HYDRATION AND FLUID REPLACEMENT KNOWLEDGE, ATTITUDES, BARRIERS, AND BEHAVIORS OF NCAA DIVISION I FOOTBALL PLAYERS AT A MIDWESTERN UNIVERSITY

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Abstract

THESIS: Hydration and Fluid Replacement Knowledge, Attitudes, Barriers, and Behaviors of NCAA Division I Football Players at a Mid-Western University

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The purpose of this study was to determine the: 1) knowledge, attitudes, and behaviors toward hydration and fluid replacement among collegiate football players at an NCAA Division I University, overall , and the relationship, if any, by position on the team, number of seasons played, and previous nutrition education; 2) relationship between the athletes' hydration knowledge, attitudes and behaviors; 3) current sources of nutrition information likely to be used by the football players; and 4) players' perception of the adequacy of, and barriers to, their fluid intake before, during, and after exercise. The players' mean Hydration Knowledge Score was 14.2 ± 1.4 out of 17 (83.5%). Common misconceptions included: 60% thought water, rather than sports drinks, should be consumed when exercising for more than one hour; 54% did not believe sports drinks are better at restoring muscle glycogen than water; 47% believed salt tablets kept players from getting dehydrated; and 42% indicated thirst is the best indicator of dehydration. No differences were detected by number of seasons, position or previous nutrition education.

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CHAPTER 1

Introduction

Hydration is critical to the health and sports performance of collegiate football players (Dunford & Doyle, 2008). Athletes need adequate fluid intake before, during, and after exercise to prevent dehydration and to maintain the physical demands of their sport. During a state of dehydration, the excessive loss of water and electrolytes and lack of their replacement can impair exercise performance and thermoregulation (Berning, 2002). In addition, dehydration can cause serious health complications including impaired brain function, heat stroke, cerebral edema (swelling of the brain), coma, and death (Berning, 2002).

Maintaining hydration may be difficult for collegiate football players as they engage in strenuous, repetitive exercise, often practicing multiple times per day. Research shows that during exercise the amount of water and electrolytes each player loses can vary dramatically, and as a result, the hydration tactics for each player should be assessed individually (ADA, 2009).

Dunn, Turner, and Denny (2007) examined the nutrition knowledge of collegiate football players. Their results indicated the players lacked basic nutrition concepts, including hydration. Ball State University's head strength and conditioning coach, Mark Naylor, has stated "hydration is the biggest nutritional barrier among our football

players" (M. Naylor, personal communication, February 18, 2010). In order to avoid health complications and help players support their sports performance, athletes need to understand the relationship between fluid balance and hydration. Nutrition education can teach players how to improve their hydration, maintain health, reach peak performance, and recover properly post-event. It is equally important that athletes are able to apply their knowledge, as education alone does not guarantee players will translate what they have learned into appropriate dietary choices.

Many factors outside the classroom can influence a college athlete's attitudes and behaviors toward nutrition, including hydration. Nichols, Jonnalagadda, Rosenbloom, and Trinkaus (2005) concluded that, in order to help collegiate athletes practice proper hydration, positive attitudes and behaviors toward hydration need to be instilled. It is important to determine what football players know about fluid balance and hydration, and to discern whether or not the players use their knowledge to avoid the potential harmful effects from dehydration. Identifying and removing barriers that prevent athletes from making healthy choices with regard to fluid and hydration is extremely important to attain success.

Purpose of the Study

The primary purpose of this study was to investigate the knowledge, attitudes, and behaviors toward hydration and fluid replacement among collegiate football players at a NCAA Division I University overall, and their relationship, if any, with the athletes' position on the team, number of seasons played, and previous nutrition education. Secondary purposes of this investigation included to determine what relationship, if any,

existed between the athletes' hydration knowledge, attitudes, and behaviors; to identify current sources of nutrition information likely to be used by Division I football players; and to identify the players' perception of the adequacy of their fluid intake and barriers that prevent them from obtaining enough fluid before, during, and after exercise.

Research Questions

1) What is the knowledge level of NCAA Division I college football players with regard to hydration and fluid needs?
    a) overall
    b) by number of years having played collegiate football
    c) by position on the team
    d) by amount of previous nutrition education:
2) What are the attitudes of NCAA Division I college football players with regard to hydration and fluid needs?
    a) overall
    b) by number of years having played collegiate football
    c) by position on the team
    d) by amount of previous nutrition education:
3) What are the behaviors of NCAA Division I college football players with regard to hydration and fluid needs?
    a) overall
    b) by number of years having played collegiate football
    c) by position on the team
    d) by amount of previous nutrition education:

4) What correlations exist between the football players' knowledge, attitudes, and behaviors?
5) What sources of nutrition information are NCAA Division I football players likely to select?
6) What is the perception of adequacy of fluid intake among NCAA Division I football players?
7) What barriers prevent NCAA Division I football players from consuming adequate fluids?

Significance of the Study

Results of this study will provide a better understanding of the hydration knowledge, attitudes, barriers, and behaviors of collegiate football players toward hydration and fluid replacement. It will also provide a better understanding of the sources of nutrition information used by collegiate football players. Previous research has demonstrated a lack of nutrition knowledge, both among collegiate football players and athletes in general. It would be beneficial if the barriers that cause disconnect between an athlete's nutrition knowledge, attitude, and the application of that knowledge could be identified. If athletes are aware of the sports performance benefits of proper hydration, but choose to employ unhealthy habits that lead to dehydration, identifying the motives and barriers that keep athletes from making better choices will aid in the development of targeted educational messages to help football players optimize their performance through adequate hydration.

Definition of Terms

- American Dietetics Association (ADA). The world's largest organization of food and nutrition professionals; Registered Dietitians (RD). ADA is committed to improving the nation's health and advancing the profession of dietetics through research, education, and advocacy (ADA, 2010).
- Anthropometric Data. Any physical measurements of the body, including height, weight, and percent body fat (Dunford & Doyle, 2008).
- Calorie. A measurement of energy in food. Calorie sources include carbohydrates (4 calories per gram), proteins (4 calories per gram), fats (9 calories per gram), and alcohol (7 calories per gram). Non-calorie sources include water, vitamins, and minerals. To maintain weight, energy intake must match energy output. A calorie deficit can result in a negative energy balance and harm high power performance (Dunford & Doyle, 2008).
- Dehydration. A water deficit of two to three percent or more of body mass (ADA, 2009).
- Electrolyte. Control the fluid balance of the body and are important for muscle contraction, energy generation, and almost every major biochemical reaction in the body. Common human electrolytes include sodium chloride, potassium, calcium, and sodium bicarbonate (Dunford & Doyle, 2008).
- Euhydration. A normal or adequate amount of water for proper physiological function. Euhydration is also referred to as hydration (Dunford & Doyle, 2008).
- Fluid Balance. The difference between the amount of water taken into the body and the amount excreted or lost.

- Glycogen. Storage form of carbohydrates in the body (Dunford & Doyle, 2008).
- Healthy Diet. A diet which emphasizes fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products; includes lean meats, poultry, fish, beans, eggs, and nuts; and is low in saturated fats, trans fats, cholesterol, salt (sodium), and added sugars (USDA, 2009).
- Hyperhydration. A temporary excess of water; beyond the normal state of hydration (Dunford & Doyle, 2008).
- Hypohydration. An insufficient amount of water; about one percent below the normal state of hydration (Berning & Steen, 1991).
- National Collegiate Athletic Association (NCAA). A voluntary organization that governs the nation's universities' athletic programs. It is comprised of institutions, conferences, organizations, and individuals committed to the best interests, education and athletics participation of student-athletes (NCAA, 2009)
- Nutrition Quackery. Extravagant claims of enhanced health or performance with no legitimate basis (Dunford & Doyle, 2008).
- Nutrition Periodization. A nutrition plan that supports training and body composition goals (Dunford & Doyle, 2008).
- Sports Nutrition. The application of eating strategies to promote good health and adaptation to training for quick recovery after each exercise training session and to perform optimally during competition (Dunford & Doyle, 2008).
- Thermoregulation. Maintenance of body temperature in the normal range (Dunford & Doyle, 2008).

Assumptions

The following assumptions were made in the development, implementation, and analysis of this study:

- The football players at this Midwestern university are representative of collegiate football players in general;
- The subjects understood the questions and answered the questions honestly;
- The instructions for the dissemination and collection of the survey were followed;
- The individuals who chose to complete the survey during the summer non-mandatory practices were representative of the football team;
- The athletes correctly differentiated “sports drinks” from “energy drinks;”

Limitations

This study was limited by the following factors:

- All of the athletes who completed the fluid and hydration survey were recruited from only one Mid-America Conference (MAC) school.
- The study was completed during the summer when incoming freshmen were not yet present and after seniors had graduated, thus reducing the pool of potential subjects.
- All data was self-reported; no direct anthropometric or dietary measurements were obtained by the investigator.
- The survey is limited to questions about fluid and hydration and players dietary influences, barriers, and sources of nutrition information; no specific information regarding nutrition knowledge, attitudes, or dietary intake was obtained.

- The survey was conducted during the summer non-mandatory practice sessions, not during the regular football season, possibly influencing the athletes' responses (e.g., no pads, no helmets in the summer); the hydration practices and behaviors observed during the summer may not be the same as during the season.
- The researcher had planned to calculate an "intention to eat a healthful diet" score using the questions in section four on the survey in the present study. Unfortunately, due to a misunderstanding, the questions selected for the present study were not the seven that had been identified by Hornstrom (2007) as the questions that measured this construct. Future researchers are urged to select the questions identified by Hornstrom (2007) or Pawlak, Malinauskas, and Rivera (2009) which load and measure this construct.

Summary

Hydration plays a key role in the health and sports performance of collegiate football players. To support peak performance, the athletes should hydrate before, during, and after exercise. A lack of nutrition knowledge among collegiate football players indicates a need for further investigation of their hydration and fluid replacement practices. It is important to determine not only what football players know about hydration, but also whether or not the players apply their knowledge to reach peak performance during competition. Results of this study can be used to develop educational programs and health messages to maximize the performance potential of this population.

CHAPTER II

Review of Literature

The primary purpose of this study is to identify the knowledge, attitudes, and behaviors toward hydration and fluid replacement among collegiate football players at a Midwest Division I University. This chapter provides general background information about the physical demands of collegiate football players and summarizes research regarding the fluid replacement needs and recommendations for collegiate athletes. This review emphasizes hydration before, during, and after exercise; the electrolytes sodium and potassium; alcohol; and the macronutrient carbohydrate. In addition, research related to the nutrition knowledge, attitudes, food consumption behaviors, perception of adequacy of fluid intake and barriers to fluid consumption will be presented. Finally, the role of coaches and dietitians in ensuring hydration, and sources of nutrition information used by collegiate athletes, will be discussed.

Background

Appropriate nutritional tactics can maximize athletes' performance potential and prevent dehydration, which, if it occurs, can lead to impaired sports performance. Nutrition knowledge, including knowledge about hydration, has been shown by several researchers to be mediocre at best among collegiate athletes (Dunn et al., 2007; Cole,

Salvaterra, Davis, Borja, Powell, Dubbs, & Bordi, 2005; Jacobson, Sobonya, & Ransone, 2001; Jonnalagadda, Rosenbloom, & Skinner, 2001). Although strength and conditioning programs for college football teams have grown tremendously over the past twenty-five years, these programs often fail to incorporate sports dietitians to teach and reinforce sound nutritional practices among football players. By adding a dietitian certified in sports nutrition to the athletic staff, suitable nutrition interventions for year-round periodized training and conditioning programs, could be implemented to offset delays in recuperation and maximize the physical preparation for athletic competition in universities, thus enhancing a football team's chance for success (Hoffman, 2008; Kraemer et al., 2009; Rhea, & Hunter, 2006).

As part of a Division I college football team, players must meet the physical demands of their sport, a rigorous training schedule, and remain in good academic standing. Division I collegiate football players devote substantial amounts of time preparing for competition. Division I football players practice almost every day of the week over the entire year (e.g., they do not take the summers off). At Ball State University, practices are usually held early in the morning or later in the evening and generally last between forty-five minutes to over two hours (M. Naylor, personal communication, February 18, 2010). During the summer pre-season, players engage in two-a-day practices. The football season is scheduled for twelve games, with half of the games at the player's home field and the other half requiring travel. The National Collegiate Athletic Association's (NCAA) rules limit students to no more than twenty hours a week toward their sport under the supervision of a coach. However, in an effort to gain a competitive edge over their opponents, athletes frequently spend additional time

toward training outside of practice. A survey by the NCAA in 2007 found that football players spent an average of 44 hours per week on their sport. The collegiate athletes in this survey also reported they felt more like “athletes” than “student athletes” (The Student-Athlete Perspective of the College Experience, 2008).

During and after all supervised practices, players at Ball State have access to water and sports drinks supplied by the coaching staff. In addition to water and sports drinks, collegiate football players are provided with a meal before or after practice and games. The majority of football players on this Division I team have scholarships, which provide them with access to three meals a day on campus. Players with scholarships who do not live on campus receive money that is intended to pay for groceries (M. Naylor, personal communication, February 18, 2010).

College students typically have around-the-clock access to food, but the food is often high in calories, and low in nutrients, fiber, fruits, vegetables, and variety, making it difficult for an athlete to know what to choose. In addition, finding enough time between classes, training, and practices to eat and allow for digestion can be challenging. Most college athletes face additional barriers that prevent them from consuming a diet that can help them reach peak performance in their sport. Common barriers include their lifestyle, stress level, traveling for competition, time and ability to prepare meals, attitudes toward nutrition, lack of money,and peer influence (Jonnalagadda et al., 2001).

Training and diet will construct different body compositions among the players. Players vary considerably in height, weight, and body composition, depending on their position, as some positions require more strength and power while others require more focus on speed and agility (Burke and Deakin, 2007). Noel, VanHeest, Zaneteas, and

Rodgers (2003) compared anthropometric studies conducted on Division I college football players in the early 1980's and 1990's. They observed players today have significantly increased in size, total body mass, skin-fold thicknesses, and body fat. Secora, Latin, Berg, and Noble (2004) measured the height and weight of collegiate football players from 1987 to 2000 and observed height to range from 154.9 centimeters (5 ft.) to 205.7 centimeters (6 ft. 9 in.) and weight varying from 72.7 kilograms (160 lbs.) to 154.9 kilograms (340 lbs.).

Sports Nutrition

Many elements are associated with the topic "sports nutrition." This review will focus on water before, during, and after exercise, the electrolytes sodium and potassium, alcohol, and the macronutrient carbohydrate as they relate to sports performance.

Water and Sport

The majority of blood plasma, muscles, and other tissues are made up of water. The status of normal hydration in the body is referred to as euhydration (Dunford & Doyle, 2008). Hyperhydration is caused by an excessive consumption of water. In contrast, hypohydration is caused by the intake of too little water, which is defined as a water deficit of about one percent of total body weight (Berning & Steen, 1991). Hypohydration and dehydration are commonly used interchangeably (Dunford & Doyle, 2008). Both states can impair thermoregulation and lead to reduced physical, cognitive, and mental performance (Szinnai, Schachinger, Arnaud, Linder & Keller, 2005; Ziv & Lidor, 2009).

Fluid balance in the body is regulated by mechanisms that influence water and sodium excretion, and affect the sensation of thirst. Excessive exercise can dull the body's thirst mechanism, making it even more difficult for these athletes to recognize their fluid needs. Sweat rates for any given activity will vary dramatically according to the ambient temperature, humidity, body weight, genetics, state of heat acclimation, and metabolic efficiency (ADA, 2009).

As players become dehydrated, their blood flow and endurance capacity deteriorates and the athletes may exhibit increased tiredness and reduced alertness. The loss of physical capacity and mental focus may put the players at a higher risk for injury (Berning & Steen, 1991). American football is different from other sports in that the possible occurrence of injury is very high and players must be optimally developed in order to endure the constant physical contact and the physiological demands of the game (Pincivero & Bompa, 1997). Steiner, Quigley, Wang, Balint, and Boland (2005) studied the number of athletes' team physician visits at a major university by type of sport. Steiner observed football players accounted for more team physician evaluations than any other sport. Results indicated the majority of injuries occurred from September through November, with the most common musculoskeletal diagnoses being sprains, contusions, and strains. According to Kraemer et al. (2009), major threats to college football players' health include the potential for traumatic neuromuscular injury and neurological injury of an acute or chronic nature. Thus, it is critical for football players to maintain hydration in order to sustain sharp mental focus and physical endurance to prevent injury given the fast paced and high impact nature of football.

