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Evaluation of knowledge, beliefs and use of nutritional ergogenic aids among collegiate athletes

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Evaluation of Knowledge, Beliefs and Use of Nutritional Ergogenic Aids Amongst Collegiate Athletes

(TITLE)

BY

Mekenzie Lewis

THESIS

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Abstract

The purpose of this study was to determine the NEA knowledge and practices of collegiate athletes. Participants of the study included 152 Division I collegiate athletes from a small Midwestern university. Athletes were both male and female participants of rugby, basketball, baseball, soccer, swimming, and/or track and field during the 2011-2012 school year. A 14 item questionnaire was developed based on concepts associated with misconceptions or wide spread beliefs about these NEAs identified through review of sports nutrition peer reviewed research articles, published text books, and based on personal experiences with college athletes. Content accuracy was established by review of instrument by professionals in the field; further, validity and was established by a pilot study. The questionnaires were all completed simultaneously in a group setting in the presences of the researcher. Descriptive statistics were determined for all variables, including demographic information, use of NEAs, and knowledge based test scores.

The mean knowledge score for all athletes was 69%; NEA users had a mean score of 68.6%, while non-NEA users, had a mean score of 80%. Athletes appeared more knoweldgable about some concets than others; however, common misconceptions, scuh as supplements being a necessity, were held by some. Athletes using

NEAs were found more likely to agree that nutritional supplements are the most effective way to build muscle and increase energy. Of the 152 participating athletes, only about half reported utilizing some form of NEA. The overwhelming majority of NEA users reported using protein, while creatine and caffeine were only being used by 15% and 8%, respectively. For men, building muscle was the main motivation, followed by doctor/coach recommendation. In women, the most popular reason for use was even cited between doctor/coach recommendations and to build muscle. By enhancing the NEA knowledge of athletes, they may be able to make more informed decisions in regard to NEA utilization, as well as overall nutrition for good health and optimal athletic performance.

DEDICATION

I would like to dedicate this thesis to the strongest woman I know, and most amazing mother, Michelle Lewis. Your indomitable will and "never give up" attitude provided me the motivation to complete this project. The positive support system you have always provided me with is something I can never thank you for enough, especially during the course of this thesis. Thanks to you I have climbed my mountain- keep climbing yours.

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Chapter I

Introduction

Nutrition is a crucial factor in an athlete's training program. Although exercise and physical training are known to increase some nutrient needs in athletes, a balanced diet with adequate calories can potentially provide the necessary nutrients needed for athletes (American Dietetic Association, 2000; Maughan, King, & Lea, 2004). However, not all athletes are able to consume a diet that meets their nutritional needs and may choose to utilize nutritional ergogenic aids (NEAs) with the intention of enhancing performance (Maughan et al., 2004).

It is a common desire for athletes to gain an edge in their sports, and attain an advantage over their competitors, especially at the collegiate level (Lombardo, 2004). Today NEAs are being used so frequently to enhance performance that they are considered a mainstream concept in the sports arena. An NEA is anything ingested by the body that enhances a person's ability to perform better (Ahrendt, 2001). The ultimate goal of using ergogenic aids is to gain a competitive edge over the opponent (Fink, Burgoon & Mikesky, 2006). In recent years, research indicates that athletes as young as thirteen are

experimenting with these NEAs to improve both appearance and athletic abilities (Calfree & Fadale, 2006). Researchers Maughan, Depiesse, and Geyer (2009) have reported that 40-60% of young athletes have taken NEAs to improve performance, as well as 85% of elite track and field athletes.

Today's athlete is more highly influenced by the well-established NEA industry to make the decision to engage in supplementation. According to Santella (2005), athletes cite many reasons for using NEAs, including: preventing illness/boosting immunity; treating injuries; increasing energy levels; feeling better; improving physical appearance; compensating for an inadequate diet, and building muscles. They also cite recommendation from a family member, team mate, nutritionist or physician; or other athletes' use as reasons for taking them. In 1994, the Dietary Supplement Health and Education Act was established. This act removed the obstacle of regulatory control by the Food and Drug administration over the development and distribution of dietary supplements, such as NEAs, to consumers (Lombardo, 2004).

Purpose/Objectives

The purpose of this study was to determine the NEA knowledge and practices of collegiate athletes. The specific objectives identified and addressed in the study were:

- To determine the knowledge level of college athletes regarding NEAs
- To determine the most widely accepted perceptions/beliefs about NEAs
- To evaluate the use of NEAs amongst collegiate athletes

Significance of the Study

This study contributed to the preexisting body of knowledge related to the prevalence of NEAs in collegiate athletics and how athletes practice the use of said NEAs. It also aided in the understanding of what collegiate athletes believe to be true about NEAs and how they used them. Findings from this study indicated the need for further education on specific topics related to NEA use.

