Evaluation of the Relationship between Nutrition Knowledge and Disordered Eating Risk in Female Collegiate Athletes

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EVALUATION OF THE RELATIONSHIP BETWEEN NUTRITION KNOWLEDGE AND DISORDERED EATING RISK IN FEMALE COLLEGIATE ATHLETES

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A dissertation submitted in partial fulfillment of the requirements for the

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ABSTRACT

EVALUATION OF THE RELATIONSHIP BETWEEN NUTRITION KNOWLEDGE AND DISORDERED EATING RISK IN FEMALE COLLEGIATE ATHLETES

by

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Involvement in collegiate sports among female athletes is at an all-time high with approximately 198,000 currently participating, (National Collegiate Athletic Association, 2012). With this increase in female participation in collegiate sports, the pressures of sport participation and academics lead some women to engage in harmful eating behaviors. These harmful eating behaviors may lead to the development of disordered eating (C. Johnson, Powers, & Dick, 1999; Quatromoni, 2008; Reel, SooHoo, Petrie, Greenleaf, & Carter, 2010; Reinking & Alexander, 2005). Many factors have been identified as contributing to the development of disordered eating but nutrition knowledge or lack thereof, has yet to be fully investigated as a potential risk factor. Female collegiate athletes may be at significant risk for disordered eating and identification of nutrition knowledge as a risk factor will aid in development of prevention and treatment interventions (Abood, Black, & Birnbaum, 2004; Schwitzer, Bergholz, Dore, & Salimi, 1998; Torres-McGehee et al., 2011). Limited information exists pertaining to the relationship between nutrition knowledge and disordered eating risk among female athletes in general (Raymond-Barker, Petroczi, & Quested, 2007) and none exists specifically for female collegiate athletes. The objective of this investigation
is to determine if a relationship exists between sports nutrition knowledge and eating disorder risk in female collegiate athletes.

This research study sought to describe the correlational relationship between the variables of nutrition knowledge and disordered eating risk using the assessment tools Nutrition Knowledge & Screening (NKS) questionnaire and Female Athlete Screening Tool (FAST) questionnaire. Two hundred four female collegiate athletes completed the two questionnaires. Demographic, questionnaires and statistical data were analyzed.

The mean NKS score for all athletes was 19.2/31 (62% correct). The mean FAST score for all athletes was 59.5 which indicate that, overall, female collegiate athletes were asymptomatic. However, 19 athletes’ scores classify them as having subclinical symptoms of eating disorders. Correlation analysis of NKS and FAST scores showed no correlation \( r (202) = -.014; p = .56 \). Evaluation of athletes who classified as having subclinical symptoms of eating disorders showed a significant positive correlation \( r (17) = .051; p = .03 \) between nutrition knowledge and a subclinical eating disorder risk.

This study suggests that although female collegiate athletes have poor nutrition knowledge it does not appear to be correlated to eating disorder risk. However, a relationship may exist between nutrition knowledge and eating disorder risk for individuals identified as exhibiting subclinical symptoms of eating disorders. Further investigation of this topic identifying female collegiate athletes with confirmed eating disorders will better clarify this relationship.
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CHAPTER 1
INTRODUCTION

Since the 1970’s, the number of women participating in sport and exercise has dramatically increased, specifically within collegiate athletics (Women's Sport Foundation, 2009b). With this increase in participation in sport and exercise, women have better physical fitness and improved health outcomes including decreased risk of heart disease, diabetes and osteoporosis (Women's Sport Foundation, 2009a). However, for some female collegiate athletes the pressure associated with college sport participation including the desire to improve athletic performances, change body physique along with the expectation of looking beautiful can be very stressful, especially for those athletes participating in “lean” sports (Beals & Manore, 1994; Bonci et al., 2008; Engel et al., 2003; Reinking & Alexander, 2005; Sundgot-Borgen, 1994). The “lean” sports are those sports that place a competitive or aesthetic value on leanness, including but not limited to gymnastics, distance running, swimming, dance, and diving (Reinking & Alexander, 2005). To achieve these unrealistic size and weight goals, some athletes, may use potentially harmful practices such as restrictive or chronic dieting and overtraining. Some female collegiate athletes may make use of these altered dietary patterns and as a result potentially develop the harmful conditions of disordered eating or eating disorders (Anderson & Petrie, 2012; Beals & Hill, 2006; Bonci et al., 2008; Coelho, Soares, & Ribeiro, 2010; C. Johnson, Powers, & Dick, 1999; Pearson & Rivers, 2006; Quatromoni, 2008; Reel, SooHoo, Petrie, Greenleaf, & Carter, 2010; Reinking & Alexander, 2005; Torres-McGehee, Monsma, Dompier, & Washburn, 2012; Zucker, Womble, Williamson, & Perrin, 1999). The continued use of these harmful practices can
predispose female athletes to under-nutrition, fatigue and potential injury as well as a syndrome known as female athlete triad, a condition of calorie insufficiency leading to amenorrhea and osteoporosis (Position, 2009; Beals & Manore, 2002). Since disturbances in nutrition intake appear to be central to the development of the female athlete triad, it seems pertinent to investigate the eating pathology of female athletes and determine the factors that play a part in the development of the pathology. Several factors have been identified as risks for developing disordered eating but yet to be closely investigated is nutrition knowledge.

**Eating Pathology and Athletes**

The literature provides ample evidence related to eating disorder development and risk among women and shows that, during their lifetime, approximately 0.6% to 1.0% of the adult population in the U.S. will suffer from a clinical eating disorder (Hudson, Hiripi, Pope Jr., & Kessler, 2007). College women, specifically athletes, are of interest due to the increased prevalence of eating disorders reported. Eating disorder rates among female collegiate athletes have been reported between 0% and 63% (Beals, 2000; Beals & Manore, 2002; Bonci et al., 2008; Coelho, Soares, & Ribeiro, 2010). Several tools have been used to assess disordered eating risk in athletes and most commonly include the following: the Eating Disorders Inventory-2 (EDI-2), the Eating Disorder Examination Questionnaire (EDE-Q), the Questionnaire for Eating Disorder Diagnosis (Q-EDD), the Eating Attitudes Test-26 (EAT-26), the Bulimia Test-Revised (BULIT-R) and the Female Athlete Screening Tool (FAST). Of the listed disordered eating assessment tools listed, only the FAST was developed specifically for use with female collegiate athletes. However, only two studies have made use of the FAST to assess risk
in female collegiate athletes (Quatromoni, 2008; Reinking, 2006). Thus underutilization of this tool may be limiting the information available regarding the existence of disordered eating within this population since the FAST may better identify risk than more commonly used tools.

Although, the roles of optimal nutrition and body weight, including body composition recommendations, are extensively documented as well as the fact that proper nutrition is a major contributor to not only good health but also sport performance (Position of the american dietetic association, dietitians of canada, and the american college of sports medicine: Nutrition and athletic performance.2009), nutrition is often overlooked as an essential component of sports training. With limited time in collegiate athletes schedules’, coaches and trainers do not generally incorporate nutrition education into the training routine and it is believed that athletes may be lacking in this vital education (Vinci, 1998).

**Nutrition Knowledge of Athletes**

Many studies have investigated nutrition knowledge and attitudes among female collegiate athletes (Barr, 1987; Dunn, Turner, & Denny, 2007; Frederick & Hawkins, 1992; Hoogenboom, Morris, Morris, & Schaefer, 2009; Hornstrom, Friesen, Ellery, & Pike, 2011; Jacobson, Sobonya, & Ransone, 2001; Rash, Malinauskas, Duffrin, Barber-Heidal, & Overton, 2008; Rosenbloom, Jonnalagadda, & Skinner, 2002; Zawila, Steib, & Hoogenboom, 2003) and results have shown scores on nutrition knowledge tests ranging from 34% and 81%. This indicates a poor to fair level of understanding of nutrition concepts among athletes in general (Barr, 1987; Heaney, O'Connor, Michael, Gifford, &
Naughton, 2011; Rosenbloom, Jonnalagadda, & Skinner, 2002; Zawila, Steib, & Hoogenboom, 2003).

The research that has been published regarding nutrition knowledge of athletes is complex and there is difficulty in drawing conclusions from the available research due to a number of issues including variations in questionnaire use, lack of questionnaire validation, and omission of pertinent data such as age and sport participation (Heaney, O'Connor, Michael, Gifford, & Naughton, 2011). Considering the variation in questionnaire use, several studies looked to assess athlete sports nutrition knowledge using self-developed questionnaires (Barr, 1987; Cupisti, D'Alessandro, Castrogiovanni, Barale, & Morelli, 2002; Guinard, Seador, Beard, & Brown, 1995; Rash, Malinauskas, Duffrin, Barber-Heidal, & Overton, 2008; Worme et al., 1990) which may or may not have been validated. Conversely, some researchers while using existing, validated nutrition knowledge questionnaires used modified versions of existing questionnaires to meet the specific needs of the study or population (Collison, Kuczmarski, & Vickery, 1996; Frederick & Hawkins, 1992; Rash, Malinauskas, Duffrin, Barber-Heidal, & Overton, 2008; Wiita & Stombaugh, 1996). The use of modified or self-generated nutrition knowledge questionnaires appears to be quite common and necessary to address the specific needs of the researcher and study sample. Due to the variations of and modifications made to nutrition knowledge questionnaires along with the omission of pertinent demographic data further clarity is needed to explain what female collegiate athletes precisely know about sports nutrition concepts. Very limited information is available regarding the relationship between nutrition knowledge and disordered eating risk in any population.
To date, no research exists that investigates the relationship between nutrition knowledge and disordered eating risk among female collegiate athletes. Furthermore, since the heavily relied upon method of eating disorder prevention and treatment is to make use of nutrition education with the desired outcome of enhanced nutrition knowledge and presuming a change in eating behaviors (Abood, Black, & Birnbaum, 2004; Collison, Kuczmarski, & Vickery, 1996; Kunkel, Bell, & Luccia, 2001; Valliant, Emplaincourt, Wenzel, & Garner, 2012; Vinci, 1998), exploration of the relationship between nutrition knowledge among female collegiate athlete, and eating disorder risk is necessary.

**Statement of the Problem**

Eating pathology in female collegiate athletes can predispose them to under-nutrition, fatigue and potential injury. Identifying the risk factors for development of various eating pathologies can aid in determining effective prevention and treatment plans. Nutrition knowledge has yet to be identified as a key factor related to the development of eating pathology. Very limited information is available regarding the relationship between nutrition knowledge and disordered eating risk. Ultimately, only one study (Raymond-Barker, 2007) has sought to identify a correlation between nutrition knowledge and disordered eating risk (as a component of female athlete triad) among female athletes, but not specifically female collegiate athletes. To date, no research exists that investigates the correlation between nutrition knowledge and disordered eating risk among female collegiate athletes.
Purpose of Study

The primary objective of this investigation was to determine if a relationship exists between nutrition knowledge and eating disorder risk in female collegiate athletes. The secondary objective is to determine if participation in a particular sport or sport type shows increased risk of eating disorder development and/or greater nutrition knowledge.

Research Hypothesis and Questions

It was hypothesized that female collegiate athletes with greater nutrition knowledge will exhibit less symptoms of disordered eating/eating disorder risk. Research questions addressed regarding the female collegiate athlete include 1) what is the status of nutrition knowledge among female collegiate athletes?, 2) what is the prevalence of clinical and subclinical symptoms among female collegiate athletes?, 3) does participation in a particular sport show increased female collegiate athlete disordered eating risk?, 4) does participation in a particular sport show increased female collegiate athlete nutrition knowledge?, 5) is disordered eating risk greater in female collegiate athletes who desire to lose weight?, 6) is nutrition knowledge greater in female collegiate athletes who desire to lose weight?, 7) does participation in “lean” sport show a greater risk of disordered eating risk?, 8) does participation in “lean” sports show a greater level of nutrition knowledge? and 9) is there a correlation between nutrition knowledge and disordered eating risk?

Limitations of Study

The questionnaires completed by the participants were done as a portion of annual pre-participation physicals for incoming and returning female student athletes. Student athletes may have given socially desirable responses and therefore created inconsistencies
between reported and actual behaviors. Student athletes with eating disorders may have been reluctant to respond truthfully due to the potential impact positive responses would have on their participation within their sport and negative responses from coaches and trainers.

The questionnaires completed by participants exist as a portion of pre-participation physicals and are used as part of the student athlete’s medical file. Since they existed originally to assess knowledge and eating disorder risk they do not contain information regarding knowledge gained from previous sports nutrition training, general nutrition courses or other courses that contain a nutrition component.

The sample was limited to one Southwestern Division I institution.

**Significance of Study**

There exists virtually no research on the correlation between nutrition knowledge and eating disorder risk among female collegiate athletes. The present study provides an opportunity to investigate the depth of this relationship. With this information, a better understanding of the role of nutrition knowledge in the development of eating disorders can be determined. Greater understanding of student athlete sports nutrition knowledge would give greater insight regarding the nutrition education needs of female collegiate athletes.

**Research Design**

This research study was a retrospective correlational study and specifically sought to describe the correlational relationship between the variables of nutrition knowledge (score on Nutrition Knowledge & Screening questionnaire) and disordered eating risk (score on FAST questionnaire).
Definition of Terms

For the purpose of this study the following terms were used:

*Clinical Eating Disorders.* Term used when an individual meets all of the diagnostic criteria for an eating disorder as indicated by the Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (*DSM-IV*) published by the American Psychiatric Association.

*Disordered Eating.* Term used to describe subclinical, abnormal eating patterns that do not meet the specific diagnostic criteria of an eating disorder (Stirling & Kerr, 2012).

*Eating Pathology.* A general term used to describe when an individual exhibits extreme concerns about food, weight and shape.

*Subclinical Eating Disorders.* A phrase used to describe individuals who have considerable eating and body weight problems but do not meet all of the *DSM-IV* criteria for anorexia or bulimia nervosa (Beals, 2000, p. 24).

Summary

Participation in collegiate sports among female athletes is at an all-time high with approximately 198,000 female student athletes which is an estimated increase in participation of 204% from 1981 to 2012 (National Collegiate Athletic Association, 2012). With this increase in female participation in collegiate sports, the pressures of sport participation and academics lead some women to engage in harmful eating behaviors. These harmful eating behaviors may lead to the development of disordered eating or eating disorders. Many factors have been identified as contributing to the development of disordered eating but nutrition knowledge has yet to be fully investigated as a potential risk factor. Female collegiate athletes may be at greater risk for disordered eating and identification of nutrition knowledge as a risk factor will aid in development
of prevention and treatment interventions. Limited information exists pertaining to the relationship between nutrition knowledge and disordered eating risk among female athletes in general and none exists specifically for female collegiate athletes.
CHAPTER 2

LITERATURE REVIEW

The evaluation of the impact of nutrition knowledge on disordered eating risk among female collegiate athletes requires an assessment of the literature of two lines of inquiry, disordered eating risk of athletes and nutrition knowledge of athletes, followed by the limited literature available on the intersection of these topics. The following literature review covers the eating pathology of athletes, including the prevalence of disordered eating among female athletes and specifically female collegiate athletes, risk factors for developing disordered eating in female collegiate athletes, and commonly used assessment tools for detecting disordered eating. Nutrition knowledge of athletes is covered with specific emphasis on nutrition knowledge status of college and university athletes, status of pertinent non-athlete populations, nutrition knowledge as a predictor of eating behavior, the impact of nutrition knowledge on dietary practices and the impact of nutrition education on nutrition knowledge. Finally, the intersection of the two lines of inquiry is reviewed and focuses on the relationship between nutrition knowledge and disordered eating risk in female collegiate athletes as well as the use of nutrition education for treatment and prevention of disordered eating in this population. The focus of this review is on research outcomes and methods with the goal of summarizing the relevant research. This literature review is exhaustive with selective citations, meaning that of the available literature on these topics the most relevant articles will be reviewed, and organized conceptually based on the two primary lines of research identified above.
Eating Pathology

The following section covers the literature related to eating pathology of athletes, specifically prevalence of disordered eating among female athletes, risk factors for developing disordered eating in female collegiate athletes, and commonly used assessment tools. The literature search for this category was completed via use of the following databases: Academic Search Complete, Academic Search Premier, Alt HealthWatch, CINAHL Plus with Full Text, Education Research Complete, ERIC, Family Studies Abstracts, Gender Studies Database, Health and Psychosocial Instruments, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, MEDLINE, MEDLINE with Full Text, PsycINFO, PubMed, SocINDEX with Full Text, SPORTDiscus with Full Text, and Women's Studies International. The following keywords were used to located appropriate studies: eating disorder, eating problems, disordered eating, eating attitudes, female, women, athletes, college and collegiate, university, risk factors and assessment tools.