It is difficult for football players to drink enough fluid to off-set the large volume of fluid lost during practice and games. As a result, their fluid balance is compromised. The position statements from the American College of Sports Medicine (ACSM) (Sawka, Burke, Eichner, Maughan, Montain & Stachenfeld, 2007), the National Athletic Trainers' Association (NATA) (Casa et al,, 2000), and the American Dietetic Association (ADA, 2009) all concur that athletes need adequate fluid intake before, during, and after exercise to prevent dehydration and to maintain the physical demands of their sport. The joint position statement from the ACSM and the ADA (ADA, 2009) encourages individualization of each athlete's fluid needs and emphasizes the importance of recording pre-exercise and post-exercise weight for each athlete to help determine their fluid loss.

Nichols et al. (2005) surveyed 139 collegiate athletes from various sports to measure their knowledge, attitudes, and behaviors concerning fluid replacement and hydration. The majority participants were male and female soccer players, including a mixture of freshmen, sophomores, juniors, and seniors. The mean age of the athletes was 19.8 years. The mean scores for knowledge, attitude, and behavior were 13.9 ± 1.8 (82%), 9.8 ± 2.2 (58%) and 12.4 ± 2.5 (73%), respectively. A significant positive correlation was reported between knowledge, attitude, and behavior scores ($p < 0.05$). Significant differences were observed between skilled (11.79 ± 2.08) and endurance (12.71 ± 2.63) athletes with regard to hydration behavior. Results indicated 32.4 percent (n=45) of the athletes incorrectly believed that thirst is the best indicator of hydration and 33.8 percent (n=47) of athletes did not know that weighing themselves before and after practice is a good way to determine how much fluid to consume. In addition, nearly one

fourth of the athletes were not be aware that excessive sweating, thirst, or cramping are warning signs of dehydration. Results suggest that these athletes need to be taught proper hydration and fluid replacement practices, and then monitored regularly to reinforce positive attitudes and behaviors.

Rosenbloom, Jonnalagadda and Skinner (2002) surveyed the nutrition knowledge of 237 Division I male and female collegiate athletes, including 111 (46%) football players. The survey was administered to a single university during the athletes' yearly physical. Ninety-four percent of men (n=223) and 92 percent of women (n=84) correctly indicated that dehydration decreases performance. The majority of these athletes (96% of men; n=228 and 95% of women; n=86) knew that fluids should be replaced before, during, and after exercise. Most athletes (79% of males; n=187 and 80% of females; n=73) agreed that thirst is not an adequate indicator of fluid needs. Only 22 percent (n=52) of the athletes agreed that sports drinks are better than water.

Hydration and Environmental Conditions

The climate, intensity, and extended nature of a football game all lead to an elevated body temperature which, in turn, initiates sweating to promote heat loss. Each player must wear a helmet and protective gear which increases sweating and body temperature. This occurs even in cool environments (Berning & Steen, 1998). Anytime a football player experiences increased sweating, they need to increase their fluid and electrolyte intake to maintain hydration (Berning & Steen, 1998).

The risk for dehydration and heat illness increases dramatically in hot, humid environments (ACSM, 2007). To maintain appropriate body temperature, the body uses a system referred to as thermoregulation (Dunford & Doyle, 2008). The majority of

metabolic heat from exercise is eliminated from the body through evaporation. In hot or dry environments, evaporation accounts for 80 percent of metabolic heat loss (ADA, 2009). As evaporation increases, blood volume decreases, causing a lower stroke volume. The heart rate must increase to compensate for the lower stroke volume and this creates an increase in body temperature. The increase in core temperature is transferred to the blood, which flows to the skin and is then transferred to the environment through evaporation, convection, and radiation (ADA, 2009).

Cardiovascular function relies on adequate blood volume. Lower blood volume caused by dehydration will impair the body's ability to dissipate heat (Berning & Steen, 1991). When ambient temperature exceeds body temperature, heat cannot dissipate by radiation or convection and the body relies mainly on evaporation. Furthermore, relative high humidity substantially reduces the body's potential to dissipate heat through evaporation of sweat. Athletes can help maintain blood volume by replacing lost fluids. Thus, it is necessary to take every precaution to assure that athletes are well hydrated, have access to fluids, and are monitored for heat-related illness (ADA, 2009; Berning & Steen, 1991).

The water loss seen in collegiate football players can be tremendous, with some players experiencing daily fluid losses of over four liters (> 1 gallon) during a two and a half hour practice session (Stofan et al., 2005). During the summer, players must be able to handle two-a–day practices in anticipation for the upcoming season. Godek, Godek & Bartolozzi (2005) measured body weight, and analyzed blood and urine samples of college football players before and after practices during pre-season training. Results revealed players lost between three and a half to five kilograms (7.7-11 lbs.) of body

weight during pre-season practices due to heavy sweating. Analysis of body weight, plasma volume, urine specific gravity, and urine sodium indicated that players become dehydrated by the second day of their pre-season training. Researchers concluded that football players struggle to maintain hydration during pre-season twice-a-day training sessions.

Dehydration can also occur in cold environments or cold weather. The air in cold environments contains less water and becomes warmed and humidified when exercising in cold weather. Dehydration can be the result of increased respiratory fluid losses as well as sweat losses that occur when heat insulated clothing is worn during intense exercise or when athletes do not ingest enough water or sports drinks to balance fluid loss (ADA, 2009).

Hydration before Exercise

Athletes should be fully hydrated prior to exercise and should rehydrate during and immediately after exercise (ADA, 2009; Dunford & Doyle, 2008). According to the Joint Position Statement on Nutrition and Athletic Performance from the ACSM (2007) and ADA (2009), athletes should drink five to seven milliliters (mL) of water or sports beverage per kilogram body weight (approximately two to three mL per pound), at least four hours before an event if hydrated. If dehydrated, they need to add an additional three to five mL of fluid per kilogram body weight two hours prior to exercise. Larger athletes (e.g., a 118 kilogram or 250 pound football player) may need between six and eight mL per kilogram four hours before an event, and, if they are dehydrated, an additional three to five mL per kilogram body weight should be consumed (Dunford & Doyle, 2008).

These time frames will allow enough time to maximize their hydration status and excrete of any excess fluid as urine before an event.

Volpe, Poule, and Bland (2009) compared the pre-practice hydration status of 138 male and 125 female NCAA Division I athletes using urine samples collected before team practice. Results indicated that, prior to practice, thirteen percent (n=34) of student-athletes appeared to be significantly dehydrated, 53 percent (n=139) appeared to be hypohydrated, and 34 percent (n=89) appeared euhydrated. In addition, a greater percentage of men (47%, n=65) were hypohydrated than women (28%, n=35).

Hydration during Exercise

Football players need to maintain peak performance for the duration of the game which typically lasts two to three hours. By studying the duration of each play during collegiate football games, researchers have estimated the average length of each play to be five seconds with an average of 36 seconds between plays for the players to get back into their position (Iosia & Bishop, 2008; Rhea & Hunter, 2006). Players are given an average of eleven minutes and 40 seconds to rest during halftime (Iosia & Bishop, 2008). Players have an opportunity to replace lost fluids and electrolytes during halftime and when their playing unit (e.g., offense vs. defense vs. special teams) is not on the field.

The ADA and ACSM recommend that all athletes who engage in exercise lasting more than one hour should consume sports beverages containing six to eight percent carbohydrates. The amount and rate of fluid replacement is dependent on an individual's sweat rate, exercise duration, and opportunities to replace fluid during exercise (ADA, 2009). Measuring pre and post exercise weight will help the players determine how much

fluid they need to drink during and after a game (Sawka et al., 2007). A general rule for all athletes' fluid consumption during exercise is to drink 150 to 200 milliliters of water or sports beverage for every fifteen to twenty minutes played (Dunford & Doyle, 2008).

Jacobson et al. (2001) measured the nutrition knowledge and attitudes of 330 male and female Division I collegiate athletes from sixteen universities. Twenty-seven percent of the athletes (n=89) identified themselves as football players. Although carbohydrate drinks were among the most frequently used supplements, only sixteen percent (n=41) of the athletes reported using carbohydrate drinks to rehydrate and replenish their muscle glycogen.

Hydration after Exercise

When rehydrating after a game, consuming sports beverages and salty foods during meals/snacks will help replace fluid and electrolyte losses. Replacing fluids is especially important when athletes exercise for more than one hour or if the athlete is in an extreme environment such as heat, cold, or high altitude (ADA, 2009). Athletes who weigh themselves both before and after exercise need to drink between 450 to 675 mL (sixteen to twenty-four ounces) of fluid for every pound (0.5 kilograms) of lost weight (Sawka et al., 2007).

Fourteen percent (n=19) of the athletes in the study by Nichols et al. (2005) described previously did not believe they should drink a sports drink within two hours after exercise. Only half (52.5%, n=73) of the athletes believed they should drink a sports drink when exercising for more than one hour and only 33.1 percent (n=46) reported drinking a sports drink when exercising for more than one hour.

Jonnalagadda et al. (2001) studied the dietary habits, attitudes, and physiological status of 31 collegiate freshmen football players. Players were given a questionnaire to determine their knowledge and attitudes. Fasting blood samples, height, and weight measurements were also obtained. Ninety percent (n=28) of the freshman football players recognized the importance of maintaining proper hydration status. However, per workout session, only 26 percent (n=8) of players reported consuming more than five cups of fluid, 52 percent (n=16) reported consuming three to five cups, and 19 percent (n=6) reported consuming one to two cups. The researchers concluded knowledge does not always translate into practice.

Sodium and Sport

Fluid balance in the body is regulated by water volume and the concentration of solutes in body fluid, such as sodium and potassium (Berning & Steen, 1998). Sodium is the most abundant electrolyte of extracellular fluid (fluid outside of cells). The body must adjust the water volume in relation to the amount of sodium in the body. Dehydration and hyponatremia (serum sodium concentration of less than 130 mEq/Liter [less than 130 milimols/Liter) can result from prolonged heavy sweating and failure to replace sodium, or from excessive water intake. Athletes can drink fluids such as sports drinks which have added sodium chloride and other electrolytes to help prevent dehydration and hyponatremia (Dunford & Doyle, 2008). The daily recommended amount of sodium for healthy adults is 1500 milligrams (1.5 grams) or one-fourth of a teaspoon of table salt (Dunford & Doyle, 2008). However, this recommendation may not be applicable to athletes.

Proper hydration tactics are especially important for players who are prone to heat cramps and are "salty sweaters" (e.g., appearance of sweating heavily and have salt caking on their skin and clothes). Athletes who are salty sweaters should consume one gram of salt per hour of exercise. Salty sweaters are encouraged to consume foods or beverages that contain sodium, or salt their food and eat salty snacks (Dunford & Doyle, 2008). Sports drinks are good choices for salty sweaters because they contain sodium. Sodium stimulates the thirst mechanism and thus sports drinks can help athletes to consume more fluids (ADA, 2009).

Skeletal muscle cramps, also referred to as heat cramps, are associated with dehydration, electrolyte deficits, and muscle fatigue (ADA, 2009). Heat cramps involve involuntary spasms of large muscle groups. During pre-season two-a-day practice sessions, Stofan et al. (2005) compared the total amount of sweat and sweat sodium losses of five players who were prone to heat cramps and five players who never experienced heat cramps. Changes in body weight (adjusted by fluid intake) were used to estimate total sweat loses. Sweat samples obtained from forearm patches were used to analyze sodium and potassium concentrations of the sweat. Over a 2 ½.hour practice session, the heat cramp group lost over twice as much sodium (5.1 ± 2.3 grams) as the non heat cramp group (2.2 ±1.7 grams). Both groups consumed sodium containing drinks on and off the field. The amount of sodium lost during exercise varied significantly between players and was independent of the player's age, height, weight and playing experience. Total sweat losses were also greater for the heat cramp group (4.0 ±1.1 liters) than the non heat cramp group (3.5 ±1.6 liters). Due to the variation between how much

salt each person will lose during exercise, trial and error is encouraged during training to determine the actual amount of salt loss by individual athletes.

Maugham, Watson, Evans, Broad and Shirreffs (2007) measured water balance and sweat losses of 22 English Premier League soccer players during a game. Sweat patches were applied to four skin sites and body mass was recorded before and after the game. The game, which lasted 96 minutes, was played during the evening when the temperature was cool (six to eight degrees Celsius). Researchers observed a large individual variability in hydration status and sweat losses among players. The mean sweat loss was 2.4 ±0.8 liters with a range from 0.82 liters to 2.24 liters. Total sweat sodium loss during the game was 2.4 ± 0.8 grams. Shirreffs, Sawka, and Stone (2007), in a review on English soccer players' water and electrolyte needs, reported the large individual variation in sweat and electrolyte losses indicate that individual monitoring should be an essential part of a player's nutritional strategy to determine water and electrolyte needs.

People with high blood pressure are often more sensitive to salt and they need to monitor their salt intake to avoid an increase in their blood pressure. Blood pressure is the force of blood pushing against blood vessel walls. High blood pressure, also called hypertension, can be dangerous because the heart must work extra hard to pump blood through the body. Hypertension also contributes to hardening of the arteries or atherosclerosis and the development of heart failure. Other factors that have been associated with hypertension include obesity, stress, insufficient intake of potassium, calcium, magnesium, and excess alcohol consumption (Mahan, & Escott-Stump, 2008). According to the American Academy of Pediatrics (Demorest, & Washington, 2010),

young athletes with hypertension should be advised to avoid substances that could affect blood pressure, such as excessive use of energy drinks, caffeine, any exogenous androgens, growth hormones, illicit drugs, alcohol, tobacco in all its forms, non-prescribed stimulants, and over-the-counter supplements that contain ephedra or other stimulants.

Since a football player's health risk for future disease may be affected by their current physical condition and presence of disease risk factors, such as hypertension and obesity, it is important to monitor their health status and body composition. Carbuhn, Womack, Green, and Morgan (2008) measured the blood pressure of 73 first year football players, and found that over 75 percent (n=56) of players were categorized as pre-hypertensive or hypertensive. The authors concluded that further research is required to determine whether the players' hypertension is a benign physical adaptation to participation in this sport or a permanent, chronic condition that negatively impacts sports performance and increases the players' risk for cardiovascular disease.

Recent research has shown a variation in the amount of salt adults can sense in foods. Hayes, Sullivan, and Duffy (2010) examined the relationship between the number of papillae (the bumps on the tongue that are surrounded by taste buds) and how salt sensation from tasting different foods with varying amounts of sodium would affect an individual's preference for and intake of salty foods. The 87 healthy non-smoking participants, whose age ranged from 20 to 40 years, were given 38 different foods with varying levels of sodium to taste. The authors added additional salt to broth to observe how increasing amounts of sodium would impact the participants' salt sensation. Results indicated PROP supertasters (those with heightened propylthiouracil [PROP] bitterness

or taste papillae number) seem to have a genetic predisposition to perceive greater saltiness from concentrated salt solutions. The super tasters tended to enjoy the taste of salty foods more, consumed them more frequently, reported greater sensory changes in certain foods, and salted their foods less frequently. PROP bitterness showed stronger associations with perceived saltiness in foods than did papillae number. The authors suggested the group with fewer papillae may be more likely to salt their products in order to achieve the same level of perceived saltiness. In contrast, having a greater number of papillae appeared to be associated with a lower intake of high-sodium foods.

Potassium and Sport

Potassium is the major electrolyte in intercellular space (inside of cells) and aids in maintaining hydration. The potential for hyperkalemia and heat stroke increases concomitant to fluid loss as the potassium within the cell increases in concentration. However, athletes should not take potassium supplements as they can lead to cardiac failure (Mahan, & Escott-Stump, 2008). Potassium is found in sports drinks, milk, fruits, vegetables, whole grains, beans, and salt substitutes. To obtain adequate intake of potassium, it is important to eat a variety of fruits and vegetables. The United State Department of Agriculture (USDA) recommends males between the ages of nineteen to 30 should consume two cups of fruit and three cups of vegetables per day (USDA, 2009).

Cole et al. (2005) collected two three-day diet records and anthropometric measurements from 28 Division I college football players. Dietary data was collected during weekend days at two different points in time when no training table (e.g., a meal prepared and served for athletes either before or after practice or competitions) was

provided. The results obtained were compared with the same age and gender group from the Third National Health and Nutrition Survey (NHANES III) data. Results indicated there were no differences between the dietary practices of the football players and the NHANES III group. The players consumed an average of 1.3 fruits per day and 1.6 vegetables per day. Together the average intake of fruits and vegetables were less than two servings per day.