Assumptions

-Participants are familiar with the supplements

-All athletes invited to participate will indeed do so

-Participants may not answer questions honestly

-NEA users will condone use

Definition of Term

For the purpose of clarity, the term referred to in this study is defined as follows:

Nutritional ergogenic aid (NEA)- substances or devices that enhance energy production, use or recovery and provide athletes with a competitive advantage (Ahrendt, 2001)

Chapter II

Review of Literature

Introduction

The purpose of this study is to determine the NEA knowledge, beliefs and practices of collegiate athletes. This review of literature will examine the background and trends of supplement use and explore the three most widely used NEAs.

NEAs are substances or devices that enhance energy production, use or recovery and provide athletes with a competitive advantage (Ahrendt, 2001). In 1994, the Dietary Supplement Health and Education Act was established. Under this act, the manufacturers of dietary supplements or dietary ingredients are responsible for ensuring that a dietary supplement/ingredient is safe before it is marketed. The United States Food and Drug Administration (FDA) is responsible for taking action against any unsafe dietary supplement product after it reaches the market (US Food and Drug Administration, 2010). So, unlike other substances prescribed by doctors, dietary supplements and NEA are not subjected to the scrutiny by the FDA, nor are they tested through clinical trials for safety or efficacy and, therefore, may not have any scientific basis for use(Santella, 2005).

The quest for performance-enhancing supplements is not new. A study, done at the Harvard School of Public Health, found that in the year 2000, dietary supplement sales reached $15.7 billion, with 48% of Americans indicating that they had used a supplement at one time or another (Santella, 2005). The most common ergogenic aids include creatine, caffeine and buffers but also include isolated proteins and herbal preparations (Australian Institute of Sport, 2010). Also common are anabolic steroid and sympathomimetics such as ephedrine and ma huang, however these illegal NEAs are associated with a number of serious adverse effects, some irreversible (Ahrendt, 2001).

Protein

According to Hoffman and Falvo (2004) proteins have long been known as the building blocks of muscle. Proteins are nitrogen-containing substances that are formed by amino acids. They serve as the major structural component of muscle and other tissues in the body. In addition, proteins produce hormones, enzymes and hemoglobin. Proteins can also be used as energy; however, they are not the primary choice as an energy sources.

Protein supplementation has been a mainstay in the training programs of athletes for many years (Lombardo, 2004). Protein supplements have been recommended to

athletes to enhance nitrogen retention, increase lean body mass, prevent protein catabolism during prolonged exercise, and support an increased synthesis of hemoglobin, myoglobin, oxidative enzymes, and mitochondria during aerobic training (Williams, 1998).

An article by Hoffman et al. (2004), states that there are different options when it comes to protein supplements. The most popular type is whey protein, a major protein found in cow's milk. Whey is one of the two major protein groups of bovine milk, accounting for 20% of the milk while casein accounts for the remainder. All of the constituents of whey protein provide high levels of the essential and branched chain amino acids. The bioactivities of these proteins possess many beneficial properties as well. Additionally, whey is rich in vitamins and minerals. Whey protein is most recognized for its efficacy in sports.

Casein, the major component of protein found in bovine milk, accounts for nearly 70-80% of its total protein and is responsible for the white color of milk. It is the most commonly used milk protein in the industry today. Casein is rarely used due to its decreased efficacy. Two less popular types of protein are egg protein and soy protein powders which are derived from egg whites and soy beans, respectively (Hoffman et al, 2004).

The Recommended Daily Intake of protein for healthy adults is 0.8 grams protein per kilogram of body weight per day, but research suggests that athletes need more protein to support their increased rate of muscle break down and synthesis. The recommendation for protein intake among athletes is within the range of 1.0-2.0 grams protein per kilogram of body weight per day, depending on type and intensity of exercise (Burke, Chilibeck , Davidson , Candow , Farthing , & Smith-Palmer, 2001). Protein recommendations for strength athletes' are 1.6-1.8g per kilogram of body weight, while protein recommendations for endurance athletes are 1.2-1.6 g per kg body weight (Williams, 1998).

Protein supplementation has been associated with minimal side effects. It is important to understand that absence of resistance or aerobic exercise when consuming protein beyond an athlete's need can lead to weight gain, due to the abundance of protein and excess energy consumed (Santella, 2005).