Prevalence among Female Athletes

The prevalence of disordered eating and eating disorders among female athletes is concerning due to the seriousness of the health consequences associated with these disorders. The literature assessing prevalence of disordered eating among female athletes gives a conflicting picture. Three research groups of the past twenty years have completed reviews and meta-analysis on the existing literature and yielded somewhat conflicting results. Sundgot-Borgen (1994), in a review article, summarized several aspects of eating disorders in female athletes including prevalence. She concluded that female athletes experienced eating disorders to various degrees based on sport
participation but overall ranged from 5% to 33%. The review showed approximately 5% of power athletes, 11% of those who played ball games, 13% of athletes participating in technical sports, 20% of endurance athletes, 25% of weight-dependent sport participants and 33% of those participating in aesthetic sports showing symptomology of eating disorders. Smolak, Murnen and Ruble (2000) completed a meta-analysis of the literature related to female athletes and eating problems competing at the high school, college and elite levels and determined, through the use of z score calculations, female athletes exhibited more eating problems then do non-athlete controls. The authors also determined that elite athletes participating in sports that emphasize thinness appeared to be at greatest risk for disordered eating. Most recently, Coelho, Soares and Ribeiro (2010) completed a systematic review of disordered eating risk among female athletes to determine if, in fact, athletes were at a greater risk of developing disordered eating than their non-athlete counterparts. Out of 169 identified studies, 22 were selected for this review based on the inclusion and exclusion criteria set by the authors. It was determined that among female athletes between the ages of 13 and 39 and participating in a variety of sports, the prevalence of disordered eating ranged from 0% to 27% and prevalence among non-athlete controls ranged from 0% to 21%. Based on these results, the authors suggest that athletes and non-athletes have similar risk of developing disordered eating. Based on the reviews listed above, it appears that female collegiate athletes are at a marginally greater risk of developing disordered eating than the general female athlete population. There is difficulty in determining precisely how prevalent disordered eating is among female athletes but it appears to be present in up to approximately 33% of the female athlete population. Female collegiate athletes experience the same pressures as
other female athletes but may experience these pressures more intensely due to the added stress associated with academic life and as a result may exhibit a greater risk for disordered eating.

**Prevalence among Female Collegiate Athletes**

The prevalence of disordered eating and eating disorder diagnosis among female collegiate athletes is of particular concern. Due to the heightened body-image and weight-related concerns associated with the sport environment, coach and peer pressures, and performance demands, college students are at particular risk for development of disordered eating, added to these pressures is the additional stress of college life. Many students experience increased stress and anxiety because of greater personal responsibility and maturation, perceived loss of social support, and increased academic demands when transitioning to the college environment (Greenleaf, Petrie, Carter, & Reel, 2009). Seven studies have investigated the prevalence of disordered eating and eating disorders among female collegiate athletes and determined that between 7% and 38% of female collegiate athletes exhibit symptomology of disordered eating and 0% to 6% meet the criteria of a clinical eating disorder (Anderson & Petrie, 2012; Beals & Hill, 2006; Greenleaf, Petrie, Carter, & Reel, 2009; C. Johnson, Powers, & Dick, 1999; Reinking & Alexander, 2005; Torres-McGehee, Monsma, Dompier, & Washburn, 2012; Zucker, Womble, Williamson, & Perrin, 1999).

The most comprehensive assessment of disordered eating prevalence among athletes was completed by Johnson, Powers and Dick (1999) where the purpose was to measure the level of pathological eating behavior and attitudes among collegiate athletes. The authors, working closely with the National Collegiate Athletic Association (NCAA),
asked student athletes from 11 colleges and universities who were competing in 11 sports including football, basketball, track, swimming, gymnastics, wrestling, cross-country, crew, tennis, Nordic skiing and volleyball to complete a 133-item questionnaire related to dieting, binge eating, body image and weight related issues. Overall, the results showed, for female collegiate athletes, 35% were at risk for anorexia nervosa and 38% were at risk for developing bulimia nervosa. Results also showed, of the female athletes questioned, 2% self-identified themselves as having anorexia nervosa while 5.5% self-identified as having bulimia nervosa. Additionally, 3% of female athletes exhibited subclinical symptomatology for anorexia nervosa and 9% had subclinical symptomology of bulimia nervosa, only 1% met all of the DSM-IV criteria for bulimia nervosa and none met the criteria for anorexia nervosa. A concern with this study is the association with NCAA. Student athletes may have felt pressure to respond in a socially desirable manner and therefore responses may indicate lower instances of pathological eating behavior than truly existed.

Several researchers have investigated disordered eating by classifying sports into “lean”/judged sports and “non-lean”/refereed sports and determining if the prevalence of disordered eating development differs between groups. Beals and Hill (2006), assessed the eating behaviors of 112 female collegiate athletes participating in 7 sports that were classified as “lean” and “non-lean” sports with “lean” sports including diving, cross-country, swimming, and track (sprint events) while the “non-lean” sports included field hockey, softball, tennis and track (field events). Using the EDE-Q assessment tool and a semi-structured interview, the authors found no significance in disordered eating risk between “lean” and “non-lean” sports but did determine an overall prevalence of
disordered eating risk at 25% of the female collegiate athletes questioned. Reinking and Alexander (2005), using the EDI-2 assessment tool, noted an overall prevalence of disordered eating risk to be 7% for all female collegiate athletes but also determined that within “lean” sports the prevalence increased to 25%. The authors did not indicate the precise sports that subjects participated in but categorized them as “lean” or “non-lean” upon entering the study. Zucker, Womble, Williamson and Perrin (1999) determined that the overall prevalence of eating disorders among female collegiate athletes was 16% but when comparing refereed sports, including tennis, basketball, volleyball, and track to judged sports including diving, cheerleading and gymnastics, they found a trend toward a higher rate of diagnosis among judged sports than for referred sports, 13% and 3%, respectively.

Specific sports have been identified as sports with greater disordered eating risk potential (Anderson & Petrie, 2012; Torres-McGehee, Monsma, Dompier, & Washburn, 2012) for participants. Torres-McGehee, et al. (2012) measured the prevalence of eating disorder risk using EAT-26 among NCAA cheerleaders at 33.1%. Anderson and Petrie (2012) evaluated eating disorder risk, using the Q-EDD assessment tool, among NCAA Division I gymnasts and swimmers/divers. The results showed that 28.9% of gymnasts and 20.9% of swimmers/divers were at risk of eating disorder development but also determined that 6.1% of gymnasts and 6.7% of swimmers/divers exhibited eating disorder diagnosis criteria, which is higher than most other studies have reported for female collegiate athletes (Beals & Hill, 2006; Coelho, Soares, & Ribeiro, 2010; C. Johnson, Powers, & Dick, 1999).
Finally, consistent with most other studies, Greenleaf, Petrie, Carter and Reel (2009) sampled 204 female NCAA Division I college athletes from three universities located in the Midwest, Southwest, and Mountain regions of the United States and assessed eating disorder and disordered eating risk. The athletes participated in 17 different sports and included gymnastics, rowing, softball, synchronized swimming, tennis, alpine skiing, basketball, cross country, cheerleading, diving, golf, field hockey, lacrosse, soccer, swimming, track and field, and volleyball. The authors, through use of the Q-EDD assessment tool, classified participants as eating disordered (2.0%), symptomatic (25.5%), and asymptomatic (72.5%). A noteworthy finding was that although some female athletes suffer from clinical eating disorders, one-quarter of female athletes were symptomatic of eating disorders indicating a subclinical status which is problematic because the risks can go undetected (Greenleaf, Petrie, Carter, & Reel, 2009).

None of the identified studies used the Female Athlete Screening Tool (FAST) assessment tool, an eating disorder screening questionnaire intended for use specifically for female athletes, as a means of assessing disordered eating risk among female collegiate athlete populations. Due to this oversight, these studies may not have identified at risk athletes since the assessment tools used are not specific to identifying risk in athletes.

**Risk Factors in Female Collegiate Athletes**

Several disordered eating risk factors or vulnerabilities have been identified among female collegiate athletes. Factors identified include drive for thinness, body dissatisfaction/altered body image, sport participation/performance, ethnicity, self-
esteem, pressure from coaches/peers, competitiveness/motivation, perfectionism, altered mood states, desire for control, negative relationships and biological factors (Arthur-Cameselle & Quatromoni, 2011; Engel et al., 2003; C. Johnson et al., 2004; Pearson & Rivers, 2006; Petrie, Greenleaf, Reel, & Carter, 2009; Stirling & Kerr, 2012). The literature identified here highlights the eating disorder risk factors or vulnerabilities that have been recognized within the female collegiate athlete population.

Utilizing the same bank of data presented in the NCAA study by Johnson et al. (1999), Engel et al. (2003) and Johnson et al. (2004) assessed risk factors and predictors of disordered eating among collegiate athletes. The research group surveyed 1445 Division I athletes at 11 different institutions participating in 11 different sports including football, basketball, track, swimming, gymnastics, wrestling, cross-country, crew, tennis, Nordic skiing, and volleyball. Student athletes were asked to complete a 133-item self-report measure that collected data in the following areas: demographics, athletic involvement, eating-related behaviors and attitudes concerning body image and weight-related issues. Using a hierarchical multiple linear regression, Engel et al. (2003) determined after measuring eating-related attitudes, self-esteem, behaviors, purge index, restriction index and binge index and using the following variables in each hierarchy: demographics, sport participation, perceptions of teammates, coach variables, academic variables and personality traits, that the specific sport an athlete participated in accounted for approximately 40% of the variance in eating disorder indicators. Johnson and colleagues looked to compare ethnic and gender differences and disordered eating attitudes and behaviors of collegiate athletes. They determined through use of analysis of variance assessment that White female athletes exhibited significantly higher drive for
thinness (p <0.001), body dissatisfaction (p <0.001) and more disordered eating behaviors (p <0.001) than Black female athletes and both Black and White male athletes (C. Johnson et al., 2004).

Petrie et al. (2009) investigated the relationship of eating pathology and body image concerns, weight pressures, sociocultural internalization and mood state among female collegiate athletes. The purpose this study was to determine if individuals classified as eating disordered or symptomatic would differ from asymptomatic individuals on measures of body image concern, general and sport-specific weight pressures, negative affect and internalization of sociocultural pressures. Female collegiate athletes from three NCAA Division I universities participating in basketball, cheerleading, cross-country, diving, fencing, field hockey, lacrosse, sport shooting, rowing, soccer, softball, swimming, synchronized swimming, tennis, track and field, volleyball, cross-country skiing, and alpine skiing were asked to complete the Q-EDD assessment tool. Upon competition of the Q-EDD, participants were classified as eating disordered, symptomatic or asymptomatic. Multivariate analysis of the data shown that eating disorder and symptomatic groups were similar on seven of eight weight pressures, three of four mood states, on internalization, and on five of six body image measures; in all instances, these two groups reported more pathological scores than the asymptomatic athletes.

The research groups of Stirling and Kerr (2012) and Arthur-Cameselle and Quatromoni (2010) published data on the qualitative assessment of eating disorder risk factors of female collegiate athletes. Both research groups completed interviews with 17 female collegiate or national level female athletes and each created two core categories
for themed responses. Arthur-Cameselle and Quatromoni (2010) determined that risk factors identified by respondents could be categorized as either internal or external risk factors. Internal factors identified and the percentage of athletes experiencing these factors included negative moods (82%), low self-esteem (76%), perfectionism/achievement (53%) and desire for control (47%). External factors identified and the percentage of athletes experiencing these factors included negative influences on self-esteem (82%), hurtful relationships (71%), hurtful role models (59%) and sport performance (41%). The authors believe that the results demonstrate that the sport environment, in particular, has a unique impact on eating disorder development. Stirling and Kerr (2012) also identified two core categories for participant responses and listed them as characteristics of the sports environment and characteristics of the individual. Factors related to the sports environment and the percentage of athletes experiencing these factors includes pressure/comments to lose weight (71%), perceived performance advantage (71%), emphasis on appearance (47%), monitoring of weight/diet (41%) and media influences (41%). Factors related to the individual and the percentage of athletes experiencing these factors includes hyper-competitiveness (65%), self-absorption (59%), achievement-orientation (53%), perfectionism (41%), need for control (35%) and pain as enjoyable (12%). One concern of the authors was the qualities identified as risk factors for eating disorder development are also factors that are valued in competitive sport.

Finally, in the review article by Pearson and Rivers (2006), the authors reviewed the literature on the risk factors, prevention and treatment methods for female collegiate athletes with eating disorders. They identified three main risk factor categorizations of
eating disorders among female collegiate athletes and include social pressures, personality characteristics, and biological factors. Social pressures identified as noteworthy concern for female collegiate athletes included exposure to muscular yet thin female models, exposure to the sports milieu that overvalues low body fat and an idealized body shape, and pressure regarding body weight and performance, especially from teammates. Personality characteristics identified as risk factors for eating disorder development included high self-expectations, competitiveness, perfectionism, drive, self-motivation, extreme pressure to be slim and perform well, self-discipline, denial, control, excessive exercise, deny pain or discomfort so they don't have to sit out of competition or practice, and low self-esteem. Many of these attributes are valued among coaches and trainers and therefore may not be recognized as a risk factor for disordered eating or eating disorders. Biological factors associated with eating disorders are not well understood but it is thought that a genetic predisposition may exist for those individuals that have family members who have experienced eating disorders.

Each of the identified risk factors related to disordered eating development among female collegiate athletes identify an area of vulnerability, however, one area has yet to be fully considered. The area of nutrition knowledge has yet to be investigated as a potential area of vulnerability. Nutrition knowledge has been investigated, however minimally, in pertinent, non-athlete population of eating disordered patients, nutrition students, and female college students but never in female collegiate athletes.

**Assessment Tools**

A multitude of assessment tools have been used to identify disordered eating risk, eating disorder symptoms as well as diagnose eating disorders among both athlete and
non-athlete populations. Assessment tools for detecting disordered eating behaviors are usually completed as either an interview or as self-reported information in the form of a questionnaire (Túry, Güleç, & Kohls, 2010). The literature regarding female collegiate athlete disordered eating behaviors shows a preference for use of the following assessment tools: the Eating Disorders Inventory-2 (EDI-2), the Eating Disorder Examination Questionnaire (EDE-Q), the Questionnaire for Eating Disorder Diagnosis (Q-EDD), the Eating Attitudes Test-26 (EAT-26), the Bulimia Test-Revised (BULIT-R) and the Female Athlete Screening Tool (FAST). Each of the identified assessment tools, omitting the Q-EDD, is considered a screening tool. Screening tools are used to determine the possibility that an eating disorder may be present which should not be confused with a diagnostic tool which is meant to determine with greater assurance that an eating disorder is, in fact, present (Warner, 2004). With all screening tools, these identified questionnaires should not serve as a sole determinant of an eating disorder but rather the first step in identifying individuals at risk for development of eating disorders.

The identified assessment tools can be categorized into three groups: general measures of eating disorder symptoms, DSM-IV diagnostic questionnaires and screening questionnaires. Of the assessment tools most commonly used in athlete populations the tools categorized as general measures of eating disorder symptoms include the EDI-2 and the EDE-Q and each functions to identify symptoms common among eating disorder patients and may also be used as a screening tool. The EDI-2, developed in 1991, is the second version of the EDI which was originally developed in 1983 and measures psychological and behavioral traits of individuals with anorexia nervosa (AN) and bulimia nervosa (BN). The EDI-2 is a self-report questionnaire and consists of ninety-
one items which represent the eight original subscales of drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interceptive awareness, and maturity fears; and includes the three additional subscales of asceticism, impulse regulation, and social insecurity. The EDE-Q is used as a measure of eating disorder symptoms and a self-report questionnaire adapted from the original semi-structured interview assessment known as the Eating Disorder Examination (Fairburn & Beglin, 1994). This 33-item assessment tool was designed to assess and describe specific aspects of eating disorders, including severity of eating pathology, key behavioral problems, and associated disturbances over the previous 28 days (Túry, Güleç, & Kohls, 2010). Each of these assessment tools focuses on the assessment of eating disorder symptoms and can serve as screening tools for identifying individuals at risk for eating disorder development.

*DSM-IV* diagnostic questionnaires function to assess individuals based on the criteria set forth in the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (*DSM-IV*) for eating disorders. The one *DSM-IV* diagnostic tool found among research related to female collegiate athletes is the Q-EDD. The Q-EDD is a 50-item self-report questionnaire that yields two primary categories: eating disordered and non-eating disordered. Within each category there are subcategories, in the non-eating disorder category, the two sub-categories are asymptomatic (no eating disorder symptoms) and symptomatic (no diagnosable disorder, but symptoms) (Túry, Güleç, & Kohls, 2010). If an eating disorder is identified, six specific diagnoses can be differentiated: AN, BN, eating disorder not otherwise specified (EDNOS) sub-threshold BN, EDNOS - menstruating AN, EDNOS - non-bingeing BN,
and Binge Eating Disorder (Túry, Güleç, & Kohls, 2010). Although the Q-EDD makes use of the *DSM-IV* criteria for determining the presence of eating disorder symptoms, confirmation of diagnosis of AN or BN should be done with administration of an interview.