Dunn et al. (2007) surveyed the nutrition knowledge and attitudes of 190 collegiate athletes based on knowledge of nutrients, food groups, expert recommendations, food choices, and the relationship between food and disease. Attitudes questions measured symptoms and concerns which are characteristic of people who have an eating disorder. The mean nutritional knowledge score was 52 percent and the mean score for the dietary recommendations section was 59 percent. Only six percent (n= 11) of the respondents demonstrated a potential for having or acquiring an eating disorder. Results also indicated many athletes at the college level lack the basic concepts of nutrition, struggle to identify healthy food choices, and have problems translating their knowledge into food choices. Only 32 percent (n= 61) of the athletes correctly indicated the number of fruit and vegetable servings recommended per day (e.g., at the time of the survey the answer was five to six servings per day).

Carbohydrates and Sport

Carbohydrates are the body's primary and preferred fuel during high intensity workouts. Carbohydrates improve exercise performance, recovery from training, and muscle gain. During exercise, the body uses stored carbohydrates (glycogen) in the

muscles and liver to supply energy needed for exercise. Extended mixed anaerobic-aerobic exercises, such as football, rely on greater breakdown of muscle glycogen. The higher the intensity of the exercise, the faster muscle glycogen stores are used (Dunford & Doyle, 2008). Without adequate glycogen tissue stores, an athlete's training and competition are impaired. If an athlete has difficulty maintaining normal exercise intensity or experiences sudden weight loss, the athlete may not be consuming enough carbohydrates (Dunford & Doyle, 2008).

In addition to providing water and electrolytes, sports drinks can help replenish carbohydrates stores which supply the body's energy. Sports beverages containing carbohydrates and electrolytes can be consumed before, during, and after exercise to help maintain hydration and endurance (ADA, 2009). When exercising for more than two hours or during heavy exercise in hot weather, athletes should consume fifteen grams of carbohydrate for every fifteen minutes of exercise from a sports drink. Most sports drinks contain six to eight percent carbohydrate and provide fourteen to eighteen grams of carbohydrates per 20 ounce serving. Per kilogram body weight, football players need between four and six grams of carbohydrates during training and competition, and six to eight grams during heavy training and competition (Dunford & Doyle, 2008).

Athletes can benefit from consuming sports drinks before, during, and immediately after exercise rather than solid foods for several reasons. Sports drinks are less likely to cause gastric upset right before and during competition, are easy to carry, can increase caloric intake, and help maintain hydration (Dunford & Doyle, 2008). However, if exercise lasts for less than one hour, use of a sports drink is not warranted.

A low consumption of carbohydrates can cause low blood sugar. This condition, called hypoglycemia, causes fatigue and compromises an athlete's ability to compete and concentrate. Symptoms of hypoglycemia include light-headedness, shakiness, and hunger (Dunford & Doyle, 2008). Additional causes of hypoglycemia include improper timing and content of meals, alcohol, or diabetes mellitus. Consumption of high glycemic index foods (e.g., white rice, potatoes, sugar, and other refined carbohydrates) prior to exercise can cause an initial spike in blood glucose (hyperglycemia) followed by a dive in blood glucose, resulting in hypoglycemia. To prevent hypo and hyperglycemia during exercise that lasts more than one hour, athletes need to be taught how to consume appropriate amounts of carbohydrates before and after exercise (Burke and Deakin, 2007).

In addition, the type of carbohydrate consumed and the timing of meals can also improve sports performance and speed up recovery. A carbohydrate rich diet is required to build and maintain energy stores (Berning, 2002). To receive the positive health and performance benefits of carbohydrates, it is crucial that a football player has an ample store of carbohydrates. Carbohydrates must be appropriate for the type, intensity, duration of the sport, manipulating and maintaining normal glycemia, and oxidation of fats (Dunford & Doyle, 2008).

Dunn et al. (2007) indicated the majority of college athletes incorrectly thought they needed to cut back on their carbohydrate intake. When asked about carbohydrate consumption recommendations, 53 percent (n=111) of respondents thought that experts recommend decreasing the amount of carbohydrates in the diet.

Cole et al. (2005) noted the influence of fad diets and an inadequate intake of carbohydrates and other nutrients among college football players. Fifteen percent (n=4)

of players indicated they were avoiding fruit and bread products completely in an attempt to reduce their weight. Despite players reporting a lower caloric intake than recommended (researchers estimated caloric intake to be 4,000 to 5,300 kilocalories), weight remained stable among the players. However, researchers postulated that players may have been under-reporting of their food intake.

Nichols et al. (2005) found many athletes (31.7%; n=44) incorrectly thought water was better at restoring muscle glycogen than sports drinks and that thirst alone was a reliable indicator of dehydration. Rosenbloom et al. (2001) found that only 63% of male college athletes (n=149) and 54% of female athletes (n=49) knew that carbohydrate and fat are the main energy sources for activity. Two-thirds (67%; n-159) of the athletes surveyed incorrectly thought that vitamins supplied energy. Results from Jacobson et al. (2001) indicated only 30 percent (n=99) of the athletes could correctly identify the recommended total percents of total calorie intake from fat, protein, and carbohydrates and slightly more than one-third (37%; n=122) of participants correctly identified the functions of vitamins.

Alcohol and Sport

Excessive alcohol consumption can lead to dehydration and hypoglycemia. Alcohol has a diuretic affect, increasing urine output (Dunford & Doyle, 2008). It costs the body eight ounces of water and takes one hour for the liver to metabolize each standard-size alcoholic beverage (Burke and Deakin, 2007). If an athlete drinks heavily the night before practice or a game, they may not allow their body enough time to process the alcohol, increasing the likelihood that they will be dehydrated.

Alcohol is a vasodilator which increases heat loss from the skin. This effect may be exacerbated if the athlete is hypoglycemic (Burke and Deakin, 2007). Thus, large quantities of alcohol consumption can impair an athlete's thermoregulation, especially if they are exercising in cold weather. Shirreffs and Maughan (2006) reviewed research on the impact of alcohol on performance. The data indicated possible negative impacts on glycogen metabolism, hydration, thermoregulation, and the ability to perform exercises after alcohol consumption. Small to moderate amounts of alcohol have been shown to have a detrimental effect on reaction time, hand-eye coordination, accuracy, balance, and complex skilled tasks (ACSM, 1982). Other possible negative consequences of excessive alcohol consumption include depression, poor school performance, and legal issues since excessive alcohol consumption may also raise an athlete's risk for drunk driving.

The NCAA bans athletes from consuming alcohol the night before a competition (NCAA, 2010). The metabolism of alcohol prevents other processes such as glycogen and protein synthesis. Therefore, if the body is occupied trying to eliminate alcohol, it will take longer to recovery from exercise, because the body cannot restore muscle glycogen as quickly. Alcohol is also high in calories (seven calories per gram) potentially resulting in unwanted weight gain (Dunford & Doyle, 2008). Nonetheless, Jonnalagadda et al. (2001) reported almost half (48%, n=15) of freshman college football players reported they don't avoid alcohol. Seven percent of collegiate athletes (n=10) in the study by Nichols et al. (2005) reported drinking more than two alcoholic beverages the day before competition.

Binge drinking after glycogen depleting exercise may reduce the athlete's consumption of carbohydrates, which reduces the body's ability to resynthesize muscle

glycogen (Burke and Deakin, 2007). Burke et al. (2003) studied athletes' ability to resynthesize muscle glycogen when drinking alcohol after exercise. When researchers replaced 120 grams of carbohydrates with alcohol (equivalent to 11 drinks), they found that it reduced glycogen synthesis by 50 percent at eight hours and sixteen percent by 24 hours.

Correlation between Nutrition Knowledge, Attitudes, and Behaviors

Knowledge can have an impact on the attitudes and behaviors of collegiate athletes. The studies reviewed in this section have investigated correlations between knowledge, attitude, and behaviors.

Nichols et al. (2005) reported a weak, but significant, positive coorelation ($p < 0.05$) between hydration and fluid replacement knowledge, attitude, and behaviors. The authors found that collegiate athletes had good general hydration knowledge, but suboptimal attitudes and behaviors which may indicate that an increase in knowledge can improve attitudes and behaviors. The authors concluded that collegiate athletes need education on hydration and fluid replacement practices, and need to be monitored on a regular basis to reinforce positive attitudes and behaviors.

Murphy and Jeanes (2006) found similar findings to Nichols et al. (2005). The authors compared nutrition knowledge and behaviors using a questionnaire and seven-day diet records. Participants included twenty-two English soccer players and twenty control subjects of the same age. Results indicated the players were consuming adequate protein and fat, but not enough carbohydrates. Researchers noticed a discrepancy between the players' nutritional knowledge and their diet records. It appeared that

nutrition knowledge had little impact on dietary intakes. The researchers concluded education may not always translate into good food choices, players may not know how to apply their knowledge, there is a need to advance athletes' knowledge of the importance of their diets in order to improve attitudes, and players also need assistance in implementing their knowledge of nutrition into their diets.

Hornstrom (2007) surveyed nutrition knowledge, food behavior practices, and attitudes toward consuming a sport-enhancing diet among 185 Division I Mid-American conference (MAC) collegiate softball players. The questionnaire items were structured to measure basic nutrition and sports nutrition knowledge (n=20); nutrition quality of typical food choices (n=7); current dietary practices based on the food guide pyramid (n=5); likely source of information; attitudes toward nutrition (n=20); and the intention to use proper nutrition to enhance softball performance (n=6). Overall, the mean nutrition knowledge score was 45.7 ± 4.7, equivalent to answering only slightly more than half (57.1%) of the questions correctly. The mean Nutrition Choice Score (NCS) was 19.4 ± 3.8 (equivalent to 69%), with the lowest possible score of seven representing the healthiest nutrition choices and the highest possible score of 28 representing the least nutritious choices. The mean Nutrition Practice Score (NPS) among the MAC softball players was 2.8 ± 1.3 (equivalent to 56%), where a score of five was associated with the healthiest nutrition practices. The mean Attitude toward a Sport-Enhancing Diet (ASED) score was 1.9 ± 0.4 (range 1 to 6), with a low ASED score representing a more positive attitude. The author concluded that those players who had low nutrition knowledge scores (e.g., scored less than 60 percent), made significantly poorer choices, were less likely to

meet the recommended number of servings from food groups, and had a more negative attitude toward a sport-enhancing diet.

In addition to measuring attitude, subjective norms, and perceived behavior toward nutritional intake were studied in college baseball players (n=108) from five university teams (Pawlak et al., 2009). The researchers used the Theory of Planned Behavior (TPB) to identify predictors of dietary behavior in this population. Researchers wanted to assess factors that play a role in the dietary intake of college athletes to help design educational programs. TPB suggests that factors such as attitude, subjective norms, and perceived behavioral control can predict behavioral intention. Results indicated that the athletes' daily routines and their perception of the impact of a healthful diet on their focus and concentration had the largest impact on their plans to eat healthy foods. Researchers observed that attitude had the most power on intention (β.383, $p < .001$), followed by subjective norms (β .291, $p < .001$), and perceived behavioral control (β .269, $p < .001$). The most important factor in predicting intention to eat a healthy diet was the belief that a healthy diet can have an effect on improvement of focus and concentration. Researchers have concluded that university athletic administrations should emphasize providing access to healthful food, especially during the season, and work with their foodservice director to provide better meal options for athletes.

Perception of Adequacy of Fluid Intake and Barriers to Fluid Consumption

Barriers may stop collegiate athletes from applying their knowledge. Malinauskas, Overton, Cucchiara, Carpenter, and Corbett (2007) measured eating habits and barriers among thirteen summer league college baseball players by collecting diet

records and administering a survey. The most frequent healthy diet barriers reported by the college baseball players were; insufficient time to cook healthy meals on non game days (92%, n=12), having to eat out frequently during away games (85%, n=11), having to eat out frequently on non game days (54%, n=7), and not knowing how to choose healthy foods when eating out during away games (69%, n=9). Researchers concluded that summer league baseball athletes would benefit from nutrition education designed to improve dietary intake.

The amount of support and guidance available to athletes and their perceived self-efficacy may also impact whether or not athletes apply their knowledge. Schnoll and Zimmerman (2001) conducted a study to determine how nutrition education classes which incorporated two self regulation strategies (goal setting and self-monitoring) would enhance dietary fiber self-efficacy and foster positive changes in fiber consumption among 113 college students. Participants were assigned to one of four treatment groups; 1) goal setting; 2) self monitoring; 3) goal setting and self monitoring; and 4) no treatment. Twenty-six students taking an introductory nutrition class served as the control group. Participants took the same introductory nutrition course as the control group and were assigned to their intervention group on week seven. Students took knowledge questionnaires during the first and thirteenth week of the fourteen week course. Participants also submitted three-day diet records and took a self-efficacy questionnaire on weeks four and thirteen. Interventions took place between weeks eight and twelve. Participants in the intervention groups continued to meet twice a week during this period. Increases in dietary fiber were significantly higher in the goal setting and self-monitoring group than all other groups. The goal setting group had significantly greater fiber intake

than the self-monitoring, no treatment, and control group. Participants who set goals consumed 91 percent more fiber and those who did not set goals and scored 15 percent higher on the dietary fiber self-efficacy scale. The goal setting and self-monitoring and the goal setting only group both had significantly higher self-efficacy scores than the control group. Researchers concluded dietary change requires active self-regulation, and an individual's behavior is driven by their confidence to perform the actions necessary to produce a specific behavior. Combining goal setting and self-regulation can significantly impact dietary behavior and this strategy can help improve nutrition education and counseling for college students.

Sources of Nutrition Information used by Collegiate Athletes

Athletes are under intense pressure to succeed in competition and are often willing to do whatever they believe is necessary to accomplish their goals. Unfortunately, the food industry is fraught with myths and inaccuracy. Sources of nutrition information for athletes include the coaches, trainers, parents, friends, peers, media, magazines, and books. Furthermore, supplement store clerks may also provide laymen dietary information to athletes. Athletes may not know how to identify reliable scientific based nutrition information against nutrition quackery. Intense marketing of products and an athlete's emotionally charged desire toward their sport may put them at greater risk to become susceptible to unsubstantiated nutritional claims (Dunford & Doyle, 2008).

Athletes are often targets for supplement advertising. Advertisement of a product in a popular muscle magazine does not make it safe or effective. Advertisers often rely on an athlete's competitive drive and willingness to do anything to improve their chances of

winning. They will make extravagant claims and use testimonials instead of research to validate the quality of their products. Furthermore, they try to trick athletes by using famous athletes to endorse the products, making claims that their products came from a recent discovery, or by stating the product contains a secret ingredient (Dunford & Doyle, 2008). It can be confusing for athletes to distinguish which products are safe and effective. Athletes may also seek nutrition guidance from their coaches and trainers. However, coaches and trainers are not qualified nutrition professionals and often have little or no nutrition education.

Burns, Schiller, Merrick and Wolf (2004) surveyed collegiate athletes (n=236) to determine the use and availability of nutrition services and the perceived nutrition knowledge of athletic trainers. Despite the presence of a sports dietitian on staff, results indicated the athletes' primary source of nutrition information were the athletic trainers (39.8%), followed by strength and conditioning coaches (23.7%), and dietitians (14.4%). The athletes reported using the following sources of nutrition information: classes (29.9% n=71), brochures (33.2%, n=78), and individual counseling (17.9%, n=42). Respondents identified athletic trainers to have strong nutrition knowledge (mean=3.8±0.9; 5-point scale).

Jacobson et al. (2001) found 22 percent of nutrition information came from the strength and conditioning coach, nineteen percent came from athletic trainers, thirteen percent from university classes, ten percent from nutritionists, and ten percent form magazines. In addition, male collegiate athletes were significantly more likely ($P<0.05$) to receive nutrition information from athletic trainers than were women. Women, in

contrast, were more likely to receive information from university classes and nutritionists.

Nutrition Education Requirements of Coaches and Trainers

Considering the serious health complications that may develop as a result of dehydration, it is imperative that collegiate athletes receive sound nutrition information from their athletic staff. According to the Commission on Accreditation of Athletic Training Education (2008), certified athletic trainers are required to complete one nutrition course. Coaches, in contrast, do not have a standardized minimum requirement to complete a nutrition educations course (Rockwell, Nichols-Richardson & Thye, 2001). Athletic departments do not routinely hire sports dietitians who have specialized training in the dietary challenges and needs of athletes. If coaches and trainers make recommendations for supplements or provide them to athletes, it is essential they are aware of the supplement's safety, effectiveness, and function since supplements can be unintentionally overused or contain illegal substances.