Creatine

According to The American College of Sports Medicine (1998) creatine is a nitrogenous organic acid that occurs naturally in animals and helps to supply energy to muscle

and nerve cells. Our body's pool of creatine can be replenished through food, supplements or by synthesis from precursor amino acids. Most of muscle creatine is stored in the form of phosphocreatine. The breakdown of phosphocreatine results in ATP, which is the major energy compound in our bodies. It is thought that creatine supplements might enhance accumulation of creatine and phosphocreatine in muscles, however findings are inconclusive as studies yield conflicting results; efficacy is undetermined. According to McArdle, Katch & Katch (2007), Creatine is comprised of three amino acids: glycine, arginine and methionine and the majority of synthesis takes place in the liver, kidneys and pancreas. The body only synthesizes about 0.7g to 1g of creatine daily. Skeletal muscle contains approximately 95% of the body's total creatine. Though muscle is the primary storage site for creatine, it is also stored in smaller quantities in the brain, liver, kidneys and testes (Lamb & Murray, 1999).

Other benefits include assisting muscles in production and circulation of more adenosine triphosphate (ATP), therefore increasing energy production, as well as delaying muscle fatigue (McArdle, Katch, & Katch, 2007).

Creatine supplementation has become a common practice among professional, elite, collegiate, amateur, and recreational athletes with the expectation of enhancing exercise performance (Terjung, Clarkson, Eichner, Greenhaff, Hespel, Israel, Kraemer, Meyer, Spriet , Tarnopolsky, Wagenmakers, & Williams, 2000). Some of the proposed ergogenic benefits of creatine include: improved power and strength performance, fuels short muscular bursts, and enhanced training capabilities by allowing for greater muscular overload (McArdle, Katch, & Katch, 2007).

The mechanism by which supplementary creatine could have potential ergogenic effects would be an increased muscle creatine and phosphocreatine concentration, leading to a higher rate of ATP resynthesis, a delay in the onset of muscular fatigue and a facilitated recovery during repeated bouts of high-intensity exercise (Padilla, 1997). This occurs by using creatine as a phosphate ion donor to ADP molecules, to increase the availability and production of ATP (Lamb & Murray, 1999). No serious adverse effects from creatine supplementation have been reported in studies looking at acute supplementation of four years or less. Because creatine is a nitrogenous compound, some data suggests the kidneys and liver are prime targets for

dysfunction. The most commonly reported side effects of creatine are mild and mainly consist of gastrointestinal symptoms, including loss of appetite, stomach discomfort, diarrhea, or nausea/vomiting (Santella, 2005; McArdle, Katch, & Katch, 2007; Bahrke & Yesalis, 2002). Also, weight gain and body mass increases are to be expected (between .5-5 kg) as a result of water retention in muscle tissue. This draws water away from other parts of the body, often leading to muscle cramping and electrolyte imbalance, secondary to dehydration (McArdle, Katch, & Katch, 2007; Bahrke & Yesalis, 2002).

Among nutritional substances suspected of having ergogenic effects, creatine has become extremely popular. It is currently the most widely used sports supplement taken by both recreational and professional athletes (Lamb & Murray, 1999; Murray, Maschke, & Wasunna, 2009). Published reports suggest that approximately 25% of professional baseball players and up to 50% of professional football players consume creatine supplements (Mayo Clinic, 2010). The acknowledged use of creatine by such professional athletes has contributed to the supplements popularity (Santella, 2005; Bahrke & Yesalis, 2002). It is becoming increasingly popular in collegiate and high school

athletics. While these users are most commonly adolescent males involved in resistance training, it has been indicated that in high school athletics creatine is commonly used among football players, wrestlers, hockey players, gymnasts, and lacrosse players. Although as many as 28% of collegiate athletes admit taking creatine, there is little information about creatine use or potential health risk in children and adolescents. (Metzl' JD, Small, E, Levine' SR, and Gershel JC, 2001).

Caffeine

Caffeine is the most widely ingested psychoactive drug in the world (Sinclair & Geiger, 2000; Paluska, 2003). It's use is legal and only at high, but readily attainable, levels is it banned from sports. Its use is widespread by athletes as young as 11 years of age who are seeking athletic advantage over fellow competitors. It is likely that caffeine's use will not decline any time soon because it is inexpensive, readily available, medically safe, socially acceptable, and by most measures legal (Sinclair &Geiger, 2000). Caffeine augments the simulatory effects of ephedra (Bell, Jacobs, & Zamecnik, 1998). Caffeine is thought to act as a central nervous system stimulant and to have effects on physical, cognitive and psychomotor functioning (Hogervorst et al., 2008), thus it has been

made a subject of ergogenic investigation. Some of the most common claims made regarding the ergogenic benefits of caffeine are that it improves performance and endurance during prolonged, exhaustive exercise, it enhances short-term, high-intensity athletic performance, improves concentration, reduces fatigue, and enhances alertness (Paluska, 2003).