Screening questionnaires found to be utilized in the literature related to female collegiate athletes include the EAT-26, the BULIT-R and the FAST. Screening questionnaires aid researchers and clinicians with assessing attitudes and behaviors consistent with those experiencing eating disorders. The Eating Attitudes Test-26 (EAT-26), which is an eating disorder screening tool that had been shortened from the original version of the test which initially contained 40 questions (Garner & Garfinkel, 1979; Garner, Olmsted, Bohr, & Garfinkel, 1982) is used commonly with both non-athlete and athlete populations. The EAT-26 has been widely used as a standardized measure of the symptoms and concerns that are characteristic of eating disorders. The EAT-26 consists of 26 items that focus on identifying three areas of eating problems: dieting, bulimia and food preoccupation and oral control. A score greater than 20 is believed to indicate disordered eating behavior (Garner, Olmsted, Bohr, & Garfinkel, 1982). The BULIT-R, published in 1991 is the revised version of BULIT originally published in 1984 (Smith & Thelen, 1984; Thelen, Mintz, & Vander Wal, 1996). The BULIT and BULIT-R were developed to assess attitudes and behaviors specific to the eating disorder BN and include weight and body shape concerns and well as binging and purging patterns (Thelen, Mintz, & Vander Wal, 1996). The BULIT-R is a 36-item self-report questionnaire is measured on a 5-point Likert scale with a maximum score of 140 and a score of 104 serving as the threshold for BN classification (Túry, Güleç, & Kohls, 2010). The FAST
screening questionnaire was developed to be used specifically with female athletes and was validated with female collegiate athletes and students (McNulty, Adams, Anderson, & Affenito, 2001). The FAST includes 33 items which are scored using a 4-point Likert-type scale and with each question scored between 1-4 points. A maximum score of 130 points is possible with asymptomatic scores less than 77, symptomatic or subclinical scores ranging from 77 to 94 and eating disordered or clinically symptomatic scores greater than 94 (Robert-McComb, 2008). McNulty et al. (2001) assessed three participant groups: female collegiate athletes diagnosed with eating disorders, female collegiate athletes with no known eating pathology, and female collegiate women who did not participate in athletics but were diagnosed with an eating disorder. Each participant group was administered the FAST, and the three well validated psychometric assessment tools of the EDE-Q, the BULIT-R and the EDI-2. A correlation analyses was completed and showed the FAST was strongly correlated to the EDE-Q ($r = 0.60$, $p<0.05$) and EDI-2 ($r = 0.89$, $p<0.001$). The reliability analysis showed a high internal consistency (Cronbach's $\alpha =0.87$) (McNulty, Adams, Anderson, & Affenito, 2001). These results indicate that FAST is a reliable measure for use in female collegiate athletes and is consistent with other validated psychometric measures used in the literature.

Only two articles were found to have reported the use of FAST as a disordered eating screening tool with female collegiate athletes. Reinking (2006) investigated exercise-related leg pain in female collegiate athletes, specifically the extrinsic and intrinsic factors related to the development of exercise-related leg pain. One theory to explain exercise-related leg pain is foot pronation but another is the inter-relationship between menstrual function and bone mineral density and exercise-related leg pain. An
explanation for this relationship is the existence of female athlete triad which is the inter-
relationship between menstrual dysfunction, low bone mineral density and disordered
eating or low energy availability. In this study, the author used the FAST screening tool
to assess eating disordered symptomology among female collegiate athletes. The author
was able to rule out disordered eating as a factor related to exercise-related leg pain as
none of the female collegiate athletes were symptomatic of disordered eating.

Quatromoni (2008) describes observations of a clinical sports dietitian as an
integral member of the sports medicine team. This article aims to substantiate the need
for nutrition services for college athletes and also describes nutrition issues that affect
athletes participating in a variety of sports. The author observed, as part of her practice, a
substantial number of female collegiate athletes exhibiting subclinical (39%) and clinical
(16%) eating disorder symptoms. Over the course of two years, 49 female collegiate
athletes were screened for disordered eating with FAST and over half were identified as
symptomatic of eating disorders with this tool. The author advocates The FAST as a
useful tool for identifying eating pathology and triggering timely interventions. Since
nutrition knowledge plays a role in the eating disorder prevention and treatment
programs, what athletes, specifically female collegiate athletes, know about nutrition
needs to be reviewed.

**Nutrition Knowledge**

The following section covers the literature related to nutrition knowledge of
athletes, specifically female collegiate athletes, but also including pertinent non-athlete
populations, nutrition knowledge as a predictor of eating behavior, the impact of nutrition
knowledge on dietary practices and the impact of nutrition education on nutrition
knowledge. The literature search for this category was completed via use of the following databases: Academic Search Complete, Academic Search Premier, Alt HealthWatch, CINAHL Plus with Full Text, Education Research Complete, ERIC, Family Studies Abstracts, Gender Studies Database, Health and Psychosocial Instruments, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, MEDLINE, MEDLINE with Full Text, PsycINFO, PubMed, SocINDEX with Full Text, SPORTDiscus with Full Text, and Women's Studies International. The following keywords were used to located appropriate studies: nutrition, diet, food, knowledge, eating, behaviors, eating practices, and nutrition education.

**Status of Collegiate Athletes**

The research completed regarding nutrition knowledge of college and university athletes is varied in its methodology which in turn makes analysis of the status of nutrition knowledge of this population complex. The variations in methodology include comparison of athletes to control groups, omission of a non-athlete control groups, variations in questionnaire use, lack of questionnaire validation, and omission of pertinent data such as age and sport participation. In 2010, Heaney, O'Connor, Michael, Gifford and Naughton sought to systematically review the level of nutrition knowledge in athletes, compare the level of nutrition knowledge to non-athlete comparison groups, and determine the impact of nutrition knowledge on dietary intake. Twenty-nine studies were reviewed and within those studies, the researchers recruited able or physically disabled, male or female, competitive (recreational or elite) athletes over the age of 13 years. Assessment of the studies yielded the following results: athletes’ knowledge was equal to or better than that of non-athletes but lower than comparison groups including nutrition
students. Although athletes appeared to exhibit equal or better knowledge than non-athletes, their level of nutrition knowledge remains fair to poor. Of the 29 studies evaluated, 19 studies reported mean nutrition knowledge scores between 50% and 70%, which is considered below average understanding of the presented concepts. For these identified studies, no distinction was made between general nutrition and sport-specific nutrition questions. When investigating additional research, several researchers are found to have utilized subscales to differentiate between general nutrition and sport-specific nutrition knowledge (Nichols, Trinkaus, Rosenbloom, & Jonnalagadda, 2005; Rosenbloom, Jonnalagadda, & Skinner, 2002; Zawila, Steib, & Hoogenboom, 2003). In these studies, athletes have been found to score higher on sport specific subscales (hydration, carbohydrate utilization, iron and functional foods) than on general nutrition concepts (Nichols, Trinkaus, Rosenbloom, & Jonnalagadda, 2005; Rosenbloom, Jonnalagadda, & Skinner, 2002; Zawila, Steib, & Hoogenboom, 2003). In the Heaney et al. (2011) review, when found statistically significant, knowledge was greater in females than males. Also, a weak (r < .44), positive association between knowledge and dietary intake was reported. Common errors found in the reviewed articles included inadequate statistical reporting, instrument validation, and relevant demographic data. The authors concluded that nutrition knowledge of athletes and its impact on their dietary intake is ambiguous.

One of the earliest studies completed in this area was by Barr (1987) and compared the nutrition knowledge of female university varsity athletes (n = 70) with university students enrolled in undergraduate psychology classes (n = 129). Each group of participants were asked to complete a two part questionnaire with part one consisting
of questions pertaining to demographic data, activity patterns, sources of nutrition information, usual dietary patterns and use of nutritional supplements. Part two of the questionnaire consisted of a self-generated knowledge test and contained 87 true/false statements, 64 were general nutrition knowledge statements and 23 were specific to nutrition and activity. The results of the knowledge test showed both athletes and non-athletes scores averaged 34% with a possible range of -100% to 100%. This initial research concluded that female student athletes had similar nutrition knowledge to non-athlete students. Frederick and Hawkins (1992) also compared nutrition knowledge of female collegiate athletes to non-athlete controls but also assessed dietary practices and bone mineral density. Four groups were assessed and included 18 post-menopausal women, 14 college age dancers, 13 track team members and 14 non-athletic women. The results related to nutrition knowledge showed the mean scores for nutrition knowledge of dancers was significantly lower \( (p < 0.05) \) than post-menopausal women, non-athletes and track athletes.

More recent studies assessing nutrition knowledge have continued to be descriptive but have omitted the comparison to non-athlete control groups. Rosenbloom, Jonnalagadda and Skinner (2002) and Nichols, Trinkaus, Rosenbloom & Jonnalagadda (2005) assessed the nutrition knowledge of both male and female collegiate athletes while Zawila, Steib and Hoogenboom (2003) assessed nutrition knowledge and attitudes of female collegiate cross-country athletes. Rosenbloom, Jonnalagadda and Skinner (2002) assessed, during yearly physicals, the nutrition knowledge of 237 male and 91 female NCAA Division I student athletes participating in football, track and field, baseball, swimming, basketball, tennis, golf, softball and volleyball. The student athletes were
asked to complete an 11-item self-generated questionnaire regarding nutrition knowledge and performance with zero as the minimum possible score and 11 as the maximum possible score. Mean score for all athletes was 5.8±1.8 with no significant difference between male (5.9±1.8) and female (5.7±1.9) collegiate athletes. A mean score of 5.8 out of a maximum of 11 indicated that student athletes do not have a strong understanding of sports nutrition related concepts. Nichols et al. (2005) assessed nutrition knowledge, specifically hydration and fluid replacement knowledge, of NCAA Division I student athletes participating in soccer, basketball, tennis, cross-country, track, baseball, softball and volleyball, using a 17-item nutrition knowledge questionnaire with a possible minimum score of zero and maximum score of 17. Results showed a mean overall score for all athletes for nutrition knowledge was 13.9±1.8, which would indicate fair comprehension of nutrition knowledge for hydration.

In a descriptive study, Zawila et al. (2003) looked to assess the nutritional knowledge and attitudes of the female collegiate cross-country runners. The nutritional questionnaire was created using components of previous researchers’ questionnaires but also included several self-generated questions. The nutritional questionnaire was administered to female collegiate cross-country runners (n = 60) at 6 colleges and universities in Illinois and Michigan. The questionnaire included a demographics section, 76 Likert-scale true-false questions, and 7 open-ended, qualitative, questions. Analysis of the questionnaires determined that cross-country runners scored overall 57% out of 100%. It was also determined that runners who completed a nutrition course in college scored significantly higher (p = 0.007) overall on the nutritional questionnaire compared to runners who did not. The authors concluded that the female collegiate cross-
country runners lack nutritional knowledge critical to preventing nutrition-related health problems.

**Status of Pertinent, Non-athlete Populations**

Due to the lack of research on the correlation of nutrition knowledge and disordered eating risk within athletic populations, a look into other related populations can give insight into this topic. Pertinent information was found when searching for additional research on nutrition knowledge and disordered eating “at risk” populations. The following three studies highlight nutrition knowledge and eating behaviors of eating disorder patients, nutrition students and college students.

Investigations that focus on assessing nutrition knowledge of individuals with a known eating disorder, offers a better understanding of the relationship between nutrition knowledge and eating behaviors. Soh et al. (2009) sought to assess the level of nutrition knowledge of young women with and without eating disorders living in both Singapore and Australia. The two groups of participants, eating disordered individuals and healthy individuals, were administered a Nutritional Knowledge Questionnaire, an acculturation questionnaire and a demographics survey. The authors noted that individuals with diagnosed eating disorders demonstrated greater nutrition knowledge than healthy individuals but the magnitude was not significant. It was also determined that greater acculturation to Western culture was associated with greater knowledge but again the relationship was not significant.

A population thought to be at risk for development of disordered eating are nutrition students, based on the suspicion that nutrition students’ will show more disordered eating patterns than non-nutrition students. Korinth, Scheiss and
Westenhoefer (2009) performed a cross-sectional comparison of nutrition students from German universities (n = 221) with a control group from other study programs (n = 114). Using a self-report questionnaire, the following components were assessed: demographics, dietary restraint and disinhibition (a lack of restraint), the tendency towards orthorexia nervosa, and dietary intake via a food frequency questionnaire. Orthorexia is not currently a diagnosable eating disorder but is a pattern of disordered eating that is characterized as an obsession with eating healthy food and avoiding unhealthy food (Korinth, Schiess, & Westenhoefer, 2010). It was determined that nutrition students showed higher levels of dietary restraint than the non-nutrition students (p < 0.01). Disinhibition and orthorexia nervosa did not differ between nutrition students and controls. Nutrition students showed healthier food choices when compared to corresponding controls, which showed slightly more unhealthy food choices (p < 0.01). The authors believe that, more than other students, nutrition students tend to restrict their food intake in order to control their weight, but they do not have more disturbed or disordered eating patterns than other students. Only one study was located that described the relationship of nutrition knowledge and disordered eating among nutrition students and was not completed in US.

Minimal research exists describing the relationship between nutrition knowledge and eating behaviors in college students and to fill the gap in current literature a cross-sectional study investigated self-reported eating patterns of 200 college students (Kolodinsky, Harvey-Berino, Berlin, Johnson, & Reynolds, 2007). First-year students participating in the university meal plan voluntarily completed an online survey. The survey was used to identify how closely respondents followed the Dietary Guidelines for
Americans 2005, and whether their eating patterns were related to their knowledge of dietary guidance. The results showed that increased knowledge was related to increased likelihood of meeting dietary guidelines for fruit, dairy, protein and whole grains. When participants were asked about their individual food choices, nutrition knowledge was related to making more healthful choices in every case. Ultimately the authors determined that increased knowledge of dietary guidance appeared to be positively related to more healthful eating patterns (Kolodinsky et al., 2007). The authors suggest that guidelines such as the Dietary Guidelines for Americans 2005, in conjunction with effective nutrition education programs, may be a useful mechanism for prompting change in dietary habits in college students. This study showed a relationship between nutrition knowledge and intake in an adult population but did not indicate that nutrition knowledge can predict eating behaviors.

**Nutrition Knowledge as a Predictor of Eating Behavior**

Two studies were conducted using logistic regressions to assess the predictability of an individual’s eating behaviors based on nutrition knowledge. The first was conducted by Wardle, Parmenter, and Waller (2000) and the purpose was to investigate the relationship between knowledge and dietary intake of select dietary components (total fat, fruit and vegetable intake) using the Nutrition Knowledge Questionnaire, a well-validated measure of nutrition knowledge. The questionnaire was completed by mail, using 1040 adult participants selected at random from General Practitioners’ lists in England. Results showed that knowledge was significantly associated with healthy choices in all three food types (vegetables: \( r = 0.36, p<0.001 \); fruit: \( r = 0.23, p<0.001 \); fat: \( r = -0.21, p<0.001 \)). Analysis of the data via logistic regression showed that respondents
in the highest quintile for knowledge were almost 25 times more likely to meet current
recommendations for fruit, vegetable and fat intake than those in the lowest quintile
(Wardle, Parmenter, & Waller, 2000). The authors believe that the results support the
value of including nutrition knowledge as a target for health education campaigns aimed
at promoting healthy eating.

The second study, performed by Sharma, Gernand, and Day (2008), sought to
examine the relationship between nutrition knowledge and eating behavior in a
predominantly Mexican-American community. This was a cross-sectional study using
data from the Que Sabrosa Vida community nutrition initiative questionnaire, which was
conducted as a telephone survey (n = 963). The results of a multiple logistic regression
examining the association between nutrition knowledge and eating behavior showed that
nutrition knowledge was a significant predictor of eating behavior. This was seen
particularly for grains, dairy, meats, beans, water, but not for fruits and (non-starchy)
vegetables. The authors concluded that nutrition knowledge predicts eating behavior for
all food groups except fruits and vegetables.

Impact of Nutrition Knowledge on Dietary Practices

In non-athletic populations, the impact of higher levels of nutrition knowledge
appears to have a positive impact on dietary practices. In 2001, two studies were
published (Pirouznia, 2001a; Pirouznia, 2001b) highlighting the influence of nutrition
knowledge on eating behavior and the roles of gender and grade level in middle school
students related to eating behaviors. Students in sixth, seventh and eighth grades were
asked to complete the CANKAP (Comprehensive Assessment of Nutrition Knowledge,
Attitudes, and Practices) questionnaire. This questionnaire measured nutrition
knowledge and eating behavior and consisted of 30 questions for sixth-grade students and 35 questions for seventh and eighth-grade students. After analysis of the data via use of Pearson r, the relationship between nutrition knowledge and eating behavior was found to be insignificant for sixth grade students, but significant for seventh (p < 0.008) and eighth (p <0.01) grade students (Pirouznia, 2001a). Pirouznia (2001b) also determined there was no correlation between nutrition knowledge and food choices in the sixth-grade male or female students. Conversely, the author determined a correlation between nutrition knowledge and food choices for girls in the seventh and eighth grades as well as for boys in the seventh and eighth grades (Pirouznia, 2001b). These studies demonstrate that as individuals’ progress in school and gain greater nutrition knowledge, their eating behaviors may improve for both genders.

