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Nutrition Knowledge of Collegiate Athletes in Endurance and Non-Endurance Sports

Lauren A. Havermale
Southern Illinois University Carbondale, lauren.dieleman@siu.edu

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by

Lauren Havermale

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Approved by:

Dr. Meungguk Park, Chair

Dr. Julie Partridge

Graduate School
Southern Illinois University Carbondale
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The purpose of this study was to measure the nutrition knowledge of endurance and non-endurance athletes to compare the nutrition knowledge of athletes in different sport categories. Nutrition knowledge differences in gender were also evaluated. Data was collected from 100 student-athletes at a NCAA Division I, mid-major university. The participants were administered a 35-question nutrition knowledge questionnaire and the statistics were measured based on questions answered correctly. Descriptive statistics revealed that the overall nutrition knowledge of the student-athletes was very low ($\bar{x} \pm SD$=19.64 ± 4.82), but there was no significant difference between the different sport categories (F = .061, p = .152) or gender (F = .014, p = .930). This study will contribute to the body of knowledge on nutrition knowledge in collegiate athletes by exploring additional contributing factors of lack of knowledge, which is a consistent trend in this population. Furthermore, this study will help athletic administrators involved in college athletics develop more effective resources which will increase the student-athletes knowledge of their nutrition needs.

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CHAPTER 1

INTRODUCTION

It is very important for athletes to properly fuel their body to satisfy their nutrition needs in order to be able to perform at their highest capacity. The beneficial effects of nutrition on exercise performance have been clearly documented by research over the past 20 years. However, studies have also found that less than 10% of collegiate athletes at the NCAA Division I level have adequate knowledge of their nutrition needs (Torres-McGehee, Pritchett, Zippel, Minton, Cellamare, & Sibilia, 2012). At most universities, athletes have access to miscellaneous resources to help educate them on how to make proper nutrition decisions. These resources can range from Registered Dieticians (RDs) to coaches and athletic trainers. However, according to the Collegiate and Professional Sports Dietitians Association, only 72 schools in major college conferences have RDs working directly with athletes for 40 or more hours per week (CPSDA, 2017). Because not every school has access to an RD it is important that the athletes themselves are educated.

Nutrition Needs of Athletes

Nutrition needs vary based on the intensity and duration of the exercise performed. The 2013-14 NCAA Sports Medicine Handbook has divided the collegiate athlete's training year into three phases: base, competition, and transition. During the base phase, training volume is usually high which usually means that the athlete's energy needs are going to be at their highest. The competition phase often indicates a decrease in training volume and an increase in higher intensity training sessions. During this phase it is very important for the athlete to adjust their calorie and macronutrient intake to prevent unwanted weight gain, and learn how to fuel their bodies before and after competition as well as during travel. The athletes' volume and intensity

are at their lowest during the transition phase, so they may have to decrease their calorie intake properly while still fulfilling nutrition needs.

Nutrition needs also vary slightly based on the type of activity in which the athlete participates. Although the diets of endurance athletes and non-endurance athletes aren't substantially different, research has found some differences. For example, for an endurance athlete, precompetition meals are very important. It is critical for endurance athletes to consume an increased amount of carbohydrates before their activity. The National Strength and Conditioning Association (NSCA) recommends that endurance athletes should aim to consume approximately 1 g of carbohydrates per kilogram body weight, 2 hours before exercise. However, in a study examining the benefits of carbohydrate loading in non-endurance athletes, there was no significant difference in performance between subjects that were on high-carbohydrate vs. moderate-carbohydrate diets (NSCA, 2016).

In addition to differing based on the type of activity, nutrition needs also vary between men and women. Studies have shown that carbohydrate loading is effective in men, but there has been mixed research found in women. A study conducted on well-trained female cyclists around the age of 30 showed that a high carbohydrate diet had a much smaller influence on muscle glycogen content than similar studies done with men (Walker et.al., 2000). Also, women on average require a lower daily caloric intake than men (NSCA, 2016).

Nutrition Knowledge of Coaches, Athletic Trainers, and Strength & Conditioning Specialists

In contrast to the athletes' nutrition knowledge, coaches, athletic trainers, and strength and conditioning specialists have historically been more educated on nutrition needs of athletes. A study conducted by Rockwell, Nichols-Richardson, and Thye (2001) at NCAA Division I

universities found that strength and conditioning specialists are the most knowledgeable members of athletic department staffs of athletes' nutrition needs, followed by athletic trainers, then coaches. Overall, 67% of the strength and conditioning specialists, coaches, and athletic trainers that participated in this study responded correctly to a series of questions about nutrition knowledge. Only 30% of their participants had access to a Registered Dietician. Because of this lack of resources, it is very important that those who work directly with athletes are able to help educate them on their nutrition needs. There is no current research to reflect the knowledge of different nutrition needs throughout the different intensities of exercise.