According to Spriet (1995), due to supporting evidence of its ergogenic effects, caffeine remains a substance of controversy in the world of sports. Because caffeine is a drug and yet is part of a normal diet, the International Olympic Committee (IOC) had placed a limit on the amount that could be consumed before exceeding 'doping' limits. However, since January 2004 the IOC removed caffeine from its banned list, though a blood content limit still exists. Ergogenic effects of caffeine occur when ingested in doses of 5-6mg/kg of body mass; an amount which results in urine values of caffeine lower than the previous IOC limit. Currently, the NCAA has a caffeine blood content limit of 15 micrograms per mL (Jenkins, 2010). Upon ingestion, caffeine is absorbed in the stomach and intestines, reaching all the body's tissues within five minutes, yet peak blood levels aren't reached until 45 minutes to an

hour post ingestion (Herman & Young, 1998; Woolf, Bidwell & Carlson, 2008). For maximum benefit, it is suggested that users refrain from caffeine 3-4 days prior to use. This allows for the tolerance levels to decrease, making the body more susceptible to caffeine when consumed (Kreider, 1999).

Athletes should also be aware of the side effects associated with consuming the legal limit of caffeine. Routine caffeine consumption may increase tolerance or cause dependence, and abrupt discontinuation of caffeine intake may produce irritability, mood shifts, headache, drowsiness, restlessness, nervousness, insomnia, tremors, hyperesthesia, dieresis and fatigue. Major organizations governing athletic competitions ban excessive use of caffeine, but current monitoring techniques are inadequate, and ethical dilemmas persist regarding caffeine intake by athletes (Paluska, 2003; Dunagan, Greenleaf, & Cisar 1998).

Doping and Prohibited Substances

Fink, Burgoon, and Mikesky (2006) define doping as the practice of enhancing performance through the use of foreign substances or other artificial means. Doping has become an epidemic in sports and not only presents risks to the health of athletes, but also to the basic tenet of fair

play in competition. The prohibited doping substances used by athletes rang from natural herbs to chemically engineered compounds, including: stimulants, narcotics, anabolic steroids, hormones and hormone releasers, glucocorticosteroids, and beta-2 antagonists (Fink, Burgoon, & Mikesky, 2006).

Preclinical, clinical, and anecdotal reports suggest that steroids may contribute to psychiatric dysfunction. Research also indicates that some users might turn to other drugs to alleviate some of the negative effects of anabolic steroids. Additionally, they are highly addictive. One of the most dangerous withdrawal symptoms is depression. When persistent, depression can sometimes lead to suicide attempts (National Institute on Drug Abuse, 2009). According to Tokish, Kocher & Hawkins,(2004), in spite of numerous reports on the health risks of anabolic steroid use, 1 to 3 million Americans have used them. Human growth hormone has been tried by up to 5% of 10th graders, although no scientific study has shown that it is an effective performance-enhancing drug. Amphetamines and similar compounds may be the most widely abused drug in baseball; recently, they have come under increased scrutiny in sport. Erythropoietin is a highly effective aerobic

enhancer that has been linked to multiple deaths in cyclists and other endurance athletes.

Addiction, masculinization (in females), and additional drug use to combat side effects are some of the negative consequences suffered from anabolic steroid use. According to Greydanus and Patel (2002), ephedra and ma huang, both potent stimulants, are two other doping aids that have also developed reputations for their negative side effects. These incidents involved otherwise healthy young adults who developed a variety of complications while taking these products including: hypertension, arrhythmias, anxiety, seizures, cerebrovascular accidents, heat attacks, and even death.

Current Research

After reviewing claims, functions, and effects of the aforementioned NEAs, there is still more to consider before engaging in a supplement regimen. The knowledge level the athlete possesses about the aid they are using can affect the results they experience. Increased knowledge of proper NEA use may lead to increased results. Understanding the aid's mechanism of action in the body, the benefits/risks

associated with usage and proper dosing can contribute to effective ergogenic aid practice.

A survey by Duellman, Lukaszuk &Prawitz (2008), was administered to 61 high school football players (39 of which were supplement users and 22 non supplement users.) The purpose of the survey was to determine supplement use, sources of information and misconceptions. Athletes using protein supplements were found more likely than non-protein supplement users to agree that athletes should take protein and needed supplements to gain as much muscle as possible. Greater misconceptions for protein supplement users may have resulted from the sources chosen for information and advice, which were found to primarily be coaches, parents, and friends. The researchers recommended nutrition education to these groups to dispel ongoing misconceptions regarding the effectiveness of supplement use (Duellman, Lukaszuk & Prawitz, 2008).

