortest time to exhaustion (Gardner, Edgerton, Barnard, & Bernauer, 1977; Gardner, Edgerton, Senewiratne, Barnard, & Ohira, 1977). Findings indicate that when iron stores are depleted, there is an
increase in reliance on glycolytic metabolism (Lukaski, 2004). Iron supplementation in deficient individuals has the ability to biochemically improve iron status and work capacity, reducing exercise heart rate and lactate concentrations (Gardner et al., 1975).

Magnesium is responsible for a wide variety of fundamental cellular activities that include glycolysis, fat and protein metabolism, adenosine triphosphate (ATP) hydrolysis, and the second-messenger system (Dunford, 2006; Lukaski, 2004). Dietary surveys in one study found male athletes tend to exceed the RDA, while female athletes tended to only be at the 60-65% range of the current recommendation of 280 mg/d (Lukaski, 1995). It is clear that magnesium deficiency impairs physical performance, as it plays a key role in glycolytic metabolism (Dunford, 2006; Lukaski, 2004). Restriction of dietary magnesium inhibits performance, and performance benefits are regained when normal levels are reached by magnesium supplementation (Dunford, 2006; Lukaski, 2004). In one study of marathon runners, runners with adequate magnesium status did not benefit from supplemental magnesium, showing no improvement in skeletal muscle function (Terblanche, Noakes, Dennis, Marais, & Eckert, 1992). Studies indicate that magnesium supplementation does not improve performance when magnesium status is normal (Lukaski, 2004; Terblanche et al., 1992).

Zinc functions as a regulatory mechanism in many bodily processes (Dunford, 2006; Lukaski, 2004). Athletes generally consume less zinc than recommended, where marginal intake is more prevalent among females (Deuster, Day, Singh, Douglass, & Moser-Vellon, 1989; Loosli et al., 1986). In one study, muscle strength and endurance were improved in middle-aged women supplemented with zinc (30 mg/d) and a placebo
in a double-blind, cross-over study (Krotkiewski, Gudmundsson, Backstrom, & Mandroukas, 1982). Studies indicate an impaired metabolic response during exercise when dietary zinc is suboptimal (Dunford, 2006; Lukaski, 2004).

Chromium is a highly marketed product targeted toward young adult athletic populations (Dunford, 2006). While chromium excretion has been shown to increase after exercise, studies indicate that supplementation that exceeds normal chromium levels do not benefit performance, though anabolic actions have been purported (Dunford, 2006; Lukaski, 2004). In one study, chromium picolinate did not significantly increase muscle mass or strength or decrease body fat in young men who were strength training (Lukaski, Bolonchuk, Siders, & Hall, 1996).

Recommendations of the ADA and ACSM state that the primary strategy of achieving optimal micronutrient statuses are through the promotion of adequate diet with a wide variety of foods (Dunford, 2006; Lukaski, 2004; Rodriguez et al., 2009). It has been found that the use of generalized vitamin and mineral supplementation has not enhanced nutritional status and physical performance of trained athletes; a study of individuals in wide variety of competitive sports have not shown any favorable effects on biochemical measure of nutritional status or sports performance above normal (Lukaski, 2004).

**Current Sources of Nutrition Information for Athletes**

In one survey of Big Ten student athletes, the perceptions surrounding athletic trainers’ nutrition knowledge was measured using the Likert scale. Students from eight NCAA Big Ten universities were asked to respond to the statement, “Athletic trainers
have a good knowledge about nutrition and nutrition supplements,” where a “5” response designated strong agreement, and “1” designated strong disagreement. A mean score of 3.8 +/- 0.9 on the 5-point scale indicated that student athletes perceived athletic trainers to have good nutrition knowledge. Only 8% indicated a score of ‘three’ or lower. In the same survey, about half of the respondents reported knowledge of a registered dietitian on staff, 23.5% reported no dietitian on staff, and 27% remained unsure of the availability of a dietitian (Burns et al., 2003). Among survey participants, 40% reported the certified athletic trainer as their primary source of nutrition information, 24% reported strength and conditioning coach as their primary source of nutrition information and 14% participants reported the registered dietitians, followed closely by 10% who reported other, 6% reported magazines, 3% reported the team physicians, and 1% reported website (Burns et al., 2003).

Young athletes, especially high school athletes, suffer from the nutrition knowledge inadequacies that exist in the sport setting (Cotugna, Vickery, & McBee, 2005). In one study, high school athletes responded that parents are their primary source of nutrition information (Douglas & Douglas, 1984). Media was the second source (Graves et al., 1991; Parr et al., 1984). High school athletes are prone to misinformation due to the amount of trust between athletes and their coaches in the high school setting, many athletes believing their coaches advice to be valid and reliable (Sossin, Gizis, Marquat, & Sobal, 1997).
Nutrition Knowledge of Coaches and Athletic Trainers

Coaches

When working with athletes, coaches are key in implementing a successful nutrition plan (Rosenbloom & Murphy, 2010). Athletes will not embrace nutrition as an important component of their training plan if coaches do not see it as such (Rosenbloom & Murphy, 2010).

As coaches are under great pressure to win, they may shoulder the responsibility of soliciting nutrition advice to their athletes (Vinci, 1998). This could be especially true in the high school setting. In one study, 98% of football coaches have advised players on gaining lean body mass, while 97% of this group felt nutrition was an important component to achieving this end (Baer, Dean, & Lambrinides, 1994). In another survey of high school coaches, 86% of participants reported that they dispense nutrition information at least monthly, and 92% believed that the coach should take an active part in advising athletes about their diets (Bedgood & Tuck, 1983). Yet, 37 participants inappropriately believed that red meat is the best source of protein and over 70% of coaches could not identify that thirst is an indication of dehydration (Bedgood & Tuck, 1983). While past thinking has regarded coaches as acceptable sources of nutrition information, research indicates that inadequacies of nutrition knowledge among coaches exist (Corley, Demarest-Litchford, & Bazarre, 1990; Douglas & Douglas, 1984; Parr, Porter, & Hodgson, 1984; Grandjean, Hursh, Majure, & Hanley, 1981). Although coaches individually vary in their certainty and knowledge in the area of nutrition, there is considerable research that displays the nutrition knowledge deficits of athletic coaches.
Athletic Trainers

Like coaches, athletic trainers are a crucial component in the nutrition practices of athletes (Graves et al., 1991). In fact, trainers may need more nutrition knowledge as they are in contact with several groups of athletes and coaches typically deal with their sport exclusively (Graves et al., 1991). In a study that evaluated the nutrition knowledge of high school athletic trainers and coaches, athletic trainers scored significantly better in their responses of nutrition-related questions (Graves et al., 1991). Of all the professionals in contact with athletes, trainers certified by the National Athletic Trainers Association were found to have the best nutrition background (Parr et al., 1984). Even while athletic trainers seem to be a more informed source of nutrition information due to their requirements of nutrition-related course work as a part of their training, studies show athletes, in general, tend to overestimate their athletic trainer’s level of understanding of nutrition (Graves, et al., 1991; Shifflett, Timm, & Kahanov, 2002). In a study consisting of a survey on the nutrition knowledge of high school coaches and trainers, trainers had attended significantly more nutrition workshop courses than coaches (Graves et al., 1991). However, due to the nature of athletic training, athletic trainers may be too busy with other demands of their jobs to focus on the nutrition concerns of athletes (Vinci, 1998).

The research is in agreement that a nutritional professional is needed in these settings, not only as a resource for athletes, but also as a resource for athletic trainers, coaches, and coaching staff (Graves et al., 1991). In one survey, 53% of coaches perceived themselves as the primary providers of information, 17% of the coaches
indicated that trainers were responsible for nutrition information, 38% of trainers perceived themselves as the most important dispensers of information, and 33% of the trainers perceived coaches as the primary providers of nutrition information. However, the most pertinent result of the study is that one in five respondents within each group said no one could be identified as having this responsibility (Graves et al., 1991). A well-rounded athletic program will realize the performance and health disparities in the absence of a dietitian, as many programs are recognizing dietitians as professionals in their field, and are working toward incorporating dietitians into these settings (Burns et al. 2003; Sossin et al., 1997).

**Nutrition Knowledge Disparities of Athletes**

**Collegiate Athletes**

In one study that examined the nutritional knowledge of college athletes, athletes scored a combined total of less than 50% on questionnaires measuring nutrition knowledge. Of the participants, comprised of 812 varsity athletes from 11 randomly selected division IA universities, 67% of athletes surveyed did not know that carbohydrates are the best sources of fuel for their bodies in sport (Jacobsen & Aldana, 1992). In answering questions on protein, 51.1% believed protein provides immediate energy, 34.2% believed that protein could be used for increasing muscle size, 35.12% believed that protein could be used for increasing muscular strength, and 41% believed protein could be used for weight gain. In this study, 40% of participants chose magazines as the most prominent source of nutrition information, followed by 31% who indicated athletic trainers, 28% who indicated friends, and 25% who indicated college courses
In another study by Grandjean et al. (1981), 98% of college athletes believed a high-protein diet improves performance, 80% indicated that increased protein builds muscle mass, and 75% believed that athletes need more vitamins than non-athletes. Rosenbloom and Jonnalagadda (2002) surveyed collegiate athlete in division NCAA schools and found a majority of athletes surveyed believed that sugar eaten before an event will adversely affect performance.

**High School Athletes**

The same results have been shown in high school athletes (Douglas & Douglas, 1984; Loosli et al., 1986). In a study of female gymnasts’ ages 11-17 who participated in a nutrition knowledge questionnaire, 50% of the participants did not know what a complex carbohydrate is, and indicated that protein, not carbohydrate, is the main source of fuel for energy (Loosli et al., 1986). In another study measuring the nutrition knowledge and food practices of high school athletes, results on the nutrition knowledge component of a questionnaire showed a mean score of 26.4 out of 48 possible correct answers (Douglas & Douglas, 1984). The nutrition knowledge component of the questionnaire contained content consisting of conceptual and factual questions on nutrition involving vitamins, minerals, lipids, proteins, and carbohydrates (Douglas & Douglas, 1984). In the same study, the mean score for food practices out of a possible score of five was a 2.21, where females scored slightly higher on average than males (Douglas & Douglas, 1984). Both studies indicated a nutrition education program would be beneficial for these athletes (Douglas & Douglas, 1984; Loosli et al., 1986).
Effective Nutrition Support Programs for Sports Nutrition

In the early 1990's, the Pennsylvania State University became the first athletic department within the National Collegiate Athletic Association (NCAA) to fund and staff a sports nutrition position with a registered dietitian (Clark, 1994). While the sports dietitian as a position in Division I athletic facilities is still not widespread, athletes are still seeking nutrition information from the media, their coaches, trainers, and physicians (Rockwell, Nickols-Richardson, & Thye, 2001). Sports dietitians are now becoming ingrained in the inner workings of the athletic setting and work alongside professionals such as athletic administrators, coaches, athletic trainers, coaches, athletic trainers, team physicians, sport psychologists and academic and financial aid counselors (Vinci, 1998).

The Iowa High School Athletic Association is one example of a school system that is trying to incorporate reliable nutrition information for parents and athletes (Denehy, 2006). Guidelines on safe weight loss and practices that would exclude athletes from participation are published on the Iowa High School Athletic Association website, http://www.iahsaa.org (Denehy, 2006). Additionally, there are resources on the website that provide information on substance abuse, strength training, and overuse injuries for parents (Denehy, 2006).

The RD at Georgia State University was able to create a nutrition program prior to the formation of the football team, allowing for her to consider both short- and long-term health of the athletes involved (Rosenbloom & Murphy, 2010). Results of this program saw the need for athletic directors to be in support of the nutrition program, the need for coaches to implement nutrition plans with athletes for athlete acceptance in realizing the
credibility of the RD, and a need for a nutrition education program that is relevant to individual athletes as well as to the team (Rosenbloom & Murphy, 2010).

The sports nutrition dietitian at Penn State University comments on the role of sports dietitians and their necessity to the athletic performance of athletes. While coaches and trainers are an integral part to the performance of athletes, an athlete who is nutritionally compromised with dehydration or lack of critical macronutrients like carbohydrates cannot physical perform at their best, whether practicing or during competition (Clark, 1999). Additionally, it is noted that nutrition should be a team effort, as the performance of the team is comprised of the effort of the individuals who comprise it, each with their own responsibility to be at in a nutritionally adequate state with their dietary intake. This program recommends parents of prospective student athletes meet with the sports nutritionist during official recruiting visits and learn how their child will be cared for from nutritional perspective. While it is believed that nutrition intervention enhances performance and protects both athletes and athletic departments from accidents involving dangerous nutrition practices that could be potentially hazardous or fatal, performance outcomes are continually necessary to document the necessity for sound nutrition practices in this arena (Clark, 1999).

The RD at the University of Washington is available for nutrition counseling to 650 student athletes and the cheer squad (Vinci, 1998). In addition to counseling sessions, nutrition talks presented to men’s and women’s teams cover topics such as exercise, the role of carbohydrate in body fueling, protein needs of athletes, fluid requirements, and hydration, planning meals on the go, eating on the road, strategies for
healthy weight gain or weight loss, use of supplements, and nutrition timing before, during, and after workouts. As an administrator, the RD is also responsible for delivering sports nutrition information throughout the athletic department. Tasks included developing protocols for nutrition supplement use in the department, advocating for the need for vending machines in athletic facilities, and collaboration with Department of Housing and Food Service to provide nutritional analysis of foods served in dorm and campus cafeterias (Vinci, 1998).

In each nutrition program it was noted that the benefit of sound nutrition programs leading to performance and health improvements have both advantages for the athlete in and outside the field of competition (Clark, 1999; Denehy, 2006; Rosenbloom & Murphy, 2010; Vinci, 1998).

**Role of Registered Dietitians Working in Sports Nutrition**

**Body Composition and Clinical Measurements of Athletes**

In the ADA position title of sports dietitians from SCAN, the position of sports dietitian is outlined. Sports dietitians are responsible for assessing and analyzing dietary practices, body composition, and energy balance of athletes, counseling athletes on optimal nutrition for specific training goals, weight management, hydration, disordered eating, recovery, travel, and supplementation (ADA, 2008). Sports dietitians are also in place to counsel athletes on proper techniques in achieving and maintaining optimal levels of body mass, body fat, and muscle mass for performance, providing personalized meal and snack plans, developing hydration protocols, and addressing individual medical
nutrition-related challenges in athletics by providing adequate medical nutrition therapy (ADA, 2008; Gilbert, 2008; Vinci, 1998).