Nutrition Knowledge of Athletes

There have been several studies measuring athletes' nutrition knowledge of their macronutrient and micronutrient needs, importance of hydration, timing and volume of nutrient consumption, and the use of supplements and ergogenic aids. Study results have ranged from 9%-51.4% of knowledgeable NCAA student-athletes, with each study using different requirements and definitions of adequate nutrition knowledge.

Each athlete requires different nutrition needs depending on the type of activity he/she participates in. There is currently research lacking that analyzes nutrition knowledge in correlation to the intensity of sport and the specific nutrition needs that type of exercise requires.

Purpose of the Study

The purpose of this study is to measure the nutrition knowledge of endurance and non-endurance athletes to compare the nutrition knowledge of athletes in different sport categories. In this study, endurance sports will include cross-country, long-distance swimming, and long-distance track. Non-endurance sports will include baseball, tennis, volleyball, softball, and short-distance/sprinting events for track & field and swimming.

In order to obtain an accurate measure of nutrition knowledge, a questionnaire will be completed which covers knowledge of micronutrients and macronutrients, supplements and performance, weight management and eating disorders, and hydration.

Research Question #1: Do NCAA Division I athletes have an adequate knowledge (Nutrition Knowledge Score ≥60%) of their nutrition needs?

Research Question #2: Do NCAA Division I endurance athletes have a better knowledge of their nutrition needs than non-endurance athletes?

Research Question #3: Do NCAA Division I female athletes have a better knowledge of their nutirition needs than male athletes?

CHAPTER 2

LITERATURE REVIEW

NCAA Nutrition and Athletic Performance Guidelines

The NCAA Sports Medicine Handbook supplies specific guidelines of the nutrition requirements that student athletes need in order to properly fuel their body. As training differs throughout the year, it is important that the athletes to adjust their caloric intake while also maintaining a nutritious diet that satisfies their body's needs during their current stage of training. As training levels are different in endurance and non-endurance sports, so are nutrition needs.

During base training when practices are often longer and the intensity is higher, the athlete's energy needs are at their peak level. As the athlete transitions in to the competition phase, he/she should adjust their caloric and macronutrient intake in order to prevent unwanted weight gain. During this phase it is also important for the athlete to be aware of what they are eating before competition and how to adjust their eating and hydration habits while they are traveling. The transition phase often requires a decrease in the total calorie intake in order to prevent weight gain during the time when the athlete's training volume is at its lowest.

During higher intensity activity, the body requires a higher amount of carbohydrates to use as fuel and in order to prevent low blood sugar by replenishing liver and muscle glycogen stores during training (NCAA, 2009). Carbohydrates have also been shown to improve immune function (NCAA, 2009). A daily intake of 6 to 10 grams per kilogram of body weight is recommended during base training. Although as training and volume increase, it isn't uncommon for the athlete's carbohydrates needs to exceed 10 grams. It is also important for athletes to consume 1 to 1.5 grams of carbohydrates within two hours after activity in order to replace

glycogen stores. The NCAA recommends whole grain breads and pasta, and whole fruits and vegetables as sources of high-quality carbohydrates.

Protein requirements differ depending on the type of activity. For endurance and strength-training athletes, protein needs are higher than the recommended protein intake of .8 grams per kilogram body weight. Endurance athletes require 1.2 to 1.4 grams of protein per kilogram of body weight and strength-training athletes require 1.6 to 1.7 grams per kilogram of body weight. It is also important to consume 10-20 grams of protein along with the recommended amount of carbohydrates within 30 minutes after training (NCAA, 2009).

During long bouts of lower-intensity training, the body depends on the fats stored in triglyceride found in muscles to provide energy during activity. It has been suggested that dietary fat intake should make up 20 to 35 percent of the total daily caloric intake (NCSA, 2016). Fat can also provide essential fatty acids and is also a carrier for fat-soluble vitamins to increase physiological immune function.