Another study conducted by Froiland, et al. (2004) utilized a survey to examine the sources of information and usage of nutritional supplements in 115 male and 88 female varsity athletes from a Division I university. Athletes were 19 years of age or older. Demographic information revealed that 66% of participants were Caucasian, 10% were

African American, 3% were Asian, 3% were Hispanic, 2% Native American, 3% were other and 14% were unknown. Sports represented in the survey included baseball, softball, volleyball, tennis, football, wrestling, bowling, yell squad and dance team, basketball, soccer, gymnastics, golf, track and field, swimming and diving and rifle. Participants were asked to define the term supplement, report supplement use and type, and reason for use. Results indicated that 89% of the subjects had used or were currently using nutritional supplements. The most frequently used supplements were energy drinks (73%), calorie replacement products of all types (61.4%), multivitamin (47.3%), and creatine (37.2%). Females were more likely to obtain information from family members regarding supplementation. Males sought information from supplement retailers, fellow athletes, friends or a coach. Overall females generally indicated their use to be for health purposes, while males reported supplementing to improve speed, agility, strength, power, and for muscle/weight gain.

Hoffman (2008) conducted a multistate, cross-regional study done to examine nutritional supplementation and anabolic steroid use in adolescent males and females, and

investigate their knowledge, beliefs, and sources of education on supplementation. The researchers used a self-reported survey with 3,248 high school aged students in 12 states. Findings indicated that use of at least one supplement was reported by 71 percent of participants. High energy drinks and multivitamins were the most frequently used NEA. The use of supplements for the purpose of altering body composition increased with age and was more prevalent in males than females. Researchers also concluded that adolescents seemed willing to take more risks with supplements to achieve their fitness/athletic goals, even if these risks endangered their health.

A similar study by Scofield and Unruh (2006) focused specifically on adolescents in central Nebraska. The purpose of this study was to investigate the prevalence of dietary supplement use among adolescent athletes, and identify the sources these student-athletes used for acquiring information about dietary supplements. One hundred thirty nine high school athletes were administered a 16 question survey consisting of questions about use of dietary supplements, reasons for use, type of sport participation, and sources of information regarding supplements. Of those reportedly taking supplements, the

most popular reason given was to improve sports performance. Thirty eight percent of users indicated their coach as their main sources of information on dietary supplements.

Another study was conducted by Dascombe, Karunaratna, Cartoon, Fergie, and Boodman (2010) to examine the nutritional supplement intake of athletes from a state-based sports institute. Seventy two athletes from seven sports (kayaking, field hockey, rowing, water polo, swimming, athletics and netball) completed a questionnaire detailing their daily usage and reasons for use. The large majority (87%) reported using nutritional supplements, with no difference between female and male athletes. Kayakers consumed a higher number of nutritional supplements than all other athletes in the study. The athletes believed that nutritional supplements are related to performance enhancements, positive doping results, and that heavy training increases supplement requirements. The most popular supplements were minerals, vitamins, iron, caffeine, protein, protein-carbohydrate mix, creatine, and glucosamine. Sixty three of supplementing athletes did not know their supplements active ingredients, side effects or mechanism of action and admitted to wanting additional

information. Only half of the athletes knew the recommended supplement dosages. The performance enhancing perception may explain the large proportion of athletes that reported using nutritional supplements, despite their lack of knowledge of the supplement.

A final study by Kristiansen, Levy, Barr and Flint (2005) involving varsity and non-varsity athletes at a Canadian university assessed athletes' reasons for and prevalence of supplement use. Two hundred forty seven varsity athletes and 204 non-varsity athletes were distributed a questionnaire regarding sports participation, supplements used, reasons for usage, perceived effects, and areas of interest about supplements. Responses established that supplements were used by 98.6% of varsity athletes and 94.3% of controls. Among varsity men, sports drinks were the most often used NEA. Varsity men also reported more overall use of NEA (including carbohydrate gels, protein powder, and creatine) more than varsity women. Caffeine products were most often reported by other groups. Health professionals and the internet were the most cited outlets for NEA information sources, with peer use/recommendation most often cited as the main influence for utilization. Many athletes indicated knowing little about supplements

and wanting to learn more, thus researchers concluded this indicates a need for further nutrition education among both varsity athletes and university students.

Conclusion

Overall, numerous nutritional ergogenic aids have been used in attempts to enhance performance, but with several exceptions most have been shown to be ineffective and further research is needed to determine these mechanisms (Williams, 1992; Kreider, 1999). Athletes use NEAs for various reasons, and have been found to be guided by misconceptions of the proposed benefits they possess.