Knowledge Source on Supplements and Ergogenic Aids

One key element for an effective sport nutrition program in college athletics is a sound information base for the rules and regulations of the NCAA (Vinci, 1998). In one program called Challenging Athletes’ Mind for Personal Success (CHAMPS)/Life skills Program, sound nutrition is a component of the commitment to personal development portion (Vinci, 1998). Magazines contain an abundance of advertisements for nutritional supplements, and navigating and interpreting tempting labels for muscle building formulas, vitamin “megapacks,” and natural “anabolics” may be beyond the skill set of the consumer (Jacobsen & Aldana, 1992). Supplements are continuing to be a growing and controversial topic, and a registered dietitian on staff could be the expert on supplements and utilized as a reference for the athletic department (Clark, 2008; Dunford, 2006; Krieder et al., 2004; Rodriguez et al., 2009).

Many athletes take nutritional supplements inappropriately and unnecessarily and use of supplements is often seen as an easy alternative to dietary change and for most athletes is more accessible than seeing professional advice, involving far less effort than changing eating habits. Without knowing supplements can be harmful in larger doses, athletes presume that more is better, often to the detriment of their health or performance (Gilbert, 2008). A registered dietitian can advise, educate, and offer alternative safe options, but their sound advice is competing with the myths fueled by the billion-dollar supplement market, the highly-influential sponsorship deals with individual athletes, and
unregulated unethical companies who profit from endorsing and selling supplements (Gilbert, 2008).

**Nutrition Education and Counseling of Athletes**

Sports nutrition is a dynamic field as it is essentially the integration of nutrition, exercise physiology, and psychology (Dunford, 2006). Sports dietitians are a specific group that is uniquely qualified to counsel athletes on nutrition practices for recovery from illness or injury (ADA, 2008). As a crucial component of the sports medicine team, a sports dietitian can be a liaison and coordinate with in-and outpatient programs for conditions like disordered eating. Additionally, the sport dietitian can effectively determine the nutritional quality and safety of supplements, and in each level, distinguish which supplements are legal for individual sport (ADA, 2008). Athletes need to know RDs understand their training regimen and lifestyle to recognize their credibility and take their advice. Gaining rapport in the counseling setting is paramount (Dunford, 2006).

Additionally, RDs need to stay informed of the latest fad and understand how to motivate their athletes to implement effective nutrition practices (Clark, 2008; Dunford, 2006). In order to achieve set goals, sport dietitians may also document performance outcomes of their athletes as well as nutrition-related achievements, mentor and educate dietetic interns as needed, and develop and oversee nutrition policies and procedures within their facilities (Shattuck, 2001; Vinci, 1998).

Athletes lead busy lives and dietitians need to adapt (Rosenbloom, 2007). Most nutrition professionals are not employed full-time as a staff member and may not have daily contact with the athlete (Rosenbloom, 2007). Since there is no perfect assessment
Risk and Prevention of Eating Disorders in Athletes

There is an increasing concern surrounding eating disorders among females and weight-restricting athletes, as well as the consequences of the female athlete triad (Abood, Black, & Birnbaum, 2004; Beals & Manroe, 1998). A large component of the problem is attributed to the personality characteristics of athletic individuals that consist of being highly driven, competitive, perfectionist, and disciplined (Vinci, 1998). High school wrestlers are of particular concern and are at risk for using potentially dangerous weight-loss measures to achieve their desired weight (Sossin et al., 1997). The female athlete triad is associated with disordered eating, amenorrhea, and osteoporosis later in life, as well as possible reproductive implications for these females (Denehy, 2006).

Registered dietitians in these settings could work as a component of team including a sport nutritionist, team physician, clinical psychologist, and athletic trainer to prevent, detect, and treat eating disorders (Vinci, 1998).

In a study measuring the confidence of collegiate athletic trainer’s in identifying and helping female athletes with eating disorders, 78% believed it was their role to identify and 97% felt they were responsible for helping with eating disorders. However, in this same study, only 27% of trainers felt effective at identifying an athlete with an eating disorder and only 38% felt comfortable in asking an athlete if she had an eating disorder (Vaughan, King, & Cottrell, 2004). The authors conclude that more training is
needed for athletic trainers surrounding this issue and that a registered dietitian should be on staff of all university athletic programs (Vaughan et al., 2004).

**Sports Injury Prevention and Compliance Issues**

A dangerous trend in the sports nutrition world is the increasing number of heat stroke and heat injuries in high school and college athletics (Clark, 1999). Since the continued push for education on the necessity of proper hydration techniques, number of deaths has decreased since past decades, but saw a slightly lessened decrease, due to in part the use of supplements and dangerous dieting tactics (Bailes, Cantu, & Day, 2002). A sports dietitian could be critically important in their role as an educator to athletes, coaches, and athletic support staff (Clark, 1994).

**Menu Analysis and Meal Planning for Athletes**

Sports dietitians should be an integral part of the food service portion of sports programs (ADA, 2008). Interacting with food service managers and personnel provides avenues in preparing a variety of nutritious meals for athletes, providing nutrition information on meals, and distributing nutrition information for the food service personnel. If needed, dietitians also have expertise in managing quality food production and distribution as well as budgeting for the purchasing and distribution of nutritional supplements, if appropriate (ADA, 2008).

**Information for Parents, Coaches, Athletic Trainers, Support Staff**

While athletic teams are continually in need of RDs to spend their time educating on nutrition information as new athletes comprise the make-up of the teams, RDs could also facilitate the education and furthering of nutrition knowledge to other professionals
involved with athletic teams and other health professionals (Rosenbloom & Jonnalagadda, 2002; Vinci, 1998). Due to the lack of knowledge of coaches and athletic trainers in the area of nutrition, it is critical for dietitians to be the source of nutrition information for the support staff of athletes. Sport dietitians should interact with families, coaches, trainers, physicians, and other professionals as needed to ensure nutrition practices are being carried out and nutrition information is available to each person interacting with athletes (Gilbert, 2008; Rosenbloom & Murphy, 2010).

**Efficiency and Productivity**

Time is a huge constraint and barrier to sound nutrition practices of athletes. Athletes are continually balancing rest, recovery, nutrition, and training, which may or may not be more than once a day. Additionally, athletes juggle competition, travel, and perhaps family commitments, school, and/or work (Rosenbloom, Jonnalagadda, & Skinner, 2007). One advantage to having a sports dietitian is the benefit of having a professional who is dedicated to keeping current on nutrition trends, research, and information. This in turn creates a culture in which all teams and members of the team are on the same page with nutrition information. Coaches and trainers can dedicate more time to coaching, mentoring, and keeping their athletes injury-free (Rosenbloom et al., 2007; Sossin et al., 1997).

Sports dietitians can optimize athlete/client recruitment and retention, speed the recovery of athletes following training, competition, surgery, illness, and/or injury; thus enhancing athletic performance and potentially increase revenue for various facilities, especially in the collegiate setting (Rosenbloom & Murphy, 2010).
Benefit of Registered Dietitians in Sports Nutrition

As athletes begin their athletic careers in high school and realize the competitiveness of their sport at this level, motivations of these athletes typically change (Denehy, 2006). While previously their motivations may have centered on competing for fun, now the desire to win may be predominant. This factor into type and intensity of training, oversight of injury, and feelings associated with failure in the case of bench time and cuts from the team (Denehy, 2006). This could put them at risk for dangerous nutrition-related practices. Many organizations delegate nutrition responsibilities to other professionals, such as coaches or trainers who may only have a very basic knowledge of nutrition and may lack the practitioner skills and expertise to effectively apply theory to practice (Gilbert, 2008). Furthermore, sports nutrition is currently a poorly regulated profession in general, often athletes have been found to be adopting practices of the media, supplement companies, or unqualified professionals without the necessary skills and qualifications to practice (Gilbert, 2008). It is crucial for nutrition professionals to be a part of this culture and RDs should be in place to dispel myths about popular nutrition practices that could be potentially dangerous to the health or well-being of athletes, especially in the high school arena during where these individuals are experiencing possible rapid growth and adolescence. Proper nutrition practices are increasingly important in the case of female athletes and those in sports where weight restriction is an issue (Denehy, 2006).
CHAPTER III

METHODOLOGY

The purpose of this study was to determine the current role and perceptions of registered dietitians (RDs) who have roles in sports nutrition. The research design of this thesis was a descriptive survey study. The data was collected using an online survey. The survey of RDs who work in sports nutrition examined their role and perceptions of their professional practice. The surveys provided insight on the role of RDs working in sports nutrition. Additionally, collegiate coaches and athletes from two midwestern universities, Indiana University, and Kent State University were surveyed to examine their perceptions of dietitians in the collegiate athletic setting, as well as the perceived nutritional needs of their athletic teams.

Population

The survey research population was approved by the Kent State University Institutional Review Board (IRB). The survey was distributed to all members of the American Dietetic Association (ADA) Sports, Cardiovascular, and Wellness Nutrition (SCAN) dietetic practice group (DPG). All student-athletes from Indiana University and Kent State University were eligible for the study. The athletic academic services of Indiana University and Kent State university were utilized to distribute the survey to all the student-athletes at these two universities. All coaches from these universities were also eligible for participation in this study, and their email addresses were obtained through the university websites, their contact information is public knowledge. Participation in the survey was voluntary. A copy of the student survey, along with a
copy of the email invitation to the study, a copy of the researcher’s Institutional Review Board (IRB) approval letter was sent in addition to the survey link. A note was made in the invitation email that the survey should not be personally forwarded by the participants. All participant information remained anonymous. Contact information of the principle researcher and thesis advisor was available for the survey participants in both the email invitation and end of survey response.

**Instrument of Measure**

Surveys through surveymonkey.com, an online survey toolkit, were utilized. The surveys were created by the researcher, due to lack of survey tools that exist surrounding this particular topic. There were three separate surveys; one for student-athletes, one for coaches, and one for RDs who work in sports nutrition. The surveys for the registered dietitians were divided into four parts: roles (Part I), perceptions (Part II), job responsibilities (Part III), and demographics (Part IV). The surveys for the coaches and student-athletes were divided into three parts demographics (Part I), team nutritional needs (Part II), and perceptions of RDs (Part III). The survey and survey supplemental materials can be found the appendices.

**RD Survey Part I: Roles of RDs in Sports Nutrition**

The first portion of the RD survey included questions to determine the role of RDs who work in sports nutrition. In this section, participants will respond to statements based on the Likert scale of “Very often,” “Often,” “Sometimes,” “Rarely,” or “Never.” An “I don’t know” option was also available. One example of a statement is, “I am the
provider for information on banned substances and ergogenic aids.” Another example is “I am involved in research surrounding sports nutrition.”

**RD Survey Part II: Perceptions of the Role of Sport Dietitian**

The second part of the RD survey consisted of statements regarding the current perceptions and beliefs of the current role of registered dietitians in sports nutrition. This part will establish what the survey participants perceive their responsibilities should be as a registered dietitian who works in sports nutrition. With this section, the Likert scale was used with a five-point scale that consists of “Strongly Agree,” “Agree,” “Disagree,” “Strongly Disagree,” and an “I don’t know” option was also available. An example question would be “Registered dietitians are the most qualified professionals to deliver reliable nutrition information to athletes.” Another example would be “I feel my practices are essential to the athletic program.”

**RD Survey Part III: Responsibilities of RDs in Sports Nutrition**

The third part of the survey covered responsibilities of registered dietitians who work in sports nutrition. An example question asked survey participants to identify which individuals they most often work with by rating their top three. Another example asked RDs to identify which sports they primarily interact with in their sports RD role.

**RD Survey Part IV: Demographics of RDs**

The fourth part of the survey will establish demographic information. Demographics of interest consist of; highest degree earned, number of years in sports nutrition practice, membership in professional organizations, level of participation with athletes, and the primary sports within which they work.
Coaches and Athletes Survey Part I: Demographics

The coaches and athlete surveys consisted of the same questions with the exception of demographics, or part I of the survey. For the coaches, the demographics consisted of school, title, number of years coaching, and level of participation with the athletes, with responses of full-time, part-time, ¼ time, and less than ¼ time. The athletes’ demographics asked school, age, sport, year in sport, and major.

Coaches and Athletes Survey Part II: Team Nutritional Needs

The second part of the coaches and athletes survey consisted of an analysis of perceived team nutritional needs. The first questions asked in they feel their team would benefit from nutrition presentations. The next two questions asked the nutrition topics that they believed their team would benefit from if more information could be provided to them, and the primary nutrition concern they feel is present on their team. At the end of Part II of both the coaches and athletes’ survey was a screening question regarding the credentials and qualifications that consist of registered dietitian status. This question was implemented into the survey to ensure that the participants were knowledgeable about how a registered dietitian is differentiated from others who solicit nutrition advice without a RD credentials.

Coaches and Athletes Survey Part III: Perceptions of RDs in Sports Nutrition

This section of the survey consisted was the same first ten questions as asked of the RDs in the perceptions portion (part II) of the RD survey. The answer responses consisted of “strongly agree, agree, disagree, strongly disagree, and don’t know.” The next three questions asked participants if they felt the practices of sport dietitians are
essential to the athletes program, if they felt nutrition information provided to my team would benefit their team, and if they felt at RD on staff would positively benefit their team. The last questions asked if they believed adequate nutrition practices are crucial to successful performance in the sport(s) in which they participate or coach, respectively.

The survey data collected from the coaches and athletes was excluded from analysis in the current investigation due to a very low response rate (n = 15 for both groups), therefore the methodology for these surveys was excluded from Chapter IV.

**Procedures**

A cover letter explaining the purpose of the study, and the link to the survey was emailed to the target population. The email letter will invite participants to take part in the study, assuring that the survey is anonymous, confidential, and participation is voluntary. There was a link within the email invitation for participants who do not wish to participate and opt out of subsequent emails about the study. It was explained that the survey was accessible by surveymonkey.com, and would take approximately 15 minutes to complete. A link within the email will take the participants to the survey. Upon arrival to the survey website, participants agreed to terms of the study, in the survey participation agreement. Within the survey participation agreement, there was a notice for the participant to please refrain from forwarding the survey. After agreeing to the terms of the study, the participant was lead to the pre-survey definitions and lead-in question. The pre-survey definitions define “sports nutrition” and “athlete” for the purpose of this study. The lead-in question determined the status of the participant as a registered dietitian who actively works in sports nutrition. “Yes” responses lead the participants to
the remaining questions of the survey. “No” responses to the lead-in question directed
the participants to a separate screen, and thanked them for their time and participation in
the study. After the survey was completed, the participants were lead to a follow-up
response screen thanking them for their participation in the study and participants were
given the option to forward their email to the researcher to receive a copy of the results
once the study has been completed.