Rockwell et al. (2001) investigated the nutrition knowledge, practices, and opinions of 53 trainers and coaches at a Division I university. The mean knowledge score was 67 percent. Strength and conditioning coaches, as well as coaches with fifteen or more years of experience, scored better than other participants. There were no significant differences between coaches and trainers' knowledge scores. Many trainers and coaches rated "body weight" as more important than "body composition." In contrast to the coaches and trainers, a sports dietitian would place greater emphasis on an athlete's fat to muscle ratio than on weight. Few coaches and trainers reported obtaining routine body

composition measurements and only half (n=26) reported recording the athletes' weight. Only 30 percent (n=16) of the coaches and trainers reported that dietitians were available to them. Of these, every coach or trainer indicated they utilized the services of the dietitian.

Gallito, Wolf, and Hoberty (1999) administered a survey to athletic trainers to measure nutrition knowledge and perceptions of the dietary habits of collegiate athletes. 50 athletic trainers from Big Ten Universities completed the survey that measured nutrition knowledge and six critical incident questions regarding intake of athletes. Nutrition knowledge scores ranged from 68 percent to 100 percent with a mean of 80 percent. Over 75 percent (n=38) of the trainers reported they had suggested nutrition interventions for athletes. Most trainers (n=33) cited coaches as the most influential person to an athlete's intake. Only fifteen percent (n=7) had referred athletes to a registered dietitian. Athletic trainers are in a position to closely scrutinize the nutrition practices of the athlete. If a sports dietitian becomes part of an athletic training staff, there is the potential for creating a strong working relationship between the dietitian and the athletic trainer.

Sports Dietitians

Registered dietitians (RD) are certified nutrition professionals who are educated and trained in the application of nutrition strategies to prevent and treat malnutrition. Board certified specialist in sports dietetics, also known as sports dietitians (RD, CSSD) specialize in working with the needs of athletic populations. Unfortunately, many athletes experiencing a nutrition deficiency may not see a dietitian until they have become

severely malnourished. Sports dietitians can be utilized to help university athletic departments develop, implement, and monitor scientific based nutrition programs to support athletes, trainers, coaches, team physicians, and sports psychologists. Sports dietitians can offer a great support to athletes (Clark, 1994). They can counsel and guide student athletes on hydration maintenance, weight control and maintenance, eating disorders, nutrition periodization, pre and post game nutrition strategies, recovery tactics, supplements, cooking demonstrations, shopping for food, grocery store tours, food budgeting, and food safety (Clark, 1994; Jonnalagadda et al., 2001).

The NCAA is the organization that governs university rules and looks out for the well being of athletes. Two goals of the NCAA related to the physical health of student-athletes include promoting peak performance by enhancing nutrition and health, and prevention of eating disorders (About the NCAA, 2009). In order to meet these goals, research has indicated athletes need better access to nutrition professionals, just as they have access to trainers and coaches to improve their physical skill.

In 1994, the NCAA Foundation and the NCAA Division I-A Athletic Directors Association developed CHAMPS (Challenging Athletes' Minds for Personal Success), also known as the Life Skills Program, to address the individual needs of each student athlete. Nutrition is recognized under commitment to personal development. According to Vinci (1998) registered dietitians should strive to become part of the CHAMPS/Life Skills program at NCAA universities.

According to Burns, Schiller, Merrick and Wolf (2004), dietitians can be a vital component to student-athlete's performance, injury rehabilitation, and source of sound advice about food choices and the benefits of good nutrition in their daily lives. Burns et

al. (2004) studied the roles of athletic trainers and dietitians in nutrition counseling by surveying 236 collegiate athletes. Many athletes (23.5%, n=56) were not aware of their access to a dietitian. Results indicated a need for better communication between the dietitians, athletes, and their athletic departments. Researchers observed most universities offered nutrition counseling services, but their use was limited. Researchers concluded that athletic trainers can be encouraged to refer their student athletes to the dietitian nutrition support on any nutritional topic. Also, dietitians and athletic trainers may combine expertise to offer improved comprehensive nutrition services.

Summary

Hydration and fluid replacement is an important aspect of nutrition education in the collegiate athletic population. Sustaining fluid and electrolyte balance is particularly essential in order to maintain appropriate mental focus and physical endurance for peak performance during each game. University trainers and coaches need to be aware of the diets of athletes and the barriers they face when trying to make good dietary choices. Those who govern the well being of athletes need to consider the highly varying levels of nutritional knowledge, attitudes, behaviors, health risks, grocery budgets, media and peer influences, age, living situations, information sources, academic and physical stresses of all the players. Taking all of these variables into account, one may conclude that athletes' nutritional needs should be addressed on an individually level. Implementation of sports dietitian's guidance can help athletes meet their nutritional needs and help to bridge the gap between nutrition knowledge and application of knowledge. It is important for researchers to identify the current dietary knowledge, practices, barriers, and trends among athletes.

CHAPTER III

Methods

The purpose of this study was to investigate the knowledge, attitudes, and behaviors toward hydration and fluid replacement among collegiate football players at a NCAA Division I University overall, and their relationship, if any, by the athletes' position on the team, number of seasons played, and previous nutrition education. Secondary purposes of this investigation included to determine what relationship, if any, existed between the athletes' hydration knowledge, attitudes, and behaviors; to identify current sources of nutrition information likely to be used by Division I football players; and to identify the players' perception of the adequacy of their fluid intake and barriers that prevent them from obtaining enough fluid before, during, and after exercise. This chapter describes the methodology used to conduct this study.

Subjects

Subjects in the study included 80 members of the Ball State University Division I Mid-American Conference (MAC) football team who participated in the team practices during the summer of 2010. Incoming freshmen football players did not participate in the survey as they did not officially join the team for practices until the fall of 2010.

Survey Instrument

Permission was obtained by the investigator to use a previously validated survey (Nichols et al., 2005) for the current study (C. Rosenbloom, personal communication, May 6, 2010). Cronhach's alpha indicated the internal consistency for all three sections of the original survey (e.g., knowledge, attitude, and behavior) were 0.94, 0.92, and 0.96, respectively. The current investigator modified the demographic questions from the original survey to make them appropriate for collegiate football players. One question concerning alcohol consumption was removed from the original survey to avoid asking the players about a behavior forbidden by NCAA and college rules. Three sections were added to the original survey. Part three included questions on the football players' sources of nutrition information, part four included questions on the players' perception of adequacy of fluid intake, and part five focused on players' perceived barriers to adequate fluid intake. Questions in sections three and four were previously used in a study on college softball players (Hornstrom, 2007). Permission was granted to use these questions for the current study (C. Friesen, personal communication May, 16, 2010).

The final survey (Appendix F) consisted of five parts. Part one included demographic questions, including the football players' age, ethnicity, number of seasons played, generic category of their position on the team, and whether or not they had any previous nutrition education. Part two included parallel questions on nutrition knowledge, attitudes, and behaviors with regard to hydration and fluid replacement. Part three included sources of nutrition information likely to be used by the college football players. Part four attempted to identify the athlete's attitude toward a sports-enhancing diet. Part

five identified the athlete's perception of the adequacy of their fluid consumption before, during, and after practice as well as the identification of barriers to adequate hydration.

Data Collection

Ball State University's Head Strengthening and Conditioning Football Coach, Mark Naylor, and his graduate assistant made the anonymous survey available to each football player after practice daily for one week between Monday, June 28 and Friday, July 2, 2010. The principal investigator provided the coach with the surveys, directions, envelopes, and pens. The Strength Coach (Appendix D) made the surveys available to the players daily and explained the details of the investigation by reading the provided script (Appendix B). Each day after their workouts, the football graduate assistant took the players to an empty room in the football complex where they completed the survey in privacy. Once seated, the graduate assistant followed the directions and read the script provided to him by the primary investigator (Appendix C). Each player was given a letter describing the study (Appendix E) and a copy of the survey (Appendix F)**.** No personal identifying information was obtained. The players gave their completed survey to the graduate assistant who sealed the surveys in an envelope labeled with the corresponding day and placed them in a locked cabinet. The researcher was not present while participants completed the survey. The survey took approximately twenty minutes to complete. This process was repeated daily for five days. On Friday July 2, 2010, the primary investigator retrieved the envelopes containing the completed surveys from the graduate assistant for data entry and analysis. The surveys will be stored in a locked file cabinet for three years after which time they will be destroyed.

Data Entry and Analysis

Data were entered into an Excel spreadsheet and uploaded into SPSS v16.0 for statistical analysis. Frequencies counts and descriptives were calculated for age, ethnic group, team position, number of seasons played, previous nutrition education, and sources of nutrition information. The hydration knowledge score, hydration attitude score, and hydration behavior score were calculated. The knowledge questions were in a true/false format, the attitude questions used a 5-point Likert scale (strongly agree to strongly disagree), and the behavior questions were in a yes/no format.

A "hydration knowledge score (HKS)" (range 0-17) was calculated by summing the total number of questions answered correctly. During the statistical analysis, statements worded negatively in the knowledge, attitude, and behavior sections (Q1, 2, 4, 5, & 6) were given the same points in the reverse order. A correctly answered knowledge questions was scored as 1; an incorrect answer was scored as 0. The maximum score for the knowledge section is 17 (100%).

The responses for attitude section were calculated in two separate ways for the 17 attitude questions. In the first calculation, a "hydration attitude score (HAS)" was calculated by giving participants points (1-5) based on their chosen answer on a five point Likert scale (strongly agree to strongly disagree). Participants scored "5" points for strongly agree, and "1" point for strongly disagree. Therefore, the more positive attitudes a player had, the more points they were given. The total number of points was then divided by 17. The minimum score possible for the attitude section was 1 and the maximum score possible was 5.

In the second analysis of the attitude section, the researcher condensed the responses of the Likert scale to calculate a "hydration attitude condensed score (HACS)." Strongly agree and agree were paired together, and strongly disagree, disagree, and undecided were also paired together. If the participant chose a positive response, it was scored as "1" and negative or undecided responses were scored as "0".

A "hydration behavior score (HBS)" was calculated for the 16 behavior questions by summing the number of positive responses, where appropriate hydration behavior answers were scored as "1" and inappropriate hydration behaviors were scored as "0." The mean scores for hydration knowledge, attitudes, and behaviors were calculated. Frequency (count and percent) were calculated to determine the most common sources of nutrition information and to identify the athletes' perception of the appropriateness of the current hydration practices.

In the sources of nutrition information section, a four point scale ranging from "very likely" to "very unlikely" was presented to players. Subjects were asked to indicate their likelihood to use a variety of resources from which current nutrition information could be obtained. Sources marked as "Very likely" scored "1" point; sources marked as "very unlikely" scored "4" points.

The players' responses in dietary influences section were analyzed using a five point Likert scale which the researcher condensed to show an overall positive or negative response to each statement. To calculate the scores, strongly agree and agree were paired together as well as disagree and strongly disagree. If the participant chose a positive response, it was scored as "1" and negative or undecided responses were scored as "0".

The Pearson correlation analysis was used to identify correlations between knowledge, attitude, and behavior. Analysis of Variance (ANOVA) was used to compare knowledge, attitude, and behavior scores with various groupings of athletes (e.g. number of seasons played, nutrition education, and team position). When analyzing number of seasons played, players were put into two groups; those who had played one or fewer seasons and those who have played for more than one season. When analyzing the players' knowledge, attitudes, and behaviors by nutrition education, players were put into two groups, those who had previous nutrition education, and those who had not. A Chi-Square analysis was used to calculate the players' above mean and below mean rates based on their likely sources of nutrition information. The qualitative data collected to describe barriers to hydration will be listed in a table, with the answers analyzed for similar responses and trends among players. Statistical significance was set at $p \leq 0.05$ for all quantitative data.

Internal Review Board Approval

This study was approved as exempt by the Institutional Review Board at Ball State University on June 23, 2010 (Appendix G). The primary researcher successfully completed the Collaborative Institutional Training Initiative (CITI) Human Subjects tutorial prior to conducting this study (Appendix H).

CHAPTER IV

Results

The purpose of this study was to study collegiate football players at a NCAA Division I University in an effort to identify: 1) the knowledge, attitudes, barriers, and behaviors toward hydration and fluid replacement overall and their relationship, if any, by the athletes' position on the team, number of seasons played, and previous nutrition education; 2) the relationship between the athletes' hydration knowledge, attitudes and behaviors; 3) current sources of nutrition information likely to be used by the players; and 4) the players' perception of the adequacy of their fluid intake and barriers that prevent them from obtaining enough fluid. Results of the study will be presented in this chapter.

Subjects

All 80 student-athletes who participated in summer football practice completed the instruments used in this study. Subjects' mean age was 19.9±1.4 years. Forty-five percent (n=36) of the participants were white (non-Latino), 47.5 percent (n=38) were African American, and the remaining athletes were Asian or Pacific Islander (n=1; 1.3%), Native American (n=1; 1.3%), mixed race (n=3; 3.5%), or "other" (n=1; 1.3%). Two (2.5%) participants classified themselves as Hispanic. Subjects (n=80) reported having played an average of 1.8 ± 1.2 seasons of collegiate football. Fourteen percent (n=11) of participants indicated they had never played collegiate football before, 34 percent (n=27)

played one season, 24 percent (n=18) played two seasons, 20 percent (n=16) played three seasons, eight percent (n=6) played four seasons, and one individual played five seasons. Approximately one-quarter (26%; n=21) reported their primary position as "back," 15 percent (n=12) as "linebacker or quarterback," 33.8 percent (n=27) as "linemen," and 25 percent (n=20) as "other." Slightly more than three-fourths (n=61; 76.3%) of the players reported they had either taken a nutrition class or had listened to a nutrition lecture; only 23.8 percent (n=19) reported receiving no previous nutrition education (Table 1).

Table 1 Demographic Characteristics of Study Participants (n = 80).

Variable	N	Percent
Age (y)*		
18	15	18.8
19	22	27.5
20	14	17.5
21	19	23.8
22	8	10
23	2	2.5
Race/Ethnicity		
White (non-Latino)	36	45
African American	38	47.5
Asian & Pacific Islander	1	1.3
Native American	1	1.3
Mixed Race	3	3.8
Hispanic	2	2.5
Other	1	1.3
Seasons played		
0	11	13.8
1	27	33.8
2	18	23.8
3	16	20
4	6	7.5
5	1	1.3
Position		
Back	21	26.3
LB/QB	12	15
Linemen	27	33.8
Other	20	25
Previous Nutrition Education		
Yes	61	76.3
No	19	23.8

RQ#1: Knowledge of Hydration and Fluid Replacement

Overall, the players' (n=79) mean Hydration Knowledge Score (HKS) was 14.2 ± 1.4 out of a possible 17, equivalent to 83.5 percent correct (Table 2). Scores ranged from a low of 11 (65% correct) to a high of 17 (100% correct). Three players (3.8%) achieved a perfect score. Two-thirds of the players (n=55; 66%) had a HKS of 14 (82.4%) or higher. If a 60 percent cut was used to indicate "pass" versus "fail," every football player passed the Hydration Knowledge test.

Analysis of variance indicated no differences in the players' HKS by position on the football team (F=2.103; p=0.107), by whether or not the player had ever taken a nutrition class or attended a sports-nutrition lecture (F=0.167; p=0.684), or by number of years having played collegiate football (F=0.198; p=.939) (Table 2).

Table 2 Mean Hydration Knowledge Scores (HKS) of Collegiate Football Players by Position, Years of Playing Collegiate Football, and Previous Nutrition Education (n=79).

Variable	N	Hydration Knowledge Score (Mean ± SD)	F	p
Position on Team			2.103	0.107
Back	21	14.5 ± 1.2		
LB/QB	12	14.8 ± 1.4		
Lineman	27	13.7 ± 1.3		
Other	19	14.1 ± 1.5		
Nutrition Education			0.167	0.684
Yes	60	14.2 ± 1.3		
No	19	14.1 ± 1.6		
# Seasons Played			0.198	0.939
0	11	14.0 ± 1.2		
1	27	14.2 ± 1.5		
2	19	14.1 ± 1.3		
3	16	14.2 ± 1.6		
4	7	14.6 ± 1.0		
Overall HKS Score	79	14.2 ± 1.4		

Subjects were most knowledgeable about the importance of drinking fluids during practice (Q4; 100% correct), and having a coach who would allow players to "drink fluids" during practice (Q5; 100% correct), competition (Q6; 100% correct), and who would "make fluids available" during practice (Q7; 100% correct) and competition (Q8; 98.7% correct). Players scored 95 percent correct or more on the signs (e.g., urine color; Q14), indicators (e.g., excessive thirst; Q16), and causes of dehydration (e.g., alcohol consumption the night before a game; Q17) (Table 3).