Chapter III

Methodology

Description of Design

The purpose of this study was to determine the NEA knowledge and practices of collegiate athletes. Data was collected using a questionnaire evaluating knowledge and perceptions of NEAs and personal utilization practices (Appendix A). Questionnaires were completed in a group setting in the presence of the researcher.

Subjects

Participants of the study included 152 Division I collegiate athletes from a small Midwestern university. Athletes were both male and female participants of rugby, basketball, baseball, soccer, swimming, and/or track and field during the 2011-2012 school year. Athletes ranged in age 18-22 years from all class levels.

Instrumentation

A questionnaire was developed by the researcher for this study to evaluate athlete's preexisting knowledge level, perceptions/beliefs, and utilization practices of NEA. The instrument was tested for validity and reliability in a pilot study of 35 NJCAA athletes completing the questionnaire as designed.

The questionnaire consisted of 14 questions. Nine of the questions dealt with various aspects of the three most widely used ergogenic aids: protein supplements, creatine, and caffeine. An additional 5 questions regarded utilization practices. Concepts associated with misconceptions or wide spread beliefs about these NEAs were identified through review of sports nutrition peer reviewed research articles, published text books, and based on personal experiences with college athletes. The questions were constructed to assess knowledge of these specific concepts.

Questions 1-9 on the survey used a four point scale of 1 (strongly disagree), 2(disagree), 3(agree), and 4(strongly agree)to indicate reaction to the statements developed from the sports nutrition literature and personal experiences. Subject matter of these questions included various aspects such as protein needs, NEAs side effects, appropriate dosing of caffeine, and belief in efficacy of NEAs. Demographic questions included sport, gender, age, year in school, and ethnicity. Further multiple choice and open ended, fill in the blank questions inquired about personal use of NEAs. To ensure the content and format of the questionnaire was appropriate and valid before

distribution, the tool was assessed by professionals in the field.

Pilot Study

A pilot study was conducted for this research in order to test the questionnaire. The questionnaire was administered to a convenience sample of 35 NJCAA swimmers (females=16, males=17) from a Midwestern junior college. It was distributed in a group setting, with 35 copies distributed, completed, and returned in the presences of the researcher. The pilot study was conducted to determine the questionnaire's validity before distributing it to the larger study population. Upon completion of this pilot, no changes or additional alterations were needed to increase validity. However, after consideration of participant perception and input from advisory superiors, the questionnaire was condensed to one document, as it was previously two individual sets of questions.

Data Collection

The coaches of each sports team were contacted by the researcher, to obtain permission for their athlete's to participate in the study. Participants agreed to consent in participation by completing an official IRB informed consent document. Team data collection meetings were

scheduled, and questionnaires were all completed simultaneously in a group setting. The researcher explained the instructions and distributed the questionnaires.

Data Analysis

For the knowledge based questionnaire, correct and incorrect responses were awarded one and zero points, respectively. Responses of strongly agree or agree were considered correct responses for true statements; responses of disagree or strongly disagree were considered correct responses for false statements. Scores received for each item were added together to calculate a total knowledge score, with a possible total score between zero and nine.

Descriptive statistics were determined for all variables, including demographic information, use of NEAs, and knowledge based test scores.

Chapter IV

Results and Discussion

Sample Characteristics.

The sample for this study consisted of 152 varsity college athletes in: track and field (47), swimming (27), soccer (19), baseball (27), rugby (18), and basketball (14). Athletes ranged in age from 18 to 22 years. All class levels were represented with 31% freshmen, 28% sophomores, 24% juniors, and 17% seniors. Forty two percent of participants were females with the remaining 48% being male.

NEA Knowledge

Athletes were asked to respond to 9 true or false statements about NEAs and athletics using a four point Likert-type scale from strongly agree to strongly disagree. Athletes were credited with a correct response (one point) when they strongly agreed or agreed with a true statement and when they disagreed or strongly disagreed with a false statement. Each athletes' total number of correct responses served as his/her total knowledge score. Possible knowledge score ranged from 0 to 9.

In an analysis of all athletes' answers, actual scores ranged from 1 to 9, with a mean score of 6.21 (69%

correct). Of NEA users, scores ranged from 1 to 9, with a mean of 6.18 (68.6% correct). Of non-NEA users, scores ranged from 2-9, with a mean score of 7.2 (80% correct). Frequency distributions of all athletes' correct responses to the knowledge based questions are listed in Appendix B.