In athletic populations, the literature regarding the impact of nutrition knowledge on dietary behaviors appears to give mixed results. One of the first studies in this area was completed by Wiita and Stombaugh (1996) and the purpose of this study, in part, was to examine changes in nutrition knowledge and dietary intakes of 22 female adolescent runners over a three year period. The participants were asked to complete nutrition knowledge questionnaires, interviews, and dietary analyses two times over a 3-year period. Analysis of the questionnaires and dietary analyses revealed mean scores on of nutrition knowledge remained stable at 67% at both year one and three. Considering dietary intake over the 3-year period, the runners increased the percentage of calories consumed as carbohydrates but they significantly decreased their mean energy intake, and I doing so lowered carbohydrate intake. The runners also significantly lowered protein, calcium, potassium, and sodium intakes. Therefore, over a 3-year period,
nutrition knowledge did not improve and the quality of dietary intakes decreased, indicating nutrition knowledge has little, if any, impact on dietary practices of adolescent runners. Among a study of both male and female college track athletes, Rash, Malinauskas, Duffrin, Barber-Heidal, and Overton (2008) sought to assess nutrition knowledge, attitude, and dietary intake. The 113 track athletes, from two NCAA Division I schools were asked to complete a self-administered nutrition knowledge and attitudes survey and food frequency questionnaire. The track athletes achieved an overall mean nutrition knowledge score of 58%, which was considered to be fair, with highest component scores reached in the categories of carbohydrate, vitamins and minerals, and protein. Overall mean diet quality was 84 of a possible 110. A very weak correlation ($r = 0.001$) existed between nutrition knowledge and diet quality. These two studies indicate a weak association between nutrition knowledge and dietary intake and are contradicted by the studies conducted by Cupisti, D'Alessandro, Castrogiovanni, Barale, and Morelli (2002) and Harrison, Worsley, MacFarlane, and Hopkins (1991).

A stronger relationship between nutrition knowledge and dietary intake can be seen in the studies completed by Cupisti et al. (2002) and Harrison (1991). Nutrition knowledge and dietary intake of Italian adolescent female athletes was compared to those of non-athletes. The nutrition knowledge and dietary intake of 60 athletes and 59 non-athletes adolescent females (14-18 years), using a 3 day food recall and a nutrition knowledge questionnaire. The dietary intake did not significantly differ between groups on most of the components that were assessed. However, the athlete group showed energy intake from carbohydrates was higher (53.6%) than non-athletes (49.8%; $p < .05$) and lipids intake was lower in athletes (30.4%) than in non-athletes (34.2%; $p < .001$).
Athletes also showed higher fiber (20.0 g/day; p < .001), iron (10.6 mg/day; p < .001) and vitamin A (804 µg/day; p < .05) intake than non-athletes (14.1 g/day, 7.5 mg/day, and 612 µg/day, respectively). Athletes scored slightly higher (77.6%) on the nutrition knowledge questionnaire (71.6%; p < .01) than non-athletes. This may indicate that sport participation can enhance athletes’ nutrition knowledge and thus positively influence dietary intake. Additionally, Harrison et al. (1991) investigated the nutrition knowledge and dietary habits of elite and non-elite athletes from New Zealand. One hundred and twelve male and female, elite and non-elite (recreational) athletes completed a nutrition knowledge and dietary habits questionnaire. The nutrition knowledge questionnaire contained three sections and included general demographics, sports nutrition and training knowledge and dietary habits. The elite athletes scored higher on nutrition knowledge and their dietary health habits were more closely aligned to the New Zealand nutrition guidelines than those of the non-elite group. A moderate correlation was found between nutrition knowledge and dietary habits (r = 0.44, p<0.01), and this relationship was significantly stronger (p<0.01) among the non-elite athletes (r = 0.62) than the elite athletes (r = 0.23). The aforementioned studies have in part investigated female athletes but not specifically female collegiate athletes.

Considering, specifically, female collegiate athletes, the impact of nutrition knowledge on dietary behaviors continues to give conflicting results. Hoogenboom, Morris, Morris, & Schaefer (2009) investigated nutritional knowledge and eating behaviors of female, collegiate swimmers while Hornstrom, Friesen, Ellery, and Pike (2011) assessed the nutrition knowledge, practices, attitudes, and information sources of Mid-American conference college softball players. The purpose of the Hoogenboom,
Morris, Morris, & Schaefer (2009) study, was to determine the nutritional knowledge of female collegiate swimmers as well as determine how effectively they apply their nutritional knowledge to their everyday eating habits. Competing at six different Michigan universities, 85 female collegiate swimmers completed a nutritional knowledge questionnaire and a 24-hour food recall survey. Analysis of the nutrition knowledge test yielded a mean score of 54.53 out of a possible 76 (71.75% correct). Mean total caloric intake of the swimmers was 3229.10 calories per day. Considering the swimmers macronutrient intake, 95.9% did not meet the recommendations for all three macronutrients. The authors concluded that this study suggests that athletes’ lack knowledge of nutrition, healthy food choices, and components of a well-balanced diet.

Contrary to the Hoogenboom et al. study, Hornstrom, Friesen, Ellery, and Pike (2011) determined that a correlation could be seen between nutrition knowledge and dietary practices for female collegiate softball players. The purpose of this study was to assess current knowledge, attitudes, and practices related to sport nutrition and to identify their preferred sources for obtaining sport nutrition information in Mid-American Conference softball players. The softball players (n = 185) completed the questionnaire with sections on basic and sports nutrition, quality of dietary choices, nutrition practices and attitudes towards nutrition as a performance enhancer. Four scores were produced from the questionnaire including the Nutrition Knowledge Score (NKS), the Nutrition Choice Score (NCS), the Nutrition Practice Score (NPS), and the Attitude Toward a Sports-Enhancing Diet (ASED) score. Analysis of the results showed a significant relationship between softball player’s KNS and NCS ($r = -0.23; p = 0.002$) which can be interpreted to mean that the lower the players’ nutrition knowledge the worse their eating
habits. Also, a significant relationship was found between NKS and NPS ($r = 0.23; p = 0.002$) which would imply that the higher the nutrition knowledge the better their nutrition practices. Each of the previous studies reviewed in this section investigated pre-existing nutrition knowledge base of participants and did not examine the impact of a nutrition education program on an individuals’ nutrition knowledge or retention.

**Impact of Nutrition Education on Nutrition Knowledge**

Nutrition-education programs are often based on the premise that superior nutrition knowledge may translate into better dietary intake (Heaney, O'Connor, Michael, Gifford, & Naughton, 2011). As was demonstrated in the Wardle, Parmenter and Waller (2000) study, the idea of translation of knowledge into actual dietary practice was supported by results from a large sample showing an association between nutrition knowledge and increased fruit and vegetable intake and reduced fat consumption. After determining that athletes may have a deficit in nutrition knowledge, improvements in general and sport-specific nutrition knowledge have been seen when nutrition education intervention programs are employed (Abood, Black, & Birnbaum, 2004; Collison, Kuczmariski, & Vickery, 1996; Kunkel, Bell, & Luccia, 2001).

Based on the assessment of athlete nutrition knowledge three studies investigated the benefits of implementing sports nutrition education programs in female collegiate athletes (Abood, Black, & Birnbaum, 2004; Kunkel, Bell, & Luccia, 2001; Valliant, Emplaincourt, Wenzel, & Garner, 2012) and each study found a significant increase in nutrition knowledge among female collegiate athletes when implementing a nutrition education intervention program. Abood, et al. (2004) investigated the effectiveness of a nutrition education intervention program with female collegiate athletes participating in
soccer and swimming with the swim team serving as the control group. Each group was asked to answer a 42 item true/false nutrition knowledge test. The test was given to the soccer team before an eight week nutrition intervention and again after the intervention. The swim team controls were administered the post-test nutrition knowledge test at approximately the same time as the soccer team, 10 weeks later. The results showed significant (p<0.05) improvements in post-test scores for the soccer team. Kunkel, Bell and Luccia (2001) made use of a peer nutrition education program as a means of intervention where junior and senior level nutrition major volunteers were assigned up to eight varsity female athletes to educate on nutrition concepts. Pre-test and post-test nutrition knowledge questionnaires were administered and consisted of 31 general and sport-specific questions. Post-test scores showed a significant (p≤0.05) improvement in overall nutrition knowledge. Valliant, Emplaincourt, Wenzel and Garner (2012) investigated the impact of nutrition education by a Registered Dietitian (RD) on the dietary intake and nutrition knowledge of a NCAA Division I volleyball team over the course of two off-seasons. Eleven female volleyball players were given a sports specific nutrition knowledge questionnaire before and after four individual meetings with the RD throughout the intervention season. Significant improvement (p=0.001) was seen in nutrition knowledge of the team after intervention. Mean pre-test scores were 24.7(SD = 5.9) and post-test scores were 31.5 (SD = 6.1) out of a possible 55 points. Collison, Kuczmarski and Vickery (1996) also found significant (p < 0.0005) increases in nutrition knowledge scores between pre-test and post-test and retention test (3 months after post-test) but observed no change in dietary habits among female collegiate varsity athletes participating in volleyball, field hockey and tennis. Evaluating if a nutrition intervention
improves knowledge only gives a partial picture regarding the benefits of enhanced nutrition knowledge. To complete the picture one needs to determine if nutrition knowledge impacts dietary behaviors to the extent of developing disordered eating.

Relationship between Nutrition Knowledge and Disordered Eating Risk

Dunn, Turner and Denny (2008) investigated nutrition knowledge and attitudes towards food, through use of an eating disorder screening questionnaire, of both male and female college athletes (n = 190) participating in basketball, golf, gymnastics, softball, swimming, soccer, tennis, cross-country, track and field, volleyball and football, assessing both nutrition knowledge and eating disorder risk but failed to correlate the two components. They did detect significant differences in overall knowledge between athletes’ collegiate sport participation and genders. Although, the majority of athletes at this university had healthy attitudes about eating behaviors, they scored low on the nutrition knowledge test.

Ultimately, only one study (Raymond-Barker, 2007) has sought to identify a correlation between nutrition knowledge and risk of developing female athlete triad (of which disordered eating is a component) among female athletes. The purpose of the study was to assess and compare nutritional knowledge in female athletes susceptible to the female athlete triad to a control group as well as to compare nutritional knowledge of those who were classified as being ‘at risk’ for developing female athlete triad and those who are ‘not at risk’. Athletes and controls completed General Nutritional Knowledge Questionnaire (GNKQ), the Eating Attitude Test (EAT-26) and survey measures of training/physical activity, menstrual and skeletal injury history. Participants included 48
endurance athletes which was comprised of runners (n = 20), cyclists (n = 4) and triathletes (n = 24), 11 trampoline gymnasts and 32 untrained controls. After analysis of the questionnaires, participants were classified being ‘at risk’ or ‘not at risk’ for female athlete triad and nutrition knowledge scores were compared for the two groups. The authors assess risk for each separate factor of female athlete triad and determined that a noticeably higher percentage of athletes were classified ‘at risk’ of menstrual dysfunction than controls (28.8% and 9.4%, respectively) and a higher percentage of athletes were “at risk” for disordered eating based on the EAT-26 test compared to controls (10.2% and 3.1%, respectively). Athletes (8.5%) were classified ‘at risk’ for bone mineral density in contrast to none from the control group. Scores for the GNKQ of athletes were higher than controls but the differences between the knowledge of ‘at risk’ and ‘not at risk’ athletes and controls were insignificant. These results lead the authors to conclude that a lack of difference in nutrition knowledge between “at risk” and “not at risk” athletes suggests that a deficit in nutrition knowledge is not accountable for restricted eating associated with the female athlete triad.

**Nutrition Education for Treatment and Prevention of Disordered Eating**

Since eating disorder prevention programs are an understudied area, Abood and Black (2000) designed, implemented and evaluated a health education program focused on eating disorder prevention in collegiate athletes. Subjects included 70 college female athletes competing in the following sports: diving, cross-country, track, swimming, softball, basketball, and volleyball. Ten participants were selected from each sport and then divided evenly among the treatment and control groups. Pre-test and post-test were given for the following tools: Eating Disorder Inventory-2, Sport Competition Anxiety
Test, Rosenberg Self-Esteem Test, Self-Rating Anxiety Scale and a nutrition inventory. The treatment group received the 8-week health education intervention which focused on self-esteem, stress management, nutrition and goal setting. Results showed that the educational intervention was associated with a decreased drive for thinness. Also seen was a decreased drive for thinness was associated with decreased body dissatisfaction. The authors believe that health education interventions may prove beneficial for preventing eating disorder development.

Torres-McGehee, Green, Leaver-Dunn, Leeper, Bishop, and Richardson (2011) sought to assess attitude and knowledge changes in collegiate dancers following a short-term, team-centered prevention program on eating disorders. This study had to aims, first to assess the effectiveness of an educational program focused on prevention of eating disorders and characteristics and behaviors related to eating disorders and second to assess changes in knowledge of eating disorders and good nutrition. Female dancers from two NCAA Division 1 schools served as experimental participants or controls. Participants were assessed on the following measures: eating disorder risk, depression, and nutritional and eating disorder knowledge. The experimental group participated in an eating disorder and sports nutrition education program that met for 8 sessions, 45-minutes each. The authors found a significant increase in knowledge scores both nutritional and eating disorder among the experimental group compared to the controls. Also the experimental group showed a decrease in scores related to depression, drive for thinness, body dissatisfaction and maturity fears compared to the control group. It was determined that a multi-session, interactive program educating college female dancers had a positive impact on changing behaviors and knowledge.
In the position statement, *National Athletic Trainers' Association Position Statement: Preventing, detecting, and managing disordered eating in athletes*, by Bonci et al. (2008), the authors highlighted the following topics: detecting disordered eating, managing athletes with disordered eating, and preventing disordered eating. Specifically, in reference to prevention of eating disorders, they make the following four recommendations: 1) mandatory educational programs for athletes, 2) all athletes should be educated on the importance of optimal nutrition practices to reduce the risk of medical and performance problems associated with prolonged energy and nutrient deprivation, 3) female athletes should be educated on the health and performance consequences of menstrual irregularities and the importance of seeking timely medical intervention at the first sign of abnormalities, 4) the educational program should be evaluated routinely to determine its effectiveness in changing the knowledge level, attitudes, and behaviors of athletes as well as those participating in their health maintenance and performance enhancement to better minimize, contain, manage, and prevent problems. From these recommendations, it is evident that nutrition education is an accepted method of eating disorder prevention.
CHAPTER 3

METHODOLOGY

The aim of this study was to assess the relationship between nutrition knowledge and eating pathology among female collegiate athletes competing at a NCAA Division I university in the southwestern United States. This study used a correlational design using pre-existing data generated from two questionnaires used as screening instruments within the athletics department of the university.

Research Questions

Research questions addressed regarding the female collegiate athlete include 1) what is the status of nutrition knowledge among female collegiate athletes?, 2) what is the prevalence of clinical and subclinical symptoms among female collegiate athletes?, 3) does participation in a particular sport show increased female collegiate athlete disordered eating risk?, 4) does participation in a particular sport show increased female collegiate athlete nutrition knowledge?, 5) is disordered eating risk greater in female collegiate athletes who desire to lose weight?, 6) is nutrition knowledge greater in female collegiate athletes who desire to lose weight?, 7) does participation in “lean” sport show a greater risk of disordered eating risk?, 8) does participation in “lean” sports show a greater level of nutrition knowledge? and 9) is there a correlation between nutrition knowledge and disordered eating risk?

Participants

The participant group was a convenience sample of all incoming and returning female collegiate athletes at an urban university located in southwestern United States participating in women’s basketball, cross-country, track and field, women’s golf,
swimming and diving, softball, tennis, cheerleading and dance team, volleyball and women’s soccer. Questionnaires were distributed as a part of the student athletes’ annual pre-participation physical and were originally intended as medical screening instruments; no informed consent was obtained or required. Criteria for inclusion included incoming and returning female student athletes who fully completed both screening instruments.

**Data Attainment Procedures**

Collegiate athletes are asked to participate in an annual pre-participation physical examination (PPE) which, according to the American College of Sports Medicine (ACSM), is to aid in:

- identifying medical and orthopedic problems that may place the athlete at risk for injury or illness;
- identify correctable problems that may impair the athlete’s ability to perform;
- maintain the health and safety of the athlete;
- assess fitness level for specific sports;
- educate athletes and parents concerning sports, exercise, injuries and other health related issues;
- and meet legal and insurance requirements (American College of Sports Medicine, 2011).

It has been suggested that the additional components of gynecology and nutrition be added to the traditional PPE (M. Johnson, 1992; Tanner, 1994) for female collegiate athletes. There currently exists no standard instrument used for PPE (Robert-McComb, 2008) for female collegiate athletes although it has been shown that a more standardized eating disorder and menstrual dysfunction screening tool is needed among NCAA Division I female athletics (Beals, 2003).

At the time of the annual PPE for student athletes, all university student athletes were asked to complete the Nutrition Knowledge Screening (NKS) to aid the Athletic
Training staff and the Head Team Physician at the university in identifying nutritional knowledge deficiencies and behaviors among athletes. In addition to the NKS, female student athletes were asked to complete the Female Athlete Screening Tool (FAST) questionnaire. This questionnaire was intended to identify eating disorder pathology specifically in female athletes; therefore, male athletes were excluded from this aspect of the PPE. Two hundred and seven female student-athletes submitted the NKS but two questionnaires were omitted for being incomplete and 208 FAST questionnaires were submitted but three were omitted from analysis for being incomplete. A total of 204 female student-athletes completed both the NKS and FAST questionnaires in their entirety and these are the questionnaires to be NKS used for analysis in this study.

**Screening Instruments**

Female collegiate athletes completed the NKS and FAST questionnaires during annual sports physicals. Questionnaires were completed either prior to reporting to campus and turned in to the Athletic Training staff on the day of the PPE or were completed on-campus prior to meeting with the Team Physician on the day of the PPE. The duration to complete each questionnaire is approximately 10 to 20 minutes.