In addition to meeting macronutrient requirements, it is very vital to performance to consume the appropriate amount of fluids, such as water, low-fat milk, or 100 percent fruit juices, to maintain hydration levels. These fluids should be consumed before, during and after training. For any activity lasting longer than 60 minutes, fluids containing electrolytes or carbohydrates are recommended as a good source of fuel and rehydration (NCSA, 2016).

Nutrition Resources & Educational Opportunities

There is one consistent fact evident in previous research studies regarding nutrition knowledge in collegiate athletes. Collegiate athletes are lacking proper nutrition knowledge necessary in order to properly fuel their bodies for optimal performance (Holley, 2015; Rosenbloom, Jonnalagadda, & Skinner, 2002; Torres-McGehee et al., 2012). In order to change

this, it is important to provide proper resources and educational opportunities to athletes, coaches, athletic trainers, strength and conditioning specialist, and any other person that an athlete may seek for nutrition advice. This lack of knowledge has been attributed to the absence of a Registered Dietician available to athletes (Torres et al., 2012).

Studies have shown that athletes who don't have access to an RD are most likely to seek nutrition advice from an athletic trainer or strength and condition specialist (Burns, Schiller, Merrick, & Wolf, 2004; Smith Rockwell, Nickols-Richardson, & Thye, 2001; Torres-McGehee et al., 2012). Even athletes who have access to an RD are often unaware of this resource. One study asked participants if they had access to an RD and only 58.2% reported that they did. However, 50.1% of the surveyed participants had access to an RD throught their athletic department and the 49.9% have access to an RD from either a private sector off of campus or the student health center (Torres-McGehee et al., 2012).

Pennsylvania State University was the first NCAA institution that hired a nutrition specialist as a part of their athletic department in the early 1990's. Since then, several schools have also hired an RD or nutrition specialist for their athletes, however not all schools have followed suit. From 2007 to 2014, the number of full-time dietians dedicated to college athletic departments grew from 13 to 50. As of 2017, there are 72 sports dietitians who spend 40 or more hours a week with college athletes. This leaves the athletes without access to a RD to find their own sources of nutrition information. Without a designated resource, athletes may not receive the same information from different sources and it may cause a miscommunication between support staff. One study conducted at a NCAA Division 1 university found that the majority of coaches in their study identified athletic trainers as responsible for body weight management and compisition monitoring of athletes, while a majority of athletic trainers deemed the coached

responsbile for this task (Smith Rockwell et al., 2001). With this overlap, athletes are not receiving the proper nutrition guideance that they should be.

Athletes are very aware of their need for additional nutrition resources. In a study measuring resources of collegiate athletes, 30% percent of participants reported having access to an RD through the athletic department, and the same percentage reported utilizing this resource (Smith Rockwell et al., 2001). In another study based on collegiate freshmen football players, 97% of participants expressed their interest of gaining knowledge of the nutrition needs required in order to achieve peak performance (Rosenbloom, Jonnalagadda, & Skinner, 2001). As we learn more about how nutrition affects performance, we must provide this knowledge athletes, coaches, athletic trainers, and strength and conditioning specialist with this knowledge so the athletes can perform at their highest level. This gap in knowledge will decrease if RD's reach out to Sports Medicine programs in order to provide more resources.

In conjunction with their Sport Science Institue, the NCAA provides some nutrition resources on NCAA.org/SSI that offer some basic information of nutrition, however this resource hasn't been mentioned in any current studies. Across the studies that have been done to measure nutrition knowledge of collegiate athletes and support staff, one application has consistently been suggested: athletic departments need access to a Registered Dietician or nutrition specialist.

CHAPTER 3

METHODS

Participants

The sample for the questionnaire consisted of 100 student-athletes who compete in varsity athletics at a NCAA Division I, mid-major university. Of these, 52 were male and 48 were female. The demographics of the 100 athletes who participated in this study are presented in Table 1. This sample consisted of mainly athletes who participate in the sport category of non-endurance (73%).