Athletes were knowledgeable about nutrition. Eighty-four percent agreed that protein requirement for an average adult is 0.8-1.0 g/kg body weight. Respondents were also knowledgeable about protein needs of athletes. Eighty-eight percent answered correctly that needs are substantially higher in athletes, compared to non-athlete's. Respondents were less knowledgeable about the efficacy of nutrition supplements, with only 43% understanding that nutritional supplements are not necessary for optimal performance. Also, only 53% disagreed that eating more protein than is recommended helps increase muscle mass and strength.

NEA Beliefs

Athletes using NEAs were found more likely to agree that nutritional supplements are the most effective way to build muscle and increase energy. 51% percent of athletes that use agreed with this statement, compared to 33% of non-users who agreed. These results were consistent with

findings from Duellman, Lukaszuk & Prawitz (2004). However, of the 80 athletes that reported using NEAs, 70 (90%) felt they experienced benefits. Forty one (51%) of athletes using NEA agreed that consuming NEAs is the most effective way to build muscle and increase energy. These findings clearly depict the confidence and conviction the participating athletes have in the efficacy of NEAs. This is similar to Dascombe et al. who reported that athletes believed nutritional supplements are related to performance enhancements, positive doping results, and that heavy training increases supplement requirements. As assumed in chapter one, NEA users were in fact, found to condone the utilization of NEAs and felt they directly benefitted from consumption.

NEA Practices

Of the 152 participating athletes, only 80 (53%) reported utilizing some form of NEA. A study by Froiland et al. found 89% of participating athletes used NEAs. A similar study by, Hoffman found 71% of athletes utilized NEAS. A final study by Dascombe et al. found 87% of athletes used NEAs. Demographically speaking, 19 year old, white, males were the most highly represent population of reported NEA users. The supporting studies did not give

detailed findings for age or ethnicity, however, Kristiansen, Levy, Barr and Flint concluded that men used NEA more than women. Findings from the current study align with these conclusions, with 34% of NEA uses being women and 66% being male. Of all sports represented, baseball players consumed a higher number of nutritional supplements than all other athletes in the study, with 89% of the team reporting use of NEAs.

The overwhelming majority of NEA users (73%) reported using protein, while creatine and caffeine were only being used by 15% and 8%, respectively. Additional NEAs listed included beta alanine, nitric oxide, and multivitamins. The most popular time of NEA consumption was immediately following a workout/practice session, as reported by 90% of users. Additionally, 36% reportedly consumed NEAs prior to exercise, and < 1% consume NEAs while exercising. Studies by Kristansen (2005), Hoffman (2008), and Froiland (2004) all found energy drinks to be the most commonly used form of NEA. Though the current study did not particularly ask about "energy drinks," caffeine was an NEA of question. Had the term "energy drink" been specifically stated in the questionnaire, responses may have been different, altering the results.

Reasons for NEA utilization included: to increase energy (20%), to improve physical appearance (21%), to build muscle (74%), influence of other athletes (3%), and doctor/ coach recommendation (29%). For men, building muscle was the main motivation (87%) followed by doctor/coach recommendation (17%). Other studies by Froiland et al. (2004) and Schofield (2006) had similar findings with reasons for NEA use in males being to improve performance, specifically to increase speed, power, and muscle. In women, the most popular reason for use was even cited between doctor/coach recommendations (52%) and to build muscle (48%), which is in agreement with the findings of Foiland et al. (2004), which found females' main reason for NEA use was for health purposes. Hoffman (2008) found a trend in results indicating the use of NEAs for the sake of improving physical appearance was more prevalent as age increased, with males citing physical appearance as a reason for NEA consumption more than females. Frequency distributions of all athletes' NEA utilization practices are listed in Appendix C.

Chapter V

Summary, Conclusions, and Implications

This study examined the NEA knowledge, perceptions/beliefs, and practices of 152 collegiate athletes. The data was analyzed to determine the knowledge level of college athletes regarding NEAs, to determine the most widely accepted perceptions/beliefs about NEAs, and to evaluate the use of NEAs amongst collegiate athletes. Collegiate athletes were found to be generally knowledgeable about NEAs, however, some athletes still held common misconceptions concerning optimal nutrition for athletes.

The analyses suggest that athletes are fairly well educated on various aspects of the three NEAs that were studied: protein, creatine, and caffeine. Although the overall group average score was favorable, there were still many individual questionnaire scores demonstrating a need for education on NEAs. This suggests some NEA principles are more widely recognized than others. Non-users yielded a higher mean score than users did. This suggests that consumption of NEAs does not necessarily imply self-education on the products. This also suggests that non-NEA

users are making an educated decision when choosing to abstain from NEA consumption.