Two weeks after the initial mailing of the email invitation letter, a follow-up
email was sent as a reminder of the survey for the study. The survey was available for
one month. Participants were given contact information of the researcher and thesis
advisor in each of the emails that sent to them and contact information was also displayed
in the survey participation agreement prior to the beginning of the survey and in the
follow-up response screen after the survey was completed.

**Statistical Analysis**

Statistical analysis was completed using SPSS (version 14.0). The survey was
analyzed for frequencies and descriptive statistics. The frequencies of the responses were
analyzed by SPSS software and individually by the researcher.
CHAPTER IV

JOURNAL ARTICLE

Introduction

It has been proven that the performance of an athlete can be impaired or improved significantly based on the adequacy of their diet (Bedgood & Tuck, 1983; Clark, 2008; Dunford, 2006; Graves, Farthing, Smith, & Turchi, 1991; Grandjean, 1989; Lukaski, 2004; Rodriguez, DiMarco, & Langley, 2009). Athletes need a proper balance of macronutrients, micronutrients, and hydration to perform at their potential (Clark, 2008; Dunford, 2006; Rodriguez et al., 2009). Consistent training, energy balance, a nutrient dense diet, proper timing of nutrient intake, and adequate rest are crucial to enhancement of sport performance (Clark, 2008; Krieder et al., 2004; Rodriguez et al., 2009).

Adequacy of dietary carbohydrates, protein, and fat are all linked to an individual’s ability to physically perform well (Clark, 2008; Dunford, 2006; Rodriguez, 2009). Carbohydrates are the main source of fuel during physical activity and it is recommended that athletes consume approximately 60-70% of their diet from carbohydrates (Clark, 2008; Dunford, 2006; Burke et al., 2004; Rodriguez et al., 2009). Fat, which is recommended to make up 20-25% of an athlete’s diet, is an equally important macronutrient for athletes in term of performance, and is largely utilized in well-trained athletes as the body’s fuel source in addition to muscle glycogen stores (Clark, 2008; Dunford, 2006; Horvath, Eagan, Fisher, Leddy, & Pendergast, 2000; Rodriguez, 2009). Additionally, athletes have higher recommendations for protein, 1.2 to 1.4 g/kg/day, and for strength athletes ranges from 1.6-1.7 g/kg/day, as protein accounts
for 10-15% of energy requirements during prolonged exercise (Dunford, 2006; Rodriguez, 2009).

The question of who is responsible for disseminating nutrition resources in athletic settings is still unclear (Graves et al., 1991). In a study of the nutrition training, recommendations, responsibility, and resource utilization of high school coaches and trainers, the majority of high school coaches believe they are the main disseminators of nutrition information, while the majority of athletic trainers believe they and the coaches are both equally responsible for providing nutrition information (Graves et al., 1991). It is interesting to note that the athletes in this setting identified neither the coaches nor the trainers as important sources of nutrition information; most cited their parents as fulfilling this role (Graves et al., 1991).

In 2006, the Sports, Cardiovascular, and Wellness Nutrition dietetic practice group and Commission on Dietetic Registration (CDR) of the American Dietetic Association (ADA) successfully approved credentials for registered dietitians (RDs) in sports nutrition. Board Certification as a Specialist in Sports Dietetics Nutrition (CSSD) is an exam-based credential offered for RDs who meet the sport dietitian requirements. Requirements include current RD status by the CDR, and maintenance of RD status for a minimum of two years from the original examination date of the specialty examination. Initial certification requires 1,500 hours of specialty practice experience as an RD within the past five years, and recertification requires documentation of 1,000 hours of specialty practice experience as an RD in the past five years, by the date the application is due (“Board certification as a specialist in sports dietetics,” n.d.).
The International Society of Sports Nutrition (ISSN) offers certification in the form of CISSN or Certified Sports Nutritionist for the International Society of Sports Nutrition (“CISSN: Get certified now,” n.d.). Eligibility is based on the criteria of having a 4-year undergraduate degree in exercise science, kinesiology, physical education, nutrition, biology, or a related biological science (“CISSN: Get certified now,” n.d.). This accreditation is the loosest certification of the aforementioned credentials and should be noted that CISSN is not a replacement or accepted credential for any state laws governing the application of nutrition in a commercial setting (“CISSN: Get certified now,” n.d.). Although these credentials exist, they are not widely known to the general population. It is believed that a sports dietitian network is needed beyond the dietetic practice group of sports, cardiovascular, and wellness nutrition.

Sports nutrition is an increasingly growing field (Kreider et al., 2004; Vinci, 1998). This is largely due to the growing prevalence of athletes who desire to control the variables affecting performance (Rodriguez et al., 2009; Burns 2003). A great deal of time and money is spent on new training theories, new coaching methods, new equipment, and/or performance-enhancing supplements; however, athletic programs are increasingly cognizant of the effectiveness of incorporating sports nutrition, a proven scientific benefit to performance (Shattuck, 2001). Competitive athletes may have a support system that includes a coach, sports psychologist, medical doctor, physical therapist, and possibly a massage therapist; however, many fail to have sports dietitians as a support service (Clark, 2008).
It has been argued that proper nutrition practices and nutrition guidance are as critical as good coaching and appropriate strength training to reduce the risk of athletic-related injury (Clark, 1999). Athletes equipped with more nutrition knowledge make better food choices that result in better health, well-being, and athletic performance (Quatromoni, 2008). Additionally, nutrition intervention enhances performance and can be a source for safe weight loss practices, counseling for eating disorders, and a protection for both athletes and athletic departments from hazards such as supplement abuse or overuse or other dangerous nutrition-related practices (Clark, 1999; Grandjean, 1997).

Since the emergence of nutrition information and its connection to the enhancement of performance in this setting professional and college athletic programs are increasingly showing interest in the acquiring and hiring of sports nutritionists to gain a competitive edge (Burns, Schiller, Merrick, & Wolf, 2004). Currently, there is little research on the role and benefit of sports dietitians within athletic teams or on how dietitians in the field view their responsibilities (Clark, 1999). Due to the lack of evidence-based research on the benefits of sports dietitians within the workings of athletic teams, additional research on this topic should be performed (Clark, 1999).

The purpose of this study is to examine the role and perceptions of sports dietitians who work in sports nutrition.
Methods

Study Population

All RDs that were members of the Sport, Cardiovascular, and Wellness Nutrition (SCAN) dietetic practice group (dpg) were eligible to participate in this study. As a student member of the SCAN, the researcher was able to obtain a list of the electronic mail addresses’ with approval from SCAN of all the members in order to contact them to complete the electronic survey. The survey research population was approved by the Kent State University Institutional Review Board (IRB). The survey was distributed to all members of the American Dietetic Association (ADA) SCAN dpg. The athletic academic services of Indiana University and Kent State university were utilized to distribute the survey to the student-athletes. Coaches’ emails were obtained through the university websites, contact information is public knowledge. Participation in the survey was voluntary. A copy of the student survey, along with a copy of the email invitation to the study, a copy of the researcher’s Institutional Review Board (IRB) approval letter was sent in addition to the survey link. A note was made in the invitation email that the survey should not be personally forwarded by the participants. All participant information was anonymous.

Instrument of Measure

Surveys (Appendix A) created with Survey monkey.com, an online survey toolkit, were utilized. The surveys were created by the researcher, due to lack of survey tools that exist surrounding this particular topic. The first question of the RD survey asked, “Are you a registered dietitian actively working in sports nutrition?” This question was
used as a filter question to eliminate participants that are not RDs working in sports nutrition. There were three separate surveys; one for student-athletes, one for coaches, and one for registered dietitians who work in sports nutrition. The surveys for the registered dietitians were divided into four parts: roles (Part I), perceptions (Part II), job responsibilities (Part III), and demographics (Part IV). The surveys for the coaches and student-athletes were divided into three parts demographics (Part I), team nutritional needs (Part II), and perceptions of RDs (Part III). The survey and survey supplemental materials can be found the appendices.

**Part I: Roles.** The first portion of the survey included questions to determine the role of sport dietitians who work in sports nutrition. In this section, participants will respond to statements based on the Likert scale of “Very often,” “Often,” “Sometimes,” “Rarely,” or “Never.” A point system was established to categorize each response. An “I don’t know” option was also available. One example of a statement is, “I am the provider for information on banned substances and ergogenic aids.” Another example is “I am involved in research surrounding sports nutrition.”

**Part II: Perceptions.** The second part of the RD survey consisted of statements regarding the current perceptions and beliefs of the current role of registered dietitians in sports nutrition. This part established what the survey participants perceive their responsibilities should be as a registered dietitian who works in sports nutrition. With this section, the Likert scale was used with a five-point scale that consists of “Strongly Agree,” “Agree,” “Disagree,” “Strongly Disagree,” and an “I don’t know” option was also available. An example question would be “Registered dietitians are the most
qualified professionals to deliver reliable nutrition information to athletes.” Another example would be “I feel my practices are essential to the athletic program.”

**Part III: Responsibilities.** The third part of the survey covered responsibilities of registered dietitians who work in sports nutrition. An example question asked survey participants to identify which individuals they most often work with by rating their top three.

**Part IV: Demographics.** The fourth part of the survey established demographic information. Demographics of interest consist of; highest degree earned, profession/title, number of years in sports nutrition practice, membership in professional organizations, level of participation with athletes, type of facility in which participants give their time, and the primary sports within which they work.

**Procedure**

The Institutional Review Board (IRB) at Kent State University approved this study. A cover letter explaining the purpose of the study, and the link to the survey was emailed to the target population. The email letter invited participants to take part in the study, assuring that the survey is anonymous, confidential, and participation is voluntary. There was a link within the email invitation for participants who do not wish to participate and opt out of subsequent emails about the study. It was explained that the survey was accessible by SurveyMonkey.com, and would take approximately 15 minutes to complete. A link within the email will take the participants to the survey. Upon arrival to the survey website, participants agreed to terms of the study, in the survey participation agreement. Within the survey participation agreement, there was a notice for
the participant to please refrain from forwarding the survey. After agreeing to the terms of the study, the participant was lead to the pre-survey definitions and lead-in question. The pre-survey definitions define “sports nutrition” and “athlete” for the purpose of this study. The lead-in question determines the status of the participant as a registered dietitian who actively works in sports nutrition. “Yes” responses lead the participants to the remaining questions of the survey. “No” responses to the lead-in question directed the participants to a separate screen, and thanked them for their time and participation in the study. After the survey was completed, the participants were lead to a follow-up response screen thanking them for their participation in the study and participants were given the option to forward their email to the researcher to receive a copy of the results once the study has been completed.

Two weeks after the initial mailing of the email invitation letter, a follow-up email was sent as a reminder of the survey for the study. The survey was available for one month. Participants were given contact information of the researcher and thesis advisor in each of the emails that sent to them and contact information was also displayed in the survey participation agreement prior to the beginning of the survey and in the follow-up response screen after the survey was completed.

**Statistical Analysis**

Statistical analysis was completed using SPSS (version 14.0). The survey was analyzed for frequencies and descriptive statistics. The responses were categorized into tables. The frequency of the responses was analyzed both by SPSS software and the researcher.
Results

The purpose of this study was to examine the current professional practices of RDs who work in sports nutrition who are members of the Sports, Cardiovascular, and Wellness Nutrition (SCAN) dietetic practice group. A total of 620 dietitians agreed to be a part of the study. Of the 620 who agreed to the terms of the study, 279 of the participants were eligible as RDs who work in sports nutrition. One conclusion that could be drawn from the number of eligible participants is that there are many RDs with several specialties that are members of SCAN, as well as student members who may not be RDs. Definitions of sports nutrition and athletes were provided prior to the start of the survey. After analyzing the results and filtering the data, there were a total of 194 participants considered for data analysis. The most common reason for eliminating a participant from analysis was missing data points, too many questions left blank, or too few questions answered. In the future, a more succinct and narrow survey may have led to a higher overall response rate. If more than 50% of responses were blank, the researcher felt this data was not valid for analysis and these participants were not included. Each question has a separate number of participants, depending on the participants who completed the question. Again, a shorter survey may have prevented this discrepancy for the number of participants for each question, however, as part of the survey agreement, participation in each question was completely voluntary. Additionally, if the same participant left the survey and came back to the survey later, with separate answers, these participants were excluded from the study. Two answers from the same participant could be a product of the survey being forwarded to a member beyond the scope of the study.
The demographics of the survey sample are listed below in Table 1. The mean age of the participants was 40.8±23.5 years, standard deviation 23.5 years. The mean number of years in practice was 7.9±11.8 years. The mean number of presentations given yearly was 16.8±6.8. In table 2, the level of participation most frequently indicated by the sample that was “less than ¼ time,” 31.9%, followed by “part-time,” 30.3%, “1/4 time,” 20.7%, and least indicated was “full time,” 17.1%, with only 32 survey participants indicating this response. Almost half of the population, 49.7%, did not indicate having CSSD credentials. After collecting the data as an open-ended question, it was found that 22.7% of the population indicated intentions and progress in obtaining CSSD credentials with responses such as, “not yet,” “working on it,” “working towards it,” indicating to the researcher that these participants were in the process of obtaining these credentials.