TABLE 1

Demographic Characteristics of NCAA Division I Endurance and Non-Endurance Student-Athletes Completing Questionnaire (n = 100)

Characteristic		*n*	% of the sample
Gender			
	Male	58	58.0
	Female	42	42.0
Sport Classification			
	Endurance	27	27.0
	Non-Endurance	73	73.0
Sport			
	Baseball	30	30.0
	Cross Country	15	15.0
	Softball	8	8.0
	Swim & Dive	18	18.0
	Tennis	14	14.0
	Track & Field	5	5.0
	Volleyball	10	10.0
Academic Standing			
	Freshman	28	28.0
	Sophomore	15	15.0
	Junior	34	34.0
	Senior	21	21.0
	Fifth-Year Senior	2	2.0

Instruments

The Nutrition Knowledge Questionnaire used in this study was adapted by Holley (2015) and Hornstrom, Friesen, Ellery, and Pike (2011) to measure basic nutrition knowledge and sports nutrition knowledge. The first section of the questionnaire included participant characteristics and demographics. The demographic information collected included age, gender, sport and academic standing. The second section of the questionnaire included 35 statements regarding basic nutrition and sports nutrition that may be correct or incorrect. This questionnaire was divided into four subcategories, which included macronutrients (10 items), micronutrients (10 items), hydration (6 items), and body composition (9 items). The participants were instructed to respond to each statement by answering "True," "False," or "Don't Know." Statements answered correctly were given a score of 1, and statements answered incorrectly, including those with the answer "Don't Know" were given a score of 0.

The researcher followed the coding process employed by Holley (2015) and Hornstrom, Friesen, Ellery, and Pike (2011). The overall score refers to the number of statements the participant answered correctly. The Nutrition Knowledge Score (NKS) was calculated by determining the percentage of statements answered correctly. Hornstrom et al. (2011), who initially developed the instrument, confirmed the face validity by using an expert review. The internal consistency method was used to estimate the reliability of the instrument. Brown (2002) indicated that Cronbach's alpha can be applied when dichotomous scored items are used. The Cronbach's Alpha coefficient for the 35-item instrument was .715, which is considered to be acceptable (Nunnally, 1978).

Procedures

Before collecting the data, permission to conduct this investigation was secured from the Human Subjects Committee at Southern Illinois University. The participants were asked to

complete a questionnaire about their nutrition needs as collegiate athletes. The Nutrition Knowledge Questionnaire was administered, along with a cover letter, via hardcopy and was returned immediately after the questionnaire was completed.

Data Analysis

Statistical Package for the Social Sciences (SPSS, Version 24) was used to analyze the data collected. The mean of the overall score of all participants was calculated. Two independent t-tests were conducted to assess the overall scores between each of the sport categories and between genders. Participant characteristics and demographics were determined using frequencies and descriptive statistics. The overall scores were then translated into NKS. A *p*-value with a significance of < 0.05 was used.

CHAPTER 4

RESULTS

The mean overall score for the entire sample was 19.64 ± 4.82, which translates to a NKS of 56.11%. The summary of the NKS amongst the demographics can be found in Table 2. An independent *t*-test was conducted to determine whether any differences in sports nutrition knowledge existed between student-athletes who participate in endurance sports and those who participate in non-endurance sports. Using a significance value of $p < 0.05$, the sports nutrition knowledge between student-athletes in different sport classification was not significant ($F = .061$, $p = .152$). An independent *t*-test was also used to compare the differences in sport nutrition knowledge in male and female student-athletes. The difference of sport nutrition knowledge between genders was also not significant ($F = .014$, $p = .930$). The summary of overall score means, standard deviations, and NKS across sport classification and genders can be found in Table 3. Descriptive statistics were used to determine the athlete's knowledge within the four subcategories of the questionnaire; macronutrients, micronutrients, hydration, and body composition. The summary of the athletes' knowledge of each individual subcategory can be found in Table 4. There was also no significant difference found between sports or academic standing.

TABLE 2

Summary of Nutrition Knowledge Score (%) Amongst Demographics Responding to Sports Nutrition Knowledge Questionnaire

Characteristic		NKS %
Gender		
	Male	56.01
	Female	56.26
Sport Classification		
	Endurance	59.37
	Non-Endurance	54.91
Sport		
	Baseball	55.90
	Cross Country	57.14
	Softball	50.00
	Swim & Dive	56.98
	Tennis	50.00
	Track & Field	60.57
	Volleyball	64.86
Academic Standing		
	Freshman	57.24
	Sophomore	57.71
	Junior	55.38
	Senior	54.56
	Fifth-Year Senior	57.14

TABLE 3

Summary of Overall Score Means and Standard Deviations ($\bar{x}$ ± SD), and Nutrition Knowledge Score across Sport Classification and Gender of Student-Athletes Responding to A 35 Question Sports Nutrition Knowledge Questionnaire