The results revealed four key misunderstandings regarding hydration among these football players. More than half of the subjects (60%) indicated that, when exercising for more than an hour, an athlete should drink water rather than sports drinks (Q13), over half of the athletes (53.8%) athletes disagreed with the statement that sports drinks are better than water because they restore glycogen in muscles (Q10), almost half of the athletes (47.5%) indicated athletes should use salt tablets to keep them from getting dehydrated during training and competition (Q1), and 42.5 percent of the athletes indicated that thirst is the best indicator of dehydration (Q2) (Table 3).

Although answered correctly by the majority of athletes, one out of every five athletes (20%) did not know that an athlete should drink seven to ten fluid ounces ten to twenty minutes before competition (Q9) and 11.3 percent did not know that a good way for an athlete to determine how much water or sports drink to consume after practice is to weigh themselves before and after practice (Q15) (Table 3).

Table 3 Collegiate Football Players' Responses to Knowledge Questions Regarding Hydration and Fluid Replacement (n = 80).

Statement	True (%)	False (%)
1. Using salt tablets keeps athletes from getting dehydrated during training and competition.[b]	47.5	52.5
2. Thirst is the best indicator of dehydration.[b]	42.5	56.3
3. Dehydration decreases athletic performance.[a]	97.5	2.5
4. An athlete should not drink water or any fluids during practice.[b]	0	100.0
5. Coaches should not let players drink any fluids during practice.[b]	0	100.0
6. Coaches should not let players drink any fluids during competition.[b]	0	100.0
7. It is important for fluids to be readily available to athletes during practice.[a]	98.8	1.3
8. It is important for fluids to be readily available to athletes during competition.[a]	100.0	0
9. Within 2 hours after exercise, athletes should drink a sports drink.[a]	78.8	20.0
10. Sports drinks are better than water because they restore glycogen in muscles.[a]	46.3	53.8
11. An athlete should drink 17 to 20 fluid ounces of water or a sports drink a couple of hours before competition.[a]	92.5	7.5
12. An athlete should drink 7 to 10 fluid ounces 10-20 minutes before competition.[a]	80.0	20.0
13. When exercising for more than an hour, an athlete should drink a sports drink rather than water.[a]	40.0	60.0
14. By monitoring the color of urine, an athlete can judge if he/she is dehydrated.[a]	96.3	2.5
15. A good way for an athlete to determine how much water or sports drink to consume after practice is to weigh before and after practice.[a]	88.8	11.3
16. Excessive sweating, thirst, and cramping are signs of dehydration. [a]	96.3	3.8
17. More than 2 drinks of alcohol the day before practice and/or competition can lead to dehydration. [a]	97.5	2.5

[a]=true, [b]=false

RQ#2: Attitude toward Hydration and Fluid Replacement

The mean Hydration Attitude Score (HAS) of these collegiate football players was 72.9 ± 4.8, equivalent to 85.8 percent positive answers (Table 4). The scores ranged from a low of 51 (60%) to a high of 82 (96.5%). The mean Condensed Hydration Attitude Score (CHAS) was 13 ± 2.0, representing a 76.5 percent positive attitude rate. The scores ranged from a low of 6 (or 35.3%) to a high of 16 (94.1%).

Analysis of variance indicated no differences in the players' HAS by position on the football team (F=1.01; p=.393), by whether or not the player had ever taken a nutrition class or attended a sports-nutrition lecture (F=0.372; p=0.544), or by number of years having played collegiate football (F=0.909; p=.464) (Table 4).

Table 4 Mean Hydration Attitude Scores of Collegiate Football Players by Position, Years of Playing Collegiate Football, and Previous Nutrition Education (n=79).

Variable	N	Hydration Attitude Score (Mean ± SD)	F	p
Position on Team			1.01	0.393
Back	19	73.6 ± 12.8		
LB/QB	12	72.4 ± 13.5		
Lineman	27	73.7 ± 13.1		
Other	18	71.4 ± 7.7		
Nutrition Education			0.372	0.544
Yes	57	73.1 ± 4.9		
No	19	72.4 ± 4.6		
# Seasons Played			0.909	0.464
0	11	72.8 ± 4.7		
1	24	72.6 ± 3.5		
2	18	72.9 ± 3.6		
3	16	72.2 ± 7.3		
4	7	76.4 ± 3.5		
Overall	76	72.9 ± 4.8		

Similar to the players' responses in the knowledge section, 90 percent or more of the participants reported positive attitudes toward the same statements regarding the importance of availability and consumption of fluids during and after practice and competition (Q 4 through Q8). Players also reported at least 90 percent positive responses on statements regarding signs of dehydration (Q14 and 16) and causes of dehydration, such as alcohol consumption the night before a game (Q17) (Table 5).

Results from the player's responses in the attitude toward hydration and fluid replacement section showed further confusion and uncertainty toward the same four statements that cause confusion with the knowledge questions (Q1, 2, 10 and 13). Only 40.1 percent of the players correctly agreed/strongly agreed with the statement that sports drinks are better for an athlete than water because of their ability to restore muscle glycogen (Q10), while more than half of the athletes indicated they were uncertain (43.8%) or they disagreed/strongly disagreed with this statement (16.3%). Slightly less than half (47.5%) agreed/strongly agreed with the statement that sports drinks should be consumed instead of water when exercising for more than one hour (Q13); slightly more than half of the athletes were either undecided (32.5%) or disagreed/strongly disagreed with this statement (17.5%). Only one-third (30.1%) of the players knew that taking salt tablets does NOT keep them from getting dehydrated during training and competition; in contrast, 37.5 percent of the players agreed/strongly indicated salt tablets did keep them from getting dehydrated during training and competition while another 32.5 percent were undecided (Q1). Slightly more than one-quarter (27.6%) of the players incorrectly indicated thirst is the best indicator of dehydration (Q2) while an additional 11.3 percent

were undecided; in contrast, 61.3 percent of the players correctly indicate that you cannot rely on thirst alone as an indicator of dehydration (Table 5).

Table 5 Collegiate Football Players' Responses to Attitude Questions Regarding Hydration and Fluid Replacement (n=80).

Statement	Percentage		
	Agree/ strongly agree	Undecided	disagree/ strongly disagree
1. I believe using salt tablets will keep me from getting dehydrated during training and competition.	37.5	32.5	30.1
2. I believe I can rely on thirst alone as an indicator of dehydration.	27.6	11.3	61.3
3. I believe dehydration decreases my athletic performance.	95	2.5	2.6
4. I believe no water or fluids should be consumed during practice.	5	3.8	91.3
5. I believe my coach should not let our players drink any fluids during practice.	5	3.8	91.3
6. I believe my coach should not let our players drink any fluids during competition.	2.6	2.5	95
7. I believe fluids should be readily available to me during practice.	97.6	1.3	1.3
8. I believe fluids should be readily available to me during competition.	98.8	1.3	0
9. I believe I should drink a sports drink within 2 hours after exercise.	83.8	15	1.3
10. I think sports drinks are better than water because they restore glycogen in muscles.	40.1	43.8	16.3
11. I think I should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	85	13.8	1.3
12. I believe I should drink 7 to 10 fluid ounces of water or sports drink 10-20 minutes before competition.	73.8	16.3	10.1
13. I believe when exercising for more than an hour, I should drink a sports drink rather than water.	47.5	32.5	17.5
14. I believe by monitoring the color of my urine, I can judge if I am dehydrated.	93.8	2.5	2.5
15. I believe weighing myself before and after practice is a good way to determine how much fluid I lost.	90.1	6.3	3.8
16. I believe excessive sweating, thirst, and cramping are signs of dehydration.	93.8	3.8	1.3
17. I believe drinking more than 2 drinks of alcohol the day before competing can lead to dehydration.	92.6	6.3	1.3

Note. These statements are truncated from the statements as printed on the survey

Even though most of the players had positive attitudes toward hydrating before competition, 16.3 percent of the athletes were undecided as to whether or not an athlete should drink seven to ten fluid ounces ten to twenty minutes before competition (Q9). In addition, another 13.8 percent of athletes were undecided as to whether or not athletes should drink seventeen to twenty fluid ounces of water or sports drink a few hours before competition (Q8).

RQ#3: Behaviors toward Hydration and Fluid Replacement

The players' mean Hydration Behavior Score (HBS) was 13.0 ± 2.0, equivalent to a score of 81.3 percent positive behaviors toward hydration and fluid replacement (Table 6). Scores ranged from a low of 6 (37.5% positive) to a high of 16 (100% positive). Only sixteen statements were presented to the players in order to avoid asking the athletes directly if they drink alcohol the night before a competition.

Analysis of variance indicated no differences in the players' hydration behavior scores by position on the football team (F=0.472; p=.703), by whether or not the player had ever taken a nutrition class or attended a sports-nutrition lecture (F=0.528; p=0.470), or by number of years having played collegiate football (F=1.377; 0.250) (Table 6).

Table 6 Mean Hydration Behavior Scores of Collegiate Football Players by Position, Years of Playing Collegiate Football, and Previous Nutrition Education (n=79).

Variable	N	Hydration Behavior Score (Mean ± SD)	F	p
Position on Team			0.472	0.703
Back	21	12.8 ± 2.6		
LB/QB	12	13.5 ± 1.3		
Lineman	26	13.1 ± 1.6		
Other	20	12.7 ± 2.1		
Nutrition Education			0.528	0.470
Yes	60	12.9 ± 2.1		
No	19	13.3 ± 1.6		
# Seasons Played			1.377	0.250
0	11	13.0 ± 1.9		
1	26	13.2 ± 1.6		
2	19	12.4 ± 2.3		
3	16	13.7 ± 1.6		
4	7	12.1 ± 2.9		
Overall	79	13.0 ± 2.0		

Similar to knowledge and attitude scores, 90 percent or more of these athletes had positive behaviors toward the importance of drinking fluids during practice (Q4), having a coach make fluids available during and after practice (Q7 & 8), and allowing the players drink during both practice (Q5) and competition (Q6). Ninety-three percent of players report that they drink plenty of fluids to prevent a decline in athletic performance due to dehydration (Q3). Players also scored at least 90 percent on statements regarding signs of dehydration such as urine color (Q14) and excessive thirst (Q16) (Table 7).

Table 7 Collegiate Football Players' Responses to Behavior Questions Regarding Hydration and Fluid Replacement (n = 80).

Statement		Percentage	
		Yes	No
1.	I use salt tablets to keep from being dehydrated when training and competing.	12.5	87.5
2.	I use thirst alone as a way to tell if I am dehydrated.	26.3	73.8
3.	I drink plenty of fluids so my athletic performance will not decrease due to dehydration.	92.5	7.5
4.	I do not drink water or some type of fluid during practice.	7.5	92.5
5.	My coach does not allow me to drink fluids during practice.	7.5	92.5
6.	My coach does not allow me to drink fluids during competition.	8.8	90.0
7.	Fluids are readily available to me during practice.	97.5	2.5
8.	Fluids are readily available to me during competition.	96.3	3.8
9.	Within 2 hours after exercise, I drink a sports drink.	72.5	27.5
10.	I drink sports drinks rather than water to restore glycogen in my muscles.	50.0	50.0
11.	I drink approximately 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	77.5	22.5
12.	I drink at least 7 to 10 fluid ounces of water or sports drink 10-20 minutes before the game.	72.5	27.5
13.	I drink sports drinks rather than water when competing for more than an hour.	48.8	51.3
14.	I use the color of my urine to determine if I am dehydrated.	91.3	8.8
15.	I weigh myself before and after practice to see how much weight I have lost from sweating and use this to determine how much water or sports drink to consume.	72.5	27.5
16.	I use excessive sweating, thirst, and cramping to warn me if I am getting dehydrated.	91.3	8.8

Two primary negative behaviors were observed regarding hydration among these football players (Table 7). Only half (50%) of the players indicated they drink sports drinks rather than water to restore glycogen in my muscles; in contrast, half of the players either do not know the relationship between the role of the carbohydrates in sports drinks as a means of restoring muscle glycogen or they believe water is just as effective a means of restoring muscle glycogen as a sports drink (Q10). Similarly, only 48.8 percent of the football players indicated they drink sports drinks rather than water when competing for more than an hour (Q13).

Slightly more than one-quarter of the athletes (26.3%) reported incorrectly using thirst alone as an indicator that they are dehydrated (Q2). Approximately one out of every four (27.5%) athletes indicated they do not drink seven to ten fluid ounces of water or sports beverage ten to twenty minutes before competition (Q11), approximately one out of every five athletes (22.5%) do not drink seventeen to twenty fluid ounces two hours before competition (Q12), and 27.5 percent indicated they do not drink a sports drink within two hours after practice (Q9). Slightly more than one out of every four players (27.5%) indicated they do not weigh themselves to determine how much water or sports drink to consume after exercising (Q15).

RQ#4: Correlation between Hydration Knowledge, Attitude, and Behavior Scores

Pearson correlation analysis revealed significant positive correlations ($p < 0.01$) between the football players' knowledge, attitude, and behavior scores. Specifically, the correlation between hydration knowledge and attitude was 0.422 ($p < 0.01$); the correlation between hydration knowledge and behavior was 0.424 ($p < 0.01$); and the

correlation between attitudes toward hydration and hydration practices was 0.250 ($p < 0.01$) (Table 8).

Table 8 Pearson Correlation Coefficients between Knowledge, Attitude, and Behavior Scores of Collegiate Football Players Regarding Hydration and Fluid Replacement (n=80).

	Knowledge score	Attitude score	Behavior score
Knowledge score	1	.422**	.424**
Attitude score	.422**	1	.250**
Behavior score	.424**	.250**	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

When the players' responses to each of the 16 parallel questions were analyzed (e.g., Q1 knowledge compared with Q1 attitude compared with Q1 behavior), it became clear that the areas of greatest consistency between the players' knowledge, attitudes and behavior related to the importance (Q7) and availability (Q8) of fluids during practice and competition. The percent of players who answered these questions positively ranged from 96.3% to 100% for each of these two concepts, clearly indicating cohesion between the players' knowledge, attitude, and behavior. Similarly, the athletes' showed great consistency with regard to their knowledge about the color of their urine (Q14) being an indicator of dehydration (96.3%), their belief that "By monitoring the color of my urine, I can judge if I am dehydrated" (91.3%), and actually indicating "I use the color of my urine to determine if I am dehydrated" (93.8%) and with regard to athletes' knowledge (Q16) that "Excessive sweating, thirst, and cramping are signs of dehydration" (96.3%),

their belief that “Excessive sweating, thirst, and cramping are signs of dehydration (93.8%), and in their actual behavior “I use excessive sweating, thirst, and cramping to warn me if I am getting dehydrated” (91.3%) (Figure1).

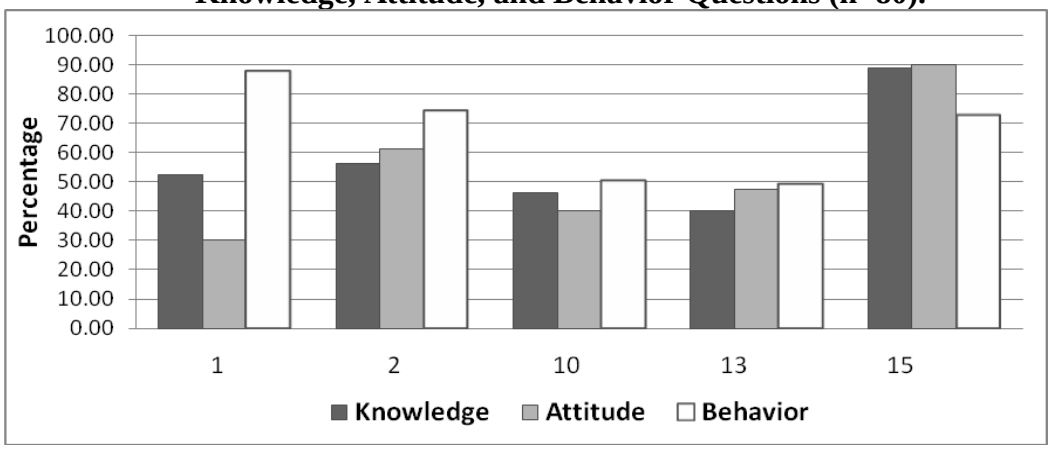
In contrast, the greatest variation or conflict in responses between the players’ knowledge, attitude, and behavior occurred with the statements related to salt tablets (Q1), using thirst as the best indicator of dehydration (Q2), and recording weight before and after practice and competition to determine fluid loss (Q15) (Figure 1). While 47.5 percent of the athletes incorrectly indicated “Using salt tablets keeps athletes from getting dehydrated during training and competition,” only 12.5 percent indicated “I use salt tablets to keep from being dehydrated when training and competing.” Similarly, while 42 percent of the athletes incorrectly indicated “Thirst is the best indicator of dehydration,” only 27.6 indicated “I believe I can rely on thirst alone as an indicator of dehydration” and only 23.6 percent actually indicated “I use thirst alone as a way to tell if I am dehydrated.” For these two concepts, while the knowledge of a high proportion of the players’ was inaccurate, the corresponding percent of athletes who actually engage in the deleterious behavior is much smaller.