Table 1

Demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Mean ($\bar{X}$)</th>
<th>SD (σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40.8</td>
<td>23.5</td>
</tr>
<tr>
<td>Number of years in practice</td>
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<td>10.6</td>
</tr>
<tr>
<td>Number of yearly presentations</td>
<td>16.8</td>
<td>6.8</td>
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</table>
Table 2

**Characteristics**

<table>
<thead>
<tr>
<th>Subject Characteristics</th>
<th>f(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest Degree Earned (n = 186)</strong></td>
<td></td>
</tr>
<tr>
<td>Bachelor</td>
<td>24.7</td>
</tr>
<tr>
<td>Master</td>
<td>65.1</td>
</tr>
<tr>
<td>Doctorate</td>
<td>10.2</td>
</tr>
<tr>
<td><strong>Level of Participation (n = 188)</strong></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>17.1</td>
</tr>
<tr>
<td>Part-time</td>
<td>30.3</td>
</tr>
<tr>
<td>¼ time</td>
<td>20.7</td>
</tr>
<tr>
<td>Less than ¼ time</td>
<td>31.9</td>
</tr>
<tr>
<td><strong>CSSD (n = 185)</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>27.5</td>
</tr>
<tr>
<td>No</td>
<td>49.7</td>
</tr>
<tr>
<td>In progress</td>
<td>22.7</td>
</tr>
<tr>
<td><strong>Sports Nutrition Department (n = 175)</strong></td>
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<tr>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>No</td>
<td>80</td>
</tr>
<tr>
<td><strong>Sports Nutrition Research (n = 182)</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35.1</td>
</tr>
<tr>
<td>No</td>
<td>73.1</td>
</tr>
<tr>
<td>In the future</td>
<td>4.4</td>
</tr>
<tr>
<td>In the past</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Table 3 lists 30 different categories in which RDs primarily interact. Most frequently listed was football, 26.2%. Pooled responses included the combinations of the responses “tactical” and “military;” “martial arts” and “boxing;” adventure racers,” “ultra-endurance” and “endurance” athletes; “mountain biking” and “cycling;” “dance,” “figure skating,” and “cheerleading” and “water polo” and “rugby” were pooled into the same “other” category due to a very small frequency of these responses.
Table 3

*Primary Sport(s) in Which RDs Interact*

<table>
<thead>
<tr>
<th>Primary Sport(s) Interact With</th>
<th>$n = 183$</th>
<th>$f(%)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>48</td>
<td>26.2</td>
</tr>
<tr>
<td>Running</td>
<td>42</td>
<td>22.9</td>
</tr>
<tr>
<td>Basketball</td>
<td>39</td>
<td>21.3</td>
</tr>
<tr>
<td>Swimming/Diving</td>
<td>39</td>
<td>21.3</td>
</tr>
<tr>
<td>Track &amp; Field</td>
<td>32</td>
<td>17.4</td>
</tr>
<tr>
<td>Soccer</td>
<td>29</td>
<td>15.8</td>
</tr>
<tr>
<td>Triathlon</td>
<td>25</td>
<td>13.6</td>
</tr>
<tr>
<td>Tennis</td>
<td>22</td>
<td>12.0</td>
</tr>
<tr>
<td>Baseball</td>
<td>21</td>
<td>11.4</td>
</tr>
<tr>
<td>Volleyball</td>
<td>19</td>
<td>10.3</td>
</tr>
<tr>
<td>Cross Country</td>
<td>18</td>
<td>9.8</td>
</tr>
<tr>
<td>Endurance/Ultraendurance</td>
<td>13</td>
<td>7.1</td>
</tr>
<tr>
<td>Dance/Figure Skating/Cheerleading</td>
<td>13</td>
<td>7.1</td>
</tr>
<tr>
<td>Ice Hockey</td>
<td>12</td>
<td>6.5</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>12</td>
<td>6.5</td>
</tr>
<tr>
<td>Softball</td>
<td>12</td>
<td>6.5</td>
</tr>
<tr>
<td>Wrestling</td>
<td>11</td>
<td>6.0</td>
</tr>
<tr>
<td>Golf</td>
<td>10</td>
<td>5.4</td>
</tr>
<tr>
<td>Military/Tactical</td>
<td>10</td>
<td>5.4</td>
</tr>
<tr>
<td>Rowing</td>
<td>9</td>
<td>4.9</td>
</tr>
<tr>
<td>Field Hockey</td>
<td>9</td>
<td>4.9</td>
</tr>
<tr>
<td>Cycling</td>
<td>9</td>
<td>4.9</td>
</tr>
<tr>
<td>Recreational Sports</td>
<td>8</td>
<td>4.4</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>7</td>
<td>3.8</td>
</tr>
<tr>
<td>Bodybuilding</td>
<td>5</td>
<td>2.7</td>
</tr>
<tr>
<td>Skiing</td>
<td>5</td>
<td>2.7</td>
</tr>
<tr>
<td>Fencing</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td>Martial Arts/Boxing</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>Other*</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>All/Variety</td>
<td>18</td>
<td>9.8</td>
</tr>
</tbody>
</table>

*= Rugby & Water polo*
Table 4 represents roles and responsibilities of RDs in sports nutrition. In this section of the survey, participants were asked to respond to several statements regarding sports nutrition responding with “Never,” “Rarely,” “Sometimes,” “Often” or “Very Often.”

Table 5 represents the perceptions of RDs working in sports nutrition. In this section of the survey, participants were asked to respond to several statements regarding sports nutrition responding with “Don’t Know,” “Strongly Disagree,” “Disagree,” “Agree,” and “Strongly Agree.”

Table 6 is educational topics that RDs address with athletes and the topics RDs most encounter with athletes. The format of the question was to have RDs check boxes of topics they felt they addressed with athletes as well as the topics they felt they encountered most often with athletes. The most ubiquitous response to the question of the educational topics that RDs address with athletes and the topics most encountered with athletes was, in both categories, the broad category of energy needs, with 98.5% and 87.5% respectively. The least prevalent in both categories was the topic of gluten sensitivity, 40.4% and 8.3% respectively.
Table 4

*Roles and Responsibilities of RD in Sports Nutrition*

<table>
<thead>
<tr>
<th>Roles</th>
<th>n</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am responsible for completing a nutrition assessment of all</td>
<td>192</td>
<td>18.1</td>
<td>14.5</td>
<td>21.3</td>
<td>31.2</td>
<td>19.2</td>
</tr>
<tr>
<td>participating athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am responsible for allocating nutritional assessments yearly.</td>
<td>193</td>
<td>18.1</td>
<td>19.7</td>
<td>22.3</td>
<td>16.6</td>
<td>13.5</td>
</tr>
<tr>
<td>I counsel one-on-one the athletes in which I work.</td>
<td>191</td>
<td>32.5</td>
<td>19.9</td>
<td>18.8</td>
<td>15.7</td>
<td>22.8</td>
</tr>
<tr>
<td>I educate entire teams or groups of athletes in which I work.</td>
<td>191</td>
<td>1.0</td>
<td>3.7</td>
<td>14.7</td>
<td>28.8</td>
<td>12.6</td>
</tr>
<tr>
<td>I am responsible for determining appropriate diet plans for athletes.</td>
<td>189</td>
<td>7.9</td>
<td>13.2</td>
<td>25.9</td>
<td>24.9</td>
<td>51.8</td>
</tr>
<tr>
<td>I am the provider for information on banned substances and ergogenic</td>
<td>191</td>
<td>3.7</td>
<td>6.3</td>
<td>24.1</td>
<td>30.9</td>
<td>28.0</td>
</tr>
<tr>
<td>aids.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I advise on the enhancement of sports performance.</td>
<td>190</td>
<td>16.3</td>
<td>14.7</td>
<td>28.4</td>
<td>18.9</td>
<td>35.1</td>
</tr>
<tr>
<td>I advise on long-term nutritional health benefits.</td>
<td>193</td>
<td>4.7</td>
<td>4.7</td>
<td>25.4</td>
<td>34.2</td>
<td>21.6</td>
</tr>
<tr>
<td>I use the ADA Nutrition Care Process in practice or work as a</td>
<td>191</td>
<td>1.0</td>
<td>2.6</td>
<td>12.0</td>
<td>37.7</td>
<td>31.1</td>
</tr>
<tr>
<td>dietitian in sports nutrition.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I document sport performance outcomes of my athletes.</td>
<td>190</td>
<td>17.9</td>
<td>21.6</td>
<td>14.7</td>
<td>26.8</td>
<td>46.6</td>
</tr>
<tr>
<td>I document sport performance outcomes for my teams.</td>
<td>187</td>
<td>17.6</td>
<td>17.6</td>
<td>31.6</td>
<td>17.1</td>
<td>18.9</td>
</tr>
<tr>
<td>I document my own progress and personal performance work outcomes.</td>
<td>190</td>
<td>31.6</td>
<td>27.4</td>
<td>23.7</td>
<td>23.3</td>
<td>16.0</td>
</tr>
<tr>
<td>I write case studies of some of my findings.</td>
<td>189</td>
<td>11.6</td>
<td>13.8</td>
<td>27.5</td>
<td>23.3</td>
<td>23.8</td>
</tr>
<tr>
<td>I am involved in research surrounding sports nutrition.</td>
<td>190</td>
<td>55.3</td>
<td>23.2</td>
<td>13.2</td>
<td>5.8</td>
<td>23.8</td>
</tr>
<tr>
<td>My role and practices are essential to the athletic program.</td>
<td>186</td>
<td>5.4</td>
<td>9.1</td>
<td>23.1</td>
<td>32.8</td>
<td>28.7</td>
</tr>
</tbody>
</table>
Table 5

*Perceptions of RDs in Sports Nutrition*

<table>
<thead>
<tr>
<th>Perception</th>
<th>n</th>
<th>Don’t Know</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A qualified sports dietitian should provide individualized nutrition</td>
<td>191</td>
<td>.5</td>
<td>0</td>
<td>0</td>
<td>25.1</td>
<td>74.3</td>
</tr>
<tr>
<td>direction and advice after a comprehensive nutrition assessment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians are the most qualified professionals to deliver</td>
<td>191</td>
<td>1.6</td>
<td>0.5</td>
<td>1.0</td>
<td>13.6</td>
<td>83.2</td>
</tr>
<tr>
<td>reliable nutrition information to athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be involved with the pre-screening of</td>
<td>189</td>
<td>2.6</td>
<td>.5</td>
<td>2.1</td>
<td>33.3</td>
<td>61.4</td>
</tr>
<tr>
<td>athletes prior to competition (ex: during mandatory athlete physicals).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should have a screening tool and assessment tool as</td>
<td>189</td>
<td>2.1</td>
<td>0.5</td>
<td>3.2</td>
<td>27.5</td>
<td>66.7</td>
</tr>
<tr>
<td>a part of the pre-competition screening process of athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be notified if nutrition risk factors are</td>
<td>191</td>
<td>.5</td>
<td>0</td>
<td>0</td>
<td>14.7</td>
<td>84.8</td>
</tr>
<tr>
<td>present in individual athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be responsible for determining appropriate</td>
<td>186</td>
<td>.5</td>
<td>0</td>
<td>0</td>
<td>21.5</td>
<td>78.0</td>
</tr>
<tr>
<td>diet plans for athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be responsible for distributing information</td>
<td>188</td>
<td>5.3</td>
<td>.5</td>
<td>3.2</td>
<td>50.5</td>
<td>40.4</td>
</tr>
<tr>
<td>on banned substance and ergogenic aids.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be responsible for recommending any</td>
<td>190</td>
<td>1.6</td>
<td>0</td>
<td>4.2</td>
<td>37.4</td>
<td>56.8</td>
</tr>
<tr>
<td>nutritional supplements for athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be responsible for monitoring athlete’s use</td>
<td>190</td>
<td>4.2</td>
<td>3.2</td>
<td>14.7</td>
<td>40.0</td>
<td>37.9</td>
</tr>
<tr>
<td>of supplements and ergogenic aids.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered dietitians should be responsible for providing education to</td>
<td>190</td>
<td>4.2</td>
<td>0</td>
<td>3.7</td>
<td>34.7</td>
<td>57.4</td>
</tr>
<tr>
<td>patients and families of current and prospective athletes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel athletic trainers respect my professional recommendations.</td>
<td>190</td>
<td>7.9</td>
<td>1.1</td>
<td>8.9</td>
<td>50.5</td>
<td>31.6</td>
</tr>
</tbody>
</table>

(table continues)
Table 5 (continued)

Perceptions of RDs in Sports Nutrition

<table>
<thead>
<tr>
<th>Perception</th>
<th>n</th>
<th>Don’t Know</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel athletes respect my professional recommendations.</td>
<td>187</td>
<td>2.1</td>
<td>0</td>
<td>1.1</td>
<td>56.1</td>
<td>40.6</td>
</tr>
<tr>
<td>I feel my professional recommendations are respected by the sports medicine dept.</td>
<td>186</td>
<td>17.2</td>
<td>.5</td>
<td>4.8</td>
<td>45.7</td>
<td>31.7</td>
</tr>
<tr>
<td>I feel the team physician respects my professional recommendations.</td>
<td>185</td>
<td>17.3</td>
<td>0</td>
<td>3.8</td>
<td>45.4</td>
<td>36.4</td>
</tr>
<tr>
<td>I feel my practices are essential to the athletic program.</td>
<td>187</td>
<td>9.1</td>
<td>.5</td>
<td>2.1</td>
<td>36.4</td>
<td>51.9</td>
</tr>
<tr>
<td>The practice of sports nutrition is growing.</td>
<td>191</td>
<td>2.1</td>
<td>0</td>
<td>1.6</td>
<td>29.3</td>
<td>67.0</td>
</tr>
</tbody>
</table>

Table 7 identifies the supplements RDs most often encountered athletes to be using. The supplements were classified into several larger categories from participants’ open-ended responses. Protein was the most commonly listed supplement with a frequency of 55.6% of respondents indicating protein supplements or powder, including those that specifically specified whey protein, muscle milk or other primarily protein supplement, or amino acids both generally and specifically referred to, including: phosphatidyl serine, L-arginine, glutamine, or branched-chain amino acids. Whey protein was particularly prevalent with 27% of the responses. Creatine and multivitamins were the second and third highest most commonly encountered supplement when counseling athletes. Nitric oxide was found in 7.1% of responses, which included responses that indicated “Jack3d®,” a supplement with the main ingredient of nitric
oxide. Recovery aids and drinks were categorized in conjunction with sport bars, gels, and meal

Table 6

*Educational Topics That RDs Address With Athletes and Topics RDs Most Encounter With Athletes*

<table>
<thead>
<tr>
<th>Topics</th>
<th>Topics RDs Address</th>
<th>Topics RDs Encounter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Needs</td>
<td>98.5 (n = 185)</td>
<td>87.5 (n = 169)</td>
</tr>
<tr>
<td>Macronutrient requirements</td>
<td>87.5 (n = 169)</td>
<td>65.2 (n = 126)</td>
</tr>
<tr>
<td>Micronutrient requirements</td>
<td>72 (n = 139)</td>
<td>34.2 (n = 66)</td>
</tr>
<tr>
<td>Fluid requirements</td>
<td>87 (n = 168)</td>
<td>56.4 (n = 109)</td>
</tr>
<tr>
<td>Hydration</td>
<td>93.7 (n = 181)</td>
<td>68.3 (n = 132)</td>
</tr>
<tr>
<td>Nutrition before, during and after exercise</td>
<td>95.3 (n = 184)</td>
<td>83.4 (n = 161)</td>
</tr>
<tr>
<td>Meal composition for the preseason</td>
<td>65.8 (n = 127)</td>
<td>30.1 (n = 58)</td>
</tr>
<tr>
<td>Meal composition for the post-season/off-season</td>
<td>65.8 (n = 127)</td>
<td>31.6 (n = 61)</td>
</tr>
<tr>
<td>Meal composition during the season</td>
<td>74.1 (n = 143)</td>
<td>45.6 (n = 88)</td>
</tr>
<tr>
<td>Timing of Meals</td>
<td>89.6 (n = 173)</td>
<td>76.1 (n = 146)</td>
</tr>
<tr>
<td>Pre-event eating</td>
<td>85.4 (n = 165)</td>
<td>60.1 (n = 116)</td>
</tr>
<tr>
<td>Eating on the road and travel meals</td>
<td>85.4 (n = 165)</td>
<td>58.5 (n = 113)</td>
</tr>
<tr>
<td>Strategies for healthy weight gain</td>
<td>83.4 (n = 161)</td>
<td>62.6 (n = 121)</td>
</tr>
<tr>
<td>Strategies for healthy weight loss</td>
<td>88.1 (n = 170)</td>
<td>69.9 (n = 135)</td>
</tr>
<tr>
<td>Use of Supplements</td>
<td>82.3 (n = 159)</td>
<td>59.1 (n = 114)</td>
</tr>
<tr>
<td>Iron Depletion</td>
<td>52.8 (n = 102)</td>
<td>22.2 (n = 43)</td>
</tr>
<tr>
<td>Gluten Sensitivity</td>
<td>40.4 (n = 78)</td>
<td>8.3 (n = 16)</td>
</tr>
<tr>
<td>Alcohol &amp; Performance</td>
<td>61.6 (n = 119)</td>
<td>23.8 (n = 46)</td>
</tr>
<tr>
<td>Cooking Skills &amp; Tips</td>
<td>60.6 (n = 117)</td>
<td>31.1 (n = 60)</td>
</tr>
<tr>
<td>Food shopping skills</td>
<td>65.8 (n = 167)</td>
<td>32.1 (n = 62)</td>
</tr>
</tbody>
</table>

replacement bars and drinks. Specific vitamins that were listed individually were kept separate from the multivitamin responses. Weight-loss supplements were pooled with responses such as “Hydroxycut®,” or “diet pills.” The hormone and steroids category
consisted of “HGH,” “HMB,” “HCG,” and “CLA.” The “other” category consisted of the very small percentages of answers such as “bicarb,” “carnitine,” “flavored milk,” and “sleeping pills.”