		($\bar{x}$ ± SD)	%
Sport Classification			
	Endurance	20.78 ± 4.66	59.37
	Non-Endurance	19.22 ± 4.85	54.91
Gender			
	Male	19.60 ± 4.89	56.01
	Female	19.69 ± 4.79	56.26
	Total	**19.64 ± 4.82**	**56.11**

TABLE 4

Summary of the Mean and Standard Deviation ($\bar{x}$ ± SD), and Percentage of Statements Answered Correctly Within the Four Subcategories of Nutrition Measured with the Sports Nutrition Knowledge Questionnaire (n = 35)

	n	*($\bar{x}$ ± SD)*	%
Macronutrients	10	4.93 ± 1.65	49.29%
Micronutrients	10	5.17 ± 1.94	57.48%
Hydration	6	4.22 ± 1.14	70.00%
Body Composition	9	5.55 ± 1.50	61.68%

CHAPTER 5

DISCUSSION

This study measured sports nutrition knowledge amongst student-athletes at a NCAA Division I institution. Three research questions were tested. The first question was if NCAA Division I athletes have an adequate knowledge of their nutrition needs. The second question asked if student-athletes who participate in endurance events have a better knowledge of their nutrition needs than those who participate in non-endurance events. The third question inquired whether or not female athletes have a better nutrition knowledge than male athletes.

Sports Nutrition Knowledge

The average NKS of the participants in this study was 56.11% out of a possible 100%. The findings of this study were consistent with previous studies measuring nutrition knowledge in collegiate athletes. A study conducted by Hornstrom, Friesen, Ellery, and Pike (2011) using a similar questionnaire found that the average NKS of NCAA Division I softball players polled in his study was 57%. Abood, Black, and Birnbaum (2004) reported athletes scoring an average of 70% on a different nutrition knowledge questionnaire. Douglas and Douglas (1984) found an average of 55% responses answered correctly, while Barr (1987) found an average of 34%. Another study by Batson, Seasem Stanek and Leski (2004) even reported that 99% of athletes in their study had a poor nutrition knowledge, as an adequate level of nutrition knowledge has previously been established to be >60% (Hornstrom et al., 2011) . Although the statistics found from these studies all range, the one consistent factor is that the athletes in these studies have very poor knowledge of what their nutrition needs are. Although this study didn’t display any statistical trends amidst the demographics, the overall deduction was that the student-athletes involved in this study have poor knowledge of their nutrition needs. The one consistency

between the participants in this study is that they all attend the same University and have access to all of the same resources. Although this particular University has a RD that is available to all students through the Student Health Center, it is safe that say that the athletes are not reaping the benefits that this resource has to offer.

Although this particular athletic department may not have an RD that works directly with the athletes, they are beginning to implement some resources in order to help the student-athletes. Within the past several years, the athletic department has created a 'fueling station' available in the main athletic facility that provides the student-athletes with healthy snacks at no cost. The athletic department has also recently hired a graduate assistant, with an undergraduate specialty in nutrition, to maintain the upkeep of the fueling station. Although this study did not measure the actual nutrition habits of the participants, they are still undereducated on what their body needs. Athletes who compete at such a high level should have more direct access to nutrition resources in order to fuel their body properly so they can compete at their highest potential. Future studies may include the correlation of the athletes' nutrition habits as well as their knowledge of their nutrition needs.

In addition to lack of direct resources, student-athletes live very busy lives. Having to be present at all team events in addition to attending all classes and maintaining a certain GPA, requires a lot of time and energy. Most athletic departments offer various resources to help the student-athletes maintain this balance. These resources include academic tutors to assist in the classroom, strength and conditioning coaches to ensure that the athletes are performing at their highest capability, and sports medicine staff to ensure that the athletes are staying physically healthy. While some schools are starting to provide more resources to student-athletes in regards

of nutrition, there are still a relatively low number of athletic departments that have a RD on their staff (CPSDA, 2017).

In addition to determining the overall mean score, the four specific dimensions of the nutrition knowledge instrument were further analyzed in order to determine where the knowledge is most lacking.