The same cannot be said, however, with regard to question 15. Although 88 percent of the players correctly indicated “A good way for an athlete to determine how much water or sports drink to consume after practice is to weigh before and after practice,” and 90 percent indicated “I believe weighing myself before and after practice is a good way to determine how much fluid I lost,” only 72 percent of the athletes indicated “I weigh myself before and after practice to see how much weight I have lost from sweating and use this to determine how much water or sports drink to consume,” clearly

indicating a need for education on the importance of weighing oneself after an event in order to determine how much fluid is needed to replenish what was lost during exercise (Figure 1).

The football players scored the lowest (less than 50%) on statements related to the concept that sports drinks are preferable to drinking water as they aid in the restoration of muscle glycogen (Q10) and the importance of consuming sports drinks when exercising for one hour or longer (Q13). Fewer than half of the athletes correctly indicated "Sports drinks are better than water because they restore glycogen in muscles" (46.3%), believed "Sports drinks are better than water because they restore glycogen in muscles" (40.1%), and indicated "I drink sports drinks rather than water to restore glycogen in my muscles" (50%). Similarly, fewer than half of the athletes indicated "I believe when exercising for more than an hour, I should drink a sports drink rather than water" (47.5%), believed "When exercising for more than an hour, I should drink a sports drink rather than water" (47.5%), and selected "I drink sports drinks rather than water when competing for more than an hour" (48.8%).

Figure 1. Percent of Athletes who Responded Positively to Select Hydration Knowledge, Attitude, and Behavior Questions (n=80).



RQ#5 Likely Sources of Nutrition Information

Subjects were asked to indicate their likelihood to use a variety of resources from which current nutrition information could be obtained. A four point scale ranging from "very likely" (1) to "very unlikely" (4) was presented to players. Results indicated the Ball State Football players were most likely to use an athletic trainer (1.21 ± 0.41), followed by a coach (1.47±0.78), as their most likely source of nutrition information (Table 9). All participants indicated they were either very likely for likely to use an athletic trainer for nutrition information. "Physicians" (1.53±0.82) and "College Nutrition/Health Courses" (1.91±0.87) ranked third and fourth out of the eleven options. Dietitians ranked sixth (2.16±1.10). Interestingly, the least likely sources of nutrition information were magazines (2.75±0.88) and academic journals (2.87±1.03).

Table 9. Likelihood that an Athlete would Use a Variety of Sources to Obtain Current Nutrition Information (n=80).

Information Source	Mean ± SD	Information Source	Mean ± SD
Athletic Trainer	1.21 ± 0.41	Friends	2.34±0.87
Coach	1.47±0.78	Parents	2.38±0.95
Physicians	1.53±0.82	Magazines	2.75±0.88
College Nutrition/Health Courses	1.91±0.87	Other	2.81±1.12
Internet	2.12±1.03	Academic Journals	2.87±1.03
Dietitian	2.16±1.10		

Note: The lower the mean, the more likely the player is to use that source

When the nutrition sources were examined categorically, comparing the athlete's likeliness to use a source by whether they scored above or below the mean knowledge

score, only one significant finding was observed. Results indicated only 25 of the 76 athletes were likely to use an academic journal as a source of nutrition information. Of these, 76% (n=19) scored below the mean on the nutrition knowledge questionnaire compared to only 27% (n=6) who scored above the mean ($\chi 2$ =0.03; p = 0.02). In contrast, of the 33 athletes who scored above the mean, only six (19%) indicated they were likely to use an academic journal as a source of nutrition information (Table 10).

Table 10 Likely Source of Nutrition Information by Subjects who Scored Above or Below the Mean on the Nutrition Knowledge Questionnaire.

Information Source		Above Mean	Below Mean	X^2	p
Athletic Trainer (n=76)	Likely to Use	33(43.4%)	43(53.6%)	(a)	(a)
	Not Use	0 (0%)	0 (%)		
Academic Journals (n=76)	Likely to Use	6(7.9%)	19(25%)	0.03	0.02*
	Not Use	27(35.5%)	24(31.6%)		
Coach (n=76)	Likely to Use	29(38.7%)	36(48.0%)	1.0	0.53
	Not Use	4(5.3%)	6(8.0%)		
College Nutrition/Health Course (n=75)	Likely to Use	26(34.7%)	34(45.3%)	1.0	0.52
	Not Use	7(9.3%)	810.7(%)		
Dietitian (n=74)	Likely to Use	20(27.0%)	26(35.1%)	1.0	0.58
	Not Use	12(16.2%)	16(21.6%)		
Friends (n=76)	Likely to Use	18(23.7%)	25(32.9%)	0.82	0.47
	Not Use	15(19.7%)	18(23.7%)		
Internet (n=76)	Likely to Use	24(31.6%)	28(36.8%)	0.62	0.33
	Not Use	9(11.8%)	15(19.7%)		
Magazines (n=75	Likely to Use	12(16%)	14(18.7%)	0.81	0.49
	Not Use	21(28.0%)	28(37.3%)		
Parents (n=75)	Likely to Use	17(22.7%)	25(33.3%)	0.81	0.42
	Not Use	15(20.0%)	18(24.0%)		
Physicians (n=76)	Likely to Use	27(35.5%)	39(51.3%)	0.32	0.21
	Not Use	6(7.9%)	4(5.3%)		
Other (n=47)	Likely to Use	7(14.9%)	8(17.0%)	1.0	0.55
	Not Use	14(29.8%)	18(38.3%)		

Note: (a) No statistics computed because likeliness to use trainer is a constant.

RQ#6 Perception of Adequacy of Fluid Intake

Players were asked if they believe they consume enough fluids before, during, and after practice. Only 19 (24%) players reported they felt they drank enough fluids at all times, while only two (3.0%) players reported they not drinking enough fluids at all times (Table 11). Although the majority of players reported drinking enough fluids before (73.8%) and during (71.3%) practice, 16.3 percent of player reported they did not drink enough fluids during practice and one out of four athletes (25%) reported not drinking enough fluids immediately after practice or (26.5%) two hours after practice.

Table 11 Collegiate Football Players' Responses Regarding Hydration and Fluid Replacement to Barrier Question: Do you think you currently drink enough fluids (n=80).

	Percentage		
Statement	**Yes**	**No**	**Unsure**
Before practice	73.8	17.5	6.3
During practice	71.3	16.3	10.0
Immediately after practice	58.8	25.0	13.8
Two hours or more after practice	58.8	26.3	11.3

RQ#7 Perceived Barriers to Adequate Fluid Intake

Players were also asked to identify barriers to hydration by providing written responses. Twenty-one players provided a written response (Table 12). The most common response by eleven players was that players forget or are not very attentive toward their fluid needs.

Table 12 Players' Written Responses Indicating their Barriers to Hydration.

Q. If you don't think you drink enough fluids during any of these time periods, what do you think keeps you from drinking more fluids?
1. Wanting to drink things more tasteful.
2. Sometime I mistake thirst for hunger and eat after practice instead.
3. I don't drink 2 hrs after practice because I drank so much before, during and after practice.
4. It makes me feel sick to drink right after practice.
5. Drinking too much water at once makes me feel full.
6. Don't want to have too much fluids *(sic)* to slow me down.
7. I don't eat or drink a lot right after a workout.
8. Just not being aware.
9. I just don't think much about it.
10. Not thinking about it during competition.
11. Just being lazy and very tired.
12. Not applying myself.
13. Not thinking about it.
14. Not being smart about it.
15. Being lazy, not feeling the effect during practice.
16. Just lay in bed, ignore thirst.
17. Falling asleep.
18. Going to sleep.
19. Availability of fluids

Note: Similar responses are grouped together.

Summary

A total of eighty collegiate football players participated in this study. Common trends between the knowledge, attitude, and behavior sections include misconceptions about using thirst to indicate dehydration and the appropriate use of sports drinks. Average scores among all three sections reveal players scored less than 60 percent on questions regarding use of sports drinks after exercising for more than one hour and use

of sports drinks to restore muscle glycogen. Players also scored less than 60 percent on a question regarding salt tablets and dehydration. There were no significant differences in knowledge, attitude, and behaviors of the football players based on their number of seasons played, position on team, nutrition education, or likeliness to use various sources for information.

The Ball State Football players were most likely to use an athletic trainer (1.21± 0.41), followed by a coach (1.47±0.78), as their most likely source of nutrition information. The majority of players have chosen positive responses regarding sports enhancing diets. Most intend to eat a sports enhancing diet (73.8%), most find a sports enhancing diet to be enjoyable (70.0%) and believe a sports enhancing diet will help make them more successful football players (87.6%).

With regard to barriers, over one-quarter of players (26.3%) reported that their practice create problems for eating a sports enhancing diet. and 37.6 percent reported their class schedule creates problems for consuming a sports enhancing diet. Only nineteen (24%) players reported drinking enough fluids at all times. The most common barrier response (indicated by eleven players) was that players forget or are not very attentive toward their fluid needs.

CHAPTER V

Discussion

This study presented information collected on collegiate football players at a NCAA Division I University to: 1) investigate their knowledge, attitudes, barriers, and behaviors toward hydration and fluid replacement and their relationship, if any, by the athletes' position on the team, number of seasons played, and previous nutrition education; 2) determine what relationship, if any, existed between the athletes' hydration knowledge, attitudes and behaviors; 3) identify current sources of nutrition information likely to be used by Division I football players; and 4) identify dietary influences and barriers to fluid consumption among Division I football players. A discussion of the results will be presented in this section.

RQ#1: Knowledge of Hydration and Fluid Replacement

The players' (n=79) scored between 65 to 100 percent correct on the 17 knowledge questions. The average score was 14.2 ± 1.4, equivalent to 83.5 percent correct. Two-thirds of the players (n=55, 66%) scored 82.4 percent or higher.

The findings of this study are comparable to other studies completed with athletes from various sports. Nichols et al. (2005) piloted and first used the same hydration and

fluid replacement survey in the present study. Nichols et al. (2005) found that the mean nutrition knowledge score for athletes (n=139) was 13.9 ± 1.8, equivalent to 81.8 percent correct, slightly lower than the results of the present study. Other researchers tended to show lower nutrition knowledge scores by athletes. Rosenbloom et al. (2002) surveyed the nutrition knowledge of 237 division I collegiate athletes, of which 46 percent (n=111) were football players. The average nutrition knowledge scores were 5.8±1.8 out of a possible 11, equivalent to 52.7 percent correct, indicating a low nutrition knowledge score. Jonnalagadda et al. (2001) studied nutrition knowledge in 31 Division I freshman football players. The players' average score was 5.5 ± 1.7 out of 11, equivalent to 50 percent correct; no athletes achieved a perfect score. Hornstrom (2007) surveyed the nutrition knowledge of 185 Division I softball players from the Mid-America Conference (MAC). The mean nutrition knowledge score was 45.7 ± 4.7 out of a possible 80, equivalent to 57.1 percent correct.

Athletes frequently have misconceptions about hydration and fluid replacement. In the present study, 42.5 percent of the athletes incorrectly indicated that thirst is the best indicator of dehydration. Similarly Nichols et al. (2005) found 32.4 percent of athletes (n=45) incorrectly thought that thirst is the best indicator of hydration. In contrast, Rosenbloom et al. (2002) found 79 percent of males athletes (n=187), and 80 percent of females athletes (n=73), agreed that thirst is not an adequate indicator of fluid needs.

Knowledge regarding the proper use of sports drinks indicated more than half of the subjects in the present study (60%) indicated an athlete should drink water rather than sports drinks when exercising for more than one hour, compared to 52.5 percent of respondents from Nichols et al. (2005) study. Over half of the athletes (53.8%) athletes in

the present study, compared to 31.7 percent in the survey by Nichols'et al (2005), incorrectly disagreed with the statement that sports drinks are better than water because they restore glycogen in muscles. Jonnalagadda et al. (2001) found that over 50 percent of athletes in incorrectly thought sports drinks were not an appropriate substitution for water to replace lost fluids. Rosenbloom et al. (2002) found only 22 percent agreement among male athletes regarding the statement "Sports drinks are better than water." However, the authors concluded this may not be an accurate reflection of the athletes' knowledge since many athletes responded: "It depends on the activity."

Almost half of the athletes (47.3%) in the present study incorrectly indicated they should use salt tablets prevent dehydration during training and competition. In contrast, Nichols et al. (2005) found only 18.7 percent of athletes incorrectly thought salt tablets would keep them from getting dehydrated.

There were no significant differences in knowledge scores of the football players based on their number of seasons played, position on team, nutrition education, or likeliness to use various sources for information in the present study. A larger sample size may have yielded different results.

RQ#2: Attitude toward Hydration and Fluid Replacement

The players' mean attitude score was 72.9 ± 4.8, equivalent to a score of 85.8 percent. The scores ranged from a low of 51 (60%) to a high of 82 (96.5%). The players' responses in the attitude section showed further confusion toward statements regarding appropriate use of sports drinks. Only 40.1 percent agreed or strongly agreed, 43.8 percent were undecided, and 16.3 percent disagreed or strongly disagreed with the

statement that sports drinks are better than water because they restore muscle glycogen. Nichols et al. (2005) found very similar results on that same statement; 51.3 percent agree or strongly agree, 31.7 percent were undecided, and 16.5 percent disagreed or strongly disagreed. The high rate of undecided responses seen in both the present study and Nichols et al. (2005) study suggest a lack of knowledge among players. High rates of undecided responses also were observed regarding the statement that sports drinks should be consumed instead of water when exercising for more than one hour; 47.5 percent agreed or strongly agreed, 32.5 percent were undecided, and 17.5 percent of players either disagreed of strongly disagreed, similar to the results obtained by Nichols et al. (2005) where 43.2 percent agreed or strongly agree, 40.3 percent were undecided, and 16.5 percent strongly disagreed or disagreed.

Football players' responses on the ability of salt tablets to prevent dehydration indicated a clear lack of knowledge, with fewer than one-third of the players correctly answering the question (37.5% agree, 32.5% were undecided, and 30.1% disagreed). In contrast, Nichols et al. (2005) found that only 14.4 percent either agreed or strongly agreed, 27.3 percent were undecided, and 58.3, compared to 30.1 percent in the present study, either correctly disagreed or strongly disagreed with the statement.

Responses to the statement that thirst is the best indicator of dehydration showed, 27.6 percent of the players in the present study incorrectly agreed or strongly agreed, 11.3 percent were undecided, and 61.3 percent correctly disagreed or strongly disagreed with the statement. Nichols et al. (2005) study yielded very similar results, with 23 percent incorrectly agreeing or strongly agreeing, 12.9 percent were undecided, and 64.1 percent, compared to 61.3 percent, correctly disagreed or strongly disagreed with the statement.

There were no significant differences in attitude scores of the football players based on their number of seasons played, position on team, nutrition education, or likeliness to use various sources for information. A larger sample size may have yielded different results.

RQ#3: Behaviors toward Hydration and Fluid Replacement

The players' behavior scores ranged from a low of 6 (37.5%) to a high of 16 (100%). The mean score was 13.0 ± 2.0, out of a possible16, equivalent to a score of 81.3 percent. The player's behaviors show inadequate use of sports drinks which may be related to their poor scores on the statements regarding sports drinks in the knowledge and attitude sections. Fifty-one percent of football players reported they do not consume a sports beverage when competing for over an hour and 50 percent do not consume sports drinks instead of water to restore muscle glycogen. Nichols et al. (2005) observed a higher rate of desired behavior on these statements (66.9% and 60.4%, respectfully).

Jacobson et al. (2001) also observed a low consumption rate of sports beverages. In a nutrition knowledge and attitude survey on 330 division I collegiate athletes (27% of which were football players, n=89), results indicated that, although carbohydrate drinks were among the most frequently used supplements, only sixteen percent of participants (n=41) reported use of carbohydrate drinks.