**Nutrition Knowledge and Screening**

This questionnaire includes statements related to nutrition that assesses the student athletes’ knowledge of general and sports nutrition concepts related to food intake and the relationship to sport performance. This questionnaire also includes questions that pertain to student athletes’ dietary behavior. The NKS (Appendix A) was developed for the purpose of identifying nutrition knowledge deficiencies among the student athlete population of the sample university and identifying concerns related to eating behavior.
In response to a request from the Athletics Department, the NKS was developed by the author and colleagues working in the Nutrition Sciences department of the same university. An exploratory factor analysis was completed on this questionnaire and the results can be found in Appendix B.

The NKS questionnaire was based on a 3-point Likert-type scale response including answer choices: agree, disagree, and don’t know. The NKS can be found in Appendix I where the desired answers are indicated. The following is a sample statement and its expected response from the NKS questionnaire: Protein is the most important nutrient for fueling muscles; disagree. Question number four of the NKS questionnaire is structured as a multiple choice question: An athlete should consume a high-_____ meal 2-3 hours before an event and with the available answer options as carbohydrate, fat, and protein. The NKS questionnaire includes a total of 40 statements. Statements 1-31 are intended to assess general and sports nutrition knowledge while statements 32-40 are associated with dietary behaviors. For this study, statements 1-31 will be scored, omitting questions 32-40. The purpose in omitting these questions is to reduce conflicting information between the dietary behaviors identified on the NKS and the FAST questionnaire, which is a validated behavior assessment tool. Questionnaires were scored out of a maximum of 31 points, 1 point given for a correct or expected response and wrong or don’t know responses will be scored as 0 points.

Female Athlete Screening Tool

The second questionnaire completed by female student athletes and includes questions related to the student athletes’ risk for developing an eating disorder. The FAST questionnaire (Appendix C) is a validated screening tool for identifying eating
pathology in female athletes (McNulty, Adams, Anderson, & Affenito, 2001) and consists of 33 questions with responses scored between 1-4 points. The maximum score for this questionnaire is 130 points. A sample question on the FAST questionnaire is: I participate in additional physical activity ≥ 20 minutes in length on days that I have practice or competition and my performance would improve if I lost weight. Robert-McComb (2008) indicates that each question is scored per the following scoring instructions:

the FAST is scored on a 4-point Likert scale. The higher the number the higher the probability (i.e., 4 points = frequently; 3 points = sometimes; 2 points = rarely; and 1 point = never). Questions 15, 28, and 32 are reversed scored. For question 32, a response of yes receives 1 point and a response of no receives 2 points. In a small group of female athletes (N = 41), subclinical scores ranged from 77 to 94, and clinical scores were > 94 (p. 367-368).

**Demographics**

Information including age, height, weight, desired body weight and current body weight were self-reported by student athletes on the NKS questionnaire. Body mass index (BMI) for each athlete was calculated when both height and weight data were available.

**Data Entry**

Prior to data entry, an identification number was assigned to each female collegiate athlete for whom both the NKS and FAST questionnaires were available. Each questionnaire was assigned the appropriate identification number and athlete names were
removed. For each FAST questionnaire, the responses for the 33 questions were transcribed into a computerized spreadsheet program and a total score tabulated for each participant. For each NKS questionnaire, answers for questions 1-31 were transcribed into a computerized spreadsheet program and a total score tabulated. The NKS questionnaire also contained data pertaining to body weight and desire to change weight that was also transcribed into a computerized spreadsheet program.

**Data Analysis**

All analyses were completed using SPSS, version 18 (SPSS Inc., Chicago, IL, 2010). Descriptive statistics are reported for age, height, weight, and body mass index (BMI). NKS and FAST questionnaires were scored as indicated above and means and standard deviations will be calculated overall and for each sport, also, mean scores of the NKS were converted to percentages and reported. The status of nutrition knowledge is reported based on the number of correct, wrong and don’t know responses on the NKS. Overall and based on sports type (“lean”/”non-lean), frequencies were tabulated of FAST scores in the three categories of clinical (>94), subclinical (77-94) and no symptoms (<77). One-way ANOVA were used to compare means of each sport to assess if participation in a particular sport shows increased nutrition knowledge and will also be used to compare the means of each sport to assess if participation in a particular sport shows increased disordered eating risk. Independent-samples t tests were used to compare the athlete’s desire to lose weight with disordered eating risk (i.e. scores on FAST) as well as the desire to lose weight with nutrition knowledge scores from the NKS. Independent-samples t tests were also utilized to compare the nutrition knowledge means of “lean” athletes against “non-lean” athletes as well as to compare the disordered
eating risk means for the same groups. Pearson product-moment correlation coefficient 
($r$) was used to assess the relationship between nutrition knowledge (scores on NKS) and 
disordered eating risk (scores on FAST).

**Human Subjects**

The questionnaires analyzed in this study were collected prior to initiation of the 
study (on the shelf) and were originally collected for non-research purposes. Before 
analysis of the instruments the university’s Institutional Review Board reviewed the 
research design and approval was obtained to conduct this study (Appendix D). No 
reference is made in written or oral materials that could link the participants to the study. 
All records are stored in the university’s Athletics Department.
CHAPTER 4

RESULTS

Analyses of the data is presented in this chapter and include assessment of the descriptive data including age, weight, height and body mass index (BMI) of the sample population. Means and standard deviations are reported for NKS and FAST scores and NKS scores were converted to percentages for ease of understanding. The status of nutrition knowledge was assessed by evaluating overall means and standard deviation and the percentages of agree, disagree and don’t know responses for the 31 nutrition knowledge statements presented in the NKS. Sports were grouped by type, as either “lean” (including cheer and dance, cross-country and swimming and diving) or “non-lean” (including basketball, golf, soccer, softball, tennis, track and field and volleyball) and frequencies were tabulated and reported for the three categories associated with FAST (clinical, subclinical, and asymptomatic). Analysis of variance (ANOVA) was used to compare the NKS means of each sport to determine if any sport exhibited greater or lesser nutrition knowledge then another sport. By use of ANOVA, the means of the FAST scores for each sport were compared to determine if any sport showed higher or lower scores than any other sport. By use of independent samples t tests, a comparison of means of NKS scores and means of FAST scores were assessed for those female collegiate athletes’ who desire to lose weight and those who did not. Based on sport type (“lean”/“non-lean”), means of NKS scores and FAST scores were evaluated. Finally, Pearson product-moment correlation coefficient (r) was used to assess the relationship between nutrition knowledge and eating disorder risk.
Participant Characteristics

Female collegiate athletes’ ages ranged from 17 to 23 years, the mean age for all athletes was 19.6 years ($SD = 1.3$). Weight ranged from 45.5 kg to 165.91 kg with a mean of 63.7 kg ($SD = 12.9$) for all athletes. Height for the athletes’ ranged from 60 inches to 76 inches, with an average of 66.2 inches ($SD = 3.2$). Based on athletes’ reported body weight and height, BMI was calculated and reported. BMI for athletes’ ranged from 18 to 44, with a mean of 22.4 kg/m$^2$ ($SD = 3.5$). Twenty-four athletes (12%) presented with a BMI greater than 25 kg/m$^2$, which is considered overweight and may indicate a health risk, however, none of the athletes presented with a BMI less than 17.5 kg/m$^2$, which is one of the diagnostic criteria for anorexia nervosa. General characteristics of participants, by sport, can be found in Table 1.

Table 1
Subject Characteristics Overall and by Sport ($M \pm SD$)

<table>
<thead>
<tr>
<th></th>
<th>no.</th>
<th>Age (yrs) $M \pm SD$</th>
<th>Actual Weight (kg) $M \pm SD$</th>
<th>Desired Weight (kg) $M \pm SD$</th>
<th>Height (in) $M \pm SD$</th>
<th>BMI (kg/m$^2$) $M \pm SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All athletes</td>
<td>204</td>
<td>19.6±1.3</td>
<td>64.1±13.8$^a$</td>
<td>61.8±10.7$^a$</td>
<td>66.3±3.3</td>
<td>22.4±3.5</td>
</tr>
<tr>
<td>Basketball</td>
<td>11</td>
<td>19.3±1.4</td>
<td>84.8±34.2</td>
<td>77.7±14.0</td>
<td>69.6±4.0</td>
<td>27.2±7.9$^b$</td>
</tr>
<tr>
<td>Cheer &amp; Dance</td>
<td>44</td>
<td>18.8±1.1</td>
<td>59.6±13.1</td>
<td>57.3±13.6</td>
<td>64.7±3.4</td>
<td>21.8±2.7</td>
</tr>
<tr>
<td>Cross-country</td>
<td>15</td>
<td>18.7±1.4</td>
<td>54.0±6.3</td>
<td>53.1±5.1</td>
<td>64.6±2.8</td>
<td>19.9±1.9</td>
</tr>
<tr>
<td>Golf</td>
<td>9</td>
<td>19.7±0.7</td>
<td>61.5±7.3</td>
<td>61.1±4.6</td>
<td>65.2±2.2</td>
<td>22.0±2.1</td>
</tr>
<tr>
<td>Soccer</td>
<td>28</td>
<td>19.1±1.2</td>
<td>60.4±5.9</td>
<td>59.3±5.1</td>
<td>65.0±2.2</td>
<td>22.0±1.7</td>
</tr>
<tr>
<td>Softball</td>
<td>21</td>
<td>19.9±1.4</td>
<td>70.6±11.4</td>
<td>66.7±9.2</td>
<td>66.6±2.5</td>
<td>24.6±3.3</td>
</tr>
<tr>
<td>Swimming &amp; Diving</td>
<td>31</td>
<td>19.1±1.3</td>
<td>63.4±6.0</td>
<td>61.3±5.4</td>
<td>67.1±2.5</td>
<td>21.7±1.8</td>
</tr>
<tr>
<td>Tennis</td>
<td>6</td>
<td>19.7±1.9</td>
<td>64.7±6.0</td>
<td>63.2±6.0</td>
<td>68.0±1.0</td>
<td>22.5±0.7</td>
</tr>
<tr>
<td>Track &amp; Field</td>
<td>25</td>
<td>19.2±1.4</td>
<td>66.6±17.2</td>
<td>63.5±11.0</td>
<td>66.5±2.3</td>
<td>23.2±5.2</td>
</tr>
<tr>
<td>Volleyball</td>
<td>14</td>
<td>19.4±1.1</td>
<td>71.9±15.4</td>
<td>70.6±26.6</td>
<td>70.4±4.5</td>
<td>22.0±1.5</td>
</tr>
</tbody>
</table>

$^a$ values differ significantly at $p < .001$

$^b$ Body Mass Index (BMI) $>25$ indicates an overweight status and may imply an increased health risk
Status of Nutrition Knowledge of Female Collegiate Athletes

Status of nutrition knowledge of female collegiate athletes was assessed. It was hypothesized that, overall, female collegiate athletes would show fair nutrition knowledge. It was judged that scores on the NKS that fall between 90 and 100 percent were considered excellent, scores between 80 and 89 percent were considered good, scores between 70 and 79 percent were considered fair, and scores between 60 and 69 percent were considered poor and, finally, scores less than 60 percent were considered very poor. Overall, it was determined that female collegiate athletes scored poorly (63%) on the NKS questionnaire (Table 2).

<table>
<thead>
<tr>
<th></th>
<th>NKS (out of 31)</th>
<th>NKS (% correct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All athletes</td>
<td>19.2±4.5</td>
<td>62%</td>
</tr>
<tr>
<td>Basketball</td>
<td>16.8±3.2</td>
<td>54%</td>
</tr>
<tr>
<td>Cheer &amp; Dance</td>
<td>17.8±4.9</td>
<td>57%</td>
</tr>
<tr>
<td>Cross-country</td>
<td>20.7±2.6</td>
<td>67%</td>
</tr>
<tr>
<td>Golf</td>
<td>17.1±6.9</td>
<td>55%</td>
</tr>
<tr>
<td>Soccer</td>
<td>21.0±4.0</td>
<td>68%</td>
</tr>
<tr>
<td>Softball</td>
<td>19.5±5.5</td>
<td>63%</td>
</tr>
<tr>
<td>Swimming &amp; Diving</td>
<td>20.4±4.7</td>
<td>66%</td>
</tr>
<tr>
<td>Tennis</td>
<td>16.3±6.7</td>
<td>53%</td>
</tr>
<tr>
<td>Track &amp; Field</td>
<td>17.9±5.7</td>
<td>58%</td>
</tr>
<tr>
<td>Volleyball</td>
<td>22.4±2.5</td>
<td>72%</td>
</tr>
</tbody>
</table>

A closer evaluation of the responses to each of the 31 statements on the NKS is listed below in Table 3. As indicated above, the overall score for all athletes was poor (63%) however; in depth evaluation shows areas of greater and lesser nutrition knowledge.
Table 3  
*Percentage (%) of agree, disagree, and don’t know responses on NKS*

<table>
<thead>
<tr>
<th>General Nutrition</th>
<th>Agree</th>
<th>Disagree</th>
<th>Don't Know</th>
</tr>
</thead>
</table>
| A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day.  
What the athlete eats is only important if the athlete is trying to gain or lose weight.  
Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need. | 68    | 8        | 24         |
| Hydration                                                                         |       |          |            |
| An athlete should replace fluids before, during, and after an event.                | 91    | 3        | 6          |
| Athletes should rely on thirst to ensure fluid replacement.                        | 9     | 84       | 7          |
| Urine color can indicate dehydration.                                             | 95    | 1        | 4          |
| During exercise, it is better to drink a large amount of fluid all at once rather than small amounts over time.  
Sports drinks are the best way to replace body fluids lost during exercise.  
Drinking beer is a good way to rehydrate after exercise.  
Drinking alcohol will add calories to your diet.  
Caffeine has been shown to improve endurance performance. | 2     | 90       | 8          |
| Macronutrients                                                                    |       |          |            |
| Carbohydrate and fat are the main energy sources for athletes.                    | 62    | 23       | 15         |
| Athletes should not eat sweets prior to an event.                                 | 66    | 26       | 8          |
| Carbohydrates make you fat.                                                       | 13    | 77       | 10         |
| An athlete should consume a high-____ meal 2-3 hours before an event.             | 55    | 45       | 0          |
| Protein is the main energy source for the muscle.                                 | 78    | 9        | 13         |
| Protein supplements are necessary for athletes.                                   | 20    | 65       | 15         |
| Carbohydrates are not as easily and rapidly digested as protein and fat.          | 23    | 37       | 40         |
| Eggs and legumes are examples of protein sources other than meat.                 | 92    | 2        | 6          |
| No more than 15% of calories in the diet should be provided by fat.                 | 47    | 5        | 48         |
| Bread and cereals are the only food groups that are a good source of fiber.        | 18    | 67       | 15         |
| Micronutrients                                                                    |       |          |            |
| Vitamin and mineral supplements increase energy levels.                           | 40    | 24       | 36         |
| A multivitamin and mineral supplement is necessary for optimal sport performance. | 22    | 50       | 28         |
| One 8-ounce glasses of milk is enough to fulfill the recommended amount of calcium per day.  
Those with a meatless diet are at a higher risk for iron deficiency.  
Due to menstruation, females need more iron in their diets than men.  
Bananas and avocados are good sources of potassium.  
Excess vitamin supplementation may be harmful.  
The body can synthesize vitamin D upon exposure to the sun.  
Potatoes, strawberries, and cantaloupe are good sources of vitamin C.  
Salt is an essential part of a healthy diet. | 25    | 44       | 31         |
|                                                                            | 81    | 3        | 16         |
|                                                                            | 83    | 2        | 15         |
|                                                                            | 93    | 1        | 6          |
|                                                                            | 77    | 6        | 17         |
|                                                                            | 59    | 3        | 38         |
|                                                                            | 58    | 15       | 27         |
|                                                                            | 49    | 28       | 23         |

*^a^* statements with the expected answer of agree  
*^b^* statements with the expected answer of disagree  
*^c^* answer options were carbohydrate, protein, fat; carbohydrate is the expected answer
Female collegiate athletes responded correctly, most frequently, to general nutrition statements (79%) and responded correctly, least frequently, to macronutrient statements (49%). Statements about hydration and micronutrients were answered correctly, on average, by 62% and 61% of female collegiate athletes, respectively. Statements regarding micronutrients were most often answered with a response of don’t know (24%). Statements on the NKS questionnaire are listed in rank order based on correct, incorrect and don’t know responses in Appendices E, F, and G, respectively.

**Prevalence of Eating Disorder Symptoms**

The prevalence of clinical and subclinical symptoms of eating disorders among female collegiate athletes was evaluated and it was hypothesized, that the majority of disordered behaviors, if detected, would be subclinical but overall most athletes would be asymptomatic. A maximum of 140 points were possible on the FAST questionnaire and frequencies were tabulated for classifications of clinical (scores > 94), subclinical (scores 77 – 94), and asymptomatic (scores < 77) scores on the FAST based on sport type (Table 4). Analysis shows that none of the questioned female collegiate athletes exhibited clinical symptoms of an eating disorder. A total of 19 (9%) female collegiate athletes presented with subclinical symptoms of eating disorders.