Macronutrients

Ten of the 35 statements in the Sports Nutrition Knowledge Questionnaire assessed knowledge of macronutrients. Macronutrients can be divided into three important classes; proteins, carbohydrates, and fats. Protein plays a very important role in the human body, as it facilitates? the primary function and structural component of every cell. These roles include the growth and development to build and repair cells, as well as serving as enzymes, hormones, and transport carriers. Although carbohydrates are not an essential nutrient, the primary role is to serve as an energy source. Fat also is a main source of energy. In addition to providing energy, stored adipose tissue in humans also protects and insulates organs, regulates hormones, and carries and stores the fat-soluble vitamins A, D, E, and K (Institute of Medicine (U.S.). Panel of Macronutrients, 2005). Although humans' diets predominantly consist of macronutrients, this is the subcategory in which the student-athletes proved to know the least. The percentage of the macronutrient statements that were answered correctly throughout the sample was 49.29%. Significant amounts of protein, carbohydrates, and fats are required in the diet; therefore, it is very alarming that the participants of this study had the lowest level of knowledge in this area.

Micronutrients

The micronutrient subcategory included statements about vitamins and minerals. This category covered nine of the 35 statements. Vitamins are organic substances that are needed in

very small amounts, but are responsible for performing specific metabolic functions. They typically serve as co-enzymes and facilitate multiple reactions in the body. Minerals are also considered a micronutrient and contribute to the structure of bone, teeth, and nails. Minerals also are responsible for performing a wide variety of metabolic functions (Institute of Medicine (U.S.). Panel on Dietary Antioxidants and Related Compounds, 2000). Surprisingly, the student-athletes proved to know more about micronutrients then macronutrients. Overall, 57.48% of the statements about micronutrients were answered correctly. Although it may be difficult to assign importance to each of these subcategories, it is surprising that the student-athletes knew more about a subject of nutrition in which their body needs less of, than a subject which predominately makes up their diet.

Hydration

A subcategory was also assigned to the knowledge of the athletes' fluid and electrolyte needs. Proper hydration is a very important component of everyone's health, but it is critical for athletes to pay close attention to their hydration status. Athletes' sweat losses can often exceed their fluid intake, which can lead to a state of dehydration (Corris, Ramirez, & Van Durme, 2004). This can also cause their core body temperature in increase, their blood plasma volume to decrease, and their heart rate as well as their rate of perceived exertion to increase. In addition to fluids, sweat losses can also include a loss of electrolytes that are essential to nerve conduction and muscle contraction (Sawka & Coyle, 1999). The most predominant electrolyte lost in sweat is sodium chloride, which helps retain more of the fluid consumed. An imbalance of electrolytes in body fluids can potentially interfere with performance, so it is very important for athletes to be aware of their hydration needs (Kilding et al., 2009). Subsequently, the percentage of hydration statements answered correctly was the highest. Although this subcategory only consisted of 6 of

the 35 statements, the student-athletes demonstrated that they have an adequate level of knowledge about their hydration needs by answering 70% of the statements correctly.

Body Composition

The remaining statements were grouped into a subcategory including questions about eating habits and weight gain/loss. These nine questions measured the athletes' knowledge of healthy diet patterns and body composition. This knowledge can be very important because an athletes' ability to gain weight or lose weight depends on numerous factors. Diet and training both need to be altered in order to change body composition. Depending on an individuals' situation, calories consumed may need to be adjusted based on activity. For instance, if an athlete is trying to gain weight, they will need to increase their calorie consumption along with incorporating appropriate training. An athlete who is trying to cut weight in order to reach a certain weight class or to improve on certain aspects of performance, such as speed and endurance, will have a different approach. Although calories consumption may have to decrease, it is very important that the athlete understands their nutrient needs in order to lose weight while keeping up with their body's needs. The participants of this study scored the second highest in this subcategory with an overall combined percentage of 61.68%.

Endurance versus Non-Endurance

There was no significant difference found in the nutrition knowledge of endurance and non-endurance athletes. Endurance athletes had an average NKS of 59.37% while non-endurance athletes had an average NKS of 54.91%. Although statistically there is no significant difference, endurance athletes averaged nearly 5% higher than non-endurance athletes. While there isn't a considerable difference in nutrition needs of athletes who participate in endurance sports compared to non-endurance sports, studies have shown that there are noticeable benefits of

specific eating habits, such as carbohydrate loading, on performance in endurance athletes (NCSA, 2016). Unless these athletes have a reliable nutrition resource and are educated about these concepts, their only option is to use the resources they have available to them. For some, that may only include their coach.

A study conducted by Torres-McGehee et al. (2012) collected data from NCAA student-athletes, coaches, athletic trainers, and strength and conditioning specialists about who they felt the best resource was for nutrition information and from whom they actually received nutrition information. Of the 579 participants, 189 of which were athletes, an insignificant number of responses suggested that coaches were a good resource for nutrition, which is consistent with the other conclusion of the study that overall, the athletes and coaches both had a low level of nutrition knowledge. However, nearly 8% of the athletes reported that their coach is the resource they use for nutrition information.