Although the influence of fad dieting was not investigated in the present study, avoidance of sports drinks could be related to fad dieting, since sports drinks contain carbohydrates. Cole et al. (2005) observed fad diet influences in college football players, including an inadequate intake of carbohydrates and other nutrients. Approximately

fifteen percent (n=5) of the 28 players reported completely avoiding fruit and bread products in an attempt to reduce their weight. Dunn et al. (2007) found the majority of collegiate athletes from various sports incorrectly thought they needed to cut back on their carbohydrate intake. When asked about carbohydrate recommendations, 53 percent (n=111) of respondents thought that experts recommend carbohydrate intake should be decreased.

In the present study, 90 percent or more of these athletes had desired behavior responses toward the importance of drinking fluids during practice and having a coach make fluids available during and after practice and in order to prevent a decline in athletic performance due to dehydration. Other researchers have observed that even though football players were aware of the importance of hydration, they were not drinking enough fluids. Jonnalagadda et al. (2001) examined the knowledge, dietary habits, attitudes, and physiological status of 31 collegiate freshmen football players. Ninety percent (n=28) of the players recognized the importance of maintaining proper hydration status. However, per workout session, only 26 percent (n=8) of players reported consuming more than five cups of fluid, 52 percent (n=16) reported consuming three to five cups, and nineteen percent (n=6) reported consuming one to two cups. The authors concluded knowledge doesn't always translate into practice.

There were no significant differences in the behavior scores of the football players based on their number of seasons played, position on team, nutrition education, or likeliness to use various sources for information. A larger sample size may have yielded different results.

RQ#4: Correlation between Hydration Knowledge, Attitude, and Behavior Scores

In both the present study and the Nichols (2005) study, researchers found a significant correlation between knowledge, attitude, and behavior responses, suggesting they do impact each other. In general, the questions in which the players scored higher in the knowledge section had correspondingly higher attitude and behavior scores, both in the present study and in the study by Nichols et al (2005). Similarly, for questions regarding sports drinks, poor knowledge led to a high rate of undecided attitude responses and less than favorable behaviors.

Fewer than half of the athletes in the present study correctly answered each of the knowledge, attitude, and behavior statements regarding the use of sports drinks to restore muscle glycogen and the use of sports drinks when exercising for more than one hour, similar to the findings of Nichols et al. (2005). The players' mean knowledge, attitude, and behavior scores were also very low (56.7%) for the statement regarding salt tablets and dehydration. Lastly, players scored less than 80 percent on the knowledge, attitude, and behavior statements regarding when and how much water or sports beverage to consume before practice and competition, indicating congruence between knowledge, attitude, and personal behavior toward the construct.

Responses between all three sections (knowledge, attitude, and behavior) varied the most in statements regarding salt tablets (56.7± 28.9), recording weight before and after practice and competition to determine fluid loss (83.8 ± 9.8), and using thirst as the best indicator of dehydration (63.8 ± 9.0). Discordance was seen between the athletes' knowledge, attitudes, and behaviors concerning salt tablets. Specifically, the players' knowledge and attitude scores were both lower than their behavior score. Fortunately,

despite the high number of players who incorrectly indicated salt tablets would help reduce dehydration, the behavior score indicated few players actually use salt tablets to prevent dehydration. Discordance was also seen between the athletes' knowledge, attitudes, and behaviors concerning the importance of weighing oneself to determine how much fluid to consume to replace losses. The players' mean knowledge and attitude scores were over 85 percent, but their mean behavior score was approximately 70 percent, indicating fifteen percent of the players knew what to do, but they didn't act on their knowledge. Clearly, as stated by Jonnalagadda et al. (2001), knowledge doesn't always translate into practice.

Other research studies have found variation between knowledge, and behavior. According to Murphy and Jeanes (2006), nutrition knowledge had little impact on the dietary intake of English soccer players as researchers noticed a discrepancy between the players' nutritional knowledge and the diet consumption recorded in their diet records. Researchers from this study concluded education may not always translate into good food choices or players may not know how to apply their knowledge. The authors concluded there is a need to advance athletes knowledge of the importance of their diets in order to improve attitudes as the soccer players also need assistance in implementing their knowledge of nutrition to their diets. Jonnalagadda et al. (2001) reported 90 percent (n=28) of freshman football players recognized the importance of maintaining proper hydration status, yet only 26 percent (n=8) of players reported consuming more than five cups of fluid, 52 percent (n=16) reported consuming three to five cups, and nineteen percent (n=6) reported consuming one to two cups after a workout session.

RQ#5 Likely Sources of Nutrition Information

In the present study, Ball State football players indicated the source they were most likely to use for nutrition information was an athletic trainer (1.21±0.41), followed by a coach (1.47±0.78). Physicians (1.53±0.82) and College Nutrition/Health Courses (1.91±0.87) ranked third and fourth out of the eleven options. Dietitians ranked sixth (2.16 ±1.10). Interestingly, the least likely sources of nutrition information were magazines (2.75±0.88) and academic journals (2.87 ±1.03).

Strength and conditioning coaches (22%) and the athletic trainers (19%) were als the prime sources of nutrition information among athletes in the study by Jacobson's et al. (2001). Nutritionists (10%) and magazines were ranked last. In contrast, among softball players, Hornstrom (2007) reported physicians (1.6±0.7 were the preferred source for the Mid-American softball players, followed closely by athletic trainers (1.8±0.8), a college nutrition or health course (1.9±0.8), or a dietitian (1.9±1.0). Burns (2004) also reported that athletic trainers (39.8%) were the primary source of nutrition information, followed by strength and conditioning coaches (23.7%), with dietitians (14.4%) ranking third. The high ranking of dietitians in Burns (2004) study was most likely due to the fact that sports dietitians were available to student athletes at the eight Big Ten Conference universities involved in the study. Ball State, a member of the MAC, does not currently employ a dietitian whose primary job is to work with student athletes, reducing the likelihood that an athlete from Ball State would access information from a dietitian.

Gallito (1999) interviewed certified athletic trainers, who indicated that coaches have the biggest influence on college athletes' food intake. Studies have shown trainers

and coachers to have poor nutrition knowledge (Gallito, 1999; Rockwell, 2001). Trainers and coaches are not nutrition experts and they do not have the educational background or training that dietitians obtain (Rockwell, 2001). Although coaches and trainers themselves may not be able to give sounds dietary advice to their athletes, they may be very influential in referring players to dietitians.

RQ#6 Perception of Adequacy of Fluid Intake

In the present study, 87.6 percent of players either agreed or strongly agreed that a sport enhancing diet would help make them more successful football players, and the majority of players (73.8%) agreed that they intended to eat a sports enhancing diet. Over one-quarter of players reported that their practice (26.3%) and class schedule (37.6%) create problems for eating a sports enhancing diet. Only half of the players (52.6%) reported that their teammates eat a sports enhancing diet on a regular basis. Schedule may be a reason why only 19 (24%) players in the present study reported drinking enough fluids at all times before, during, immediately after, and two hours after practice.

The Theory of Planned Behavior (TPB) suggests that factors such as attitude, subjective norms, and perceived behavioral control can predict behavioral intention. While studying the TPB in college baseball players, Pawlak et al. (2009) found the following two statements had a significant impact on an athlete's intention to eat a healthful diet: "My eating a healthful diet will help me to focus and improve my concentration" and "My daily schedule affects my dietary intake."

RQ#7 Perceived Barriers to Adequate Fluid Intake

The most common perceived barrier to adequate fluid intake reported by eleven players was that players forget or are not very attentive toward their fluid needs. This barrier may either indicate a lack of knowledge or that the players are too busy with their schedules and either become forgetful or simply don't make time to do what they know should be done. Malinauskas et al. (2007) indicated the most frequent barriers to healthy eating among college baseball players were insufficient time to cook healthy on non-game days, having to eat out frequently during away and non-game days, and not knowing how to choose healthy foods when eating out during away games. Results of the present study would support the results of Malinauskas et al. (2007).

Summary

Ball State's football players' hydration and fluid replacement knowledge, attitudes, and behaviors were significantly correlated in the present study. In general, knowledge translated into more desirable attitudes and behaviors, and poor knowledge revealed less desirable attitude and behavior scores. There was no significant difference between knowledge, attitudes, and behaviors of the football players based on their position on team, number of seasons played, nutrition education, and likely sources of nutrition information.

The most likely sources of nutrition information were trainers and coaches, who often have little or no formal nutrition education (Gallito, 1999; Rockwell, 2001). Use of sports drinks, thirst as an indicator of dehydration, and salt tablets were the most frequently misunderstood concepts among the football players. Education alone does not

ensure players will improve their diets. Athletes lack nutrition information and need education (Malinauskas et al., 2007; Nichols et al., 2005; Pawlak et al., 2009; Rosenbloom et al., 2002). In addition to nutrition education, athletes also need assistance in implementing their knowledge of nutrition to their diets (Jonnalagadda et al., 2001; Murphy and Jeanes, 2006; Schnoll and Zimmerman, 2001).

CHAPTER VI

Conclusions and Recommendations for Future Research

Despite the popularity of collegiate sports, little information about collegiate football player's hydration and fluid replacement practices is documented in the scientific literature. Although players in the present study had good overall knowledge scores, they revealed poor knowledge on use of sports drinks, salt tablets, and thirst as an indicator of hydration. Players also had poor attitude and behavior scores on statements regarding sports drinks. Since sports drinks can hydrate athletes faster than water alone, provide electrolytes to help maintain fluid balance, provide carbohydrates that help provide energy and restore muscle glycogen (Dunford & Doyle, 2008), it is important that athletes receive education on sports drinks to enhance sports performance.

Results from this study and previous studies on collegiate athletes from various sports suggest that improving attitudes in addition to knowledge may have a positive impact on athletes' behaviors (Jonnalagadda et al., 2001; Murphy and Jeanes, 2006; Nichols et al., 2005; Pawlak et al., 2009; Rosenbloom et al. 2002). To better assist football players' needs, it is important not only to educate the athletes, but also to reinforce knowledge over time to ensure they have the support and the ability to apply their knowledge. According to Schnoll and Zimmerman (2001, p.1010), "dietary change does not come from knowledge alone. Setting specific goals and keeping written

monitoring records are essential for achieving change. These strategies increase perceived self-efficacy and improve dietary behavior." The author concluded more cognitive, behavioral, and motivational research can provide a more complete picture of the basis of dietary behavior change.

In the present study, despite evidence that trainers and coaches have shown poor nutritional knowledge (Gallito, 1999; Rockwell, 2001), the football players indicated their most likely source of nutrition information were trainers, coaches and physicians, while their least likely sources of nutrition information were magazines and academic journals. Dietitians, the nutrition experts, ranked sixth out of the twelve choices. Considering the serious health complications that may develop as a result of dehydration, it is imperative that athletes receive sound nutrition information from their athletic staff. Ideally the athletic staff would have a registered sports dietitian dedicated toward helping athletes meet their nutrition needs (Clark, 1994; Jonnalagadda et al., 2001).

Recommendations for Future Research

Based on the results of this study, the following recommendations for future research are made:

1. Increase the population size by conducting the study after incoming freshmen football players have joined the football team for training.
2. Repeat the study among multiple football teams within the MAC (or some other) division or conference.
3. Include the specific questions from studies by Hornstrom (2007) or Pawlak et al. (2009) which have been shown to calculate an athlete's intention to eat a healthful

diet and exclude the seven questions from the present survey in section three. This will allow future researchers to calculate an intention to eat a healthy diet score for the athletes.

4. In part three of the survey instrument, instead of asking the players to "please indicate your likelihood to use the following sources," modify the question to ask "Out of the following, please indicate your current sources for nutrition information?" In addition, the four point Likert scale can be modified to "often, sometimes, seldom, or never" instead of "very likely to very unlikely."
5. Measure fluid intake of players and take pre and post practice weights for more than one day to identify players who are dehydrated and then compare the results to the players' knowledge, attitude, and behavior scores.
6. Have the players attend a lecture about hydration and fluid replacement. Administer the survey twice as a pre and post education test to see if education has a positive impact on attitudes and behaviors. In addition, use the instrument presented in Schnoll and Zimmerman's study (2001) to measure the athletes' self efficacy before and after the nutrition class.
7. Modify question #1 to read "All football players need to consume salt supplements to maintain proper hydration." This clarification acknowledges that some athletes are "salty sweaters" who may, in fact, need salt supplements.
8. Modify question six on the survey which asks players to indicate if they have previously received some type of nutrition education. This question appeared to be unclear to participants; specifically, three players indicated they both had and

had not had previous nutrition education. This question could be re-worded to just ask athletes if they have taken a nutrition classes or attended a nutrition lecture.

9. Include questions related to caffeine intake of the athlete.

Recommendations for Practice

The results of this and other studies suggest, to maximize an athlete's performance, a registered dietitian, preferably a sports dietitian, should be added to the staff of university athletic departments so all student athletes can have access to a nutrition professional. Specifically, as suggested by Clark (1994) and Jonnalagadda et al. (2001), a sports dietitian can:

1. Develop, implement, and monitor scientific-based nutrition programs to support athletes, trainers, coaches, team physicians, and sports psychologists, including the concept of train-the-trainer and the use of peer mentors;
2. Counsel and guide student athletes on nutrition education concerning hydration maintenance, pre and post game nutrition strategies, recovery tactics, nutrition periodization, weight control and maintenance;
3. Take part in meal planning for university cafeterias, pre and post game meals, and training table meals;
4. Provide handouts and materials concerning supplements, shopping for food, eating disorders, food safety, food budgeting; and
5. Provide cooking demonstrations and grocery store tours.

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APPENDIX A

Letter to Head Football Strength and Conditioning Coach

June 25, 2010

Mark Naylor
Head Football Strength and Conditioning Coach
Ball State University
Fisher Football Training Complex
2000 W. University Ave. Muncie, IN 47306

Dear Coach Naylor

Thank you for agreeing to have your team participate in this research study. Upon completion of this study, a copy of the overall results will be sent to you.

The purpose of this study is to investigate the knowledge, attitudes, and behaviors among elite collegiate football players at a Midwest NCAA Division I University with regard to hydration and fluid replacement. For this study, as previously agreed upon, your players will be asked by you to complete a survey. I will provide all materials needed to administer the survey. As you have agreed, your only role in this study will be to notify the athletes of the availability of the survey on a given Monday June 28, and remind the athletes about its availability daily throughout that week (Tuesday through Friday). You will notify the players by reading the script that has been provided to you. The survey will take the athletes approximately 25 minutes to complete.

You have also agreed to have your graduate assistant administer and collect of the surveys following your daily practices. This is the graduate assistant's only role in this study. You will need to provide your graduate assistant with the surveys, envelopes, pens, and the directions to administer the survey. Ideally the survey should be administered to players in the same location within the football training complex each day so the environment in which the survey is completed will be similar for all participants. After administering the survey each day, your graduate assistant will collect the completed surveys, place them in an envelope I will provide, seal that envelope, and place it in a locked cabinet.

On Friday July 2nd, the last day the survey will be administered, I would appreciate it if your graduate assistant would place all unused surveys in the same envelope along with the completed surveys. The pens do not need to be returned. Once this is done, either you or your graduate assistant can contact me to pick up the envelopes for data analysis and compilation.

Thank you again for your assistance.

Sincerely,

Roberta Kumley
Graduate Student
(719)650-7963

APPENDIX B

Coach's Statements/Script to the Football Team

Coaches Statement on Monday:

I would like to invite all of you to participate in a brief survey about hydration. I would appreciate it if you would volunteer to participate in this study. This brief survey will identify your knowledge, attitudes, and behaviors with regard to hydration and fluid replacement. All data collected in this study will be confidential; no personal identifiers will be collected. Your responses are anonymous. Only the researcher and her thesis committee will have access to your responses. The answers you provide will be analyzed collectively as a group, not individually. I would like you to take the survey after practice any day this week. Our graduate assistant, Josh Kosier, will be available to administer and collect the survey. I would really appreciate your participation in this survey, as the information will help us identify any changes we need to make to optimize our team's hydration practices.

Coaches Statement for Tuesday through Friday:

I would like to remind you about the brief hydration survey. I would really like you to take this survey. The information you provide is anonymous and the answers you provide will be analyzed collectively as a group, not individually. A graduate student from the nutrition department will collect and analyze the data. Please see Josh Kosier after practice and he will give you with the survey. I would really appreciate your participation in this survey, as the information will help us identify any changes we need to make to optimize our team's hydration practices. Friday will be the last day that you can take this survey.