<table>
<thead>
<tr>
<th>FAST score classification by group</th>
<th>Clinical (&gt;94)</th>
<th>Subclinical (77-94)</th>
<th>Asymptomatic (&lt;77)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All athletes</td>
<td>0</td>
<td>19</td>
<td>185</td>
</tr>
<tr>
<td>“lean” sports</td>
<td>0</td>
<td>11</td>
<td>79</td>
</tr>
<tr>
<td>“non-lean” sports</td>
<td>0</td>
<td>8</td>
<td>106</td>
</tr>
</tbody>
</table>
Eating Disorder Risk and Sport Participation

Eating disorder risk was assessed based on sports participation and it was hypothesized that at least one sport would have a mean FAST score significantly higher than the other sports. Athletes participating in cross-country, tennis and volleyball showed no symptoms of eating disorders. The following indicated the number of athletes, by sport, scoring between 77 and 94 on FAST indicating subclinical symptomology of eating disorders: basketball, n = 2 (18%), cheer and dance, n = 7 (16%), golf, n = 2, (11%), soccer, n = 1, (4%), softball, n = 2, (10%), swimming and diving, n = 4, (13%), and track and field, n = 1, (4%). Analysis of variance showed statistical significance difference between sports teams, $F(9, 194) = 2.29, p = .018$ but post-hoc analysis showed no pairwise differences (Table 5).

Table 5
*FAST scores by sport (M ± SD)*

<table>
<thead>
<tr>
<th>Sport</th>
<th>FAST (out of 140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All athletes</td>
<td>59.5±11.9</td>
</tr>
<tr>
<td>Basketball</td>
<td>62.5±13.3</td>
</tr>
<tr>
<td>Cheer &amp; Dance</td>
<td>64.5±11.6</td>
</tr>
<tr>
<td>Cross-country</td>
<td>53.7±11.5</td>
</tr>
<tr>
<td>Golf</td>
<td>60.0±15.3</td>
</tr>
<tr>
<td>Soccer</td>
<td>56.8±10.8</td>
</tr>
<tr>
<td>Softball</td>
<td>62.2±11.5</td>
</tr>
<tr>
<td>Swimming &amp; Diving</td>
<td>60.1±12.6</td>
</tr>
<tr>
<td>Tennis</td>
<td>54.2±12.6</td>
</tr>
<tr>
<td>Track &amp; Field</td>
<td>55.2±11.0</td>
</tr>
<tr>
<td>Volleyball</td>
<td>57.6±4.8</td>
</tr>
</tbody>
</table>
Nutrition Knowledge and Sports Participation

Nutrition knowledge was assessed based on sports participation and it was hypothesized that no differences would be seen between the mean scores of NKS for any sport. Analysis of variance detected statistical significance difference between sports teams, $F(9, 194) = 2.02, p = .003$ but again post-hoc analysis identified no pairwise differences. NKS scores by sport can be found in Table 2.

Eating Disorder Risk and Sport Type

Eating disorder risk was assessed based on participation in a “lean” versus “non-lean” sports and it was hypothesized that female collegiate athletes who participate in “lean” sports will exhibit higher scores on FAST (i.e. exhibit greater eating disorder risk) than do those participating in “non-lean” sports. Utilizing an independent samples $t$ test, it was determined that individuals who participate in “lean” sports scored significantly higher ($M = 61.18, SD = 12.44$) on the FAST than did those individuals who participate in “non-lean” ($M = 58.21, SD = 11.26$), $t(202) = 1.78, p = 0.04$ (Table 6).

Nutrition Knowledge and Sport Type

Nutrition knowledge of female collegiate athletes was assessed based on participation in “lean” versus “non-lean” sports. It was hypothesized that the nutrition knowledge scores of female collegiate athletes who participate in “lean” sports would not differ from that of individuals who participate in “non-lean” sports. Utilizing an independent samples $t$ test, it was determined that individuals who participate in “lean” sports scores ($M = 19.27, SD = 5.19$) did not significantly differ on the NKS compared to those individuals who participate in “non-lean” ($M = 19.16, SD = 4.66$), $t(202) = -0.166, p = 0.87$ (Table 6).
Table 6  
*FAST and NKS scores compared to type of sport*

<table>
<thead>
<tr>
<th>Type of Sport</th>
<th>FAST (out of 140)</th>
<th>NKS (out of 31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“lean” sports</td>
<td>61.2±12.4*</td>
<td>19.3±4.2</td>
</tr>
<tr>
<td>“non-lean” sports</td>
<td>58.2±11.3</td>
<td>19.2±4.7</td>
</tr>
</tbody>
</table>

* Significance found at \( p = .04 \)

**Eating Disorder Risk and Desire to Lose Weight**

Overall, female collegiate athletes desired to lose an average of 2.3 kg or approximately 5 pounds. It was hypothesized that female collegiate athletes who desire to lose weight would exhibit greater eating disorder risk (higher FAST scores) than female collegiate athletes who did not desire to lose weight. Analysis of this hypothesis, utilizing an independent samples \( t \) test, determined that female collegiate athletes who indicated a desire to lose weight scored significantly higher (\( M = 63.96, SD = 10.92 \)) on the FAST than did those athletes who do not indicate a desire to lose weight (\( M = 53.37, SD = 11.21 \)), \( t(177) = 6.21; p < .001 \) (Table 7).

**Nutrition Knowledge and Desire to Lose Weight**

It was hypothesized that nutrition knowledge (NKS scores) of female collegiate athletes who desire to lose weight will not differ from that of individuals who do not desire to lose weight. Analysis of this hypothesis, utilizing an independent samples \( t \) test, determined that female collegiate athletes who indicate a desire to lose weight scored no differently (\( M = 19.01, SD = 4.70 \)) on the NKS than did those athletes who do not indicate a desire to lose weight (\( M = 20.09, SD = 4.33 \)), \( t(177) = 1.53; p = .13 \) (Table 7).
Table 7

FAST and NKS scores compared to desire to lose weight

<table>
<thead>
<tr>
<th></th>
<th>FAST (out of 140)</th>
<th>NKS (out of 31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All athletes</td>
<td>59.5±11.9</td>
<td>19.2±4.5</td>
</tr>
<tr>
<td>Desired to lose weight</td>
<td>64.0±10.9*</td>
<td>19.0±4.7</td>
</tr>
<tr>
<td>No desire to lose weight</td>
<td>53.4±11.2</td>
<td>20.1±4.3</td>
</tr>
</tbody>
</table>

* Significance found at \( p < .001 \)

**Correlation between Nutrition Knowledge and Eating Disorder Risk**

A correlation between nutrition knowledge and eating disorder risk was assessed by correlating female collegiate athletes’ scores on the NKS and FAST. Female collegiate athletes with greater nutrition knowledge were hypothesized to exhibit less symptoms of disordered eating thus showing a negative relationship between nutrition knowledge and disordered eating risk. Correlation analysis, using Pearson product-moment correlation coefficient (\( r \)), showed no correlation \( r (202) = -.014; p = .56 \) (Figure 1) between nutrition knowledge and eating disorder risk when comparing the scores on the NKS and the scores on the FAST.
Further evaluation of the correlation between nutrition knowledge and eating disorder risk was completed by assessing the relationship between NKS scores and FAST scores of the 19 female collegiate athletes that scored in the subclinical range on the FAST questionnaire. Correlation analysis, using Pearson product-moment correlation coefficient (r), showed a significant positive correlation $r (18) = .511; p = .05$ (Figure 2) between nutrition knowledge and eating disorder risk when comparing the scores on the NKS and the scores on the FAST.

*Figure 1*. Correlation between NKS and FAST scores of female collegiate athletes.
Figure 2. Correlation between NKS and FAST scores of female collegiate athletes scoring in the subclinical range on FAST.

\[ y = 0.4891x + 73.386 \]

\[ R^2 = 0.2612 \]
CHAPTER 5
DISCUSSION

Some female athletes may use potentially harmful practices such as restrictive or chronic dieting to achieve unrealistic size and weight goals created by the collegiate sports milieu. These practices can lead to the development of disordered eating or eating disorders. Several factors have been identified as risks for developing these conditions but nutrition knowledge has yet to be fully examined as a risk factor. To date, no other research has sought to correlate nutrition knowledge and eating disorder risk in female collegiate athletes. The aims of this research were to determine if a correlation exists between nutrition knowledge (scores on NKS) and eating disorder risk (scores on FAST) as well as assess the status of nutrition knowledge and eating disorder risk prevalence in a sample of female collegiate athletes.

**Nutrition Knowledge Status of Female Collegiate Athletes**

The results of this study show the nutrition knowledge status of female collegiate athletes as poor, with participants responding correctly, on average, to 62% of the statements on the NKS questionnaire. These poor results are consistent with Rosenbloom, Jonnalagadda and Skinner (2002) who tested the nutrition knowledge of 328 Division I, NCAA student athletes with an 11-question survey and determined that participants had poor nutrition knowledge when they responded correctly to only 53% of statements. The current study results were also consistent with Zawila, Steib, and Hoogenboom (2003) whose results also showed poor nutrition knowledge, 57% correct responses, in female collegiate cross-country runners. In the present study, out of the nine teams evaluated only the volleyball team scored in the fair range with a team mean
of 72%. On average, female collegiate athletes did not know 38% of nutrition information presented in the NKS questionnaire. This lack of knowledge indicates a need for greater exposure to nutrition information. Also, nutrition and athletic training professionals working with female collegiate athletes should not assume that athletes have adequate knowledge of nutrition. As of the completion of this project, and as highlighted in other research projects evaluating nutrition knowledge of athletes (Hoogenboom, Morris, Morris, & Schaefer, 2009), no standard nutrition and more specifically sports nutrition knowledge questionnaire has been presented in the literature and therefore the use of the NKS questionnaire cannot be compared to a standard, validated sports nutrition knowledge questionnaire.

Statements on the NKS were categorized into general nutrition, hydration, macronutrient and micronutrient subcategories. Regarding the general nutrition knowledge subcategory, female collegiate athletes, overall, scored 79% correct implying that they understand the basic concepts of sound nutrition. Female collegiate athletes scored 62% on the hydration statements, which is lower than what was observed in a study done by Nichols, Trinkaus, Rosenbloom, and Jonnalagadda (2005) whose study results showed good knowledge of hydration needs for athletes with a total mean score of 87%. One hydration statement on the NKS, in particular, “Sports drinks are the best way to replace body fluids lost during exercise” was of note in the current sample. The expected response to the statement was “agree” and 41% of participants responded correctly, however, an additional 41% of participants responded “disagree” and 18% responded “don’t know”. This indicates a substantial lack of understanding related to the benefits and usage of sports beverages in the sport environment. The athletes’ responses
contradict common knowledge of sports drinks generally gained from advertising and the wide availability of sports drinks in athletic environments, but, this may be due to the athlete’s exposure to sports beverage usage within the athletic department. Many university sports teams have limited budgets and choose to eliminate the expense of offering sports beverages during practices to best manage expenditures. Unfortunately, this may leave the athletes with the impression that sports beverages have equal if not lesser nutritional value than the water that is typically provided and leads one to be concerned about proper fluid replenishment habits of female collegiate athletes.

The nutrition knowledge subcategory with the lowest mean score was macronutrients at 49%. The statement in this category with the most frequent incorrect responses (78%) includes “Protein is the main energy source for the muscle” where the expected response was “disagree”. Interestingly, a majority of participants (65%) responded correctly to the statement “Protein supplements are necessary for athletes” in which the expected response was “disagree”. There appears to be a disconnection between the participants’ understanding of protein needs and the metabolic functions of protein. Two statements in the macronutrient category that athletes indicated a lack of knowledge were “No more than 15% of calories in the diet should be provided by fat” for which the response of “don’t know” was given by 48% of female collegiate athletes and “Carbohydrates are not as easily and rapidly digested as protein and fat” for which the response “don’t know” was given by 40% of athletes. It appears that female collegiate athletes may benefit from education efforts targeted on protein, carbohydrate and fat needs and metabolic functions.
The NKS subcategory of micronutrients yielded a mean score of 61% from all athletes but also yielded the highest rate of “don’t know” responses at 24%. This implies that female collegiate athletes are most confused about vitamin and mineral needs and functions. Statements of which less than half of athletes responded correctly include “Vitamin and mineral supplements increase energy levels” and “A multivitamin and mineral supplement is necessary for optimal sport performance”, and “Salt is an essential part of a healthy diet”. This tells us that female collegiate athletes are likely confused by media messages regarding the metabolic functions of and need for vitamins and minerals and would benefit from exposure to simplified, accurate micronutrient information and a trustworthy nutrition professional.

**Eating Disorder Prevalence in Female Collegiate Athletes**

It was hypothesized that the majority of disordered eating behaviors, if detected, would be subclinical but overall most athletes would be asymptomatic. The results support this hypothesis. No clinical symptoms were detected in the sample of female collegiate athletes, however, subclinical symptoms were detected in a total of 9% of female collegiate athletes (n = 19), of which, 5% (n = 11) were participating in “lean” sports and 4% (n = 8) were participating in “non-lean” sports. The prevalence of eating disorder risk in the current study was very low when compared to the results of other studies. The results of a study conducted by Greenleaf, Petrie, Carter, & Reel (2009) showed that among NCAA Division I female collegiate athletes, 26% were symptomatic and 2% presented with clinical symptoms of eating disorders. Beals and Hill’s (2006) results showed that among NCAA Division II female collegiate athletes, overall 25% met the criteria for disordered eating and Johnson, Powers and Dick (1999) indicated that
among NCAA Division I athletes as many as 38% were at risk for eating disorders, however, less than 1.5% of athletes showed symptoms of clinical eating disorders. Considering specific sport prevalence of eating disorder risk, in 2012, Anderson and Petrie published results that showed 29% of gymnasts and 21% of swimmers and divers were at risk for eating disorders while 6% of gymnasts and 7% of swimmer and divers showed clinical symptoms of eating disorders. Gymnastics was not a sport at the participating university but when comparing these results to the swimmers and divers from the current sample population, only 13% were at risk for eating disorders and 0% showed clinical symptoms of eating disorders. Torres-McGehee, Monsma, Dompier, and Washburn (2012) determined the prevalence of eating disorder risk among female collegiate cheerleaders was 33% where in the current sample the prevalence of eating disorder risk was much lower at 16% among the cheer and dance teams. In the current sample, the majority of female collegiate athletes (91%) scored in the asymptomatic range for eating disorder risk on the FAST Questionnaire. This questionnaire is intended to be sensitive to detecting eating disordered behavior in athletic women, however, in the current study prevalence was not detected at the same rate as other studies and the sensitivity of this tool to detect eating disorder risk accurately comes into question. Conversely, one can question, would scores on the FAST questionnaire have been higher if the questionnaires were given anonymously and not as part of the pre-participation physical? Another explanation for low rates of eating disorder risk detection is that the sample population is simply not developing disordered eating behaviors as seen in other collegiate athletic populations.
Eating Disorder Risk, Nutrition Knowledge, and Sport Type

A common way to categorize athletes to assess eating disorder risk is by sport type, “lean” vs. “non-lean” sports. “Lean” sports being those with a competitive edge given to individuals with a leaner physique. In contrast to “lean” sports, “non-lean” sports tend to not be dependent on a lean physique for athletes to be successful. It was hypothesized that female collegiate athletes who participate in “lean” sports would exhibit higher scores on the FAST questionnaire (i.e. exhibiting greater eating disorder risk) than do those participating in “non-lean” sports. Results showed that individuals who participate in “lean” sports scored significantly higher ($p = 0.004$) on the FAST questionnaire than did those individuals who participate in “non-lean”. These results imply that athletes participating in “lean” sports may trend toward greater eating disorder risk which is consistent with Reinking and Alexander (2005), who determined that within “non-lean” sports, 3% of athletes showed eating disorder risk and in “lean” sports the prevalence increased to 25%. It should be noted that the mean scores, although significantly different, still fall within the asymptomatic category.

It was hypothesized that the nutrition knowledge scores of female collegiate athletes who participate in “lean” sports would not differ from that of individuals who participate in “non-lean” sports. Results supported the hypothesis and showed that individuals who participate in “lean” sports scores did not significantly differ on the NKS compared to those individuals who participate in “non-lean”.

Eating Disorder Risk, Nutrition Knowledge, and Desire to Lose Weight

Of the female collegiate athletes that reported body weight, 63% indicated a desire to lose weight, although, only 12% of the sample ($n = 28$) presented with a BMI that was
indicative of excess body weight (BMI > 25 kg/m²). These results are consistent with the results of a study done in Madrid, Spain that investigated the desire to lose weight on food habits and knowledge of 234 university students (Navia et al., 2003). The authors found that 48% of female university students desired to lose weight, however, when comparing the nutrition knowledge of these women with that of women who did not desire to lose weight, no differences were detected. In the current group of athletes, no differences in nutrition knowledge were detected between those who did and did not desire to lose weight; nevertheless, the number of athletes who desire to lose weight is particularly concerning due to the overall lack of nutrition knowledge found in this sample population. As female collegiate athletes are lacking nutrition knowledge but desiring to lose weight, their practices for achieving weight loss could very likely be unsafe.