The study by Torres-McGehee (2012) also concluded that in addition to having an inadequate level of nutrition knowledge, the athletes and coaches also reported that they were confident in many of the questions they answered incorrectly. This may suggest that the athletes in the current study may be misinformed or undereducated on nutrition because their coach may not understand the importance of nutrition, and may not prioritize it to the athletes.

Male versus Female

The findings of this study suggest that there were no significant differences in nutrition knowledge between males and females. This does not support previous results that have been found. In a study done by Holley (2015), using the same nutrition knowledge questionnaire and same scoring criteria, females had a significantly higher knowledge score than males in the NCAA Division I setting ($p = .008$) (Holley, 2015). Other studies done by Dunn et al. (2007) and

Worme et al. (1990) have also found that females had a significant higher level of their nutrition needs than males. One possible reason for this could be the priority that this group of females is assigning nutrition. Conceivably, the female athletes in this study may not understand the importance of nutrition as the female athletes of the previous studies have. There was no data collected in this questionnaire to measure important or value of nutrition so it is hard to definitively make this conclusion, but it is a possibility. Further research should be conducted to discover any possible development as to what may cause female athletes to be more knowledgeable about their nutrition needs than male athletes and if this is a trend that is changing.

Practical Implications

In the past, this university has offered a nutrition class for incoming freshmen student-athletes. One option would be to implement this class again by offering it at different times of the year, and to make it mandatory for all athletes. In addition to reincorporating this class, the athletic department could outsource an RD with a specialty in sports nutrition to consult with each team before their season. At the beginning of their corresponding season every year, all of the teams are required to meet and discuss the expectations of being a student-athlete with a variety of administrators such as the athletics director, athletic academic advisor, director of compliance, and a member of the sports medicine team. In addition to these presentations, the athletic department could allow time for a RD to present the importance of nutrition and provide the student-athletes with educational material in order to help them understand their nutrition needs throughout the season and off-season.

College athletic programs may also implement peer-educated programs (Holley, 2015) that were found to be effective in improving nutrition knowledge in female student-athletes

(Kunkel, Bell, & Luccia, 2001). Kunkel et al. (2001) investigated the effect of female peer educators on collegiate female athletes' nutrition knowledge. The study found that peer counseling had a significant positive impact on female student athletes' nutrition knowledge.

Nutrition intervention programs (e.g., food records) can also be useful in enhancing student-athletes' nutrition knowledge. Abood, Black, and Birnbaum (2004) and Villiant and colleagues (2012), who examined the effect of the nutrition education intervention programs, found that their intervention programs were effective in improving student-athletes' dietary intake after the interventions. For example, Villiant et al. (2012) measured the volleyball athletes' 3-day food record (pre and post-intervention), and following the intervention, they found a significantly improved intake of total energy, carbohydrate and protein.

All collegiate athletic departments should take into consideration the findings from this study as well as the other studies that were mentioned, and consider the possibility of providing the necessary resources to their student-athletes.

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APPENDICES

APPENDIX I:

Cover Letter

Dear Participants,

My name is Lauren Havermale, and I am a graduate student in the Sport Studies Program and a graduate assistant athletic trainer at Southern Illinois University. Thank you for agreeing to participate in this study. You must be at least 18 years of age to take part.

The main purpose of this study is to examine the knowledge of athletes' nutrition needs in endurance sports compared to non-endurance sports. The second purpose is to assess the difference of nutrition knowledge of men compared to women.

This study is being completed as a part of my graduate research paper. This questionnaire was divided into two parts. Section 1 is related to your demographic information. Section 2 asks you to answer a series of true/false questions measuring nutrition knowledge. It is estimated that this questionnaire will take approximately 10-15 minutes. Participation in this study will be entirely voluntary.

You may be assured of complete confidentiality. Individual responses will not be identified or reported. As the conclusion of the study, the data sheets and corresponding numbers on the questionnaires will be destroyed and disposed. The published and reported results of the study will not be linked to the name of any individual or institution, and any discussion will be based on group date. We will take all reasonable steps to protect your identity.

You may contact me at any time. It is estimated that the research project will be completed in the next few months. If you wish to have a copy of the results, please contact me. You may also contact my advisor, Dr. Meungguk Park at parkm@siu.edu. By completing this questionnaire, you are implying your consent. Thank you for your time and assistance.