APPENDIX C

Directions for the Football Team's Graduate Assistant to Administer the Survey

Directions for the Football Team's Graduate Assistant to Administer the Survey

1. The Head Strength and conditioning coach will read a daily script which informs players about the surveys availability (for one week, Monday through Friday). Your role is to administer, collect, and store the surveys during the week in which the study is conducted. Players who wish to participate will approach you following practice. These players should be taken to an empty quiet room with in the football training complex to complete the survey. All players should be taken to the same room.

2. Before handing out the survey, read the purpose of the study:

   > The purpose of this study is to investigate the knowledge, attitudes, and behaviors among elite collegiate football players at a Midwest NCAA Division I University with regard to hydration and fluid replacement.

3. Once the participants have been read the purpose of the study, each individual who chooses to participate should be given a copy of the letter of information, a survey, and a pen. All materials will be provided to you by the primary investigator.

4. Before participants begin the survey read the "**Football Players' Directions for Completing the Survey"**

Storing and Returning Completed Surveys

Each day after surveys have been completed, seal them into the envelope labeled with that corresponding day. I have provided you with five envelopes, each labeled by the week day. Please store the completed surveys in a locked cabinet. On Friday, the last day the survey will be administered, place all unused surveys in the "Friday" envelope, along with the completed surveys. The Primary Investigator, Roberta Kumley, will be available to collect the completed surveys. Please contact her by phone to pick up the completed surveys at the end of the week in which the study is conducted. Thank you!

Questions

Any questions or concerns may be directed to the primary investigator, Roberta Kumley, or her faculty advisor, Dr. Carol Friesen. Please feel free to contact Ms. Kumley at (719) 650-7963 or rfkumley@bsu.edu; you can reach Dr. Friesen at (317) 326-2994 or cfriesen@bsu.edu

Football Players' Directions for Completing the Survey

1. Upon deciding to participate in this study, you will receive a copy of the letter of information, a survey, and a pen.

2. The letter of information attached to the survey is yours to keep. You only need to return the pen and the completed survey.

3. In no way will the survey be used to identify you, the individual, and you SHOULD NOT put your name on the survey.

4. All information obtained on the survey will be complied for group analysis, NOT individually. Surveys are not intended to analyze individuals, or be used as a measure of judgment against the team or individual players.

5. The coaching staff will not have access to the surveys. All completed surveys will be placed in an envelope, sealed, and given to the primary researcher of the study for data analysis.

6. You should not talk to each other or on your cell phone while completing the survey.

7. All information should be completed by placing a circle around the answer or filling in a blank answer to questions that best describes you nutritional knowledge, attitudes, behaviors, sources of information, and dietary influences with regard to hydration and fluid replacement.

8. You should answer all questions to the best of your ability; your honesty is essential to the integrity of the study.

Questions

Any questions or concerns may be directed to the primary investigator, Roberta Kumley, or her faculty advisor, Dr. Carol Friesen. Please feel free to contact Ms. Kumley at (719) 650-7963 or rfkumley@bsu.edu; you can reach Dr. Friesen at (317) 326-2994 or cfriesen@bsu.edu
Thank you!

APPENDIX D

Letter of Support to IRB from Head Strength Coach

June 15, 2010

The Institutional Review Board Committee,

This is a letter of support for Roberta Kumley's research study, Knowledge, Attitudes, and Behaviors of NCAA Division 1 Football Players at a Midwestern University Related to Hydration and Fluid Replacement.

I am looking forward to having Ball State Football players participate this study. This study is important to me not only to find out more valuable information concerning my football player's hydration and fluid replacement knowledge and practices, but to potentially utilize this information to enhance my player's performance.

I am aware that the researcher has chosen survey questions that should keep the player's identities anonymous. However, in the event that any of the player's identities were to become known, no retaliatory action will be taken.

Regards,

APPENDIX E

Letter of Information to Football Players from Investigator

June 2010

Dear Ball State Football Players,

I, Roberta Kumley, am investigating the knowledge, attitudes, and behaviors of elite collegiate football players. The title of my research study is, "Knowledge, Attitudes, and Behaviors of NCAA Division 1 Football Players at a Midwestern University Related to Hydration and Fluid Replacement". I would appreciate it if you would assist me in this endeavor. This research project will provide a better understanding in this area of sports nutrition which will help coaches and trainers identify and aid the best interests of collegiate football players.

The survey will take approximately 25 minutes to complete. All data collected in this study will be confidential; no personal identifiers will be collected. Your responses are anonymous. Only the researcher and her thesis committee will have access to the data which will be stored in a locked file cabinet and destroyed after three years. Your participation is voluntary, and you may withdraw from the study at any time and for any reason. There is no penalty for not participating in, or withdrawing from, this study.

If you agree to participate, you will be asked to complete an anonymous paper survey. The personal benefits for participation include insight into your knowledge and behaviors related to hydration practices critical to collegiate football players. There are no other known physical, psychological, legal, social, economic, or other risks associated with participation in this research project. There are no costs to you or any other party.

This project has been reviewed according to Ball State University's procedures governing participation in this research. If you have any questions about this survey, you may contact me in the Department of Family and Consumer Sciences at Ball State University. I may also be reached at (719) 650-7963 or via email at rfkumley@bsu.edu for questions or complaints. Additionally, you can contact my thesis advisor, Dr. Carol Friesen, in the Department of Family and Consumer Sciences. She can be reached by phone at (765) 285-5925 or via email at cfriesen@bsu.edu and will be glad to answer any questions or complaints. For questions about your rights as a research participant, please contact Research Compliance, Sponsored Programs Office, Ball State University, Muncie, IN 47306, (765) 285-5070, irb@bsu.edu. You may also contact the Ball State University's Office of Academic Research and Sponsored Programs at (765) 285-1600 or at http://cms.bsu.edu/About/AdministrativeOffices/SPO.aspx if you have any questions or comments regarding your rights as a participant in this research.

Thank you so much for your willingness to participate in this study.

Sincerely,

Bobbi Kumley
Graduate Student
Department of Family and Consumer Science

APPENDIX F

Fluid and Hydration Survey

Appendix B

Fluid and Hydration Survey

Please answer the following questions about fluids and hydration. Do NOT put your name on the survey. Your answers will be kept confidential, so please be honest in your answers.

Part 1:

1. Age: _____

2. Race (check one).
   - ____ White (non-Latino)
   - ____ African American
   - ____ Asian & Pacific Islander
   - ____ Native American
   - ____ Mixed Race
   - ____ Other: _____

3. Are you Hispanic?
   - ____ Yes
   - ____ No

4. How many seasons have you played collegiate football?

   _____ seasons

5. What is your primary position on the football team at Ball State University?

   _____ Back _____LB/QB _____ Lineman _____Other

6. Please check all that apply.
   - ___ I have taken a nutrition class in college.
   - ___ I have sat in on a nutrition lecture given by a dietitian in college.
   - ___ I have never had any formal nutrition education.
   - ___Other nutrition education: (please describe)_____

Part 2: Questions about Fluid and Hydration.

Read each statement carefully and circle your response.

1. Using salt tablets keeps athletes from getting dehydrated during training and competition.	T	F
2. Thirst is the best indicator of dehydration.	T	F
3. Dehydration decreases athletic performance.	T	F
4. An athlete should not drink water or any fluids during practice.	T	F
5. Coaches should not let players drink any fluids during practice.	T	F
6. Coaches should not let players drink any fluids during competition.	T	F
7. It is important for fluids to be readily available to athletes during practice.	T	F
8. It is important for fluids to be readily available to athletes during competition.	T	F
9. Within 2 hours after exercise, athletes should drink a sports drink.	T	F
10. Sports drinks are better than water because they restore glycogen in muscles.	T	F
11. An athlete should drink 17 to 20 fluid ounces of water or a sports drink a couple of hours before competition.	T	F
12. An athlete should drink 7 to 10 fluid ounces 10-20 minutes before competition.	T	F
13. When exercising for more than an hour, an athlete should drink a sports drink rather than water.	T	F
14. By monitoring the color of urine, an athlete can judge if he/she is dehydrated.	T	F
15. A good way for an athlete to determine how much water or sports drink to consume after practice is to weigh before and after practice.	T	F
16. Excessive sweating, thirst, and cramping are signs of dehydration.	T	F
17. More than 2 drinks of alcohol the day before practice and/or competition can lead to dehydration.	T	F

Circle strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD) for each statement.

1. I believe using salt tablets will keep me from getting dehydrated during training and competition.	*SA*	A	U	D	SD
2. I believe I can rely on thirst alone as an indicator of dehydration.	*SA*	A	U	D	SD
3. I believe dehydration decreases my athletic performance.	*SA*	A	U	D	SD
4. I believe no water or fluids should be consumed during practice.	SA	A	U	D	SD
5. I believe my coach should not let our players drink any fluids during practice.	SA	A	U	D	SD
6. I believe my coach should not let our players drink any fluids during competition.	SA	A	U	D	SD
7. I believe fluids should be readily available to me during practice.	SA	A	U	D	SD
8. I believe fluids should be readily available to me during competition.	SA	A	U	D	SD
9. I believe I should drink a sports drink within 2 hours after exercise.	SA	A	U	D	SD

10. I think sports drinks are better than water because they restore glycogen in muscles.	SA	A	U	D	SD
11. I think I should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	SA	A	U	D	SD
12. I believe I should drink 7 to 10 fluid ounces of water or sports drink 10-20 minutes before competition.	SA	A	U	D	SD
13. I believe when exercising for more than an hour, I should drink a sports drink rather than water.	SA	A	U	D	SD
14. I believe by monitoring the color of my urine, I can judge if I am dehydrated.	SA	A	U	D	SD
15. I believe weighing myself before and after practice is a good way to determine how much fluid I lost.	SA	A	U	D	SD
16. I believe excessive sweating, thirst, and cramping are signs of dehydration.	SA	A	U	D	SD
17. I believe drinking more than 2 drinks of alcohol the day before competing can lead to dehydration.	SA	A	U	D	SD

Circle yes (Y) or no (N) for each statement.

1. I use salt tablets to keep from being dehydrated when training and competing.	Y	N
2. I use thirst alone as a way to tell if I am dehydrated.	Y	N
3. I drink plenty of fluids so my athletic performance will not decrease due to dehydration.	Y	N
4. I do not drink water or some type of fluid during practice.	Y	N
5. My coach does not allow me to drink fluids during practice.	Y	N
6. My coach does not allow me to drink fluids during competition.	Y	N
7. Fluids are readily available to me during practice.	Y	N
8. Fluids are readily available to me during competition.	Y	N
9. Within 2 hours after exercise, I drink a sports drink.	Y	N
10. I drink sports drinks rather than water to restore glycogen in my muscles.	Y	N
11. I drink approximately 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	Y	N
12. I drink at least 7 to 10 fluid ounces of water or sports drink 10-20 minutes before the game.	Y	N
13. I drink sports drinks rather than water when competing for more than an hour.	Y	N
14. I use the color of my urine to determine if I am dehydrated.	Y	N
15. I weigh myself before and after practice to see how much weight I have lost from sweating and use this to determine how much water or sports drink to consume.	Y	N
16. I use excessive sweating, thirst, and cramping to warn me if I am getting dehydrated.	Y	N

Part 3. Sources of Nutrition Information

Please indicate your likelihood to use the following resources for current information regarding nutrition, including hydration by circling the response.

VL = Very Likely **L** = Likely **U** = Unlikely **VU** = Very Unlikely

	VL	L	U	VU		VL	L	U	VU
Athletic Trainer	1	2	3	4	Coach	1	2	3	4
Academic Journals	1	2	3	4	Magazines	1	2	3	4
Friends	1	2	3	4	College Nutrition/Health Courses	1	2	3	4
Parents	1	2	3	4	Dietitian	1	2	3	4
Physicians	1	2	3	4	Other	1	2	3	4
Internet	1	2	3	4	(Please indicate other source)				

Part 4. Dietary Influences

Circle strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD) for each statement.

1. I intend to eat a sport enhancing diet	*SA*	A	U	D	SD
2. Most of my teammates eat a sports enhancing diet on a regular basis	*SA*	A	U	D	SD
3. My classes create problems for eating a sports enhancing diet	*SA*	A	U	D	SD
4. My practice schedule creates problems for eating a sports enhancing diet	SA	A	U	D	SD
5. Eating a sport enhancing diet will help me to be a more successful football player	SA	A	U	D	SD
6. For me eating a sport enhancing diet would be enjoyable	SA	A	U	D	SD
7. My teammates think I should eat a sports enhancing diet	SA	A	U	D	SD

Part 5. Barriers to Fluid Consumption.

1. Do you think you currently drink enough fluids:
   - a. Before practice ☐ Yes ☐ No ☐ Not sure
   - b. During practice ☐ Yes ☐ No ☐ Not sure
   - c. Immediately after practice ☐ Yes ☐ No ☐ Not sure
   - d. Two hours or more after practice ☐ Yes ☐ No ☐ Not sure

2. If you *don't* think you drink enough fluids during any of these time periods, what do you think keeps you from drinking more fluids? Please write in your answers below.

Thank you for completing this survey!

APPENDIX G

IRB Letter

Determination of Exempt Status

BALL STATE UNIVERSITY

Institutional Review Board

DATE:	June 25, 2010
TO:	Roberta Kumley, M.S. Dietetics
FROM:	Ball State University IRB
RE:	IRB protocol # 172456-1
TITLE:	Knowledge, Attitudes, and Behaviors of NCAA Division 1 Football Players at a Midwestern University Related to Hydration and Fluid Replacement
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	June 23, 2010

The Institutional Review Board reviewed your protocol on June 23, 2010 and has determined the procedures you have proposed are appropriate for exemption under the federal regulations. As such, there will be no further review of your protocol, and you are cleared to proceed with the procedures outlined in your protocol. As an exempt study, there is no requirement for continuing review. Your protocol will remain on file with the IRB as a matter of record.

While your project does not require continuing review, it is the responsibility of the P.I. (and, if applicable, faculty supervisor) to inform the IRB if the procedures presented in this protocol are to be modified or if problems related to human research participants arise in connection with this project. **Any procedural modifications must be evaluated by the IRB before being implemented, as some modifications may change the review status of this project.** Please contact please contact Chris Mangelli at (765) 285-5070 or cmmangelli@bsu.edu if you are unsure whether your proposed modification requires review or have any questions. Proposed modifications should be addressed in writing and submitted electronically to the IRB (http://www.bsu.edu/irb) for review. Please reference the above IRB protocol number in any communication to the IRB regarding this project.

Reminder: Even though your study is exempt from the relevant federal regulations of the Common Rule (45 CFR 46, subpart A), you and your research team are not exempt from ethical research practices and should therefore employ all protections for your participants and their data which are appropriate to your project.

APPENDIX H

CITI Collaborative Institutional Training Initiative Certificate

Certificate of Completion: Roberta Kumley

CITI Collaborative Institutional Training Initiative

Social & Behavioral Research - Basic/Refresher Curriculum Completion Report
Printed on 6/15/2010

Learner: roberta kumley (username: rkumley)
Institution: Ball State University
Contact Information
6151 Carvel Ave.
Indianapolis, Indiana 46220 United States
Department: Family and Consumer Science
Phone: 719-650-7963
Email: rkumley@bsu.edu

Social & Behavioral Research - Basic/Refresher: Choose this group to satisfy CITI training requirements for investigators and staff involved primarily in Social/Behavioral Research with human subjects.

Stage 1. Basic Course Passed on 06/15/10 (Ref # 4541000)

Required Modules	Date Completed	Score
Belmont Report and CITI Course Introduction	06/15/10	3/3 (100%)
Students in Research - SBR	06/15/10	9/10 (90%)
History and Ethical Principles - SBR	06/15/10	4/4 (100%)
Defining Research with Human Subjects - SBR	06/15/10	5/5 (100%)
The Regulations and The Social and Behavioral Sciences - SBR	06/15/10	5/5 (100%)
Assessing Risk in Social and Behavioral Sciences - SBR	06/15/10	4/5 (80%)
Informed Consent - SBR	06/15/10	4/5 (80%)
Privacy and Confidentiality - SBR	06/15/10	3/3 (100%)
Research with Prisoners - SBR	06/15/10	4/4 (100%)
Research with Children - SBR	06/15/10	4/4 (100%)
Research in Public Elementary and Secondary Schools - SBR	06/15/10	4/4 (100%)
International Research - SBR	06/15/10	3/3 (100%)
Internet Research - SBR	06/15/10	4/4 (100%)
HIPAA and Human Subjects Research	06/15/10	2/2 (100%)
Workers as Research Subjects-A Vulnerable Population	06/15/10	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects	06/15/10	2/2 (100%)
Ball State University	06/15/10	no quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Course Coordinator