Within the current sample, female collegiate athletes desired to lose an average of 2.3 kg or approximately 5 pounds. It was hypothesized that female collegiate athletes who desired to lose weight would exhibit greater eating disorder risk (higher scores on FAST) than those who did not desire to lose weight. The results showed that female collegiate athletes who indicated a desire to lose weight scored significantly higher (p < 0.001) on the FAST than did those athletes who do not indicate a desire to lose weight again, it should be noted that the mean scores, although significantly different, still fall within the asymptomatic category of eating disorder risk. These results are not unexpected based on the emphasis on leanness in our culture and the aesthetic nature of “lean” sports. Similar results were seen in a 2001 study (Ste-Marie, Clark, Findlay, & MacMahon, 2001), where the authors showed that three groups of female athletes (figure
skaters, rugby players and soccer players) experienced no difference in societal pressure to lose weight but figure skaters reported significantly greater sport pressure to lose weight when compared to either rugby or soccer. The results were also consistent with Reinking and Anderson (2005) findings where “lean” sport athletes had a significantly lower desired body weight than these of “non-lean” sport athletes. “Lean” sport athletes may benefit from specific eating disorder prevention education and training.

**Relationship between Eating Disorder Risk and Nutrition Knowledge**

It was hypothesized that a negative correlation would be seen between eating disorder risk and nutrition knowledge in female collegiate athletes, demonstrating that as an athlete’s nutrition knowledge increased, her eating disorder risk would decrease. Overall, among the sample population, no correlation was detected between eating disorder risk and nutrition knowledge ($r = -.014; p = .56$). These results are not surprising since the majority of female collegiate athletes presented as asymptomatic and scored poorly on the NKS questionnaire. Raymond-Barker, et al., (2007) found no statistically significant relationship between nutrition knowledge and eating disorder risk in female athletes, supporting the current study’s primary finding. However, by isolating and assessing the relationship between the FAST and NKS scores of the 19 athletes identified as exhibiting subclinical eating disorder risk, we see a positive correlation begin to emerge ($r = .051; p = .03$) which contradicts the original hypothesis. These results indicate that a relationship exists between eating disorder risk and nutrition knowledge in individuals exhibiting subclinical eating disorder symptoms. It remains to be seen if this relationship also exists in individuals with clinical eating disorders and if at risk individuals seek out greater nutrition knowledge or if greater knowledge predisposes
individuals to greater eating disorder risk. It appears that among female collegiate athletes, a need exists for not only better nutrition knowledge but additional training on how to translate nutrition information and knowledge into sound dietary choices and behaviors. Fostering a healthy sports environment may be instrumental in this training and should target those who create and maintain that environment including athletic trainers, coaches and administrators and strength and conditioning specialists.

**Implications**

Although female collegiate athletes show a very basic understanding of general nutrition concepts, they show a distinct lack of nutrition knowledge pertaining to hydration needs and benefits of sports beverage usage, macronutrients needs and functions, as well as micronutrient needs and functions. The results of the study show a strong need for nutrition education programs focusing on carbohydrate, fat, and protein, as well as vitamin, mineral and hydration needs of female collegiate athletes. Dietetic professionals, specifically Registered Dietitians, are in a unique position to provide accurate and suitable nutrition information to athletes as well as influence the sport environment by providing nutrition training to athletic trainers, coaches and administrators (Rosenbloom, Jonicalagadda, & Skinner, 2002).

The results of this study suggest that “lean” sport athletes may benefit from eating disorder prevention education and training with particular attention on sound nutrition practices but also eating disorder symptoms, identification of eating disorder risk factors and prevention techniques. Also, athletic trainers, coaches, and administrators serving as models of sound nutrition practices may improve the athletes’ relationship with food and
reduce the sport related pressure or desire to lose weight in those individuals who would
not benefit from a weight loss.

Overall, these results imply a need for not only more nutrition education for
female collegiate athletes but additional training on how to translate nutrition information
and knowledge into sound food choices and behaviors.

Limitations

One limitation of the study was the study population, all participants were student
athletes at one Southwestern, public Division I university in one academic year. Also,
with the use of the validated FAST screening tool, which utilizes cut-off scores to
categorize level of eating disorder risk, female collegiate athletes with scores on the
borderlines may have been categorized incorrectly. Another, particularly noteworthy,
limitation to this study is that the questionnaires were originally not intended for research
purposes and as part of the PPE may have caused female collegiate athletes to feel
pressure to give socially desirable responses which may have led to underreporting of
unhealthy eating habits and behaviors. Since the NKS was originally used for the
purposes of screening student athletes during the PPE, it has not been validated which
limits the ability to know if the NKS measures what it is intended to measure. Lastly, it
has been identified that self-report questionnaires, like FAST, where answers can easily
be falsified, leads to an underestimation of the actual prevalence of disordered eating
(Sundgot-Borgen & Torstveit, 2004).

Future Research

Based on the results of the study, there are several recommendations for future
research. Based on the limitations identified, future research could include female
collegiate athletes from additional geographic locations outside the Southwest. An interview with participants, confirming answers on the FAST questionnaire may reduce the underestimation of eating disorder symptoms in future investigations. Further studies could make use of the same NKS questionnaire to assess nutrition knowledge of additional populations, including male athletes, athletes of various ages as well as athletic trainers, coaches, and strength and conditioning specialists.

Inadequate dietary intake can contribute to the development of the female athlete triad (Beals & Hill, 2006) and additional research is necessary to determine the relationship between nutritional knowledge and the components of the triad: low energy availability, menstrual disturbances, and low bone mineral density.

Additionally, there is a need for further researchers to develop a well-validated instrument that reliably measures nutrition knowledge of athletes. Research is also needed, on the relationship between the quality of nutrition knowledge and its influence on dietary habits. Further investigation of the relationship between nutrition knowledge and eating disorder risk is needed. Future investigations should identify female collegiate athletes with confirmed eating disorders and seek to correlate these athletes’ FAST scores with NKS scores to better clarify the relationship between eating disorder risk and nutrition knowledge.

**Conclusions**

Female collegiate athletes participating in NCAA Division I athletics at one Southwestern university exhibit poor nutrition knowledge, particularly they lack understanding of macronutrient, micronutrient and hydration needs and functions. This
This study identified a need for, perhaps, ongoing, formal nutrition education programs for female collegiate athletes.

This sample of athletes appears to display less eating disorder risks than other similar samples. Nevertheless, this study did determine that female collegiate athletes participating in “lean” sports and who desire to lose weight may be at greater risk for development of an eating disorder but further investigation is necessary to determine the role of these factors in eating disorder development.

This study suggests that although female collegiate athletes have poor nutrition knowledge it does not appear to be correlated to eating disorder risk, likely due to the large number of asymptomatic athletes. However, a relationship may exist between nutrition knowledge and eating disorder risk for individuals identified as exhibiting subclinical symptoms of eating disorders. Further investigation of this topic identifying female collegiate athletes with confirmed eating disorders will better clarify this relationship.
Appendix A: Nutrition Knowledge Survey (NKS)

Nutrition Knowledge and Screening / UNLV Athletic Training

<table>
<thead>
<tr>
<th>Name</th>
<th>Sport</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is your height? _______ inches

What is your desired weight? _______ lbs.

What is your current weight? _______ lbs.

What is your body fat? _______ %

Don’t know

What is your serum cholesterol? _______ mg/dL

Don’t know

In the last year, what was your highest weight? _______ lbs.

And lowest weight? _______ lbs.

Date ______/_____/_____

Please circle the answer that best answers the question.

<table>
<thead>
<tr>
<th>1</th>
<th>Carbohydrate and fat are the main energy sources for athletes.</th>
<th>Agree</th>
<th>Disagree</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Athletes should not eat sweets prior to an event.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>3</td>
<td>Carbohydrates make you fat.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>4</td>
<td>An athlete should consume a high-____ meal 2-3 hours before an event.</td>
<td>Carbohydrate</td>
<td>Protein</td>
<td>Fat</td>
</tr>
<tr>
<td>5</td>
<td>Protein is the main energy source for the muscle.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>6</td>
<td>Protein supplements are necessary for athletes.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>7</td>
<td>An athlete should replace fluids before, during, and after an event.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>8</td>
<td>Athletes should rely on thirst to ensure fluid replacement.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>9</td>
<td>Urine color can indicate dehydration.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>10</td>
<td>Vitamin and mineral supplements increase energy levels.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>11</td>
<td>A multivitamin and mineral supplement is necessary for optimal sport performance.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>12</td>
<td>Carbohydrates are not as easily and rapidly digested as protein and fat.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>13</td>
<td>Eggs and legumes are examples of protein sources other than meat.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>14</td>
<td>No more than 15% of calories in the diet should be provided by fat.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>15</td>
<td>One 8-ounce glasses of milk is enough to fulfill the recommended amount of calcium per day.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>16</td>
<td>Those with a meatless diet are at a higher risk for iron deficiency.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>17</td>
<td>Due to menstruation, females need more iron in their diets than men.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>18</td>
<td>Bananas and avocados are good sources of potassium.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>19</td>
<td>Excess vitamin supplementation may be harmful.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>20</td>
<td>The body can synthesize vitamin D upon exposure to the sun.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>21</td>
<td>Potatoes, strawberries, and cantaloupe are good sources of vitamin C.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>22</td>
<td>Salt is an essential part of a healthy diet.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>23</td>
<td>Bread and cereals are the only food groups that are a good source of fiber.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>24</td>
<td>During exercise, it is better to drink a large amount of fluid all at once rather than small amounts over time.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>25</td>
<td>Sports drinks are the best way to replace body fluids lost during exercise.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>26</td>
<td>Drinking beer is a good way to rehydrate after exercise.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>27</td>
<td>Drinking alcohol will add calories to your diet.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>28</td>
<td>Caffeine has been shown to improve endurance performance.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>29</td>
<td>A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>30</td>
<td>What the athlete eats is only important if the athlete is trying to gain or lose weight.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>31</td>
<td>Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>32</td>
<td>I lose weight regularly to meet weight requirements for my sport.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>33</td>
<td>I have experienced bone stress fractures.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>34</td>
<td>During my season, I find I am too busy to eat breakfast.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>35</td>
<td>I limit my fat consumption.</td>
<td>In season</td>
<td>Off season</td>
<td>Never</td>
</tr>
<tr>
<td>36</td>
<td>I carefully control my calorie intake.</td>
<td>In season</td>
<td>Off season</td>
<td>Never</td>
</tr>
<tr>
<td>37</td>
<td>I have skipped meals to prepare for competition.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>38</td>
<td>I have fasted for 24 or more hours for competition or training.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>39</td>
<td>To lose weight, I have reduced my carbohydrate intake.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
<tr>
<td>40</td>
<td>To lose weight, I have reduced my milk and dairy intake.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Don’t know</td>
</tr>
</tbody>
</table>
Appendix B: Exploratory Factor Analysis of NKS

An exploratory factor analysis with a Varimax (orthogonal) rotation of 25 of 31, 3-point Likert-type scale questions from the Nutrition Knowledge and Screening (NKS) questionnaire was conducted on data collected from 204 participants. An examination of the Kaiser-Meyer-Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = .759).

The results of an orthogonal rotation of the solution are shown in table below. Factor loading less than 0.30 were suppressed.

<table>
<thead>
<tr>
<th>Rotated component loadings*</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance of sports nutrition</td>
<td>0.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need for fluids during exercise</td>
<td>0.697</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehydration after exercise</td>
<td>0.654</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beliefs regarding weight gain or loss</td>
<td>0.621</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good sources of potassium</td>
<td>0.512</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good sources of fiber</td>
<td>0.449</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol and performance</td>
<td>0.394</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good sources of protein</td>
<td>0.336</td>
<td>0.32</td>
<td>0.305</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein supplements</td>
<td>0.743</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin and mineral supplements</td>
<td>0.682</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multivitamin supplement and sport performance</td>
<td>0.797</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harm due to vitamin supplementation</td>
<td></td>
<td>0.517</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D needs</td>
<td></td>
<td>0.515</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sources of vitamin c</td>
<td></td>
<td>0.773</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caffeine and performance</td>
<td></td>
<td>0.369</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweets prior to an event.</td>
<td></td>
<td>0.441</td>
<td>-0.497</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrates digestibility</td>
<td></td>
<td>0.485</td>
<td>0.338</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk of iron deficiency</td>
<td></td>
<td></td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Menstruation and iron needs</td>
<td></td>
<td></td>
<td>0.682</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid replenishment</td>
<td></td>
<td></td>
<td></td>
<td>0.733</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thirst and fluid replenishment</td>
<td></td>
<td></td>
<td></td>
<td>0.532</td>
<td></td>
<td></td>
</tr>
<tr>
<td>how to detect dehydration</td>
<td></td>
<td></td>
<td></td>
<td>0.579</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macronutrient needs of athletes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.656</td>
<td></td>
</tr>
<tr>
<td>Fuel needs prior to competition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.729</td>
<td></td>
</tr>
<tr>
<td>Fuel needs during competition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.478</td>
<td></td>
</tr>
</tbody>
</table>

Loadings = >.30
The six topic factors were identified are explained here. Eight items loaded into Factor 1. It is clear from the table that these eight items all relate to basic sports nutrition concepts. Three items loaded into the second factor and related to dietary supplementation. Four items loaded into the third factor and related to single nutrient needs and food sources. Four items loaded into Factor 4 and related to the impact of sport on nutrient needs. Three items loaded into the fifth factor, which related to fluid needs. Finally, three items loaded into Factor 6 and are related to nutrients needs related to competition.

The following six items did not load into one of the six factors: carbohydrates role in fat deposition, protein as an energy source for muscle, requirement of fat in the diet, amount of calcium in select foods, salt as an essential part of the diet, what constitutes a sound diet.
Appendix C: Female Athlete Screening Tool (FAST)

Nutrition Screening for Female Athletes

<table>
<thead>
<tr>
<th>Definitions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice = Scheduled time allotted by coach to work as a team or individually in order to improve performance.</td>
</tr>
<tr>
<td>Training = Intense physical activity. The goal is to improve fitness level in order to perform optimally.</td>
</tr>
</tbody>
</table>

**Please answer as completely as possible:**

1. I participate in additional physical activity ≥ 20 minutes in length on days that I have practice or competition.
   1) Frequently 2) Sometimes 3) Rarely 4) Never

2. If I cannot exercise, I find myself worrying that I will gain weight.
   1) Frequently 2) Sometimes 3) Rarely 4) Never

3. I believe that most female athletes have some form of disordered eating habits.
   1) Strongly Agree 2) Agree 3) Disagree 4) Strongly Disagree

4. During training, I control my fat and calorie intake carefully.
   1) Frequently 2) Sometimes 3) Rarely 4) Never

5. I do not eat foods that have more than 3 grams of fat.
   1) Strongly Agree 2) Agree 3) Disagree 4) Strongly Disagree

6. My performance would improve if I lost weight.
   1) Strongly Agree 2) Agree 3) Disagree 4) Strongly Disagree

7. If I got on the scale tomorrow and gained 2 pounds, I would practice or exercise harder or longer than usual.
   1) Frequently 2) Sometimes 3) Rarely 4) Never

8. I weigh myself
   1) Daily 2) 2 or more times per week 3) Weekly 4) Monthly or less

9. If I chose to exercise on the day of competition (game/meet), I exercise for:
   1) 2 or more hours 2) 45 minutes to 1 hour 3) 30 to 45 minutes 4) Less than 30 minutes

10. If I know that I will be consuming alcoholic beverages, I will skip meals on that day or the following day.
    1) Frequently 2) Sometimes 3) Rarely 4) Never

11. I feel guilty if I choose fried foods for a meal.
    1) Frequently 2) Sometimes 3) Rarely 4) Never

12. If I were to be injured, I would still exercise even if I was instructed not to do so by my athletic trainer or physician.
    1) Strongly Agree 2) Agree 3) Disagree 4) Strongly Disagree

13. I take dietary or herbal supplements in order to increase my metabolism and/or assist in burning fat.
    1) Frequently 2) Sometimes 3) Rarely 4) Never

14. I am concerned about my percent body fat.
    1) Frequently 2) Sometimes 3) Rarely 4) Never

15. Being an athlete, I am very conscious about consuming adequate calories and nutrients on a daily basis.
    1) Frequently 2) Sometimes 3) Rarely 4) Never
16. I am worried that if I were to gain weight, my performance would decrease.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

17. I think that being thin is associated with winning.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

18. I train intensely for my sport so I will not gain weight.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

19. During season, I choose to exercise on my one day off from practice or competition.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

20. My friends tell me that I am thin but I feel fat.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

21. I feel uncomfortable eating around others.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

22. I limit the amount of carbohydrates that I eat.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

23. I try to lose weight to please others.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

24. If I were unable to compete in my sport, I would not feel good about myself.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

25. If I were injured and unable to exercise, I would restrict my calorie intake.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

26. In the past 2 years, I have been unable to compete due to an injury.
   1) 7 or more times  2) 4 to 6 times  3) 1 to 3 times  4) No significant injuries

27. During practice I have trouble concentrating due to feelings of guilt about what I have eaten that day.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

28. I feel that I have a lot of good qualities.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

29. At times I feel that I am no good at all.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

30. I strive for perfection in all aspects of my life.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

31. I avoid eating meat in order to stay thin.
   1) Strongly Agree  2) Agree  3) Disagree  4) Strongly Disagree

32. I am happy with my present weight.
   1) Yes  2) No

33. I have done things to keep my weight down that I believe are unhealthy.
   1) Frequently  2) Sometimes  3) Rarely  4) Never

Thank you for completing this survey.
Appendix D: IRB Approval

Biomedical IRB – Exempt Review
Deemed Exempt

DATE: June 7, 2013

TO: Dr. John Young, Kinesiology & Nutrition Sciences

FROM: Office of Research Integrity – Human Subjects

RE: Notification of IRB Action
Protocol Title: Evaluation of the Relationship between Nutrition Knowledge and Eating Disorder Risk in Female Collegiate Athletes
Protocol # 1305-4463M

This memorandum is notification that the project referenced above has been reviewed as indicated in Federal regulatory statutes 45CFR46 and deemed exempt under 45 CFR 46.101(b).4.