Table 7

*Supplements RDs Most Encountered Athletes Using*

<table>
<thead>
<tr>
<th>Supplement Classification</th>
<th>n = 169</th>
<th>f(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein/amino acids</td>
<td>94</td>
<td>55.6</td>
</tr>
<tr>
<td>Creatine</td>
<td>56</td>
<td>33.1</td>
</tr>
<tr>
<td>Multivitamins</td>
<td>21</td>
<td>12.4</td>
</tr>
<tr>
<td>Energy Drinks</td>
<td>13</td>
<td>7.7</td>
</tr>
<tr>
<td>Nitric Oxide</td>
<td>12</td>
<td>7.1</td>
</tr>
<tr>
<td>Recovery Aids/Drinks</td>
<td>11</td>
<td>6.5</td>
</tr>
<tr>
<td>Caffeine</td>
<td>9</td>
<td>5.3</td>
</tr>
<tr>
<td>Sport Drinks</td>
<td>8</td>
<td>4.7</td>
</tr>
<tr>
<td>Calcium</td>
<td>8</td>
<td>4.7</td>
</tr>
<tr>
<td>Iron</td>
<td>6</td>
<td>3.5</td>
</tr>
<tr>
<td>Stimulants</td>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td>Hormones/Steroids</td>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td>Weight-Loss Supplements</td>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 8 represents the question in the RD survey stating, “I most often interact with:” which asked participants to rank their top three responses of the given list below, 1 being the most time spent, 3 the lesser time spent. The most frequent responses were coaches (77.2%), and athletics trainers (65.1%), and strength and conditioning staff (56.1%; n = 66).

Table 8

*Interactions With Professionals in the Field*

<table>
<thead>
<tr>
<th></th>
<th>f(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaches</td>
<td>77.2% (n = 54)</td>
</tr>
</tbody>
</table>
Athletic Trainers 65.1% (n = 43)
Strength and Conditioning Staff 56.1% (n = 37)
Sports Medicine Staff 37.8% (n = 25)
Athletic Administrators 22.7% (n = 15)
Team Physician 19.7% (n = 13)
Sport Psychologist 10.6% (n = 7)
Academic Counselors 4.5% (n = 3)
Financial Aid Counselors 0% (n = 0)

Discussion

Roles and Responsibilities

In the ADA position title of sports dietitians from SCAN, the position of sports dietitians are outlined to be responsible for assessing and analyzing dietary practices, body composition, and energy balance of athletes, counseling athletes on optimal nutrition for specific training goals, weight management, hydration, disordered eating, recovery, travel, and supplementation (ADA, 2008). Sports dietitians are indicated to be in place to counsel athletes on proper techniques in achieving and maintaining optimal levels of body mass, body fat, and muscle mass for performance, providing personalized meal and snack plans, developing hydration protocols, and addressing individual medical nutrition-related challenges in athletics by providing adequate medical nutrition therapy (ADA, 2008; Vinci, 1998). The current investigation indicated that RDs do believe their roles are in addressing the topics of energy needs, macro-and micronutrient requirements, fluid requirements, hydration, nutrition before, during, and after exercise, meal composition for the preseason, postseason/off-season, and during the season, the timing of meals, pre-event eating, strategies for both healthy weight gain and weight loss, use of supplements, iron depletion, gluten sensitivity, alcohol and performance, cooking skills &
tips, and food shopping skills with athletes. The position stand of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine states that sport dietitians should be competent in the areas of educating in food selection, purchasing, and preparation; identifying and treating nutritional issues that impact performance and health; addressing energy balance and weight management issues; providing or overseeing menu planning and design, including pre-event, post-event, and travel, and addressing nutritional challenges to performance including gastrointestinal disturbances, iron depletion, eating disorders, and supplement use among athletes (Rodriguez, 2009). The current investigation indicates that the topics of carbohydrates, fat, protein, fluid requirements, and micronutrient requirements are topics being addressed widely among the survey sample and confirms the necessity for RDs in sports nutrition to provide nutrition direction on these topics in this setting, as presented in the review of literature (Dunford, 2010, and Rodriguez, 2009). It is stated in the position stand on Nutrition and Athletic Performance that physical activity, athletic performance, and recovery from exercise are enhanced by optimal nutrition, specifically from assessment of the need of these factors in an individual’s diet (Rodriguez, 2009).

The American Dietetic Association (ADA) formulated the Standards of Practice and Standards of Professional Performance in Sports Dietetics to be the framework of the position of sport dietetics (ADA, 2009). These are considered to be authoritative statements that describe a competent level of behavior in the profession, including activities related to provision of services, application of research, communication and
application of knowledge, use of resources, quality in practice, continued competence and professional accountability (ADA, 2009).

The Standard of Practice 1 dictates the need for use of an accurate and relevant tool to identify nutrition-related problems that affect health, fitness, exercise, and sport performance. This is directly related to both the first question on the role of RDs survey in Table 3, and on the perceptions of RDs in Table 4. While nearly 100% of RDs surveyed agreed or strongly agreed that “a qualified sports dietitian should provide individualized nutrition direction and advice after a comprehensive nutrition assessment,” only 52.5% report that they often or very often are “responsible for completing a nutrition assessment of athletes,” only 30.1% report “I am responsible for allocating nutritional assessments yearly,” and only 38.5% indicate they often and very often “counsel athletes one-on-one.” It is emphasized in the Standards of Practice for Sport Dietitians that nutrition assessment provide the foundation for nutrition diagnosis, the second step of the nutrition care process, and only 68.8% of the sample reported that they often and very often use the ADA Nutrition Care Process (ADA, 2009).

Standard of Practice 4 dictates nutrition monitoring and evaluation, essentially following through on the goals set by the intervention plan. This step of the nutrition care process helps determine if the goals or expected outcomes of the nutrition care are being met; progress should be monitored, measured, and evaluated in this step of the process. Standard 5 states that the RD in sports dietetics evaluates the quality of services and improves practice based on evaluating clinical/dietary and physical performance outcomes. However, the current investigation found that the sample reported 32.4%
never and rarely report or document performance outcomes of their teams. Additionally, 59.0% of participants reported “never” and “rarely” to the statement, “I document my own progress and personal performance work outcomes.” Documenting outcomes is critically important not only for the advancement of the specialty profession of sport dietetics, but key to creating evidence-based literature surrounding to topic of sports nutrition. Outcomes-based models serve as a framework to standardize and guide nutrition practitioners’ judgments and thinking processes and document information linking nutrition care to individual outcomes, creating a baseline to compare meaningful information and findings (Hakel-Smith & Lewis, 2004).

Another finding of the study is that almost 50% of the sample indicated they do not hold, or are not progressing towards the CSSD credentials. Lack of CSSD credentials held by the given population could be linked to the findings that the most prevalent response to the “level of participation” question was that most RDs that are working in sports nutrition indicate this is less that ¼ of their time spent as an RD. This conclusion could lend to the fact that a portion of requirements of obtaining and renewing CSSD credentials are that a certain number of hours working in sports nutrition is required. Initial certification requires 1,500 hours of specialty practice experience as an RD within the past five years, and recertification requires documentation of 1,000 hours of specialty practice experience as an RD in the past five years, by the date the application is due (“Board certification as a specialist in sports dietetics,” n.d.). Due to the findings from the current investigation, perhaps a better solution would be to require an education component with specialty continuing education credits that could work towards a CSSD
credential rather than a rigid structure of minimum hours of experience, especially since this may be only a small component of the actual job or career of a given RD. This way, the focus would be on educating and continuing education in the sports nutrition field, and perhaps expand familiarity with the CSSD credentials and what stand for and mean.

The response “gluten sensitivity” was the lowest frequency of educational topics covered by RDs. It is thought by the researcher that gluten sensitivity is a particularly specific topic with a very small population of individuals who possess characteristics that need information on this topic specifically. Only 77.9% strongly agree and agree RDs should be giving advice on ergogenic aids. One thought is that RDs might feel a responsibility to promote food as the most important aspect of an athlete’s diet and see ergogenic aids in a negative light. Additionally, ergogenic aids could be beyond the scope of the RD’s knowledge, in some cases, or survey participants could have perceived the term ergogenic aids to be those substances or aids beyond the area of food and nutrition.

This study also indicates that the presence of supplements of a wide variety exists in athletic circles and RDs do encounter a numerous array and type of supplement use among their athletes. This furthermore justifies the necessity of registered dietitians to be present in sports nutrition positions with current evidence-based knowledge on these topics to dispel myths and give factual information on these supposed ergogenic aids and supplements. There were more than several supplements listed in the “Supplement I most often encounter athletes using?” question, indicating that supplement use is may be an issue for many and many types of athletes. In the current investigation, only 54.1% of
RDs reported that they “advise on the enhancement of sports performance” and 58.9% report that they are the “provider for information on banned substances and ergogenic aids.” This almost seems contradictory in that 90.9% report that they agree and strongly agree, “Registered dietitians should be responsible for distributing information on banned substance and ergogenic aids.” Again, the seemingly contradictory results could be based on the idea that RDs in this field are mostly working from a less-than full time position and may not be fully responsible for an athlete’s complete assessment in the area of supplements specifically. However, the majority indicated they do believe that RDs are the most qualified individuals to be soliciting information on supplements. This may show a gap exists between knowledge and beliefs and practices.

**Perceptions**

In the early 1990s, the Pennsylvania State University became the first athletic department within the National Collegiate Athletic Association (NCAA) to fund and staff a sports nutrition position with a registered dietitian (Clark, 1994). While the sports dietitian as a position in Division I athletic facilities is still not widespread, athletes are still seeking nutrition information from the media, their coaches, trainers, and physicians (Rockwell, Nickols-Richardson, & Thye, 2001). Sports dietitians are now becoming ingrained in the inner workings of the athletic setting and work alongside professionals such as athletic administrators, coaches, athletic trainers, coaches, athletic trainers, team physicians, sport psychologists and academic and financial aid counselors (Vinci, 1998). The current investigation indicates that while sports nutrition is becoming a position in Division I athletics, 17.3% do not believe that their professional opinions are
highly regarded by the team physician, and 17.2% do not believe that their professional
opinions are highly regarded by the sports medicine department.

Of the sample surveyed, 99.4% agree and strongly agree “a qualified sports
dietitian should provide individualized nutrition direction and advice after a
comprehensive nutrition assessment” and 94.2% believe “registered dietitians should
have a screening tool and assessments tool as a part of the pre-competition screening
process of athletes.” This is in contrast to the findings of the roles of RDs in these
positions. This could mean that the RDs in these roles are working in less than a full-
time capacity and may not be the RDs responsible for the tasks they believe are so crucial
to the practice of sport dietetics. Another notion may be that a discrepancy exists
between the knowledge and beliefs and the actual practices of sports RDs in the field.

Nutrition intervention enhances performance and protects both athletes and
athletic departments from accidents involving dangerous nutrition practices that could be
potentially hazardous or fatal for individual athletes. Therefore, performance outcomes
are continually necessary to document the necessity for sound nutrition practices in this
arena (Clark, 1999). The presence of an RD is essential for the safety, particularly in the
area of hydration of athletes. Additionally, the role of RDs as a nutrition resource, an
avenue where athletes may lack information, RD practices contribute to both
performance gains and increased health knowledge among athletes. The current
investigation confirms that 99.5% reported that they agree and strongly agree,
“Registered dietitians should be responsible for determining appropriate diet plans for
athletes.” Future studies could perhaps involve studies that examine the role of RDs and
the performance gains of the athletes who interact with RDs, however, it should be noted that the topic of performance is broadly defined and not easily measured across sports and individuals. Lastly, 96.3% of RDs surveyed reported that they agreed and strongly agreed the practice of sports nutrition is growing, yet 11.7% report they strongly disagree, disagree, or only sometimes feel their practices are essential to the athletic program, with 9.1% reporting they “strongly disagree” with this statement. These findings confirm the researcher’s believed notion that sports nutrition is a growing field with continued opportunity for RDs. However, perhaps a conclusion from these data points is that when RDs do not work in a full-time capacity in sports nutrition, they do not feel as strongly that their practices are essential to the athletic programs with which they work.

**Limitations**

The main limitation of the study was that the participants were a convenience sample. Although all the coaches and student-athletes at Indiana University and Kent State University were eligible to take the survey and sent the survey link, only 15 people from both groups took the survey, which may have not been representative of the entire group of coaches and student-athletes at the prospective schools. Although the RDs at the University of Notre Dame, University of North Carolina-Chapel Hill, University of Nebraska, University of Mississippi, and University of Maryland agreed to forward the survey to the respective coaches and student-athletes of their schools, there were no actual responses from any persons from these schools. Also, the RD at the University of Nebraska later recanted their willing participation to forward the survey to coaches and student athletes after they failed to gain approval from the university athletic director.
There were many limitations to the survey component of this study due to the very limited research that has been done on this topic specifically, and the lack of surveys that exist within this topic and the nature of this study. Many format flaws were identified after analyzing the raw survey data. In Table 5, which highlights the questions of “Topics that have been addressed include:” and “What topics do you most encounter with athletes?” it should be noted that participants commented in the “other” box given at the end of the questions that these two particular questions were too similar and actually repetitive of each other, and presented almost as if being asked the same questions twice.