The responses to the utilization practices portion of the questionnaire suggest that slightly half of collegiate athletes consume some form for NEA. The most highly cited reason overall for NEA use was 'to build muscle.' However, as a group, females cited 'doctor/coach recommendation' as their main reason for use. These findings indicate that while some athletes appear uneducated on the topic of NEAs, it is the recommendations of professionals to begin using NEAS that provoke consumption in others. This might imply that these athletes are receiving appropriate education and referral for NEA use.

The greater part of athletes using NEAs were found more likely to agree that nutritional supplements are the most effective way to build muscle and increase energy. Of these athletes the vast majority felt they experienced benefits. As assumed in chapter one, NEA users were in fact, found to condone the utilization of NEAs and felt they directly benefitted from consumption. This suggests that NEA users are more likely to believe they are reaping benefits, merely based on anticipation of perceived effects.

By enhancing the NEA knowledge of athletes, they may be able to make more informed decisions in regard to NEA utilization, as well as overall nutrition for good health and optimal athletic performance. Coaches would also benefit from NEA education, as they would further be able to counsel their athletes on the appropriateness of NEA practices.

Further research is needed to determine the relationship between NEA knowledge, perceptions/beliefs, and practices. Additional research is also needed to determine the most effective method of presenting NEA information to athletes and coaches in order to develop effective nutrition education programs.

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Appendix A

QUESTIONAIRRE

SPORT: _____

GENDER: M F

AGE: _____

YEAR: Fr So Jr Sr

ETHNICITY: African American Asian Caucasian Pacific Islander Hispanic

Statements about nutrition ergogenic aids (supplements) are given below. Please indicate your reaction to each statement by selecting the alterative that best describes how you feel about the statement.

Using a scale of don't know, strongly agree, agree, disagree, or strongly disagree, circle the corresponding number:

0 if you do not know (DK)

1 if you strongly disagree with the statement (SD)

2 if you disagree but do not feel strongly about the statement (D)

3 if you agree but do not feel strongly about the statement (A)

4 if you strongly agree (SA)

		DK	SD	D	A	SA
1	Protein intake for an average adult is .8-1 g/kg body weight.	0	1	2	3	4
2	Protein needs of most athletes are substantially higher than the needs of nonathletes.	0	1	2	3	4
3	Creatine supplementation has virtually no negative side effects	0	1	2	3	4
4	Eating more protein than is recommended helps to increase muscle mass and strength	0	1	2	3	4
5	Creatine supplements are the fastest and most effective way to build muscle mass.	0	1	2	3	4

6	There is no such thing as an acceptable dose of caffeine.	0	1	2	3	4
7	Creatine and creatinine are the same thing.	0	1	2	3	4
8	Taking nutritional supplements is the most effective way to build muscle and increase energy.	0	1	2	3	4
9	Nutritional supplements are necessary for optimal performance of the athlete.	0	1	2	3	4

10. Do you use nutritional supplements? Y N

11. If so, what supplements do you use:

a. Caffeine b. Creatine c. Protein
Other_____

12. When do you supplement?

a. Before activity b. Immediately after c. During

13. What influenced you to begin supplementing?

a. increase energy

b. treat injury

c. other athletes are taking them

d. encouraged by a coach/teammate

e. improve physical appearance

f. build muscle

g. recommended by a doctor

Other_____

14. If you do supplement, list the supplements you use and indicate what benefits you believe you gain from each.

Appendix B

Responses of Athletes to Knowledge Items:

Frequency Distributions

	College Athletes Selecting the Correct Responses	
	N	(%)
Protein intake for an average adult is 0.8-1 g/kg body weight	127	84%
Protein needs of most athletes are substantially higher than the needs of non-athletes	134	88%
Creatine supplementation has virtually no negative side effects	130	86%
Eating more protein than is recommended helps to increase muscle mass and strength	80	53%
Creatine supplements are the fastest and most effective way to build muscle mass	104	68%
There is no such thing as an acceptable does of caffeine	103	68%
Creatine and creatinine are the same thing	118	78%
Taking nutritional supplements is the most effective way to build muscle and increase energy	86	57%
Nutritional supplements are necessary for optimal performance of the athlete	66	43%

	Mean
Total Nutrition Knowledge Score (Possible score= 9)	6.18

Appendix C

Responses of Athletes Regarding NEA Utilization Practices:

Frequency Distributions

	Total NEA Users	
	N	(%)
If you consume NEAs, what type:		
Protein	58	73
Creatine	12	15
Caffeine	6	8
When do you typically consume NEAs:		
Before activity	28	36
During	1	>1
Immediately after	72	90
What influenced you to begin taking NEAs:		
Increase energy	16	20
Improve physical appearance	17	21
Build muscle	59	74
Treat injury	0	0
Other athletes influence	2	3
Recommended by doctor/coach/teammate	23	29