Any changes to the application may cause this project to require a different level of IRB review. Should any changes need to be made, please submit a Modification Form. When the above-referenced project has been completed, please submit a Continuing Review/Progress Completion report to notify ORI – HS of its closure.

If you have questions or require any assistance, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 895-2794.
## Appendix E: Statements from NKS Rank Ordered by Percent Correct

<table>
<thead>
<tr>
<th>Statements from NKS Rank Ordered by Percent Correct</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine color can indicate dehydration.</td>
<td>95</td>
</tr>
<tr>
<td>Drinking beer is a good way to rehydrate after exercise.</td>
<td>94</td>
</tr>
<tr>
<td>Bananas and avocados are good sources of potassium.</td>
<td>93</td>
</tr>
<tr>
<td>Eggs and legumes are examples of protein sources other than meat.</td>
<td>92</td>
</tr>
<tr>
<td>Learning about nutrition is not important for athletes because they eat so much food</td>
<td>92</td>
</tr>
<tr>
<td>they always get the nutrients their bodies need.</td>
<td></td>
</tr>
<tr>
<td>An athlete should replace fluids before, during, and after an event.</td>
<td>91</td>
</tr>
<tr>
<td>During exercise, it is better to drink a large amount of fluid all at once rather than</td>
<td>90</td>
</tr>
<tr>
<td>small amounts over time.</td>
<td></td>
</tr>
<tr>
<td>Athletes should rely on thirst to ensure fluid replacement.</td>
<td>84</td>
</tr>
<tr>
<td>Due to menstruation, females need more iron in their diets than men.</td>
<td>83</td>
</tr>
<tr>
<td>Drinking alcohol will add calories to your diet.</td>
<td>83</td>
</tr>
<tr>
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<td>83</td>
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<tr>
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<td>Excess vitamin supplementation may be harmful.</td>
<td>77</td>
</tr>
<tr>
<td>A sound nutritional practice for athletes is to eat a wide variety of different food</td>
<td>68</td>
</tr>
<tr>
<td>types from day to day.</td>
<td></td>
</tr>
<tr>
<td>Bread and cereals are the only food groups that are a good source of fiber.</td>
<td>67</td>
</tr>
<tr>
<td>Protein supplements are necessary for athletes.</td>
<td>65</td>
</tr>
<tr>
<td>Carbohydrate and fat are the main energy sources for athletes.</td>
<td>62</td>
</tr>
<tr>
<td>The body can synthesize vitamin D upon exposure to the sun.</td>
<td>59</td>
</tr>
<tr>
<td>Potatoes, strawberries, and cantaloupe are good sources of vitamin C.</td>
<td>58</td>
</tr>
<tr>
<td>An athlete should consume a high-_____ meal 2-3 hours before an event.</td>
<td>55</td>
</tr>
<tr>
<td>A multivitamin and mineral supplement is necessary for optimal sport performance.</td>
<td>50</td>
</tr>
<tr>
<td>Salt is an essential part of a healthy diet.</td>
<td>49</td>
</tr>
<tr>
<td>One 8-ounce glasses of milk is enough to fulfill the recommended amount of calcium per</td>
<td>44</td>
</tr>
<tr>
<td>day.</td>
<td></td>
</tr>
<tr>
<td>Sports drinks are the best way to replace body fluids lost during exercise.</td>
<td>41</td>
</tr>
<tr>
<td>Carbohydrates are not as easily and rapidly digested as protein and fat.</td>
<td>37</td>
</tr>
<tr>
<td>Athletes should not eat sweets prior to an event.</td>
<td>26</td>
</tr>
<tr>
<td>Vitamin and mineral supplements increase energy levels.</td>
<td>24</td>
</tr>
<tr>
<td>Caffeine has been shown to improve endurance performance.</td>
<td>16</td>
</tr>
<tr>
<td>Protein is the main energy source for the muscle.</td>
<td>9</td>
</tr>
<tr>
<td>No more than 15% of calories in the diet should be provided by fat.</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix F: Statements from NKS Rank Ordered by Percent Incorrect

<table>
<thead>
<tr>
<th>Statements from NKS Rank Ordered by Percent Incorrect</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein is the main energy source for the muscle.</td>
<td>78</td>
</tr>
<tr>
<td>Athletes should not eat sweets prior to an event.</td>
<td>66</td>
</tr>
<tr>
<td>Caffeine has been shown to improve endurance performance.</td>
<td>54</td>
</tr>
<tr>
<td>No more than 15% of calories in the diet should be provided by fat.</td>
<td>47</td>
</tr>
<tr>
<td>An athlete should consume a high-______ meal 2-3 hours before an event.</td>
<td>45</td>
</tr>
<tr>
<td>Sports drinks are the best way to replace body fluids lost during exercise.</td>
<td>41</td>
</tr>
<tr>
<td>Vitamin and mineral supplements increase energy levels.</td>
<td>40</td>
</tr>
<tr>
<td>Salt is an essential part of a healthy diet.</td>
<td>28</td>
</tr>
<tr>
<td>One 8-ounce glasses of milk is enough to fulfill the recommended amount of calcium per day.</td>
<td>25</td>
</tr>
<tr>
<td>Carbohydrate and fat are the main energy sources for athletes.</td>
<td>23</td>
</tr>
<tr>
<td>Carbohydrates are not as easily and rapidly digested as protein and fat.</td>
<td>23</td>
</tr>
<tr>
<td>A multivitamin and mineral supplement is necessary for optimal sport performance.</td>
<td>22</td>
</tr>
<tr>
<td>Protein supplements are necessary for athletes.</td>
<td>20</td>
</tr>
<tr>
<td>Bread and cereals are the only food groups that are a good source of fiber.</td>
<td>18</td>
</tr>
<tr>
<td>Potatoes, strawberries, and cantaloupe are good sources of vitamin C.</td>
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</tr>
<tr>
<td>Carbohydrates make you fat.</td>
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</tr>
<tr>
<td>Athletes should rely on thirst to ensure fluid replacement.</td>
<td>9</td>
</tr>
<tr>
<td>Drinking alcohol will add calories to your diet.</td>
<td>9</td>
</tr>
<tr>
<td>What the athlete eats is only important if the athlete is trying to gain or lose weight.</td>
<td>9</td>
</tr>
<tr>
<td>A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day.</td>
<td>8</td>
</tr>
<tr>
<td>Excess vitamin supplementation may be harmful.</td>
<td>6</td>
</tr>
<tr>
<td>Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need.</td>
<td>5</td>
</tr>
<tr>
<td>An athlete should replace fluids before, during, and after an event.</td>
<td>3</td>
</tr>
<tr>
<td>Those with a meatless diet are at a higher risk for iron deficiency.</td>
<td>3</td>
</tr>
<tr>
<td>The body can synthesize vitamin D upon exposure to the sun.</td>
<td>3</td>
</tr>
<tr>
<td>Eggs and legumes are examples of protein sources other than meat.</td>
<td>2</td>
</tr>
<tr>
<td>Due to menstruation, females need more iron in their diets than men.</td>
<td>2</td>
</tr>
<tr>
<td>During exercise, it is better to drink a large amount of fluid all at once rather than small amounts over time.</td>
<td>2</td>
</tr>
<tr>
<td>Drinking beer is a good way to rehydrate after exercise.</td>
<td>2</td>
</tr>
<tr>
<td>Urine color can indicate dehydration.</td>
<td>1</td>
</tr>
<tr>
<td>Bananas and avocados are good sources of potassium.</td>
<td>1</td>
</tr>
</tbody>
</table>
### Appendix G: Statements from NKS Rank Ordered by Percent Don’t Know

<table>
<thead>
<tr>
<th>Statements from NKS Rank Ordered by Percent Don’t Know</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No more than 15% of calories in the diet should be provided by fat.</td>
<td>48</td>
</tr>
<tr>
<td>Carbohydrates are not as easily and rapidly digested as protein and fat.</td>
<td>40</td>
</tr>
<tr>
<td>The body can synthesize vitamin D upon exposure to the sun.</td>
<td>38</td>
</tr>
<tr>
<td>Vitamin and mineral supplements increase energy levels.</td>
<td>36</td>
</tr>
<tr>
<td>One 8-ounce glasses of milk is enough to fulfill the recommended amount of calcium per day.</td>
<td>31</td>
</tr>
<tr>
<td>Caffeine has been shown to improve endurance performance.</td>
<td>30</td>
</tr>
<tr>
<td>A multivitamin and mineral supplement is necessary for optimal sport performance.</td>
<td>28</td>
</tr>
<tr>
<td>Potatoes, strawberries, and cantaloupe are good sources of vitamin C.</td>
<td>27</td>
</tr>
<tr>
<td>A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day.</td>
<td>24</td>
</tr>
<tr>
<td>Salt is an essential part of a healthy diet.</td>
<td>23</td>
</tr>
<tr>
<td>Sports drinks are the best way to replace body fluids lost during exercise.</td>
<td>18</td>
</tr>
<tr>
<td>Excess vitamin supplementation may be harmful.</td>
<td>17</td>
</tr>
<tr>
<td>Those with a meatless diet are at a higher risk for iron deficiency.</td>
<td>16</td>
</tr>
<tr>
<td>Carbohydrate and fat are the main energy sources for athletes.</td>
<td>15</td>
</tr>
<tr>
<td>Protein supplements are necessary for athletes.</td>
<td>15</td>
</tr>
<tr>
<td>Due to menstruation, females need more iron in their diets than men.</td>
<td>15</td>
</tr>
<tr>
<td>Bread and cereals are the only food groups that are a good source of fiber.</td>
<td>15</td>
</tr>
<tr>
<td>Protein is the main energy source for the muscle.</td>
<td>13</td>
</tr>
<tr>
<td>Carbohydrates make you fat.</td>
<td>10</td>
</tr>
<tr>
<td>Athletes should not eat sweets prior to an event.</td>
<td>8</td>
</tr>
<tr>
<td>During exercise, it is better to drink a large amount of fluid all at once rather than small amounts over time.</td>
<td>8</td>
</tr>
<tr>
<td>Drinking alcohol will add calories to your diet.</td>
<td>8</td>
</tr>
<tr>
<td>What the athlete eats is only important if the athlete is trying to gain or lose weight.</td>
<td>8</td>
</tr>
<tr>
<td>Athletes should rely on thirst to ensure fluid replacement.</td>
<td>7</td>
</tr>
<tr>
<td>An athlete should replace fluids before, during, and after an event.</td>
<td>6</td>
</tr>
<tr>
<td>Eggs and legumes are examples of protein sources other than meat.</td>
<td>6</td>
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<tr>
<td>Bananas and avocados are good sources of potassium.</td>
<td>6</td>
</tr>
<tr>
<td>Urine color can indicate dehydration.</td>
<td>4</td>
</tr>
<tr>
<td>Drinking beer is a good way to rehydrate after exercise.</td>
<td>4</td>
</tr>
<tr>
<td>Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need.</td>
<td>3</td>
</tr>
<tr>
<td>An athlete should consume a high-_____ meal 2-3 hours before an event.</td>
<td>0</td>
</tr>
</tbody>
</table>
REFERENCES


American College of Sports Medicine. (2011). In ACSM (Ed.), *Pre-participation physical examinations* ([Brochure] ed.). Indianapolis, IN:


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EDUCATION

2013 University of Nevada, Las Vegas, Las Vegas, NV
Kinesiology
Doctor of Philosophy – ABD

2004 Kent State University, Kent, OH
Nutrition
Master of Science/Dietetic Internship

2003 Kent State University, Kent, OH
Exercise, Leisure and Sport – Exercise Physiology
Master of Art

2000 Kent State University, Kent, OH
Nutrition and Food
Bachelor of Science

THESIS

Thesis: “Impact of a one-time nutritional education session on dietary intake of college freshmen”

ACADEMIC INTERESTS

Sports nutrition knowledge among athletes
Influence of nutrition on performance and exercise training
Body dysmorphic disorder as an eating disorder
International nutrition issues and global food ways
Chronic disease prevention
PROFESSIONAL EXPERIENCE

**Lecturer:** Nutrition Program, Department of Kinesiology and Nutrition Sciences, University of Nevada, Las Vegas, Las Vegas NV. August 2010 – 2012.

Maintain 12 credit hour load each semester and office hours to support students in mastering nutrition sciences. Provide service to university and community.

**Visiting Lecturer:** Department of Nutrition Sciences, University of Nevada, Las Vegas, Las Vegas NV. August 2007 – July 2010.


**Exercise Physiologist:** Department of Physical Therapy, St. Rose Dominican Hospital, Henderson, NV. March 2005 – June 2006.

Administer exercise tests and nutrition assessment with exercise and nutrition consultations to improve quality of life of residents in a 55+ community.

**Part-time Instructor:** Nutrition Program, School of Family and Consumer Studies, Kent State University, Kent, OH. August 2003 – December 2004.

**Nutrition Outreach Program Coordinator:** Nutrition Program, School of Family and Consumer Studies, Kent State University, Kent OH. January 2003 – December 2004.

**COURSES TAUGHT**

University of Nevada, Las Vegas
- Human Nutrition (introductory course for non-majors)
- Principles of Nutrition (introductory course for majors)
- Introduction to Sports Nutrition
- Nutrition, Health and Ethnic Issues
- Sports Nutrition Practicum
- Nutrition Assessment
- Complementary and Integrative MNT
- Foundations of Kinesiology

Kent State University
- Food Choices for Prescribed Dietary Modification
- Nutrition
- Maternal and Child Nutrition
- Introduction to Nutrition & Dietetics
RELEVANT PROFESSIONAL EXPERIENCE

**NUTR 121 Coordinator**: Nutrition Program, Department of Kinesiology and Nutrition Sciences, University of Nevada, Las Vegas, Las Vegas, NV. August 2010 – May 2011

 Coordinate instructors and teaching assistants for multi-section introductory nutrition course for non-majors. Maintain exam statistics for each course section and standardization of course materials.

**NUTR 121 Co-developer of Standardized Materials**: Nutrition Program, Department of Kinesiology and Nutrition Sciences, University of Nevada, Las Vegas, Las Vegas, NV. August 2007 – May 2008

 Worked in collaboration to create PowerPoint lectures, study aid materials, exam questions and course administration policies.

**Dietetic Internship Preceptor (Community)**: Department of Physical Therapy, St. Rose Dominican Hospitals, Henderson, NV. August 2005 – May 2006

**Nutrition Outreach Program Development**: Nutrition Program, School of Family and Consumer Studies, Kent State University, Kent, OH. January 2002 – December 2002

 Primary in development of campus-wide nutrition and wellness program for the School of Family and Consumer Studies.

**Course Development**: Nutrition Program, School of Family and Consumer Studies, Kent State University, Kent, OH. January 2002 – May 2002

 Primary in development of a one-credit hour introductory course (Introduction to Nutrition and Dietetics).

**PUBLICATIONS**

PRESENTATIONS


SERVICE

University
Consulting Dietitian for UNLV Athletics, 2007 – Present
Graduate Student Senator, Kent State University, 2001 - 2002
Representative for School of Family and Consumer Studies

School
Academic Standards Committee, 2011
School of Allied Health Sciences, UNLV
Kinesiology and Nutrition Sciences representative
Search Committee – Department of Physical Therapy, 2011
School of Allied Health Sciences, UNLV
External member
Course Evaluation Ad Hoc Committee, 2011
School of Allied Health Sciences, UNLV
Nutrition Sciences Representative
Curriculum Committee, 2001 – 2003
School of Family and Consumer Studies, Kent State University
Graduate Representative

Community
Aid Station Captain – Silverman Triathlon, 2007-2010
POSTER PRESENTATIONS

Wight, M., Vergara, C., and Miracle, A. (2010, April). Nutrition periodization: An educational approach for enhancing the athlete’s knowledge of food and nutrition as it relates to the training season. SCAN Symposium, San Diego, CA

Miracle, A. (2002, April) High dietary protein intake increases serum enzyme activity following damaging exercise in humans. The Ohio Academy of Science Symposium at Capital University, Columbus, OH.

Miracle, A. (2002, April) Varying Protein Intakes, Serum Enzyme Activity and Exercise. GSS Research and Presentation Colloquium, Kent State University, Kent, OH.

MEMBERSHIPS AND AFFILIATIONS

American Dietetic Association
   DPG: Sports, Cardiovascular and Wellness Nutritionists (SCAN)
Ohio Dietetic Association
American College of Sports Medicine

CERTIFICATIONS

Registered Dietitian (RD), Registration # 930471, 2004 - Present
Certified Specialist in Sports Dietetics, 2008 – Present