In the question asking participants to identify the sports within which the most interact, the question was phrased in an open-ended blank answer format. Of the 194 participants that were analyzed, only 183 participants answered this question. A limitation of this question could be that the RD feels there is not one or few sports within which they work, but a multitude of sports. The question might have been phrased better as a ‘check all that apply’ format to increase the number of responses from the participants on this question.

There were several limitations to the study that were presented in the form of glitches from the survey toolkit, surveymonkey.com. Missing data points, and misconstrued data were apparent in some question summaries, most likely due to computer error from surveymonkey.com. This may have been avoided with a more advanced and accurate survey toolkit.

Another possible limitation from the researcher’s perspective is how the respondents interpreted the term “supplement” in the question, “Supplement I most often
encounter athletes using?” speculated from the high volume of answers as well as the large variation seen in the open-ended responses of the participants. The question could have been classified into categories such as dietary supplements, non-dietary supplements, ergogenic aids, and those supplements believed to be performance enhancers for the RDs to categorize their responses. Additionally it could have been beneficial to the study to examine the supplements most often recommended by the RDs in this role, or an even more broad approach would have been to have an open-ended question asking how the individual RDs feel about supplement use among their athletes and their comfort level in not only soliciting information on supplements, but also recommending their use to athletes they feel appropriately need them.

Some questions from the original survey were discarded due to the researchers inability to group responses, or because the open-ended answers could not be pooled into similar responses for analysis. These questions included, “Profession/Title,” “Type of facility/employment setting,” “Are you a member of any professional organizations?” “Do you have any other specialty credentials?” “Who do you get your referrals from?” and “Who is responsible for nutrition screening at your facility?” Additionally, questions at the end of the roles section of the RD surveys were eliminated due to improper categorization of the those questions as being the type of questions reflecting on the perceptions of RDs in the field, rather than the roles of RDs in the field. These statements included “Athletes consider and respect my professional recommendations,” “Athletic trainers respect my professional recommendations,” “The sports medicine department respects my professional recommendations,” “The team physician respects
my professional recommendations,” and “My role and practices are essential to the athletic program.” These questions remained in the perceptions portion of the survey and displayed in Table 4.

The question of “I most often interact with…” displayed in Table 7, participants were given the choice of nine professionals as responses. The question was formatted so that survey participants were asked to rank their top three responses. However, due to technical difficulties with the online survey monkey toolkit, these data points were very misconstrued in the analysis. An $n = 66$ was used after filtering the data, however, it is unknown by the researcher if this is representative of the sample. The question format was not translated well into data points, and this is the result of assumed software error with this question. Due to this error, it is unlikely that the data from this question is representative of the sample population.

A more effective way of collecting data would have been to give some questions a more structured format for the questions that could be interpreted differently depending on the respondents’ point of view. An example would be if the researcher would have had a method for respondents to indicate if in the specific sports they most encounter, they work with a “men’s” or “women’s” team, or if they actually work with both. Additionally, on the RDs surveys, there were a large number of participants who indicated that the number one person with which they interact with was “financial aid counselors.” It is entirely possible that this answer could take the form of several different people, in which the meaning ranges from a person who works in an athletic
department and handles the financial aid of collegiate athletes, to an individual such as an accountant for an RD in private practice.

Another question that might have been more effective in classifying the RDs who work in sports nutrition is to have asked which age group RDs most often encounter, and having the participants indicate a high school age group, college-age age group, or older group such as master’s athletes.

After analyzing the data for the perception questions of the RD survey, another prospective approach could be to further look at how the participants would have responded to the question of how they feel more categories of individuals respect their professional opinions as dietitians. For example, how strongly RDs feel strength and conditioning coaches, as well as specific sport coaches respect their professional opinions as RDs.

Despite the previously discussed risk associated with typical weight restricting and body-image sports, these are not the sports most listed by participants as being the sports in which they most interact. Particularly wrestling only represented 6.0% of the frequency of responses, and gymnastics only represented 6.5%. Dance, figure skating, and cheerleading represented only a slightly higher percentage of 7.1%. A future study could discuss the implications of the lack of presence of an RD within these sports and teams and the ramifications of this reality.

Another topic that could have been addressed by the survey was the prevalence of RDs who participate in body composition testing, and/or the prevalence of other
professionals who are responsible for this task, and whether the results are provided for the RDs in sport nutrition settings.

**Applications and Future Directions**

There are many benefits to analyzing the roles, responsibilities, and perceptions of RDs in sports nutrition, and one large component is that 83% of RDs surveyed believed RDs are the most qualified professionals to deliver reliable nutrition information to athletes. Universities across the nation are beginning to realize the importance and benefit of employing RDs to handle the nutrition education component of athletic programs, and reaping the performance benefits of sound nutritional practices within their teams (Grandjean, 1996). This data has numerous implications for dietitians in sports nutrition. First, it confirms the data that jobs in sports nutrition are rarely full-time (Dunford, 2010). Trends show the field of sports nutrition is growing, and therefore opportunities are continuing to grow, however, opportunities for full-time positions in sport nutrition are still few (Dunford, 2010). The U.S. Olympic Committee employs full-time sport dietitians, however, there is only been at maximum four positions (Dunford, 2010). Professional teams in the U.S. as well as Australia and Western Europe hire sport dietitians, but most positions are not full-time (Dunford, 2010). Many sport dietitians in these areas are in private practice or work additionally in academia (Dunford, 2010). It is shown in Table 2, in which there were over 30 sports listed as primary sports in which RDs interact, and this could be due to the flexibility of dietitians to interact with athletes that are within reach, not necessarily a factor of which sports or entities employ dietitians.
Athletes spend millions of dollars on dietary supplements each year for purposes of improving performance and health (Dunford, 2006). The current investigation, according to the reports of RDs who work in sports nutrition, confirms that supplement use is not only widespread, but also very diversified among several populations that interact with sport RDs. Standards in the ADA Standards of Practice for Sport RDs, specifically sections 1.2C1, which cover sport/dietary supplement evaluation including safety, efficacy, quality, application to sport and performance, and 6.1B which consists of maintaining practice with evidence-based guidelines, best practices, and current research findings clearly outline the importance of RDs in staying current on role of supplements in the practices and diets of athletes (ADA, 2009).

In the question examining the type of sports in which RDs interact, two of the top three sports listed as the primary sport in which RDs interact were the sports of football and basketball, the two greatest revenue-producing sports in intercollegiate athletics (Odenkirk, 1981). Perhaps a future study could investigate the perceptions of football and men’s basketball coaches, individually, and their thoughts surrounding the involvement of RDs as well as the necessity of sound nutrition practices among their athletes. This is additionally interesting to note as a potential source for dietitians to be marketing themselves and their sports nutrition background and knowledge through these sport specific avenues, as football and men’s basketball are revenue producing; and RDs in sports nutrition, according to the population surveyed, are found to be most prevalently working with these populations, but also with non-revenue producing sports such as running (22.9%), swimming/diving (21.3%), track and field (17.4%), and soccer (15.8%).
The responses in this category were very widespread and wide-ranging which indicates involvement in the field is growing.

A separate but closely related topic to the area of sports nutrition is the field of eating disorders, those RDs who extend their sports nutrition efforts to counsel athletes with eating disorders, and particularly in the collegiate setting, the recognition of the female athlete triad. A future study could examine the role of sport RDs and their involvement with these athletes, as well as the prevalence and occurrence of these RDs recommending and referring these athletes to an outside eating disorder-specific counseling service or the services of other medical professionals.

Another interesting avenue could be to study RDs who specifically work in intercollegiate athletics, however, after examining the question of the “level of participation” of RDs in sports nutrition in which the slight majority work with athletes on a less than ¼ time period; this indicates to the researcher that this may not have generated a large enough sample size for descriptive study. Additionally, it is interesting to note from the current investigation the growing segment of RDs who consider themselves sport RDs who are working as a sub-sect of sports nutrition in the military sector. This may be a growing field for not only military personnel, but an area for growth for civilians as well as these are highly trained individuals who need the guidance of a sports dietitian.

**Conclusion**

In conclusion, the role and perceptions of RDs measured in this study have been shown to be synonymous with the limited research that exists in this field as to the role of
the sports dietitian. The findings suggest that RDs in sports nutrition are indeed largely responsible for tasks associated with this field, despite confirming the conclusion that sport dietetics is often a less than full-time position for most individuals in the field.

The Standards of Practice and Standards of Professional Performance continue to be key resources for RDs in this practice, and this current investigation confirms the notion that it is the combined practice of all individuals considered to be a part of this field that construct the professional roles, not any one indicator or standard (ADA, 2009). The Standards of Practice should continue to define the professional practice and role of the registered dietitian in sports nutrition.
APPENDICES
Appendix A
Survey Letters and Survey

Email Invitation

Hi, my name is Stephanie Horvath and I am a graduate student with Kent State University in the College of Education, Health and Human Services (EHHS). I am currently working on my thesis research on the role and perceptions of registered dietitians who work in sports nutrition and dietetics. I am asking for your help by answering a few questions regarding your thoughts on the role and viewpoints of registered dietitians in sports nutrition.

If you choose to participate, you will be asked to complete an online anonymous survey that take approximately 15 minutes to complete. The survey is completely anonymous and confidential. Your participation is completely voluntary and you may refuse to participate or withdraw from the study at any time without penalty or negative impact. You may end your participation by logging off the survey on Surveymonkey.com or by simply closing your Internet browser. There will be no cost to you nor is there any compensation for participating in this study. By completing the survey, you are agreeing to be in the study. The link to the survey is:(link to respective surveys)

The Institutional Review Board of Kent State University has approved this study. If you have any questions or comments about this study, please feel free to contact me via email at shorvat7@kent.edu, or my advisor, Natalie Caine-Bish, PhD. R.D., L.D., at 330-672-2148 or ncaine@kent.edu. Thank you for your consideration and participation in this online survey. Your time and your responses are valued and appreciated.

Sincerely,

Stephanie Horvath
Principal Investigator
Nutrition and Dietetics Master of Science Candidate
School of Health Sciences
Kent State University

Natalie Caine-Bish, PhD., R.D., L.D.
Associate Professor and Thesis Advisor
School of Health Sciences
Kent State University
ncaine@kent.edu
330-672-2148
Survey Participation Agreement

Dear Survey Participant,

By clicking on the link below, you are agreeing to participate in this study. Your participation is completely voluntary, and you may refuse to participate or withdraw from the study at any time without penalty or negative impact. Please DO NOT FORWARD THIS LINK (if you know someone who would be interested in participating in the survey, please contact the researcher directly). You may end your participation by logging off the survey or by closing the Internet browser. As a participant in this survey, you are entitled to receive results of the study after it has been completed, approximately 6 months from now. If you are interested in obtaining the results or have any questions, please do not hesitate to contact me at shorvat7@kent.edu. Thank you again.

Sincerely,

Stephanie Horvath
Principal Investigator
Nutrition and Dietetics Master of Science Candidate
School of Health Sciences
Kent State University

Natalie Caine-Bish, PhD.
Associate Professor and Thesis Advisor
School of Health Sciences
Kent State University
ncaine@kent.edu
330-672-2148
Dear Survey Participant,

This study involves a web-based on-line survey on the role and perceptions of having registered dietitians in athletic settings. The study is being conducted by myself, Stephanie Horvath of Kent State University and is approved by the Institutional Review Board. No deception is involved, and the study involves no more than minimal risk to participants.

The survey will take approximately 15 minutes to complete, and is completely anonymous. The survey will ask different questions with various possible answers attached; some questions are left blank for open-ended questions. All responses are treated as confidential, and in no case will responses from individual participants be identified. Rather, all data will be pooled and published in the form of aggregate data only. Participants should be aware that the survey is not being run from a “secure” https server of the kind typically used to handle credit card transactions, so there is a small possibility that responses could be viewed by unauthorized third parties (e.g. computer hackers).

By answering the statement below to enter the survey, you are agreeing to participate in this study. Your participation is completely voluntary, and you may refuse to participate or withdraw from the study at any time without penalty or negative impact. Please DO NOT FORWARD THIS LINK (if you know someone who would be interested in participating in the survey, please contact the researcher directly). You may end your participation by logging off the survey or by closing the Internet browser. As a participant in this survey, you are entitled to receive results of the study after it has been completed, approximately 6 months from now.

If you are interested in obtaining the results or have any questions, wish to lodge a complaint or concern, please do not hesitate to contact me at shorvat7@kent.edu or the Kent State IRB, at (330) 672-2704. Thank you again.

Sincerely,
Stephanie Horvath
Principal Investigator
Nutrition and Dietetics Master of Science Candidate
School of Health Sciences
Kent State University

Natalie Caine-Bish, PhD.
Associate Professor and Thesis Advisor
School of Health Sciences
Kent State University
ncaine@kent.edu
330-672-2148
Pre-Survey Definitions, Lead-In Question for Registered Dietitians

Sports nutrition as defined for this study is the study and practice of assisting athletes and teams in achieving optimal performance and long-term health benefits through the use of sound nutrition education and practices.

For the purposes of this study, athlete is defined as a person who is actively participating in high school, collegiate, professional sports or who is actively seeking national recognition or Olympic status as a competitive athlete.

Are you a Registered Dietitian actively working in sports nutrition? YES or NO

1 If the response is yes, the participant will be directed to the rest of the survey. If the response is no, the participant will be directed to this phrase: The survey has ended, thank you for taking the time to participate.

The Roles, Responsibilities, and Perceptions of Registered Dietitians in Sports Nutrition
Parts I-IV: Registered Dietitians

Part I: Roles of Registered Dietitians in Sports Nutrition
Responses: Very Often Often Sometimes Rarely Never

1. I am responsible for completing a nutrition assessment of all participating athletes.

2. I am responsible for allocating nutritional assessments yearly.

3. I counsel one-on-one the athletes in which I work.

4. I educate entire teams or groups of athletes in which I work.

5. I am responsible for identifying athletes at nutritional risk as potential candidates for nutrition counseling.

6. I am responsible for determining appropriate diet plans for athletes.

7. I am the provider for information on banned substances and ergogenic aids.

8. I advise on the enhancement of sports performance.

10. I use the ADA Nutrition Care Process in practice or work as a dietitian in sports nutrition.


14. I write case studies of some of my findings.

15. I am involved in research surrounding sports nutrition.

16. Athletes consider and respect my professional recommendations.

17. Athletic trainers respect my professional recommendations.

18. The sports medicine department respects my professional recommendations.

19. The team physician respects my professional recommendations.

20. My role and practices are essential to the athletic program.

**Part II: Perceptions of Registered Dietitians in Sports Nutrition**

Responses: Strongly Agree, Agree, Disagree, Strongly Disagree, And Don’t Know

1. A qualified sports dietitian should provide individualized nutrition direction and advice after a comprehensive nutrition assessment.