Sincerely,

Lauren Havermale, ATC, LAT
Graduate Assistant Athletic Trainer
Southern Illinois University, Carbondale, IL 62901
E-mail: lauren.dieleman@siu.edu Tel: 270-227-7702

This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: siuhsc@siu.edu

APPENDIX II:

Questionnaire

Part 1: Demographic Information

To respond to this section, please indicate the appropriate response in the area provided.

What is your age? _____

What is your gender? ☐ Male ☐ Female

In which NCAA sport(s) do you participate?

☐ Baseball

☐ Basketball

☐ Cross Country

☐ Football

☐ Golf

☐ Softball

☐ Swimming & Diving; Event(s) _____

☐ Tennis

☐ Track & Field; Event(s) _____

☐ Volleyball

What is your current academic standing?

☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior ☐ Fifth-year Senior

Part 2: Sports Nutrition Knowledge Questionnaire

To respond to this section, please indicate your answer to each statement by marking the box that best corresponds to what YOU know about that statement.

	True	**False**	**Don't Know**
Carbohydrates are not as easily and rapidly digested as protein and fat	☐	✓	☐
Foods such as potatoes and honey are best eaten after exercise	✓	☐	☐
Eggs and legumes are examples of protein sources other than meats	✓	☐	☐
Protein is the primary source of muscular energy for the athlete	☐	✓	☐

Protein is not stored in the body; therefore, it needs to be consumed every day	✓	☐	☐
Increasing protein in the diet is necessary in order to increase muscle mass of the body	☐	✓	☐
No more than 15% of calories in the diet should be provided by fat	☐	✓	☐
Iron-deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood	✓	☐	☐
Cheese is a good source of iron in the diet	☐	✓	☐
Vitamin supplementation is recommended for all physically active persons	☐	✓	☐
Excess vitamin supplementation may harm the physically active person	✓	☐	☐
Vitamins are a good source of energy	☐	✓	☐
Carrots are a good source of vitamin A	✓	☐	☐
Whole milk is a better source of vitamin D than skim or 2% milk	☐	✓	☐
Fiber in the diet may help to decrease constipation, decrease blood cholesterol levels, and prevent cancers	✓	☐	☐
Dehydration can impair physical performance	✓	☐	☐
During activity, thirst is an adequate guide to the need for fluids	☐	✓	☐
During exercise, mass ingestion of large amounts of fluid is preferred over frequent ingestion of small amounts	☐	✓	☐
Sports drinks are the best way to replace body fluids lost during exercise	☐	✓	☐
Alcohol has more calories per gram than protein	✓	☐	☐
Caffeine can increase the risk of dehydration	✓	☐	☐
An athlete involved in endurance events (eg, distance running) should follow a considerably different diet than one participating in events of short duration (eg, sprinting)	☐	✓	☐

A physically fit person eating a nutritionally adequate diet can improve his or her performance by consuming great amounts of nutrients	☐	✓	☐
A 200-pound person uses about twice as many calories to run a mile as a 100-pound person	✓	☐	☐
A person with a higher percentage of body fat may weigh less than a person of the same size with a greater muscle mass	✓	☐	☐
A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day	✓	☐	☐
Skipping meals is justifiable if you need to lose weight quickly	☐	✓	☐
When trying to lose weight, acidic foods such as grapefruit are of special value because they burn fat	✓	☐	☐
If trying to lose weight, carbohydrates should come from fruits and vegetables rather than from breads and pastas	✓	☐	☐
Nutrition is more important during the competitive season than during the off-season for the athlete	☐	✓	☐
A high fat meal, which is slowly digested, should be avoided before athletic events	✓	☐	☐
The pre-event meal should be eaten about 3-4 hours before competition	✓	☐	☐
What the athlete eats is only important if the athlete is trying to gain or lose weight	☐	✓	☐
An athlete should drink no water during practice, but rather rinse out his or her mouth or suck on ice cubes	☐	✓	☐
A lack of iron in the diet can result in fatigue, injury, and illness	✓	☐	☐

VITA

Graduate School
Southern Illinois University

Lauren Havermale

Lauren.havermale@gmail.com

Culver-Stockton College, Canton, Missouri
Bachelor of Science, Athletic Training, May 2015

Research Paper Title:
Nutrition Knowledge Of Collegiate Athletes In Endurance And Non-Endurance Sports

Major Professor: Meungguk, Park (Ph.D)