2. Registered dietitians are the most qualified professionals to deliver reliable nutrition information to athletes.

3. Registered dietitians should be involved with the pre-screening of athletes prior to competition (ex: during mandatory athlete physicals).

4. Registered dietitians should have a screening tool and assessment tool as a part of the pre-competition screening process of athletes.

5. Registered dietitians should be notified if nutrition risk factors are present in individual athletes.
6. Registered dietitians should be responsible for determining appropriate diet plans for athletes.

7. Registered dietitians should be responsible for distributing information on banned substance and ergogenic aids.

8. Registered dietitians should be responsible for recommending any nutritional supplements for athletes.

9. Registered dietitians should be responsible for monitoring athlete’s use of supplements and ergogenic aids.

10. Registered dietitians should be responsible for providing education to patients and families of current and prospective athletes.

11. I feel athletic trainers respect my professional recommendations.

12. I feel athletes respect my professional recommendations.

13. I feel my professional recommendations are respected by the sports medicine dept.

14. I feel the team physician respects my professional recommendations.

15. I feel my practices are essential to the athletic program.

16. The practice of sports nutrition is growing.

Part III: Job Responsibilities
1. I most often interact with: (Rank your top three responses, 1 being the most time spent, 3 the lesser time spent)
   ____ Athletic Administrators
   ____ Coaches
   ____ Athletic Trainers
   ____ Sports Medicine Staff
   ____ Sport Psychologist
   ____ Strength and Conditioning Staff
   ____ Team Physician
   ____ Academic Counselors
   ____ Financial Aid Counselors
   Other (write-in): _____________________
2. Topics that have been addressed include (check all that apply):

- Energy Needs
- Macronutrient requirements
- Micronutrient requirements
- Fluid requirements
- Hydration
- Nutrition before, during, and after exercise
- Meal composition for the preseason
- Meal composition for the postseason/off-season
- Meal composition during the season
- Timing of meals
- Pre-event eating
- Eating on the road and travel meals
- Strategies for healthy weight gain
- Strategies for healthy weight loss
- Use of supplements
- Iron Depletion
- Gluten Sensitivity
- Alcohol and Performance
- Cooking Skills &Tips
- Food shopping skills
- Other (write-in): ________________________

3. How many times per year do you do presentations?

4. Who do you get your referrals from?

5. When counseling athletes, what is your primary concern?

6. What topics do you most often encounter with athletes? (Check all that apply)

- Energy Needs
- Macronutrient requirements
- Micronutrient requirements
- Fluid requirements
- Hydration
- Nutrition before, during, and after exercise
- Meal composition for the preseason
- Meal composition for the postseason/off-season
- Meal composition during the season
- Timing of meals
- Pre-event eating
Eating on the road and travel meals
Strategies for healthy weight gain
Strategies for healthy weight loss
Use of supplements
Iron Depletion
Gluten Sensitivity
Alcohol and Performance
Cooking Skills & Tips
Food shopping skills
Other (write-in): ________________________

7. Supplement I most often encounter athletes using?

Part IV: Demographics

1. Age _____

2. Highest Degree Earned ______________________

3. Profession/Title______________________

4. Number of years in sports nutrition practice ________________

5. What is your level of participation with athletes?
   I work…Full-time Part time ¼ time less than ¼ time

6. Primary sport(s) of the athletes you work with ________________________

7. What type of facility or employment setting do you work in?

8. Are you a member of any professional organizations? (Please list)

9. Do you have any other specialty credentials?

10. Who is responsible for nutrition screening at your facility?

11. Does your facility have a sports nutrition/athletic nutrition department specifically?

12. Are you involved with any research studies regarding sports nutrition?
Team Nutritional Needs and Perceptions of Registered Dietitians in Sports Nutrition
Parts I-III: Coaches

Part I: Demographics

1. School ____________________
2. Title ____________________
3. Number of years coaching ______________
4. What is your level of participation with athletes?
   I work…Full-time   Part time   ¼ time less than ¼ time

Part II: Team Nutritional Needs

1. I feel my team would benefit from nutrition presentations. Yes/No

2. Nutrition topics I believe my team would benefit from more information on would be (Check all that apply):
   ___Energy Needs
   ___Macronutrient requirements
   ___Micronutrient requirements
   ___Fluid requirements
   ___Hydration
   ___Nutrition before, during, and after exercise
   ___Meal composition for the preseason
   ___Meal composition for the postseason/off-season
   ___Meal composition during the season
   ___Timing of meals
   ___Pre-event eating
   ___Eating on the road and travel meals
   ___Strategies for healthy weight gain
   ___Strategies for healthy weight loss
   ___Use of supplements
   ___Iron Depletion
   ___Gluten Sensitivity
   ___Alcohol and Performance
   ___Cooking Skills &Tips
   ___Food shopping skills
   ___Other (write-in): ____________________
3. I feel the primary nutrition concern or issue on my team is (Check all that apply)
   ___ Energy Needs
   ___ Macronutrient requirements
   ___ Micronutrient requirements
   ___ Fluid requirements
   ___ Hydration
   ___ Nutrition before, during, and after exercise
   ___ Meal composition for the preseason
   ___ Meal composition for the postseason/ off-season
   ___ Meal composition during the season
   ___ Timing of meals
   ___ Pre-event eating
   ___ Eating on the road and travel meals
   ___ Strategies for healthy weight gain
   ___ Strategies for healthy weight loss
   ___ Use of supplements
   ___ Iron Depletion
   ___ Gluten Sensitivity
   ___ Alcohol and Performance
   ___ Cooking Skills & Tips
   ___ Food shopping skills
   ___ Other (write-in): _________________________

Screening Question: A registered dietitian is which of the following:
   A) An individual who has a bachelor’s degree in nutrition or related field
   B) An individual who has completed a bachelor's degree with approved courses in
      nutrition, completed an accredited supervised practice program, and passed a
      national registration exam
   C) An individual who has a master’s degree in nutrition or related field and is
      licensed to practice nutrition

Upon correct answer selection of choice B, participants will be guided to part III.

Part III: Perceptions of Registered Dietitians in Sports Nutrition
Responses: Strongly Agree, Agree, Disagree, Strongly Disagree, And Don’t Know

1. A qualified sports dietitian should provide individualized nutrition direction and
   advice after a comprehensive nutrition assessment to athletes.

2. Registered dietitians are the most qualified professionals to deliver reliable
   nutrition information to athletes.
3. Registered dietitians should be involved with the pre-screening of athletes prior to competition (ex: during mandatory athlete physicals).

4. Registered dietitians should have a screening tool and assessment tool as a part of the pre-competition screening process of athletes.

5. Registered dietitians should be notified if nutrition risk factors are present in individual athletes.

6. Registered dietitians should be responsible for determining appropriate diet plans for athletes.

7. Registered dietitians should be responsible for distributing information on banned substance and ergogenic aids.

8. Registered dietitians should be responsible for recommending any nutritional supplements for athletes.

9. Registered dietitians should be responsible for monitoring athlete’s use of supplements and ergogenic aids.

10. Registered dietitians should be responsible for providing education to patients and families of current and prospective athletes.

11. I feel the practices of sport dietitians are essential to the athletic program.

12. I feel nutrition information provided to my team would benefit my team.

13. I feel a Registered Dietitian on staff would positively benefit my team.

14. I believe adequate nutrition practices are crucial to successful performance in the sport in which I coach.
Team Nutritional Needs and Perceptions of Registered Dietitians in Sports Nutrition

**Parts I-III: Student-Athletes**

**Part I: Demographics**

1. School ___________________
2. Age _____
3. Sport ___________________
4. Year in Sport ______________
5. Major _______________

**Part II: Team Nutritional Needs**

1. I feel my team would benefit from nutrition presentations. Yes/No

2. Nutrition topics I believe my team would benefit from more information on would be (Check all that apply):

   - Energy Needs
   - Macronutrient requirements
   - Micronutrient requirements
   - Fluid requirements
   - Hydration
   - Nutrition before, during, and after exercise
   - Meal composition for the preseason
   - Meal composition for the postseason/off-season
   - Meal composition during the season
   - Timing of meals
   - Pre-event eating
   - Eating on the road and travel meals
   - Strategies for healthy weight gain
   - Strategies for healthy weight loss
   - Use of supplements
   - Iron Depletion
   - Gluten Sensitivity
   - Alcohol and Performance
   - Cooking Skills & Tips
   - Food shopping skills
3. I feel the primary nutrition concern or issue on my team is (Check all that apply)
   ___Energy Needs
   ___Macronutrient requirements
   ___Micronutrient requirements
   ___Fluid requirements
   ___Hydration
   ___Nutrition before, during, and after exercise
   ___Meal composition for the preseason
   ___Meal composition for the postseason/ off-season
   ___Meal composition during the season
   ___Timing of meals
   ___Pre-event eating
   ___Eating on the road and travel meals
   ___Strategies for healthy weight gain
   ___Strategies for healthy weight loss
   ___Use of supplements
   ___Iron Depletion
   ___Gluten Sensitivity
   ___Alcohol and Performance
   ___Cooking Skills &Tips
   ___Food shopping skills
   ___Other (write-in): ________________________

Screening Question: A registered dietitian is which of the following:
   A) An individual who has a bachelor’s degree in nutrition or related field
   B) An individual who has completed a bachelor's degree with approved courses in
      nutrition, completed an accredited supervised practice program, and passed a
      national registration exam
   C) An individual who has a master’s degree in nutrition or related field and is
      licensed to practice nutrition

Upon correct answer selection of choice B, participants will be guided to part III.

Part III: Perceptions of Registered Dietitians in Sports Nutrition
Responses: Strongly Agree, Agree, Disagree, Strongly Disagree, And Don’t Know

1. A qualified sports dietitian should provide individualized nutrition direction and
   advice after a comprehensive nutrition assessment to athletes.

2. Registered dietitians are the most qualified professionals to deliver reliable
   nutrition information to athletes.
3. Registered dietitians should be involved with the pre-screening of athletes prior to competition (ex: during mandatory athlete physicals).

4. Registered dietitians should have a screening tool and assessment tool as a part of the pre-competition screening process of athletes.

5. Registered dietitians should be notified if nutrition risk factors are present in individual athletes.

6. Registered dietitians should be responsible for determining appropriate diet plans for athletes.

7. Registered dietitians should be responsible for distributing information on banned substance and ergogenic aids.

8. Registered dietitians should be responsible for recommending any nutritional supplements for athletes.

9. Registered dietitians should be responsible for monitoring athlete’s use of supplements and ergogenic aids.

10. Registered dietitians should be responsible for providing education to patients and families of current and prospective athletes.

11. I feel the practices of sport dietitians are essential to the athletic program.

12. I feel nutrition information provided to my team would benefit my team.

13. I feel a Registered Dietitian on staff would positively benefit my team.

14. I believe adequate nutrition practices are crucial to successful performance in the sport(s) in which I participate.
Follow-Up/End Screen Response

Dear Survey Participant,

Thank you for your participation in this research study! Your responses and participation are very much appreciated. Thank you.

If you are interested in the outcome of this research study and would like to know the results, please provide your email address where you can be contacted: ______________________________. The researcher will then email the results of the study to you when they become available, approximately 6 months from now. Thank you.

Sincerely,

Stephanie Horvath, B.S.
Principal Investigator
Nutrition and Dietetics Master of Science Candidate
School of Health Sciences
Kent State University

Natalie Caine-Bish, Ph.D., R.D., L.D.
Associate Professor and Thesis Advisor
School of Health Sciences
Kent State University
ncaine@kent.edu
330-672-2148
APPENDIX B

REQUIREMENTS FOR ATHLETES
# Appendix B

## Requirements for Athletes

### Fluid Requirements for Athletes

<table>
<thead>
<tr>
<th>Position Stand</th>
<th>Before Exercise</th>
<th>During Exercise</th>
<th>After Exercise</th>
<th>Electrolyte Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>American College of Sports Medicine (1996)</td>
<td>Drink ~500 mL (~17 oz) about 2 h before exercise.</td>
<td>Start drinking early and at regular intervals in an attempt to consume fluid at a rate sufficient to replace all of the water lost through sweating.</td>
<td>No recommendation.</td>
<td>For exercise lasting &gt; 1 hour, include 0.5-0.7 of sodium per liter of fluid to enhance palatability, promote fluid retention, and reduce the risk of hyponatremia.</td>
</tr>
<tr>
<td>National Athletic Trainers Association (2000)</td>
<td>Consume approximately 500-600 mL (17-20 oz) of water or sport drink 2-3 H before exercise and 200-300 mL (7-10 oz) 10-20 min before exercise.</td>
<td>Fluid replacement should approximate sweat and urine losses, with the goal of keeping weight loss &lt;2% body mass. Example: 200-300 mL (7-10 oz) every 10-20 min, but individualized recommendations should be followed.</td>
<td>To ensure hydration within 4-6 h after exercise, drink about 25-50% more than existing weight loss.</td>
<td>Adding a modest amount of salt (0.3-0.7 g/L) is acceptable to stimulate thirst, increase voluntary fluid intake, and decrease the risk of hyponatremia.</td>
</tr>
<tr>
<td>American Academy of Pediatrics (2000)</td>
<td>Before prolonged physical activity, the child should be well-hydrated.</td>
<td>Periodic drinking should be enforced, even if a child is not thirsty. Example: for a child weighing 40 kg (88 lb), drink 150 mL of water or a flavored, salted beverage every 20 min.</td>
<td>No recommendation.</td>
<td>Make water or a flavored, salted beverage available for active children.</td>
</tr>
<tr>
<td>American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine</td>
<td>2 h before exercise, drink 400-600 mL (14-22 oz).</td>
<td>Ingest 150-350 mL (6-12 oz) every 15-20 minutes, depending on tolerance.</td>
<td>Drink ≥ 450-675 mL (16-24 oz) for every pound (0.5 kg) of body weight lost during exercise.</td>
<td>Sodium in amounts between 0.5-0.7 g/L is recommended during exercise lasting &gt;1h because it may enhance palatability &amp; the drive to drink, therefore increasing the amount of fluid consumed. Athletes can also rehydrate in conjunction with a sodium-containing meal.</td>
</tr>
<tr>
<td>USA Track and Field (2003)</td>
<td>Consume approximately 500-600 mL (17-20 oz) of water or sport drink 2-3 H before exercise and 300-360 mL (10-12 oz) 0-10 min before exercise.</td>
<td>During the race drink no more than 1 cup (8-10 oz) every 15-20 min.</td>
<td>Drink about 25% more than sweat losses to ensure optimal hydration 4-6 h after the event.</td>
<td>Addition of modest amounts of sodium (0.5-0.7 g/L) can offset sodium lost in sweat and may minimize medical events associated with electrolyte imbalances (eg, muscle cramps, hyponatremia).</td>
</tr>
</tbody>
</table>

100
### Fat Soluble Vitamin Needs For Athletes

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Effect of Exercise on Requirements</th>
<th>Recommended Intake for Athletes</th>
<th>Food Sources</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Exercise may increase needs; results equivocal. Beta carotene may be better than preformed vitamin A, but not definitive.</td>
<td>DRI, but not more than the UL</td>
<td>Carrots, broccoli, tomatoes</td>
<td>Beta carotene supplements are not recommended.</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI, but not more than the UL</td>
<td>Oily fish, liver, eggs, fortified foods such as margarine, breakfast cereals, bread, milk, and powdered milk</td>
<td>Higher levels may be needed in the winter if living in northern states (to prevent bone loss).</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Exercise may increase needs.</td>
<td>DRI, but not more than the UL</td>
<td>Plant oils (eg, soybean, corn, olive oils), nuts, seeds, wheat germ</td>
<td>Strong antioxidant effects in endurance athletes, and older athletes.</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI, but not more than the UL</td>
<td>Leafy green vegetables (eg, spinach, turnip greens), cabbage, green tea, alfalfa, oats, cauliflower</td>
<td>Increased needs may be needed for bone formation.</td>
</tr>
<tr>
<td>Mineral</td>
<td>Effect of Exercise on Requirements</td>
<td>Recommended Intake for Athletes</td>
<td>Food Sources</td>
<td>Comments</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------</td>
<td>---------------------------------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Calcium</strong></td>
<td>Individuals who consistent exercise in the heat may have greater requirements.</td>
<td>DRI, but not more than the UL (those who exercise in the heat should take above the DRI, but less than the UL - base on dietary intake).</td>
<td>Milk, cheese, yogurt, tofu processed with calcium, kale, almonds, collard greens, spinach, canned salmon with bones, bok choy, soy milk fortified with calcium</td>
<td>Higher calcium intakes may also be related to fat loss - important for athletes in sports with weight limitations.</td>
</tr>
<tr>
<td><strong>Phosphorus</strong></td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Milk, cheese, yogurt, nuts, oatmeal, sardines, asparagus</td>
<td>Phosphate loading has not been researched enough may be more harmful than helpful.</td>
</tr>
<tr>
<td><strong>Magnesium</strong></td>
<td>Exercise does not seem to increase needs, however, those exercising in hot environments may require more.</td>
<td>DRI</td>
<td>Peanuts, tofu, broccoli, spinach, Swiss chard, tomato paste, nuts, seeds</td>
<td>No ergogenic effects established.</td>
</tr>
<tr>
<td><strong>Sulfur</strong></td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Garlic, legumes, nuts, seeds, red meat, eggs, asparagus</td>
<td></td>
</tr>
<tr>
<td><strong>Potassium</strong></td>
<td>Exercise does not seem to increase needs; however, individuals with a high sweat rate may need more.</td>
<td>DRI</td>
<td>Oranges, bananas, tomatoes, sardines, flounder, salmon, potatoes, beans, blackstrap molasses</td>
<td>No ergogenic effects observed at this time.</td>
</tr>
<tr>
<td><strong>Sodium</strong></td>
<td></td>
<td>DRI</td>
<td>Luncheon and cured meats, processed cheese, and most prepared foods.</td>
<td></td>
</tr>
<tr>
<td><strong>Chloride</strong></td>
<td>Same as sodium</td>
<td>DRI (same as sodium - DRI is established as sodium chloride)</td>
<td>Similar to foods with high sodium levels, because most are as sodium chloride, also found in salt substitutes as potassium chloride</td>
<td></td>
</tr>
<tr>
<td>Mineral</td>
<td>Effect of Exercise on Requirements</td>
<td>Recommended Intake for Athletes</td>
<td>Food Sources</td>
<td>Comments</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------</td>
<td>---------------------------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>Iron</td>
<td>Exercise may increase requirements if a person becomes iron depleted or iron-deficient anemic. DRI, but may need more if iron depleted or iron-deficient anemic.</td>
<td>Oysters, red meat, egg yolks, salmon, tofu, raisins, whole grains</td>
<td>May have an ergogenic effect if the athlete is iron depleted or iron-deficient anemic.</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>Exercise does not seem to increase needs; however, transient loses are often observed. DRI, but not more than the UL.</td>
<td>Oysters, red meat, poultry, fish, wheat germ, fortified cereals.</td>
<td>May have ergogenic effects, but not definitive and mostly animal studies; may impact thyroid hormone function if zinc-deficient.</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>Exercise does not seem to increase needs.</td>
<td>Red meat, fish, soy products, mushrooms, sweet potatoes</td>
<td>May have ergogenic effects, but not definitive and mostly animal studies; may impact thyroid hormone function if zinc-deficient.</td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td>Despite antioxidant properties, exercise does not seem to increase needs. DRI, but not more than the UL.</td>
<td>Fish, meat, poultry, cereal, grains, mushrooms, asparagus</td>
<td>More research is needed</td>
<td></td>
</tr>
<tr>
<td>Iodide</td>
<td>Exercise does not seem to increase needs.</td>
<td>Eggs, milk, strawberries, mozzarella cheese, cantaloupe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoride</td>
<td>Exercise does not seem to increase needs.</td>
<td>Fluoridated water, fish, tea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>Exercise does not seem to increase needs, though more research is required due to transient losses seen. DRI</td>
<td>Broccoli, potatoes, grape juice, turkey ham, waffles, orange juice, beef</td>
<td>Was thought to increase muscle mass, but research has consistent shown that it does not; may have a positive impact in individuals with type 2 diabetes.</td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td>Exercise does not seem to increase needs.</td>
<td>Liver, kidneys, wheat germ, legumes, nuts, black tea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molybdenum</td>
<td>Exercise does not seem to increase needs.</td>
<td>Peas, leafy green vegetables (eg spinach, broccoli), cauliflower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>Exercise does not seem to increase needs.</td>
<td>Apples, pears, grapes, leafy green vegetables, nuts</td>
<td>Despite research on its possible effects on bone and muscle, boron does not seem to have ergogenic effects.</td>
<td></td>
</tr>
<tr>
<td>Vanadium</td>
<td>Exercise does not seem to increase needs.</td>
<td>Mushrooms, shellfish, black pepper, parsley, dill weed, grains, grain products</td>
<td>May have a positive impact in individuals with type 2 diabetes</td>
<td></td>
</tr>
</tbody>
</table>
## Water-Soluble Vitamin Needs for Athletes

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Effect of Exercise on Requirements</th>
<th>Recommended Intake for Athletes</th>
<th>Food Sources</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin B-6</td>
<td>Exercise does not cause transient changes in B-6 status</td>
<td>DRI</td>
<td>Liver, chicken, bananas, potatoes, spinach</td>
<td></td>
</tr>
<tr>
<td>Vitamin B-12</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI; vegan athletes may need supplement</td>
<td>Fish, milk and milk products, eggs, meat, poultry, fortified breakfast cereals</td>
<td></td>
</tr>
<tr>
<td>Folate</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Leafy greens (eg spinach, turnip greens), dry beans, peas, fortified cereals, grain products, strawberries</td>
<td></td>
</tr>
<tr>
<td>Thiamin</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Wheat germ, brewer’s yeast, oysters, beef liver, peanuts, green peas, raisins, collard greens</td>
<td>Ergogenic effects are equivocal; positive effects are not strong.</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Organ meats, milk, cheese, oily fish, eggs, dark leafy green vegetables</td>
<td></td>
</tr>
<tr>
<td>Niacin</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Beef, pork, chicken, wheat flour, eggs, milk</td>
<td>Does not seem to have ergogenic effects; more research is needed.</td>
</tr>
<tr>
<td>Pantothenic acid</td>
<td>Not enough information.</td>
<td>DRI</td>
<td>Eggs, whole grain cereals, meat</td>
<td></td>
</tr>
<tr>
<td>Biotin</td>
<td>Not enough information.</td>
<td>DRI</td>
<td>Kidney, liver, eggs, dried mixed fruit</td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Increased intakes may prevent upper respiratory tract infections.</td>
<td>At least the DRI; ultra-endurance athletes need more than the DRI, but below the UL</td>
<td>Brussels sprouts, broccoli, chili and sweet peppers (red and green), kiwi, oranges, papaya, guava.</td>
<td>Strong antioxidant properties reported for endurance athletes.</td>
</tr>
<tr>
<td>Choline</td>
<td>Exercise does not seem to increase needs.</td>
<td>DRI</td>
<td>Liver, egg yolks, peanuts, cauliflower, soybeans, grape juice, and cabbage</td>
<td>Does not seem to have an ergogenic effect; more research required.</td>
</tr>
</tbody>
</table>
APPENDIX C

COACHES AND ATHLETES SURVEY DATA TABLES
Appendix C
Coaches and Athletes Survey Data Tables

Head Coaches: Demographics

<table>
<thead>
<tr>
<th>Indiana University</th>
<th>Colgate University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women’s Water Polo</td>
<td>Women’s Volleyball</td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
</tr>
<tr>
<td>Women’s Field Hockey</td>
<td></td>
</tr>
</tbody>
</table>

Assistant Coaches: Demographics

<table>
<thead>
<tr>
<th>Indiana University</th>
<th>Kent State University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men’s Soccer</td>
<td>Men’s Soccer</td>
</tr>
<tr>
<td>Women’s Rowing</td>
<td>Track &amp; Field (2)</td>
</tr>
<tr>
<td>Baseball</td>
<td>Women’s Gymnastics</td>
</tr>
<tr>
<td>Diving</td>
<td></td>
</tr>
</tbody>
</table>

Number of Years Coaching= 11.8±8.6

Coaches: Team Nutritional Needs

<table>
<thead>
<tr>
<th>Topics</th>
<th>Team would Benefit from more information on</th>
<th>Primary Nutrition Concern of Team</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n = 13$</td>
<td>$n = 13$</td>
</tr>
<tr>
<td>Energy Needs</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Macronutrient requirements</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Micronutrient requirements</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Fluid requirements</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Hydration</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Nutrition before, during and after exercise</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Meal composition for the preseason</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Meal composition for the post-season/off-season</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Meal composition during the season</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Timing of Meals</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Pre-event eating</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Eating on the road and travel meals</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Strategies for healthy weight gain</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Strategies for healthy weight loss</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Use of Supplements</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Iron Depletion</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Gluten Sensitivity</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Alcohol &amp; Performance</td>
<td>13</td>
<td>7</td>
</tr>
</tbody>
</table>
### Coaches Perceptions of RDs

<table>
<thead>
<tr>
<th>Perception</th>
<th>Don’t Know</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A qualified sports dietitian should provide individualized nutrition direction and advice after a comprehensive nutrition assessment.</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Registered dietitians are the most qualified professionals to deliver reliable nutrition information to athletes.</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Registered dietitians should be involved with the pre-screening of athletes prior to competition (ex: during mandatory athlete physicals).</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Registered dietitians should have a screening tool and assessment tool as a part of the pre-competition screening process of athletes.</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Registered dietitians should be notified if nutrition risk factors are present in individual athletes.</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for determining appropriate diet plans for athletes.</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for distributing information on banned substance and ergogenic aids.</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for recommending any nutritional supplements for athletes.</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for monitoring athlete’s use of supplements and ergogenic aids.</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for providing education to patients and families of current and prospective athletes.</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>I feel the practices of sport dietitians are essential to the athletic program.</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>I feel nutrition information provided to my</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>
I feel a Registered Dietitian on staff would positively benefit my team.  
I believe adequate nutrition practices are crucial to successful performance in the sport in which I coach.

---

### Athlete Demographics

<table>
<thead>
<tr>
<th>Indiana University</th>
<th>Kent State University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women’s Rowing</td>
<td>Men’s Track and Field</td>
</tr>
<tr>
<td>Women’s Basketball</td>
<td>Men’s Cross Country</td>
</tr>
<tr>
<td></td>
<td>Women’s Volleyball</td>
</tr>
</tbody>
</table>

### Athletes: Team Nutritional Needs

<table>
<thead>
<tr>
<th>Topics</th>
<th>Team would Benefit from more information on</th>
<th>Primary Nutrition Concern of Team</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n = 12$</td>
<td>$n = 12$</td>
</tr>
<tr>
<td>Energy Needs</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Macronutrient requirements</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Micronutrient requirements</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Fluid requirements</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Hydration</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Nutrition before, during and after exercise</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Meal composition for the preseason</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Meal composition for the post-season/off-season</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Meal composition during the season</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Timing of Meals</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Pre-event eating</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Eating on the road and travel meals</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Strategies for healthy weight gain</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Strategies for healthy weight loss</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Use of Supplements</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Iron Depletion</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Gluten Sensitivity</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Alcohol &amp; Performance</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Cooking Skills &amp; Tips</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Food shopping skills</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

### Athletes Perceptions of RDs

<table>
<thead>
<tr>
<th>Perception $n = 10$</th>
<th>Don’t Know</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
A qualified sports dietitian should provide individualized nutrition direction and advice after a comprehensive nutrition assessment.

<table>
<thead>
<tr>
<th>Registered dietitians are the most qualified professionals to deliver reliable nutrition information to athletes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered dietitians should be involved with the pre-screening of athletes prior to competition (ex: during mandatory athlete physicals).</td>
</tr>
<tr>
<td>Registered dietitians should have a screening tool and assessment tool as a part of the pre-competition screening process of athletes.</td>
</tr>
<tr>
<td>Registered dietitians should be notified if nutrition risk factors are present in individual athletes.</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for determining appropriate diet plans for athletes.</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for distributing information on banned substance and ergogenic aids.</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for recommending any nutritional supplements for athletes.</td>
</tr>
<tr>
<td>Registered dietitians should be responsible for monitoring athlete’s use of supplements and ergogenic aids.</td>
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I feel the practices of sport dietitians are essential to the athletic program.

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